ESCCAP

EUROPEAN SCIENTIFIC COUNSEL COMPANION ANIMAL PARASITES®

9 Parasite Control in Travelling and Imported Pets

ESCCAP Guideline 09 First Edition – May 2025

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1. INTRODUCTION

Over the past two decades, multiple factors have led to the increased movement of domestic dogs and cats between countries and regions, both inside and outside of Europe. The welfare of dogs and cats has been negatively impacted by natural disasters, persecution of strays and puppy farming. Consequently, there is a growing public desire to adopt pets from abroad that have had their welfare compromised by the aforementioned factors. Since its introduction in 2001, the relaxation of European pet travel rules under the PETS scheme has also led to a rise in European pet travel, including animals accompanying owners on holidays and to sports events and shows. Furthermore, the growing movement of people seeking refuge or improved socio-economic conditions is a contributing factor to the permanent relocation of pet dogs and cats.

Driven by this increased movement and climate changes that are also affecting bird migration, vector distribution and some wildlife reservoir populations, the threat of novel parasites and zoonoses spreading into previously unaffected areas is growing. Even in the absence of suitable climate or vectors for a specific parasite, introducing infected animals still carries the risk of these parasites establishing as conditions may become more favourable for transmission over time.

The aim of this guideline is to provide veterinary professionals with concise information and practical advice concerning parasite control in travelling and imported dogs and cats. It offers recommendations to assist in the prevention (or minimisation) and treatment of novel parasite infections in these animals.

Veterinarians examining imported or travelled pets should prioritise early detection of parasitic infections using a structured approach. Key steps should include:

- Obtaining a comprehensive travel history, including regions visited, duration and potential exposures.
- Performing a thorough clinical examination, focusing on signs of vector-borne diseases, gastrointestinal parasites and ectoparasites.
- Recognising key clinical red flags such as anaemia, lymphadenopathy, respiratory distress, neurological abnormalities or dermatological conditions.
- Using targeted diagnostic tests (e.g. serology, PCR, blood smears) based on clinical suspicion.
- Educating pet owners on the risks of zoonotic transmission and preventive measures.
- Administering appropriate treatments and follow-up screenings, especially for parasites with long incubation periods like *Leishmania* and *Dirofilaria immitis*.

By following these recommendations, veterinarians can ensure early intervention, improved patient outcomes and reduced risk of parasite spread.

While the scope of this guideline excludes bacterial infections, *Brucella canis* has been included in the screening section as there is concern in the veterinary profession and some governmental organisations about its spread to non-enzootic countries. As such it is included in some national parasite prevention guidelines. Parasites that have a ubiquitous distribution across Europe such as *Toxocara* spp. have not been included as their treatment and prevention is unlikely to be significantly impacted by pet travel.

Further information on helminths may be found in ESCCAP Guideline 1[1] and vector-borne parasites in ESCCAP Guideline 5[2]. For tropical areas, further information is available on the website of the Tropical Council for Companion Animal Parasites.

[1] See ESCCAP Guideline 1: Worm Control in Dogs and Cats
[2] See ESCCAP Guideline 5: Control of Vector-Borne Diseases in Dogs and Cats

2. PARASITE CONTROL MEASURES REQUIRED BY LAW

The only infectious disease prevention requirements for pets travelling into Europe are protection against rabies and, in some cases, the tapeworm *Echinococcus multilocularis* (see section 3.3). Dogs and cats travelling internationally, must be vaccinated against rabies, and some countries require antibody titre blood testing before entry. Antibody titre testing is often required for pets returning to Europe, especially if they have travelled to countries with a high risk of rabies. Requirements for individual nations should be checked before travel. Some European countries with *E. multilocularis*-free status, require compulsory praziquantel treatment for dogs before entry. Currently these are Finland, Norway, Malta, Ireland and the UK. This treatment must be given 1–5 days before arrival in the destination country. For further information see europa.eu/youreurope/citizens/travel/carry/animal-plant/index_en.htm and www.gov.uk/bring-pet-to-great-britain.

3. PREVENTATIVE MEASURES WHILE TRAVELLING WITH PETS ABROAD TO LIMIT PARASITIC INFECTION/DISEASE RISK

Travelling pets may encounter a range of parasites not enzootic in their country of origin. Parasite prevention measures for these pets will help to reduce parasitic disease risk for the individual pet as well as help limit zoonotic risk and parasite spread. For further advice before travelling with pets, visit www.esccap.org/travelling-pets-advice/. This resource provides an immediate impression of the parasites and vector-borne diseases present and thus, the risks to a pet. Information can also be found at https://europa.eu/youreurope/citizens/travel/carry/animal-plant/index_en.htm.

3.1 Tick-borne parasite infections

Pets travelling abroad may come into contact with a range of ticks and tick-borne pathogens such as *Babesia* spp., *Ehrlichia* spp., *Anaplasma* spp., *Rickettsia* spp., *Borrelia* spp., filarioid nematodes and flaviviruses. Similarly, imported pets may already be carrying these pathogens or infected ticks. Ticks are enzootic throughout most of Europe and their distribution depends on several factors, including environmental conditions and host availability. Peaks of tick activity depend on the geographical location and the tick species. Year-round activity is observed in many countries, particularly with warming climate. Tick-borne pathogen transmission in Europe is most commonly associated with exposure to *Dermacentor reticulatus* (ornate cow tick, ornate dog tick, meadow tick or marsh tick), *Rhipicephalus sanguineus* (brown dog tick, kennel tick or pantropical dog tick), *Ixodes ricinus* (castor bean tick, sheep tick or deer tick) and *Ixodes hexagonus* (hedgehog tick)[3]. Examples of common and potentially serious tick-borne pathogens transmitted by these ticks in Europe are listed in ESCCAP Guideline 3[4] and detailed in ESCCAP Guideline 5[2].

[2] See ESCCAP Guideline 5: Control of Vector-Borne Diseases in Dogs and Cats
[3] See current distribution maps of some important ticks in Europe by country or region on the ESCCAP website
[4] See ESCCAP Guideline 3: Control of Ectoparasites in Dogs and Cats

3.1.1 Preventative treatments

It is essential that pets are treated with an effective repellent (anti-feeding effect) plus an acaricide (tick-killing product) before, during and after travel. Acaracide and repellency effects can be achieved with a single product. Even if the animal is vaccinated against some tick-borne diseases, such preventative treatments remain necessary. This is because vaccines only exist for some tick-borne diseases and they cannot provide 100% protection against tick-borne infections.

