Parasites & Vectors

REVIEW

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A review on the occurrence of companion vector-borne diseases in pet animals in Latin America

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Abstract

Companion vector-borne diseases (CVBDs) are an important threat for pet life, but may also have an impact on human health, due to their often zoonotic character. The importance and awareness of CVBDs continuously increased during the last years. However, information on their occurrence is often limited in several parts of the world, which are often especially affected. Latin America (LATAM), a region with large biodiversity, is one of these regions, where information on CVBDs for pet owners, veterinarians, medical doctors and health workers is often obsolete, limited or non-existent. In the present review, a comprehensive literature search for CVBDs in companion animals (dogs and cats) was performed for several countries in Central America (Belize, Caribbean Islands, Costa Rica, Cuba, Dominican Republic, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Puerto Rico) as well as in South America (Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, French Guiana, Guyana (British Guyana), Paraguay, Peru, Suriname, Uruguay, Venezuela) regarding the occurrence of the following parasitic and bacterial diseases: babesiosis, heartworm disease, subcutaneous dirofilariosis, hepatozoonosis, leishmaniosis, trypanosomosis, anaplasmosis, bartonellosis, borreliosis, ehrlichiosis, mycoplasmosis and rickettsiosis. An overview on the specific diseases, followed by a short summary on their occurrence per country is given. Additionally, a tabular listing on positive or non-reported occurrence is presented. None of the countries is completely free from CVBDs. The data presented in the review confirm a wide distribution of the CVBDs in focus in LATAM. This wide occurrence and the fact that most of the CVBDs can have a quite severe clinical outcome and their diagnostic as well as therapeutic options in the region are often difficult to access and to afford, demands a strong call for the prevention of pathogen transmission by the use of ectoparasiticidal and anti-feeding products as well as by performing behavioural changes.

Keywords: Companion vector-borne diseases (CVBDs), Dog, Cat, Occurrence, Vector, Latin America (LATAM), Prevalence

Background

Companion vector-borne diseases (CVBDs) have among others a major impact on the welfare of pets. They may also represent a constant risk to humans due to their zoonotic nature, which emphasizes the importance of pets as reservoirs.

In Latin America (LATAM), a region with one of the largest biodiversities in the world, a combination of factors such as intensification of agricultural practices, landscape modification, poor ecosystem protection and potentially slight unstable economics, creates host populations conducive to the performance and persistence of parasites and vectors.

This is especially important for CVBDs affecting dogs and cats as companion animals, as a significant proportion of those (i.e. 52–75%) [1, 2], even though owned by pet holders, roam freely, besides an exploding number of stray dogs and cats. In LATAM, the lack of sensitive awareness of animal welfare and disease issues, the

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restricted economic and technological access to proper veterinary care, and the absence of responsible pet ownership, have created conditions for the emergence and persistence of many diseases that ultimately will affect people, livestock, and wildlife [3–10]. Besides, socioeconomic, demographic and ecological factors, including globalization, increase in international trade, tourism and travel, climate change and its effect on vector distribution in time and space, have also to be reconsidered.

This article summarizes the data of reported detection (or prevalence when available) of the most significant CVBDs affecting companion animals in LATAM in tabular form and as detailed information per country and discusses research gaps to be addressed in future studies. In case of very scarce published data, additionally the occurrence of the pathogens in potential vectors, wild canids or felids and in humans is listed, to illustrate the fact that the pathogen is occurring in a respective region, even though not officially reported in companion animals so far. Beforehand a brief introduction on the diseases, usually followed by a short summary or references for more detailed data on diagnostic methods, treatment indications and ways of prevention are given.

Generally, for many of the vector-borne diseases (VBDs) described here, diverse diagnostic tests are available (microscopic, serological, molecular). Nevertheless, besides their different performance regarding sensitivity and specificity in acute and chronic disease, only few are readily available as diagnostic tools at most clinical practices in the reported LATAM regions.

Parasitic diseases

Babesiosis

Babesiosis in pet animals in LATAM is mainly caused by *Babesia vogeli* and *Babesia gibsoni* [11–13]. The disease has been reported in many areas especially of South America, whereas reports from Central America are scarce so far. *Babesia vogeli* is transmitted directly *via* tick bites [*Rhipicephalus sanguineus* (*sensu lato*)], whereas *B. gibsoni* in LATAM is expected to be transmitted *via* blood transfer through dog bites, blood transfusions and transplacental supply [14–18]. Clinical signs, depending on the species, and further details on clinical and laboratory findings can be found in Irwin [14]. As diagnosis microscopy remains the simplest and most accessible diagnostic test. Different sensitivity during the cause of disease may be supported by molecular methods (see Irwin [14] for details). Treatment does not eliminate the parasite, but only reduces parasitemia and supports resolution of clinical signs and is summarized elsewhere [14]. Animals diagnosed with *Babesia* spp. should be considered permanent carriers of the infection. Due to the missing elimination of the pathogen during treatment, vaccines have been introduced with variable efficacy (see Irwin [14] for summary). According to the authors' knowledge, the vaccines are only available in Europe, so that prevention of vector exposure in form of acaricidal treatment is essential especially for LATAM.

Dirofilariosis

Dirofilariosis is caused by *Dirofilaria immitis*, presenting as an important disease, causing cardiopulmonary problems and even death in dogs worldwide and commonly known as canine heartworm disease, and by *Dirofilaria repens*, a subcutaneous parasite of dogs and cats in Europe, Africa and Asia.

Canine heartworm disease

Canine heartworm disease has a wide distribution in LATAM (except Belize, Guatemala, Panama, French Guiana, Chile and Uruguay; for specific data see individual country sections). The pathogen is transmitted by several mosquito species. As a mosquito-transmitted disease, it is more prevalent in tropical and subtropical regions, due to favorable conditions for mosquito propagation [19–21]. Clinical signs vary from nearly asymptomatic to very severe and are listed elsewhere [22–24]. Diagnostic methods include microfilaria testing of blood samples, ideally after a concentration technique (modified Knott's test or filtration test), and antigen testing. For details on different test sensitivities and combinations please see the guidelines of the American Heartworm Society (AHS) [25]. Treatment against heartworm varies depending on the severity of the disease and always aims to improve the clinical condition and to eliminate all life stages of the heartworms with minimal post-treatment complications. Prevention by the use of chemoprophylactic drugs is strongly recommended year-round in endemic areas. For full recommendations see the guidelines of the Tropical Council of Companion Animal Parasites (TroCCAP) [26] and the AHS [25]. Prevention of vector exposure on the basis of antifeeding and/or insecticidal treatments and by the use of mosquito screens etc. and reduction of suitable breeding sites for mosquitoes support a successful prevention scheme.

Subcutaneous dirofilariosis

Subcutaneous dirofilariosis is a filarial disease caused by *D. repens*. Again, transmitted by diverse mosquito species, adult worms are located mainly in subcutaneous tissues. The presence of adult *D. repens* worms in subcutaneous tissues and/or subcutaneous nodules [27] often goes unnoticed but can also cause cutaneous disorders [28–31], as well as extradermic symptoms [32]. For further details on the parasite see also Genchi et al. [33] and Simón et al. [34]. The disease is mainly distributed in Europe, Africa and Asia, and only single reports with closely related variants for LATAM exist [35, 36]. Diagnostic methods usually rely on the detection of microfilariae in blood samples as described for *D. immitis*. If clinically apparent, surgical excision and subsequent histopathological confirmation is the general treatment option. From the medical standpoint, here especially regarding the Old World, *D. repens* is the most frequent and most widely distributed in comparison to *D. immitis* and other *Dirofilaria* species [37] and thus especially of zoonotic importance. For the New World, different species might be involved.

Hepatozoonosis

Hepatozoonosis has been described infrequently in LATAM, despite high prevalences reported from some rural areas of Brazil and Costa Rica [38–41]. Canine hepatozoonosis is caused by *Hepatozoon canis*, a protozoan transmitted by ingestion of ticks containing mature *H. canis* oocysts. Clinical signs of hepatozoonosis and laboratory changes can be found in Sherding [42] and Baneth [43]. The disease is debilitating and often fatal if not treated. *Hepatozoon canis* infection is frequently diagnosed by microscopic detection of intracellular gamonts in stained blood smears. Antibody detection and molecular detection *via* PCR are also available; see Baneth [43] for further details. Complete elimination may frequently not be achievable [44]; for details on treatment see Baneth [43]. Prognosis of treated dogs depends on the parasitaemia. Prevention of vector exposure in form of ectoparasiticidal treatment is supporting the protection against *H. canis*.

Leishmaniosis

Leishmaniosis in LATAM is mainly caused by *Leishmania infantum* (syn. *Leishmania chagasi*). Other species (e.g. *Leishmania braziliensis*, *Leishmania amazonensis*) can also be involved in causing disease. While *L. infantum* is the most important causative agent of canine visceral leishmaniosis in South America [45], *L. amazonensis* has as well been reported causing visceral leishmaniosis in dogs [46], whereas *L. braziliensis* has been detected in dogs with cutaneous leishmaniosis [47]. The parasites are transmitted mainly by sand flies (for LATAM, species of the genus *Lutzomyia* [48, 49]). Clinical signs can vary from very subtle (asymptomatic) to very severe. Clinical staging has been deeply elaborated by LeishVet and published in Solano-Gallego et al. [50, 51] for dogs and in Pennisi et al. [52] for cats. The most useful diagnostic approaches include demonstration of the parasite DNA in blood or other tissues and detection of specific serum anti-leishmanial antibodies [50, 51, 53–55], but might not be available in all regions in LATAM. Direct parasite detection by cytology and further diagnostic approaches are described and evaluated in the LeishVet guidelines for the practical management of canine leishmaniosis [51]. Treatment for leishmaniosis is controversial in many countries and includes several anti-leishmanial drugs. Treatment regimens for the different stages of disease have been published in Solano-Gallego et al. [50, 56]. In South America, canine leishmaniosis treatment might often not routinely be performed. The elimination of seropositive dogs (euthanasia/culling program) has been practiced, e.g. in Brazil, even though for Brazil this control measure has been subject of intense, ongoing debate, due to ethical reasons and the lack of scientific evidence supporting the effectiveness of this strategy [57–59]. Meanwhile, a veterinary drug based on oral miltefosine has been authorized for marketing in Brazil [60]. As *L. infantum* has zoonotic potential, and dogs are regarded as the main reservoir for this pathogen, prevention is essential from the standpoint of animal welfare as well as under the aspect of One Health. Besides a reduced exposure to sand flies based on behavioral codes, insecticidal prophylaxis is strongly recommended. Another approach to help controlling canine leishmaniosis was the introduction of a vaccine, which has been licensed in Brazil in 2014 and which proved to be effective to reduce the number of canine visceral leishmaniosis cases in vaccinated animals [61].