Licensed drug classes such as isoxazolines, pyrethroid and bispyrazole formulations are all highly effective and available as spot-on, tablet/chewable, injectable or collar products. Topically applied pyrethroid spot-on and collar preparations may have their duration of action reduced by shampooing or regular/prolonged swimming, therefore pet lifestyle should be taken into account when selecting a product. Following data sheet recommendations is important to choose the appropriate effect (repellent and/or acaricidal), help prevent environmental contamination and avoid inappropriate contact with children and non-target pet species. Licensed pyrethroid repellents will also help to prevent sand flies biting and indirectly reduce *Leishmania* spp. transmission if travelling to enzootic countries. Some pyrethroid products also have a mosquito bite reduction claim with the potential to reduce *Dirofilaria* spp. transmission. This should not be solely relied upon however in *D. immitis* enzootic countries. With the exception of flumethrin in collars, other pyrethroid products are toxic to cats and should therefore be avoided in households with cats. Pyrethroid products should be applied at least one week before travel to maximise efficacy although some products should reach efficacy in a shorter time period. Duration of action should be considered and repeated application might be necessary for some products during longer stays. Correct application is also crucial, including applying spot-on products to the skin rather than the fur and ensuring collars are the correct size.

3.1.2 Vaccines

The use of *Borrelia* vaccines (Lyme disease) is still a controversial issue, as seropositive dogs from exposure to the parasite have a low incidence of clinical disease. However, licensed vaccines are available for Lyme disease prevention in dogs. The vaccines prevent migration of the spirochete to the feeding tick's salivary glands, reducing the risk of infection as a result.

One vaccine for the prevention of severe canine clinical babesiosis, but not *Babesia* spp. infection, is available in some European countries. The level of immune protection is likely to vary depending on the species, antigenic structure of the strains and immune status of the host. It provides protection only against infection with homologous *B. canis* strains and does not prevent infection by other *Babesia* species. Re-vaccination every six months for pets living in, or spending prolonged periods of time in, highly enzootic areas is advised. Vaccination of pregnant or lactating animals is contraindicated. Post-vaccination side effects include diffuse swelling and/or hard painful nodules at the site of injection but these are generally transient and disappear within four days. Rarely, reactions following the second vaccination dose may persist for up to 14 days.

Tick-borne encephalitis (TBE) is caused by a flavivirus (tick-borne encephalitis virus, TBEV) and is mainly transmitted by *Ixodes ricinus* and *Dermacentor reticulatus* ticks, although alimentary infections can also occur. It is known in humans and dogs and the number of TBE cases is spreading and increasing in Europe. Few TBEV infections in dogs lead to clinical signs but peracute/fatal as well as subacute and chronic cases have been reported. In Europe, there are currently two TBE vaccines licensed for human use in the prevention of tick-borne encephalitis but neither have been licensed for animal use. Off-label studies in dogs have shown some value but further safety and efficacy studies are required before they could be routinely used in high-risk areas. In countries where unlicensed use is legally permitted, the TBE vaccine for children should be used if vaccination is desired in dogs, with signed consent from the pet owner.

3.1.3 Other preventative measures

While highly efficacious, tick products are not 100% effective and pets should be checked for ticks after outdoor activity. If found, ticks should be removed with a tick removal device. Compressing or crushing ticks *in situ* with blunt tweezers or fingers might lead to a reflux of gastrointestinal contents and saliva, possibly leading to increased pathogen transmission.

Traditional techniques to loosen ticks, such as the application of alcohol, petroleum jellies or burning will also increase this likelihood and are not recommended.

Tick identification by referral laboratories, veterinary practices, academic institutions or government agencies will help to determine potential tick-borne pathogen exposure in pets and evaluate the risk of *Rhipicephalus sanguineus* establishing in household or kennel environments.

Adult ticks can be examined by the naked eye to identify gross features. Anatomical features can be examined more closely under a dissecting/stereo microscope 10x or 40x magnification, using “top” incident light. Larval ticks and nymphs are smaller and will require microscopic examination for identification. They can be placed in a drop of water or liquid paraffin on a slide, under a coverslip. Features can then be examined under a 4x or 10x objective lens. It is important to establish that the ectoparasite removed is a tick and not a mite. Adults and nymphs are usually large enough to distinguish on size. Larval ticks are similar in size to some mites, but only have six legs and other typical tick features such as a hypostome equipped with backward-facing teeth in their mouthparts. *Ixodes* spp. ticks can be differentiated from ticks of other genera by the anal groove, which in *Ixodes* spp. ticks is anterior to the anus. In *Dermacentor* spp. and *Rhipicephalus* spp. ticks, this groove is posterior to the anus. In addition, they have other features that can be used for identification such as festoons, eyes and ornate patterns on their scutum. Tick identification keys are available. An example can be found on the ESCCAP UK & Ireland website at www.esccapuk.org.uk/page/Tick+ID/48/.

3.2 Diptera-transmitted parasites (e.g. *Dirofilaria* spp., *Leishmania* spp., *Thelazia callipaeda*, *Onchocerca lupi*)

A number of filarioid worms, enzootic in Europe and transmitted by mosquitoes (Culicidae/culicids), need to be considered in dogs and cats moving between enzootic and non-enzootic countries[5]. Filarioid worms are nematodes infecting the connective tissues and vascular system of dogs and cats. *Dirofilaria immitis*, the canine and feline heartworm, is the most pathogenic species, while *Dirofilaria repens*, which mainly causes subcutaneous dirofilariosis, is the most important species responsible for zoonotic *Dirofilaria* infections in Europe.

Dirofilaria immitis primarily infects canids but can also infect other mammals, particularly ferrets and cats. It is enzootic throughout southern and parts of eastern Europe and is a significant cause of severe cardiorespiratory disease in dogs and cats. Parasitic granulomas in the lungs, resembling a lung tumour, due to aberrant migratory larvae of *D. immitis* have been rarely reported in humans in different European countries.

Definitive hosts for *D. repens* are carnivores, including dogs and cats. Humans can also be infected with the parasite via exposure to infected mosquito bites, usually with the worms not reaching patency. Adult worms live in skin nodules and subcutaneous tissues. Infection can be subclinical or lead to the presence of unique or multiple visible skin nodules. Less commonly, adult worms migrate to the eyes of the host where they may be visible and cause conjunctivitis. Prevalence of cutaneous dirofilariosis in cats tends to be only one tenth of that in dogs and typically occurs in areas of high canine infection rates. Nevertheless, subcutaneous nodules in imported cats should prompt further evaluations to exclude other subcutaneous worms, ectopic *D. immitis* or *Leishmania* spp. Due to the potential for misdiagnosis, microfilariae should be differentiated from *D. immitis* using morphological or molecular methods.

[5] See ESCCAP website for a map showing the approximate distribution of *Dirofilaria immitis* and *Dirofilaria repens* in Europe

Leishmaniosis is caused by intracellular protozoan parasites of the genus *Leishmania,* with *Leishmania infantum* being the predominant species in south European dogs and cats. Transmission occurs primarily through Phlebotominae/phlebotomine (sand fly) bites. Other non-vectorial routes of transmission have been reported in non-enzootic areas, such as vertical, venereal (mainly from infected male to the bitch) and via blood transfusion. These alternative routes account for the occurrence of sporadic cases in dogs that have never travelled outside non-enzootic areas (real autochthonous cases). Leishmaniosis has zoonotic potential which is currently thought to occur purely via sand fly bites.