Trypanosomosis

Trypanosomosis is a disease of human medical and veterinary importance caused mainly by *Trypanosoma cruzi*. This disease, also known as Chagas disease or American trypanosomosis, has been recognized by the World Health Organization (WHO) as the most important parasitic disease in the Americas by disability adjusted life years (DALYs) [62]. An estimated 99.8% of the disease burden occurs in LATAM and the Caribbean region [63–67]. Dogs are considered the predominant domestic reservoir for Chagas disease (*T. cruzi*) in many areas of endemicity [68]. Other trypanosomatid pathogen species such as *Trypanosma evansi* and *Trypanosoma rangeli* have been also implicated in infections in dogs. The recognized vectors for *T. cruzi* are triatomine species, while *T. evansi* is transmitted in several ways *via* biting insects, sucking insects and vampire bats [69, 70]. Clinical signs of *T. cruzi* infection in dogs may vary from acute to chronic disease [71]. Regarding *T. evansi*, dogs usually experience acute fatal infections [72, 73]. The most common and easiest diagnostic method for *Trypanosoma* infection is microscopic identification in a blood smear or the buffy coat, successful during the acute stage. For chronic Chagas disease, diagnosis relies on serological tests. Recommendations on serological tests in the chronic phase [74–81] and a detailed review [82] offer further information. Regarding dogs, there are few studies focusing on the diagnosis of *T. cruzi* infection [83–87] and even fewer in naturally infected dogs using recombinant antigens [88]. Different antigens have been tested by Brasil et al. [82] for their suitability in dogs. The drug of choice for treatment is benznidazole, but nifurtimox can also be used [89]. Symptomatic treatment for heart failure and arrhythmias is also recommended [90]. Prevention of disease transmission especially in humans is among others heavily relying in vector control [68]. As the dog is a major reservoir for human Chagas disease, vector control should also include the prevention of disease transmission in dogs.

Bacterial diseases

Anaplasmosis

Anaplasmosis in dogs and cats can be caused by *Anaplasma phagocytophilum*, causative agent of canine granulocytic anaplasmosis (CGA), mainly occurring in temperate zones of the world, and *Anaplasma platys*, the pathogenic agent of canine cyclic thrombocytopenia, occurring worldwide with a higher incidence in tropical and and subtropical areas [91]. For LATAM, both species have been reported in infections, but mainly with *A. platys*.

Even though most dogs naturally infected with *A. phagocytophilum* probably remain healthy, clinical signs [92–95] and hematological changes [94] have been reported. In general, infection with *A. platys* may go along subclinically (e.g. in the USA and Australia), but distinct clinical abnormalities have also been reported, besides hematological abnormalities (in Europe and Israel [96, 97]). A good overview for both pathogens is given in Sainz et al. [98]. In the majority of dogs both types of anaplasmoses pose a diagnostic challenge and clinical and hematological abnormalities should be combined with laboratory and diagnostic tests. Microscopic detection of morulae (intracytoplasmatic inclusions) in neutrophils (for *A. phagocytophilum*) or platelets (for *A. platys*) in stained blood smears is indicative for an infection with an intracytoplasmic coccus, but not distinguishing between *A. phagocytophilum* and other *Ehrlichia* spp. [98], respectively sensitivity appears to be rather low for *A. platys* [99], so that serology and ideally PCR should also be performed additionally for definitive diagnosis. For details on diagnostic interpretation see Sainz et al. [98] and Carrade et al. [100]. For treatment of both pathogen infections doxycycline is effective (see Sainz et al. [98] for a summary on treatment parameters). The prevention of anaplasmosis in dogs must be focused on tick control, even though the vector of *A. platys* is still unknown or unproven. But ticks of various genera (e.g. *Rhipicephalus*, *Dermacentor* and *Ixodes*) have been found naturally infected by *A. platys* around the world [101–105]. Regarding *A. phagocytophilum*, tick control is an essential demand enforced even by the zoonotic character of the pathogen.

Bartonellosis

Bartonellosis has been described in dogs and cats sporadically in LATAM. The most common species detected in dogs are *Bartonella henselae* and *Bartonella vinsonii berkhoffii*, while *B. henselae* and *Bartonella clarridgeiae* are the most commonly detected species in cats [106]. *Bartonella* species can be transmitted to companion animals and humans by several insects, including fleas, sand flies, lice, bed bugs, mites and ticks (e.g. [107–131]), and also directly by cat scratches, bites, blood transfusion and organ transplant (even though the last two have been mostly reported in humans) (e.g. [130, 132–150]. Clinical appearance may include a large variety of signs (e.g. [143, 144, 151–170] and laboratory abnormalities [165, 167, 171–173]. Diagnosis of *Bartonella* infection can be performed by IFA test, PCR, or blood culture. Unfortunately, their use is mostly restricted to research due to their limited access (especially in antigen types used for IFA test). In recent years, DNA amplification after blood culture pre-enrichment became the gold standard for diagnosis of *Bartonella* infection [174]. Treatment of bartonellosis is very difficult, requiring long term treatment with a combination of antibiotics (i.e. azithromycin/minocycline) (e.g. [175–181]. As the pathogens possess a zoonotic potential, prevention of pathogen transmission is essential especially in form of ectoparasite control. This must include also cats as a major reservoir for *Bartonella* spp.

Lyme borreliosis

Lyme borreliosis (LB) caused by spirochetes of the *Borrelia burgdorferi* (*sensu lato*) species complex is a zoonotic disease affecting humans, dogs, horses and other mammalian species. Vectors in focus are hard ticks of the genus *Ixodes*, but neither the role of the different tick species in the transmission cycle nor the clinical relevance of the different *B. burgdorferi* (*s.l.*) species detected in those tick species in South America is clarified [182–184]. Moreover, a report of the detection of *B. burgdorfei* (*sensu stricto*) in *Dermacentor nitens* ticks in Brazil suggests that the etiology of LB in LATAM is far from being understood [185]. LB has hardly and mainly only based on seroprevalence data been described in pets in LATAM, especially in Mexico [186, 187] and Brazil [38, 188]. Clinical signs in dogs are listed elsewhere [189–194] and only few reports on LB exist in cats [195–198]; for more detailed data see Pantchev et al. [198]. The clinical diagnosis of borreliosis in dogs is very difficult since compatible clinical symptoms with other vector-borne pathogens are very common. Direct detection methods (PCR and/or culture) are difficult and of little practical relevance as the organisms are rarely detected in body fluids [199–201]. Regarding serological diagnosis, detection of specific antibodies does not necessarily correlate with the presence of clinical disease [189]. The method of choice for serological diagnosis is a two-tiered laboratory test [202], consisting of an enzyme-linked immunosorbent assay (ELISA) and immunoblotting (Western blotting); for more detailed information see also Krupka & Straubinger [189]. Furthermore, a commercial ELISA based on C6 peptide is also widely used for serodiagnosis (see Krupka & Straubinger [189] for additional information and further literature). Treatment of LB should be initiated as early as possible [189]. Whether dogs (or cats) should be treated when specific antibodies are detected in the absence of clinical signs is controversial [203–205]. Treatment is recommended for a period of 28 to 30 days, and the most commonly used drug is doxycycline. For further information on treatment regimens etc., see Krupka & Straubinger [189]. Again, prevention of pathogen transmission by ectoparasiticidal control is an essential aspect, especially also because of the zoonotic potential of the pathogens.

Ehrlichiosis

Ehrlichiosis in dogs and cats has been reported in LATAM. The causative agents are *Ehrlichia canis* (responsible for canine monocytic ehrlichiosis [CME]), *Ehrlichia chaffeensis* and *Ehrlichia ewingii*, with ticks as the transmitting vectors [206–208]. Clinical signs of CME are very similar to the ones presented in granulocytic anaplasmosis and partly also occur in cats. *Ehrlichia ewingii* infection is also reported to go along with clinical signs in dogs, but none in cats, whereas *E. chaffeensis* infection usually presents mildly or subclinically unless present in co-infection, and again with no reported signs in cats. For more details on CME see Sainz et al. [98] and on all three pathogens see Allison & Little [209]. Detection of *E. canis* morulae (an aggregate of *E. canis* organisms) in a blood smear, ideally a buffy coat smear, is indicative, but rather rare in clinical cases [210]. Further diagnostic tests, such as serology or molecular techniques (PCR) must be performed. CME can be diagnosed with IFA test or ELISA [211–213]. A fourfold increase in IgG antibodies over time has been suggested to be taken as evidence of an ongoing infection [213], as well as the combination of serology and PCR has been recommended for diagnosis of infection [214]. Nevertheless, use of some of these test systems might not be available for whole of LATAM. Additionally, rapid serological tests are available; for more detailed information on diagnostics see also Sainz et al. [98] and Allison & Little [209]. Doxycycline is considered the treatment of choice for rickettsial infections [100, 215, 216], thus also for ehrlichiosis; for details on the treatment regimen see among others Allison & Little [209] and Sainz et al. [98]. Again, avoidance of tick exposure and prevention of transmission by use of ectoparasiticidal compounds are essential. This is of vital importance as the mentioned pathogens may have zoonotic character (Venezuela [217], LATAM [218–223]).

Hemotropic mycoplasmosis

Hemotropic mycoplasmosis (formerly known as hemobartonellosis) has rarely been reported in LATAM. The disease in dogs is caused mainly by *Mycoplasma haemocanis* and *Mycoplasma haematoparvum*. In cats, the disease can be caused by single- or co-infections with *Mycoplasma haemofelis*, *Mycoplasma haemominutum* and *Mycoplasma turicensis*. Blood transfusions have been reported as a source of infections (e.g. [224, 225]), but blood-sucking arthropods are likely to be involved in the transmission as well [226–231]. Generally, little is known on the ecology and form of transmission of these bacteria. Clinical signs may vary and are listed elsewhere [232, 233]. Specific conventional and quantitative real-time PCR systems have been introduced and are now considered the gold standard [234–239]. Treatment is performed depending on the severity of the infection. Antibiotics such as doxycycline or tetracycline should be effective, but consistent clearance of infection was not seen with a range of antibiotics [233]; for more details on treatment see among others Messick [233] and Willi et al. [240]. As with all potentially vector-transmitted pathogens, prevention in form of vector control is essential.