Canine leishmaniosis is enzootic in southern Europe with prevalence rates of infection of up to 60% in exposed populations by serological diagnosis. Figures in ESCCAP Guideline 5 show the approximate northern limit of the enzootic area[6]. Outside this area, many imported cases of canine leishmaniosis and a few cases in cats have been diagnosed and treated. However, there have been increasing reports of isolated cases in dogs that have not travelled through, or resided in, enzootic areas and of transmission between dogs in non-sand fly enzootic areas. Most probably, focal transmission can occur for a limited period of time if there is sufficient infection pressure from imported infected dogs in the absence of competent vectors via these non-vectorial routes.

Thelazia callipaeda (the 'oriental eye worm') is a zoonotic vector-borne nematode, which resides in the conjunctival sac of definitive hosts (domestic and wild carnivores, rabbits and hares) and has zoonotic potential. Widely found in Asia, the parasite is spreading through southern and eastern Europe. The vector in Europe is the drosophilid fly (fruit fly), *Phortica variegata*, that feeds on lacrimal secretions. Third stage larvae are deposited to a new host when feeding on tear secretions and mature to adults in the conjunctival sac. *Thelazia callipaeda* was first reported in Europe in Italy and since 2007, autochthonous cases have spread east and northwards, being reported in southern and central European countries including some regions of France, Germany, Austria, Switzerland, Spain and Portugal, and more recently into eastern Europe, including Romania and Hungary. It is predominantly a parasite of dogs, though clinical cases of ocular thelaziosis have also been reported in cats in many enzootic areas.

Onchocerca lupi is a parasite found in ocular and periocular nodules with the potential to cause disease of varying severity in dogs. This filarioid nematode has also been recognised as a zoonotic agent, though the information about the biology and epidemiology of infection is largely unknown. The identity of vectors of this parasite remains unclear, but as for most *Onchocerca* spp., one or more species of *Simulium* (blackflies) may have a role. In Europe, the Iberian Peninsula and Greece are known to be enzootic areas, but cases have also been reported in Romania, Hungary, Germany and Austria.

Acanthocheilonema reconditum is a filarial parasite transmitted by fleas and lice, which serve as intermediate hosts. While it is generally considered non-pathogenic, it can be confused with *Dirofilaria immitis* microfilariae in diagnostic tests. *Acanthocheilonema* (or *Dipetalonema*) *dracunculoides* is another filarial parasite, with *Rhipicephalus sanguineus* acting as its intermediate host. Additionally, *Cercopithifilaria* species are filarial parasites transmitted by *Rhipicephalus sanguineus* ticks, but their microfilariae remain in the skin rather than circulating in the bloodstream.

[6] See current distribution maps of leishmaniosis in Europe on the ESCCAP website

3.2.1 Preventative treatments

Monthly administration with a licensed macrocyclic lactone such as milbemycin, moxidectin, selamectin or eprinomectin is highly effective as a preventative treatment in pets travelling to countries enzootic for *D. immitis* (not all of these compounds are licensed in all European countries and are often found in combination products). Licensed macrocyclic lactones given within 30 days of exposure will kill transmitted larvae but only a limited number of moxidectin products are licensed for any form of prophylactic effect. Consequently, for most products, treatment is important 30 days after travel, even if the duration of travel is less than this. Drug resistant *D. immitis* are present in North America but to date, no non-travelled infections have been reported in Europe. However, reports indicate resistant cases have been imported into Europe. An injectable, sustained-release moxidectin has been approved in some European countries for use only in dogs older than six months and is registered to give protection for one year. A licensed pyrethroid mosquito repellent can be a useful secondary line of defence in dogs but should not be solely relied upon. Moxidectin/imidacloprid spot-on preparations are licensed for the prevention of *D. repens* infection. Products licensed in some countries for the prevention and/or treatment of *T. callipaeda* infection are moxidectin/imidacloprid spot-on solution, moxidectin/afoxolaner, milbemycin oxime tablets, milbemycin oxime and praziquantel tablets (if monovalent unavailable), afoxolaner plus milbemycin oxime tablets, fipronil/(S)-methoprene/eprinomectin/praziquantel and esafoxolaner, eprinomectin and praziquantel.

Use of a pyrethroid to reduce *L. infantum* transmission is essential for pets visiting enzootic countries. A number of pyrethroid spot-on formulations and collars are licensed for sand fly repellency in dogs. A flumethrin/imidacloprid collar is licensed for dogs and cats and, in some countries, carries a claim to reduce the risk of canine *L. infantum* transmission in enzootic areas. This is currently the only available option in cats (off-label). The cat collar does not have a specific sand fly repellency claim but has shown in some studies to effectively reduce the risk of *Leishmania* transmission. Spot-on or collar pyrethroid repellents should be used at least one week before travel.

3.2.2 Vaccines

Two vaccines are currently licensed in Europe for reducing disease caused by *L. infantum* infection. One is composed of Protein Q, a recombinant protein constructed from the union of five antigenic fragments of four proteins of *L. infantum*. This vaccine can be given as an initial single injection followed by annual revaccination. The second is a DNA vaccine (administered intranasally every six months for the first year and then annually) based on the plasmid vector pPAL which contains an encoding gene for the *L. infantum* activated protein kinase C receptor analogue (LACK). It was approved by the European Medicines Agency in 2023 and is still only available on the market in Spain.

These vaccines can only be administered to healthy uninfected dogs of six months of age or older. They are indicated to reduce the risk of developing clinical disease or to reduce the risk of severe disease presentation following exposure to *L. infantum* infection. They do not interfere with the detection of *L. infantum*-specific antibodies and thus allow the discrimination of vaccinated, from naturally-infected dogs. Vaccination should not be relied upon as a sole means of protection against leishmaniosis but always in addition to the use of sand fly repellents/products with a demonstrated reduced risk of transmission.

3.3 Parasites transmitted through predation and the consumption of raw meat/offal

Travelling dogs and cats may be exposed to a range of tapeworm infections through predation and the consumption of raw meat/offal. Of these, the most significant in Europe is the fox tapeworm, *E. multilocularis*, the cause of alveolar echinococcosis in humans. This is a severe zoonosis and *E. multilocularis* has spread rapidly across Europe over the past 20 years[7]. The adult tapeworm is carried by foxes, raccoon dogs, some other wild canids and rarely, dogs and cats. Foxes act as a reservoir of infection and microtine voles as intermediate hosts. Dogs, foxes and less commonly cats become infected by predation of these voles, with infection in urban fox populations and dogs bringing the parasite into close proximity to people. Cats can act as definitive hosts for *E. multilocularis* but have a lower worm burden with lower fecundity than canids, though in individual cases, considerable *E. multilocularis* egg shedding can occur.