Rickettsiosis

Rickettsiosis has long been associated only with tick-borne *Rickettsia* species from the spotted fever group, with two very prominent representatives: *Rickettsia rickettsii* [agent of Rocky Mountain spotted fever (RMSF) and Brazilian spotted fever (BSF), also called fiebre manchada in Mexico and febre maculosa in Brazil] [241] and *Rickettsia conorii* [agent of Mediterranean spotted fever (MSF) or Boutonneuse fever] [242]. Meanwhile several further species have been identified as human and partly also companion animal pathogens, which are not only tick-borne (e.g. *Rickettsia massiliae*, *Rickettsia parkeri*, *Rickettsia felis*). Several tick species, among others from the genera *Amblyomma*, *Dermacentor* and *Rhipicephalus*, but also flea species from the genera *Ctenocephalides* and *Archeopsylla*, have been identified as vectors for the above-mentioned different *Rickettsia* species

[243]. Infection of dogs and cats with *Rickettsia* species is often subclinical, inapparent, but may also result in severe disease (especially in the case of *R. rickettsii*) [244], potentially being even fatal [245]. For an overview on the different *Rickettsia* species see also Nicholson et al. [215] and Allison & Little [209]. Diagnosis of rickettsial pathogens is usually achieved by PCR assays, serological assays or response to treatment in most clinical cases. When PCR is not practical or available, serology, and here particularly documentation of seroconversion in an acutely ill individual, should be used. For detailed information on the different diagnostic approaches in *Rickettsia* spp. see also Allison & Little [209]. The antibiotic treatment of choice is doxycycline [215, 246]. Prompt treatment is critical as delays can result in fatality [209]. Besides the clinical effect of some *Rickettsia* species in dogs, dogs are important sentinels of infection and disease (e.g. in *R. conorii*) [247, 248]. They are also expected to play an important role as biological hosts of the ticks and serve to increase the infected tick population in close association with human habitation (again for *R. conorii*) [215]. Thus, ectoparasitic control is essential also under the zoonotic aspect and the concept of One Health.

At the end of the presentations of the relevant VBDs we want to remark that veterinarians should be aware of synergistic effects and clinically relevant immunosuppression in co-infected animals [249] as well as an altered clinical appearance in co-infected animals, potentially making diagnosis more difficult and probably leading to a more serious disease outcome [250]. This is relevant for the whole LATAM region as exposure to several pathogens seems possible.

Country files

Subsequently a listing of occurrence of the pathogens respectively of corresponding seroprevalence data in LATAM by country in alphabetical order follows, based on an actual literature search. Additionally, all described data are summarized in Table 1.

Argentina

Parasitic diseases

As in many countries in LATAM, the most common parasitic diseases reported in Argentina are trypanosomosis (responsible for Chagas disease in humans), dirofilariosis and leishmaniosis.

Babesiosis due to *B. vogeli* has been described in three dogs from Buenos Aires [12, 251] and detected in 10% (2/21) and 6.8% (3/41) of shelter dogs from Córdoba and Santa Fé, respectively, by molecular methods [252]. Large piroplasms have furthermore been detected in 0.2% of tested animals in a large canine survey with more than 16,000 dogs [12, 251]. *Babesia vogeli* was also detected in cat fleas (*Ctenocephalides felis*) collected from shelter dogs in Córdoba and Santa Fé (R. Maggi, unpublished data). Interestingly, *Babesia* was not detected in any of 48 free ranging Pampas gray foxes (*Lycalopex gymnocercus*) from Rio Negro that showed high prevalence for hepatozoonosis [253].

Dirofilariosis caused by *D. immitis* has been reported in Buenos Aires [254–256] and Mendoza [257]. Epidemiological studies in Argentina suggest that the prevalence of dirofilariosis in dogs is highly variable, showing a significantly heterogeneous temporal and spatial distribution [254–256, 258, 259]. In Buenos Aires, screening of 19,298 blood samples from 65 localities showed prevalence values of 1.63% by microhematocrit tube technique, 3.65% by modified Knott's test, and 14.41% by antigen test [255].

Hepatozoonosis has been reported in dogs (infected with *H. canis*) from Buenos Aires [251, 260], and in up to 50% of 48 blood samples from free ranging Pampas gray foxes (*L. gymnocercus*) from Rio Negro (infected with *Hepatozoon* sp.) [253, 261]. *Hepatozoon* sp. infection has further been described in single canine cases in the Buenos Aires region [262]. No prevalence studies are available up to date.

For leishmaniosis, only few records are available regarding the overall prevalence in Argentina. *Leishmania braziliensis* and *L. infantum* have been associated with canine leishmaniosis in several provinces of the country, including Entre Rios, Santa Fé, Misiones, Chaco, Salta and Santiago del Estero [263–270]. Reports from Misiones, which represents one of the areas with highest endemicity for the disease in Argentina, indicate prevalences as high as 57% in dogs (43.6% seropositive and 47.3% positive by PCR) [266]. In other provinces, i.e. Salta, a significant seroprevalence (13.0–27.4%) has also been reported [263, 268].