[7] See current distribution maps of *Echinococcus* tapeworms in Europe on the ESCCAP website

The dog tapeworm, *Echinococcus granulosus*, the cause of cystic echinococcosis, is another small tapeworm that is enzootic throughout most of Europe[7] inhabiting the small intestine of dogs and some other canids, excluding foxes. Dogs become infected by eating viscera (mostly offal) containing hydatid cysts of *E. granulosus*. Each cyst contains numerous brood capsules with several protoscolices per capsule; so, for every cyst ingested, hundreds or even thousands of tapeworms will appear in the dog's small intestine.

Both tapeworms, *E. granulosus* and *E. multilocularis*, induce extra-intestinal metacestode stages in intermediate hosts and both are zoonoses of major public health concern. Zoonotic infection occurs through ingestion of eggs passed in the faeces of infected definitive hosts, such as dogs and foxes, which are immediately infective. This can occur through contact with contaminated dog fur, contamination of public areas with dog or fox faeces, or through eating contaminated fruit and vegetables intended for raw consumption.

E. granulosus is a species complex composed of zoonotic and non-zoonotic genotypes/species. Several distinct genotypes of *E. granulosus* are recognised, with a range of intermediate hosts. Not all genotypes cause infections in humans and the genotype associated with the majority of cystic echinococcosis infections is principally maintained in a dog–sheep–dog cycle. Other domestic animals, however, may act as intermediate hosts for zoonotic genotypes including cattle, goats and pigs. Both *E. granulosus* and *E. multilocularis* infections result in the formation of cysts, most commonly in the liver (*E. multilocularis, E. granulosus*) or in the lung (*E. granulosus*). When untreated, they can have fatal consequences. Dogs can also act as intermediate hosts through the ingestion of eggs, with similar serious health consequences.

Taenia spp. of dogs, capable of infecting livestock intermediate hosts, have a similar life cycle to *E. granulosus* and may also be introduced to non-enzootic areas by pet movement. *Taenia* spp. of dogs are not considered a significant zoonosis by the World Health Organisation but the presence of cysts in livestock can lead to offal and meat condemnation at inspection.

Several cases of the nasal pentastomid *Linguatula serrata* ("tongue worm") have been seen in the UK, Germany, Switzerland, Scandinavia and Spain in dogs imported from eastern Europe and the Middle East. Infection of this parasite is acquired from the consumption of raw meat and offal in enzootic countries. *Linguatula serrata* is potentially zoonotic, with humans acting as both dead-end and definitive hosts, acquiring infection through ingestion of undercooked meat/offal or via eggs from nasal secretions and faeces. Most cases of infection in dogs and cats are subclinical or manifest in the upper respiratory tract causing nasopharyngitis, rhinitis or sinusitis. Due to its large size, it may cause irritation, nasal discharge and obstruction of the upper airways resulting in sniffling.

3.3.1 Preventative treatments

Treatment with praziquantel is the mainstay of control for *Echinococcus* spp. infection, both to prevent zoonotic exposure but also to prevent establishment of the parasite in intermediate reservoir hosts in new geographical areas. The prevention of patent infection can be achieved by monthly treatment with praziquantel. This is essential for free-roaming dogs living in enzootic countries and those travelling in enzootic areas where predation, scavenging of rodent carcasses and access to raw offal may occur. Cases of infection in cats are uncommon but have been reported, so these cats should also be treated if moving into enzootic geographical areas or if they are frequent hunters. The 1–5 day period, allowed for compulsory treatment before entry into an *E. multilocularis*-free country, offers a window of opportunity for infection before travel. All travelled dogs should therefore receive an additional praziquantel treatment within four weeks after entry into an *E. multilocularis*-free geographical area. There is no licensed treatment for *L. serrata* infection.

[7] See current distribution maps of *Echinococcus* tapeworms in Europe on the ESCCAP website

3.3.2 Other preventative measures

The transmission of these parasites can be mitigated through the responsible disposal of dog faeces and the prevention of scavenging, predation and the consumption of raw or undercooked meat and offal. However, this can be challenging in some situations, such as when dogs are off their leads or have access to pasture. Rapid identification and treatment of *L. serrata* in newly-adopted dogs is important to limit any zoonotic risk and prevent exposure to other hosts such as sheep, cattle and pigs. Whilst there are no licensed treatments for *L. serrata*, moxidectin, ivermectin and milbemycin have demonstrated some efficacy in case reports and anecdotally. Using rhinoscopy to visualise and remove parasites is a useful adjunct to treatment and for assessing parasite burden. Good hand and environmental hygiene will also help to reduce zoonotic exposure.

4. PREVENTATIVE MEASURES POST TRAVEL AND IN IMPORTED PETS

The rapid identification of parasitic infection and/or disease in travelled and imported dogs and cats forms an essential part of preventing new parasites and vectors establishing in new geographical areas through these routes. These may be “rescues” via charities or individuals or pets imported for breeding, showing etc. Although risk will be relative depending on the history of the pet, the risk that imported parasites represent to individual pets, the public and wider biosecurity means that a systematic approach to these pets in practice is required. This consists of a thorough travel history, clinical examination, diagnostic testing/screening, checking for ecto- and endoparasites and removing any found for identification and applying post-travel preventative treatments.

4.1 General examination and travel history

A thorough and comprehensive clinical examination of imported pets will identify adverse clinical signs. These can then be compared to exotic parasitic diseases and those in the countries that the pet has visited. This examination should include haematology and biochemistry profiles as well as urinalysis. A travel history should include countries visited throughout the whole of the animal’s life as some parasites may remain in a subclinical state for months (e.g. heartworm) or years (e.g. *L. infantum*) before manifesting clinically. It should be considered when taking a patient’s history, that travel history might not always be available in dogs that have had multiple homes through readoption. Imported dogs and cats may also have been moved through more than one country before reaching their final destination. Clinical signs for each individual pathogen can be many and varied and sometimes shared by more than one parasite. Some clinical signs, however, are commonly seen with specific parasitoses.

4.1.1 Tick-borne pathogens

A range of tick-borne pathogens need to be considered when performing a clinical examination.
Examples include:

Babesia spp.
Hepatozoon spp.
Ehrlichia spp.
Anaplasma spp.

Clinical signs and laboratory results typically associated with imported tick-borne disease arising from infection with these pathogens include:

Anaemia and thrombocytopenia – *Babesia* spp. infection can lead to immune-mediated haemolytic anaemia and thrombocytopenia in dogs with subsequent regenerative anaemias developing. Most commonly, these anaemias are acute and typically present pale mucous membranes, icterus, pyrexia and hepato-splenomegaly. Associated depression and anorexia may be present, as well as dark brown urine associated with haemoglobinuria. Concurrent thrombocytopenia may be present with petechiae on the gums, spontaneous bleeding or bruising. *Babesia* spp. infection should be suspected in imported dogs or those that have travelled to enzootic regions and exhibit these signs. Clinical presentation and clinicopathological abnormalities can vary depending on the *Babesia* species. Large *Babesia* species (*B. canis*, *B. vogeli*, *B. rossi*) typically manifest as acute disease whereas small *Babesia* species (*B. gibsoni*, *B. vulpes*) are more likely to present a chronic state (including, for example, kidney disease/glomerulopathies). Travel history will often be present for acute infections but may have occurred months or years previously, as infection with *Babesia* spp. can be lifelong and chronic, with relapses of clinical disease common. *Anaplasma* spp. can be a cause of thrombocytopenia in dogs therefore this should be considered as differential diagnosis in travelled dogs suffering from recurrent bouts of thrombocytopenia. It is also a common sign in subacute and chronic ehrlichiosis where inappetence, wasting and continuous alterations in haematology and blood biochemistry are commonly seen, along with potential bone marrow suppression, musculoskeletal and kidney disease in more advanced cases.

Lymphadenopathy and pyrexia – Many clinical tick-borne infections will present acutely with lymphadenopathy and pyrexia including (but not limited to) those transmitted by *Ixodes* spp. (e.g. *Borrelia burgdorferi*, tick-borne encephalitis virus, small *Babesia* spp., *Anaplasma phagocytophilum*), *Rhipicephalus sanguineus* (e.g. *Ehrlichia canis*, *Hepatozoon canis*, *Rickettsia* spp.) and *Dermacentor reticulatus* (e.g. *Babesia canis*). Travelled and imported dogs presenting these signs should be tested for these parasites and checked for *R. sanguineus* ticks as house infestation is a possibility. It is also important to recognise these acute signs of *E. canis* and *Babesia* spp. infection because, without treatment, they may progress to the chronic, often fatal form in dogs.

Neurological signs – Tick-borne encephalitis and both acute and chronic ehrlichiosis may present signs associated with meningitis and meningoencephalitis. These include ataxia, seizures, paresis, hyperesthesia, cranial nerve deficits and vestibular signs. Dogs may exhibit these symptoms following recent travel or, in cases of chronic ehrlichiosis, after a period of months or even years. *Babesia canis* infections can also lead to neurological signs resulting from hypoxia. These cases are rare but frequently fatal.

Polyarthritis – *Borrelia* spp., *Anaplasma phagocytophilum* and *E. canis* infections can all cause polyarthritis.

4.1.2 *Leishmania infantum*

Leishmaniosis is a chronic disease with a variety of presentations and periods of remission. Signs are due to parasitic granulomas and/or immune complex deposition in various organs and include non-specific clinical signs such as asthenia, weight loss, lymphadenopathy; cutaneous lesions (e.g. exfoliative dermatitis with generalised and focal alopecia, periocular alopecia, nasal/plantar hyperkeratosis, ulcers, nodular forms etc.) and splenomegaly, vasculitis, epistaxis, polyarthritis, uveitis, onychogryphosis and polyuria/polydipsia associated with immune-mediated glomerulonephritis. Less commonly, thrombocytopenia, anaemia, neutropenia, gastrointestinal signs as well as neurological signs associated with spinal and central nervous system granulomas may be present. A range of ocular signs may be seen in addition to uveitis in some cases, including ocular inclusion bodies, keratoconjunctivitis and blepharitis. Leishmaniosis should be considered as a differential in imported (rescue or travel) dogs from enzootic areas. Signs may take months or years to develop so infection may not be recent. Infected pets may be subclinical and mixed infections with vector-borne pathogens are common therefore a pet positive for *L. infantum* infection, may have other infections responsible for, or contributing to, presenting clinical signs.

4.1.3 *Thelazia callipaeda* (eye worm)

Although often subclinical, ocular thelaziosis can commonly cause conjunctivitis, keratitis, epiphora, eyelid oedema, corneal ulceration and, in severe cases, blindness. Close examination of the conjunctiva, particularly under the nictitating membrane will often reveal worms actively moving on the surface and checking is vital in all imported dogs and cats to detect low grade or subclinical infections. Use of anaesthetic eye drops before examination is recommended. Prompt identification and treatment will improve individual prognosis and by removing infection, prevent exposure to vectors.

4.1.4 *Dirofilaria immitis* (heartworm)

In sick dogs, common clinical signs include coughing, tachypnoea, dyspnoea and exercise intolerance. Acute clinical signs are associated with thromboembolism, subsequent pulmonary hypertension and caval syndrome. Worm death can also lead to thromboembolism and anaphylaxis. Typical resulting acute clinical signs include sudden death, anorexia, weakness, dyspnoea, vomiting and rarely, respiratory signs linked to pleural effusion. Clinical signs in cats are often respiratory in nature but other non-specific signs and sudden death may also occur. Clinical signs commonly develop many months or years after initial infection.

4.1.5 *Dirofilaria repens* (subcutaneous worm)

Cases of *D. repens* infection are most commonly subclinical but clinical signs associated with infection can rarely occur. Dermatitis is the most common clinical presentation (as multifocal nodules in the skin or papular dermatitis) and is more frequently seen in cats than dogs. These signs can reoccur seasonally for years after infection resulting in pruritus, erythema, papules and focal or multifocal alopecia. Less commonly, hyperkeratosis, crusting, distinct nodules, acanthosis and secondary pyoderma can occur. These signs are partially immune-mediated in nature and partially due to disruption and irritation caused by the physical movement of the worms. Ocular migration of worms into the vitreous is uncommon, but does occur; therefore, *D. repens* should be considered as a differential should worms be visible there. It should also be considered as a differential in cats and dogs presenting with dermatitis that have lived in, or visited, enzootic countries.

4.1.6 *Linguatula serrata*

Most cases of *L. serrata* infection in dogs and cats are subclinical. However, large burdens can lead to rhinitis and nasopharyngitis with associated chronic sneezing and/or coughing, purulent nasal discharge and epistaxis. It is vital that these signs are detected early in infected dogs to limit zoonotic exposure to owners and other in-contact individuals who may ingest infective eggs in nasal discharge or from faecal contamination. Often, these parasites are first detected when they are expulsed from a dog's nasal passages and veterinary practices are subsequently contacted for identification.

4.2 Diagnostic tests and screening of imported dogs for parasitic infections

Dogs and cats that have travelled abroad for short periods should be tested for pathogens based on any clinical signs being demonstrated or ticks found. When being imported on a long-term basis or permanently, however, they should be screened for the pathogens listed in Table 1, using one or more of the recommended tests. *L. infantum*, tick-borne pathogens, heartworm and subcutaneous worms can all have long incubation periods before clinical signs develop. Infection can also be lifelong and, in some cases, carry a poor prognosis. Screening for these parasites in dogs and cats imported from enzootic countries will lead to early diagnosis, preparing the owner for what could be a lifetime of potential treatment, associated zoonotic risk and limiting wider spread through effective treatment and tick control. Pet owners should be made aware that negative results for many tests do not completely rule out the possibility of infection and further testing is required. Testing for heartworm and *Leishmania* should be carried out 6–9 months after arrival in a new country or region, as well as on entry.