Trypanosomiasis is one of the most important endemic VBDs in Argentina. Serological surveys in the northern rural regions have shown prevalences in dogs ranging between 23–84%; while seroprevalence in cats has been reported at 28.7% [83, 263, 271–277]. In hyperendemic regions, such as Chaco, molecular prevalence as high as 53% has been reported in dogs [278].

Bacterial diseases

Anaplasmosis due to *A. platys* infection was reported in prevalences ranging between 13.5–37.5% in sick dogs from Buenos Aires [251, 279, 280] detected by molecular techniques, and in 12.5% and 17.4% of dogs from Cordóba and Santa Fé [252], respectively. No data are available from other provinces. Nevertheless, *A. platys* was detected in *R. sanguineus* (*s.l.*) ticks from Chaco Province [281], and from cat fleas (*C. felis*) collected from

Table 1 Tabular overview on the occurrence of CVBDs in dogs, cats, humans and wild carnivores in LATAM based on an actual literature search (partly only based on seroprevalence data; single case reports included; questionable cross-reactivities neglected)

Country	Host	Bab	HWD	SD	Hep	Leish[a]	Tryp[b]	Ana	Bart	Bor	Ehr	Myc	Rick
Argentina	Dogs	Y	Y	–	Y	Y	Y	Y	Y	–	Y	Y	–
	Cats	–	–	–	–	–	Y	–	Y	–	–	–	–
	Humans	–	–	–	–	Y (CL, VL)	Y	–	–	Y	Y	–	Y
	Wild carnivores	–	–	–	Y	–	–	–	–	–	–	Y	Y
Belize	Dogs	–	–	–	–	–	–	–	–	–	–	–	–
	Cats	–	–	–	–	–	–	–	–	–	–	–	–
	Humans	–	–	–	–	Y (CL)	Y	–	–	–	–	–	–
Bolivia	Dogs	–	Y	–	–	Y	Y	–	–	–	Y	–	Y
	Cats	–	–	–	–	–	–	–	–	–	–	–	–
	Humans	–	–	–	–	Y (CL, VL)	Y	–	–	Y	–	–	–
Brazil	Dogs	Y	Y	–	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Cats	Y	–	–	–	Y	Y	Y	Y	–	Y	Y	–
	Humans	–	–	–	–	Y (CL, VL)	Y	–	–	Y	–	Y	Y
	Wild carnivores	–	–	–	–	–	–	–	Y (in captivity)	–	–	Y (in captivity)	
Caribbean Islands	Dogs	Y	Y	–	Y	–	Y	Y	Y	–	Y	Y	–
	Cats	Y	Y	–	–	–	–	–	Y	–	Y	Y	–
	Humans	–	–	–	–	Y (CL, VL)	–	–	–	–	–	–	–
Chile	Dogs	–	–	Y	–	–	Y	Y	Y	–	Y	–	Y
	Cats	–	–	–	–	–	Y	–	Y	–	–	–	–
	Humans	–	–	Y	–	–	Y	–	–	Y	–	–	–
	Wild carnivores	–	–	–	–	–		–	–	–	–	Y	Y
Colombia	Dogs	Y	Y	–	Y	Y	Y	Y	Y	–	Y	–	Y
	Cats	–	–	–	–	–	–	–	–	–	–	–	–
	Humans	–	–	–	–	Y (CL, VL)	Y	–	–	Y	–	–	–
Costa Rica	Dogs	Y	Y	–	Y	–	Y	Y	–	Y	Y	–	Y
	Cats	–	–	–	–	–	–	–	–	–	–	–	–
	Humans	–	–	–	–	Y (CL)	Y	–	–	–	–	–	–
Cuba	Dogs	–	Y	–	–	–	–	–	–	–	–	–	–
	Cats	–	–	–	–	–	–	–	–	–	–	–	–
	Humans	–	–	–	–	–	–	–	–	Y	–	–	–
Dominican Republic	Dogs	–	Y	–	–	–	–	–	–	–	–	–	–
	Cats	–	–	–	–	–	–	–	–	–	–	–	–
	Humans	–	–	–	–	Y (CL)	–	–	–	–	–	–	–
Ecuador	Dogs	Y	Y	–	–	Y	Y	Y	Y	–	Y	Y	–
	Cats	–	Y	–	–	–	–	–	Y	–	–	Y	–
	Humans	–	–	–	–	Y (CL)	Y	–	–	–	–	–	–
El Salvador	Dogs	–	Y	–	–	–	Y	–	–	–	–	–	–
	Cats	–	–	–	–	–	Y	–	–	–	–	–	–
	Humans	–	–	–	–	Y (CL, VL)	Y	–	–	–	–	–	–
French Guiana	Dogs	–	–	–	–	Y	–	Y	–	–	Y	–	–
	Cats	–	–	–	–	Y	–	–	–	–	–	–	–
	Humans	–	–	–	–	Y	Y	–	–	–	–	–	–
Guatemala	Dogs	–	–	–	–	Y	Y	–	–	–	–	–	–
	Cats	–	–	–	–	–	–	–	Y	–	–	–	–
	Humans	–	–	–	–	Y (CL, VL)	Y			–	–	–	–
Guyana (British Guyana)	Dogs		Y	–	–	–	–	–	–	–	–	–	–
	Cats	–	–	–	–	–	–	–	–	–	–	–	–
	Humans	–	–	–	–	Y (CL)	Y	–	–	–	–	–	–