4.2.1 Blood smear examination and screening for tick-borne pathogens

Light microscopy of blood smears is a useful test to perform in all imported dogs. Dogs infected with *Hepatozoon canis* typically have gametocytes present in peripheral blood smears (mainly neutrophils) and are often subclinical. Piroplasms of *Babesia* spp. in red blood cells as well as morulae of *E. canis* in monocytes, *Anaplasma phagocytophilum* in neutrophils and *Anaplasma platys* in thrombocytes may also be seen. Sensitivity is increased for some of these parasites if buffy coat smears are used and may be considered if peripheral blood smears are negative. Capillary blood smears may also be considered to increase sensitivity when looking for *Babesia* spp. infection. Blood smears are quick and simple to prepare but require practice to perform with the correct motion, leading to an even film. While freshly prepared smears are preferable, blood samples can be stored in EDTA tubes if immediate preparation is not feasible or if samples are destined for an external laboratory for blood smear preparation. Blood samples should not be refrigerated prior to blood film examination however, as this may affect *Babesia* piroplasm morphology. Because the sensitivity of blood smear examination is low, the practice of storing a blood sample in an EDTA tube enables molecular diagnosis by PCR. PCR blood testing carries a far higher sensitivity than blood smears. Some parasites such as *Trypanosma* spp. may be seen in blood smears extracellularly[8].

To determine the *Babesia* species, it is necessary to run PCR with specific primers, mainly because not all have the same therapy approach. Screening for *E. canis* and *Anaplasma* spp. requires PCR and serology testing. Serology is highly sensitive and specific for detecting exposure to the parasite. Quantitative serology is useful in the case of *E. canis* and *A. phagocytophilum* where acute infection is suspected. A fourfold increase in test titres taken two weeks apart is indicative of active infection. Seroconversion also indicates active infection. Quantitative serology is also useful for the presence of *B. gibsoni* infection although PCR would be required to confirm species. PCR testing of blood samples is also a highly specific and sensitive test for these tick-borne pathogens to confirm an active infection. PCR is also essential for subclinical *Babesia* spp. infections and clinical cases which have moved out of the initial acute clinical phase.

4.2.2 Screening for *Leishmania* spp. infection in subclinical and clinically affected dogs

Sick dogs can be tested by serology, PCR and/or histology/cytology of targeted tissues (bone marrow, lymph nodes, spleen aspirates and skin). Conjunctival swab PCR is a useful non-invasive test with approximately 85% sensitivity, although sensitivity drops in dogs with low antibody titres. Both eyes should be swabbed separately to maximise cell yield. Blood PCR is highly specific but carries a lower sensitivity. There can be large differences in sensitivity based on the PCR protocol and target gene. In infected but clinically healthy dogs, quantitative serology over time is useful for detecting emerging clinical disease, as is the monitoring of haematological parameters, blood proteins and urine for other clinicopathological abnormalities. Serology is mainly an indicator of disease, so also turns negative if disease is well controlled, making it an excellent tool for monitoring disease status over time. Serology is less sensitive, however, in the first few months post infection.

[8] See ESCCAP Guideline 4: Parasitological Diagnosis in Dogs, Cats and Equines and ESCCAP Guideline 5: Control of Vector-Borne Diseases in Dogs and Cats

4.2.3 Screening for *Dirofilaria immitis* and other filarioid nematode infections

Before travelling from enzootic to non-enzootic areas, dogs should be screened for dirofilarial infections, treated against adult heartworms and cleared of both *D. immitis* and *D. repens* microfilariae. Furthermore, animals with unknown history should receive prophylactic treatment for two months to kill potential migrating L3–L4 and be tested for circulating antigens and microfilariae six and twelve months later. Testing for antigen (secreted-excreted primarily by female adult *D. immitis*) is a highly specific and sensitive diagnostic test in infected dogs from six months post infection. A second test in newly imported animals, six months after arrival, is useful to rule out infection too immature for detection at the time of import. The modified Knott's test (or filtration test) carried out by some diagnostic laboratories concentrates microfilariae in the blood and is a useful test in positive dogs to identify and quantify the numbers of circulating microfilariae. It also improves sensitivity if used alongside antigen testing. Screening for *D. immitis* infection is important before heartworm preventatives are applied due to anaphylaxis and thromboembolism risk from killed microfilariae and dying adult worms, respectively. Microfilariae of other filarioid nematodes may also be detected by this method, and it is important to differentiate any other species present. This can be achieved morphologically or by PCR. This is both to confirm the presence of *D. immitis* but also to identify other potential filarioid worms of veterinary significance such as *Dirofilaria repens*. Microfilariae from other apathogenic filarioid nematodes may also be present such as *Acanthocheilonema dracunculoides* (prevalent in Spain and other countries).

4.2.4 Faecal testing for intestinal helminths

Although some intestinal nematodes such as *Strongyloides* spp. and *Toxocara* spp. are thought to be relatively ubiquitous, others such as hookworms have more regional distributions. Faecal testing for intestinal roundworms by faecal flotation, antigen testing or PCR will indicate if roundworms are present and treatment required. *Taenia* tapeworms are difficult to detect by microscopic faecal examination techniques but PCR testing is commercially available in some countries for *Echinococcus* spp. Due to the high zoonotic risk *Echinococcus* poses however, testing should not replace routine treatment for free-roaming dogs living in enzootic countries and those travelling in enzootic areas where predation, scavenging of rodent carcasses and access to raw offal may occur. Relevant clinical signs for intestinal worm infection may also be present including diarrhoea, poor body condition and anaemia.

4.3 Checking for ticks, fleas and other ectoparasites

Dogs and cats should be checked for ticks, and any found subsequently identified as described in section 3.1.3. It is important to check for other ectoparasites, especially in pets that have been rescued or rehomed, as adequate parasite protection may not have been in place. If fleas are present and allowed to establish in homes, then subsequent zoonotic exposure to pathogens such as *Bartonella* spp., *Rickettsia felis* and *Dipylidium caninum* may occur. Skin scrapes should be performed on cats and dogs with dermatological signs consistent with sarcoptic, demodectic or notoedric mange such as variable pruritus, papular eruptions, crusting, excoriation, erythema and secondary alopecia and pyoderma.