Table 1 (continued)

Country	Host	Bab	HWD	SD	Hep	Leish[a]	Tryp[b]	Ana	Bart	Bor	Ehr	Myc	Rick
Honduras	Dogs	–	Y	–	–	Y	Y	–	–	–	Y	–	–
	Cats	–	–	–	–	Y	Y	–	–	Y	–	–	Y
	Humans	–	–	–	–	Y (CL, VL)	Y	–	–	–	–	–	–
Mexico	Dogs	–	Y	Y	–	Y	Y	Y	–	Y	Y	–	Y
	Cats	–	–	–	–	Y	Y	–	–	–	–	–	–
	Humans	–	–	–	–	Y (CL, VL)	Y	–	–	Y	–	–	Y
Nicaragua	Dogs	Y	Y	–	Y	–	–	Y	–	–	Y	–	Y
	Cats	–	–	–	–	–	–	–	–	–	–	–	–
	Humans	–	–	–	–	Y (CL, VL)	Y	–	–	–	–	–	–
Panama	Dogs	–	–	–	–	Y	Y	Y	–	–	Y	–	Y
	Cats	–	–	–	–	–	–	–	–	–	–	–	–
	Humans	–	–	–	–	Y (CL)	Y	–	–	–	–	–	–
Paraguay	Dogs	Y	Y	–	–	Y	Y	Y	–	–	Y	–	–
	Cats	–	–	–	–	–	Y	–	–	–	–	–	–
	Humans	–	–	–	–	Y (CL, VL)	Y	–	–	–	–	–	–
Peru	Dogs	–	Y	–	–	Y	Y	Y	Y	Y	Y	–	Y
	Cats	–	–	–	–	–	–	–	Y	–	–	–	Y
	Humans	–	–	–	–	Y (CL)	Y	–	–	Y	Y	–	Y
Puerto Rico	Dogs	–	Y	–	–	–	–	Y	–	–	Y	–	–
	Cats	–		–	–	–	–	–	–	–	–	–	–
	Humans	–	Y	–	–	–	–	–	–	–	–	–	–
Suriname	Dogs	–	Y	–	–	Y	Y	–	–	–	–	–	–
	Cats	–	–	–	–	–	–	–	–	–	–	–	–
	Humans	–	–	–	–	Y (CL)	Y	–	–	–	–	–	–
Uruguay	Dogs	–	–	–	–	Y	–	Y	–	–	–	–	Y
	Cats	–	–	–	–	–	–	–	–	–	–	–	–
	Humans	–	–	–	–	–	Y	–	Y	–	–	–	Y
Venezuela	Dogs	Y	Y	–	Y	Y	Y	Y	–	–	Y	–	–
	Cats	–	Y	–	–	–	–	–	–	–	–	–	–
	Humans	–	–	–	–	Y (CL, VL)	Y	–	–	Y	–	–	–

[a] In case of human visceral and cutaneous leishmaniosis, if not cited otherwise within the additional files, status for humans is according to the WHO webpages [708, 709]

[b] In case of human trypanosomosis, if not cited otherwise within the additional files, status for humans is according to the WHO webpage [710]

Abbreviations: Y, yes (reported); –, not reported; Bab, babesiosis; HWD, heartworm disease; SD, subcutaneous dirofilariosis; Hep, hepatozoonosis; Leish, leishmaniosis; Tryp, trypanosomosis; Ana, anaplasmosis; Bart, bartonellosis; Bor, borreliosis; Ehr, ehrlichiosis; Myc, mycoplasmosis; Rick, rickettsiosis; CL, cutaneous leishmaniosis; VL, visceral leishmaniosis

shelter dogs in Córdoba and Santa Fé (R. Maggi, unpublished data).

Bartonellosis due to *B. vinsonii berkhoffii* has been detected in dogs with endocarditis in Buenos Aires (R. Maggi, unpublished data). *Bartonella* infection has been detected at a molecular prevalence of 3% in shelter dogs from Córdoba (close homology to *B. tribocorum*), and from Santa Fé (*B. clarridgeiae*). *Bartonella clarridgeiae* has also been detected in cat fleas (*C. felis*) collected from shelter dogs in Córdoba and Santa Fé (R. Maggi, unpublished data). Additionally, *B. henselae* and *B. clarridgeiae* have been detected at a molecular prevalence of 17.8% in cats from Buenos Aires [282].

Lyme borreliosis in dogs or cats in Argentina has not been reported yet. Nevertheless, the detection of *B. burgdorferi* (*s.l.*) infecting ticks in northern provinces [184], as well as the detection of antibodies against *B. burgdorferi* in farm workers has been reported [283].

Ehrlichiosis due to *E. canis* has been reported at a molecular prevalence in 7% of sick dogs from Buenos Aires [251]. No data are available on detection or prevalence of *Ehrlichia* spp. infecting dogs from other provinces, although *E. canis* was detected in *R. sanguineus* (*s.l.*) ticks from Formosa Province [281]. *Ehrlichia chaffeensis* has been found at a prevalence of 14% in people from Jujuy [221] and detected in *A. parvum* ticks collected from several mammal species (including a dog and humans) from Santiago del Estero [208].