Table 1. Summary of screening tests for imported pets

Species	Screening Test(s)
Leishmania infantum	Serology with option to sample clinically affected sites by cytology and PCR (both serology and PCR with quantitative options for staging, prognosis and monitoring). Blood can be used for PCR but with likely lower sensitivity as a screening tool.
Dirofilaria immitis	Antigen blood test and microfilariae testing (ideally in combination, and with the option to differentiate microfilariae and to preheat samples negative for antigen; preheating is not recommended for screening in non-enzootic countries).
Dirofilaria repens **and other subcutaneous worms**	Gross visualisation, microfilariae testing and PCR.
Ehrlichia canis **and** ***Anaplasma*** **spp.**	Serology and PCR (PCR should be used in addition to serology for clinical cases of *Anaplasma* spp. to differentiate *A. platys* from *A. phagocytophilum*, serology should be used for chronic *E. canis* with the sensitivity of PCR depending on the material used).
Hepatozoon canis	Blood smear or PCR (if blood smear is negative, preferably buffy coat smear based on target cells).
Babesia **spp.**	Blood smear (initially for clinical cases; consider capillary blood) and PCR for confirmation and species differentiation as well as blood smear negative samples. Serology may be useful for *B. vogeli* cases as serology may be positive in PCR negative infections.
Brucella canis	Serology for dogs imported into non-enzootic countries.
Ancylostoma **spp.,** ***Strongyloides stercoralis*** **and other intestinal nematodes**	Faecal examination by flotation, antigen testing or PCR to check for the presence of exotic helminths. Baermann may be considered for *Strongyloides* spp. and lungworm infections.

Testing should be repeated 3–6 months after entry for *Brucella canis* and 6–9 months after entry for *Leishmania infantum* and *Dirofilaria immitis* or at the time compatible clinical signs occur. There is an opportunity to repeat testing for all three pathogens approximately six months after arrival in the country.

APPENDIX 1 – BACKGROUND

ESCCAP (European Scientific Counsel Companion Animal Parasites) is an independent, not-for-profit organisation that creates guidelines based on up-to-date scientific information and promotes good practice for the control and treatment of parasites in companion animals. With application of the proper advice, the risk of diseases and parasitic transmission between animals and humans can be minimised. ESCCAP aspires to see a Europe where companion animal parasites no longer threaten the health and well-being of animals and humans.

There is great diversity in the range of parasites and their relative importance across Europe and the ESCCAP guidelines summarise and highlight important differences which exist in different parts of Europe and, where necessary, specific control measures are recommended.

ESCCAP believes that:

- Veterinarians and pet owners must take measures to protect their pets from parasitic infections.
- Veterinarians and pet owners must take measures to protect the pet population from risks associated with travel and its consequent potential to change local parasite epidemiological situations through the export or import of non-endemic parasite species.
- Veterinarians, pet owners and physicians should work together to reduce the risks associated with zoonotic transmission of parasitic diseases.
- Veterinarians should be able to give guidance to pet owners regarding risks of parasite infection and diseases and measures which can be taken to minimise these risks.
- Veterinarians should attempt to educate pet owners about parasites to enable them to act responsibly not only for their own pet's health but for the health of other pet animals and people in their communities.
- Veterinarians should wherever appropriate, undertake diagnostic tests to establish parasite infection status in order to provide the best possible advice.

To achieve these objectives, ESCCAP produces:

- Detailed guidelines for veterinary surgeons and veterinary parasitologists.
- Translations, extracts, adaptations and summarised versions of guidelines which address the varied requirements of European countries and regions.

Versions of each guideline can be found at www.esccap.org

Disclaimer:

Every effort has been taken to ensure that the information in the guideline, which is based on the authors' experience, is accurate. However, the authors and publishers take no responsibility for any consequence arising from the misinterpretation of the information herein nor is any condition or warranty implied. ESCCAP emphasises that national, regional and local regulations must be borne in mind at all times before following ESCCAP advice. All dosages and indications are provided for guidance. However, vets should consult individual data sheets for details of locally approved treatment regimens.

APPENDIX 2 – GLOSSARY

Acaricide	Acaricides are compounds that act against ectoparasites belonging to the (acaricidal compound) class Arachnida, sub-class Acari by zoological nomenclature. In this guideline ticks and mites are acarids.
Anaphylaxis	An extreme and dangerous allergic reaction.
Antigen	A foreign substance which induces an immune response in the body, especially by producing antibodies.
Apathogenic	Not capable of causing disease.
Application	Like treatment, but describing the various forms of veterinary medicinal products which can be given (applied) to animals, such as spot-ons, pour-ons, oral products, injectables etc.
Autochthonous	Native or indigenous rather than imported.
Autoimmune disease	A disease or condition where the body's immune system mistakenly attacks its own tissues or cells, causing inflammation and damage.
Biochemistry profile	A blood test or series of blood tests that assess a wide range of biochemical markers relating to organ function, metabolic health, electrolyte balance etc.
Clinicopathological	The combined study and interpretation of clinical signs and laboratory tests, particularly those relating to pathology.
Control	General term comprising 'therapy' (treatment) and 'prevention' (prophylaxis).
Culicidae	The scientific name for the family of insects that includes mosquitoes.
Cutaneous	Relating to or affecting the skin.
Cyst	Environmentally-resistant parasitic life stage excreted with faeces able to survive outside the host.
Cytology	The scientific study of cells from bodily tissue or fluids.
Definitive (or final) host	This is the host in which a parasite completes its development into the sexually mature/adult stages producing eggs or larvae.
Differential diagnosis	A differential diagnosis occurs when clinical signs correlate with more than one condition. Additional tests will therefore be necessary before an accurate diagnosis is made.
Diptera	A large order of insects that comprises the two-winged or true flies. It includes many biting forms such as mosquitoes and tsetse flies that are vectors of disease.
Drosophilidae	Family of flies within the order Diptera.
Ectoparasite	A parasite that lives on the outside of its host.
EDTA tubes	EDTA (ethylenediaminetetraacetic acid) is a chemical compound used as an anticoagulant in blood collection tubes.
Efficacy	The ability of a drug to produce the desired therapeutic effect at the recommended dosage. In the field, faecal egg reduction counts are just one example of a wide range of tests used to demonstrate efficacy.
Endemic	Prevalent in, or restricted to, a particular region.
Endoparasite	A parasite that lives inside the body of its host.
Enzootic	Constantly present in animals within a specific region.
Epidemiology	Study of the causes, distribution and control of disease.
Faecal flotation	A veterinary diagnostic test used to detect the presence of parasitic cysts and ova, using the densities at which they float to separate them from other faecal matter.
Fecundity	The ability to produce an abundance of offspring.
Filarial	Relating to nematode worms now classified as Onchocercidae.

Filarioid	Parasitic nematodes (roundworms) belonging to the family Onchocercidae.
Flavivirus	A genus of viruses that cause serious diseases such as West Nile virus, dengue virus, tick-borne encephalitis virus, yellow fever virus, Zika virus and several other viruses which may cause encephalitis.
Gametocyte	A gametocyte is a sexual precursor cell that develops into a gamete (sperm or egg) during the sexual stage of the life cycle of certain parasites.
Gastrointestinal	Relating to both the stomach and the intestine.
Genotype	The genetic makeup of an organism.
Granuloma	A localised area of inflammation and immune cell aggregation that forms in response to a persistent stimulus, such as infection or a foreign body.
Haematology	The scientific study of blood and blood components.
Helminth	A parasitic worm such as a roundworm (ascarid, strongyle, pinworm), tapeworm or fluke.
Histology	The microscopic study of the structure of tissue and cells.
Host	An organism that harbours parasites.
Hypostome	The harpoon-like structure that forms part of the mouthparts of certain parasitic arthropods including ticks, that allows them to anchor themselves firmly in place on a host vertebrate while sucking blood.
Immune-mediated	A disease or condition in which the immune system plays a role in its origin or development.
Incubation	In parasitology, the period of time from parasite exposure to the onset of clinical symptoms.
Infection	Invasion and multiplication of microorganisms in body tissues.
Infective	Capable of producing infection.
Infestation	In this context, the presence of parasites in the environment, on the skin, or in the hair of a host.
Ingestion	Taking into the body by mouth.
Intermediate host	This is a host harbouring immature stages of a parasite species which develop into infective stages for the definitive host.
Intracellular	Within the cell.
L1 – L2 – L3 – L4 – L5 or Pre-adult	This is the normal larval development sequence of nematodes, beginning with the first larval stage (L1) which moults four times to the pre-adult stage. Generally, the development of nematodes from first stage larvae (L1) to third stage larvae (L3) occurs in the environment or in an intermediate host and the fourth stage larvae (L4), L5 or pre-adult and adult within the host.
Larvae	The active immature form of an insect, especially one that differs greatly from the adult and forms the stage between egg and pupa.
Metacestode	The larval stage of a tapeworm that infects an intermediate host and is capable of infecting the definitive host.
Microfilaria/microfilariae	An early stage (minute or pre larva) in the life cycle of certain parasitic nematode worms. Sometimes abbreviated to “mf”. Plural: microfilariae.
Microscopy	The use of microscopes.
Morphology	The form and structure of organisms.
Morulae	A solid ball of cells resulting from division of a fertilised ovum (singular: morula).
Multifocal	Existing in more than one place in the body or part of the body.
Nematode	Roundworms, in this context parasitic.
Neutrophil	A type of granulocyte or white blood cell which forms an essential part of the innate immune system.
Nymph	The immature stage of certain arthropods, particularly ticks and mites, that undergo incomplete metamorphosis without a pupal stage, resembling the adult form but with underdeveloped reproductive organs and wings.

Parasite burden	The number of parasites a host organism harbours, a key factor in determining the severity of parasitic infections.
Parasitoses	Diseases or conditions caused by parasitic infections.
Patent infection	A parasitic infection where parasite stages are detectable in the host's body, indicating an active and ongoing infection.
Pathogen	An agent capable of causing disease.
Pathogenic	Relating to an agent that is capable of causing disease.
PCR (polymerase chain reaction)	A molecular technique used to detect and identify parasite DNA, enabling more sensitive and accurate diagnosis of parasitic infections than traditional methods like microscopy.
Pentastomid	Worm-like arthropods that are obligate endoparasites of the respiratory tract of vertebrates.
Peracute	A condition or disease that is severe and has a very rapid, sudden onset and progression, often leading to a rapidly fatal outcome.
Plasmid vector pPAL	A non-replicative, antibiotic-free mammalian expression vector used for developing third-generation vaccines, including therapeutic vaccines, and it induces immunomodulation based on the Th1 T-cell response.
Prevalence	A term describing the proportion (usually given as a percentage) of infected hosts within any group of animals.
Prevention	Measures implemented before any infection or disease occurs in the animal.
Prophylactic	Measures taken to prevent or reduce the risk of infection.
Protoscolices	The juvenile, infective stages of tapeworms (cestodes), particularly those of the genus *Echinococcus*, which develop within hydatid cysts and are capable of developing into adult worms in the definitive host.
Protozoa	Single-celled microscopic organisms.
Pruritus	Severe itching.
Recombinant protein	Artificially produced proteins using genetic engineering techniques, often used for research, diagnostics, and vaccine development by expressing parasite genes in a different host.
Repellency	The ability of a substance or treatment to deter or prevent parasites, like ticks or mosquitoes, from attaching, biting or feeding on a host, essentially causing them to avoid a treated area or host.
Repellent	A compound, which makes a host unattractive to a parasite and thus can prevent attack or establishment.
Reservoir host	An animal that harbours a parasite, often without showing any signs of illness, and serves as a source of infection for other susceptible species.
Resistant	Something that has the capacity to withstand the effects of a harmful chemical agent.
Scutum	A hard, shield-like plate or scale covering the dorsal (back) surface of hard ticks.
Sensitivity	The rate of true-positive samples (as judged by a "Gold Standard" test) or the likelihood that an infected animal can be detected as positive by the test.
Seroconversion	The change from a seronegative to a seropositive result owing to the development of specific antibodies in the blood serum as a result of infection or immunisation.
Serology	The scientific study or diagnostic examination of blood serum, especially with regard to the response of the immune system to pathogens or introduced substances.
Seronegative	Giving a negative result in a test of blood serum.
Seropositive	Giving a positive result in a test of blood serum.
Subacute	Between acute and chronic when relating to a condition.
Subclinical	Relating to a disease which is not severe enough to present definite or observable symptoms or clinical signs.
Subcutaneous	Under the skin.

Sustained-release	A formulation designed to slowly release a drug in the body over an extended period of time especially to sustain therapeutic levels.
Therapy	Any medical intervention to cure a disease; this includes the use of veterinary medicinal products (treatment), to eliminate an existing parasite infection.
Tick-borne	Tick-borne diseases are infections transmitted by ticks.
Titre	A measurement of the concentration of a substance in an amount of blood.
Topically	Administered to the outside of the body.
Treatment	Administration of veterinary medicinal products (medication) as deemed necessary based on any given diagnosis.
Vector	An organism, typically a biting insect or tick, that transmits a pathogen or parasite from one animal or plant to another.
Vector-borne	Vector-borne diseases are infections transmitted by infected arthropod species such as a mosquito, tick or sand fly.
Venereal transmission	Infections passed on through sexual contact.
Vertical transmission	When the transmission of causative agents occurs from mothers to their offspring.
Viscera	Soft internal organs of the body.
Visceral	Relating to the viscera.
Vitreous	The gel-like fluid that fills the eye's posterior cavity, the space between the lens and the retina, where parasites, like certain nematodes, can sometimes be found.
Zoonosis	Any infectious disease that can be transmitted between animals (usually vertebrates) and humans.
Zoonotic	Transmissible between animals (usually vertebrates) and humans.

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