Hemotropic mycoplasmosis mainly due to infection with *M. haemocanis* or *M. haematoparvum* has been detected at molecular prevalences of 83.3% and 73.9% in shelter dogs from Córdoba and Santa Fé, respectively [252]. Similarly, both pathogens were also detected in cat fleas (*C. felis*) collected from shelter dogs in Córdoba and Santa Fé (R. Maggi, unpublished data). Other species (*Mycoplasma suis*) have also been described in dogs [252]. Hemotropic mycoplasmas were also detected in up to 8.3% of 48 blood samples from free ranging Pampas gray foxes (*L. gymnocercus*) from Rio Negro [253].

Rickettsiosis has not been reported in dogs or cats yet in Argentina, but in 2.1% from 48 blood samples from free ranging Pampas gray foxes (*L. gymnocercus*) from Rio Negro [253]. Cases of human rickettsiosis due to *R. rickettsii* and *R. parkeri* infection have been reported in Jujuy and Buenos Aires [221, 284–287]. *Rickettsia* species have been reported in several tick species: *R. parkeri* and *R. bellii* in *Amblyomma triste* from Entre Rios, Santa Fé, Córdoba, Buenos Aires, La Rioja, and in other northern provinces, and *R. massiliae* in *R. sanguineus* (*s.l.*) in Buenos Aires [279, 280]. Meanwhile *R. felis* has been detected in single cat fleas (*C. felis*) collected from dogs [288].

Belize

Data on VBDs in pet animals from Belize are very scarce or not existent.

Parasitic diseases

Leishmaniosis and trypanosomosis are the only two VBDs reported in people and vectors and as such their pathogens could be recognized as potential infectious agents for pets. *Leishmania donovani*, *L. braziliensis* and *L. mexicana* have been reported in people and sand flies [289–295], and meanwhile *Trypanosoma* infection has been reported in people and *Triatoma* species [296, 297].

Bacterial diseases

Rickettsiois: spotted fever group rickettsiae, especially *R. amblyommatis* and *R. parkeri*, were detected in *Amblyomma* species among others from dogs, suggesting a risk of tick-borne rickettsioses to humans and animals in Belize [298].

Bolivia

Data on VBDs in pet animals from Bolivia are very scarce or not existent.

Parasitic diseases

Dirofilariosis due to *D. immitis* has been reported in dogs at an average of 33% seroprevalence (range: 22–41%) in different villages [299] and at *c.*10% in the Isoso of Bolivia [300]. Leishmaniosis has been reported in healthy dogs at a seroprevalence of 11.8% [301]. Trypanosomosis due to *T. cruzi* in dogs was detected at a seroprevalence of 9.6% in Santa Cruz [302].

Bacterial diseases

Lyme borreliosis has been detected in people in the Santa Cruz department, south-eastern Bolivia, whereas dog sera failed to show positive seroprevalence for this pathogen [303, 304]. Ehrlichiosis due to *E. canis* was reported at a seroprevalence of 86% in domestic dogs [299]. Rickettsiosis in dogs due to *R. rickettsii* was reported at seroprevalences ranging between 68.2–86.0% [299, 305], while antibodies against *R. parkeri* were detected in 2.3% of dogs from Cochabamba [305]. Rickettsial species were also detected in *Amblyomma* ticks (*Amblyomma tigrinum*) [305].

Brazil

A comprehensive review on VBDs has been published by Dantas-Torres [38].

Parasitic diseases

Babesiosis due to *B. vogeli* has been recognized in Brazil since the beginning of the 20th century. *Babesia gibsoni* infection in dogs has also been reported virtually in all Brazilian regions. The reported seroprevalence of infection in dogs ranges between 35.7–72.0% [38, 306–314]. In cats, *B. vogeli* has been reported at a molecular prevalence ranging between 11.9–16.0% [315, 316].

Dirofilariosis: Canine heartworm infections due to *D. immitis* are frequently reported in Brazil with prevalences that range from 2% to up to 23.1% [38, 174, 317–320].

Hepatozoonosis due to *H. canis* is present in almost all regions. Prevalences of 39.2–58.8% have been reported in rural and urban areas [38, 39, 307, 321, 322].

Leishmaniosis was firstly recognized in Brazil during the 1930s. Canine visceral leishmaniosis by *L. infantum* is endemic in all Brazilian regions, meanwhile also occurring in the South of the country [38, 306, 323–326]. Canine cutaneous leishmaniosis is also prevalent in all regions with prevalences ranging between 3.2–50.3%, depending on the area and methods of diagnosis used [323, 327–335]. The seroprevalence of *Leishmania* infection in dogs varies widely and can be as high as 67% in highly endemic foci [336]. In cats, seroprevalence of 54% has been also reported [337].

Trypanosomosis has been reported in almost all areas of Brazil. In areas where American trypanosomosis (or Chagas disease) is endemic, seroprevalences to *T. cruzi* between 16.0–71.6% in dogs were reported [338–340]. Clinically, the infection is of minor significance, as infected dogs are often asymptomatic carriers [38]. In cats, *T. cruzi* seroprevalence of 51% has been reported [337]. *Trypanosoma evansi* infection in dogs is found predominately in the Center-West and the South regions [341–350]. The seroprevalence of infection in dogs with *T. evansi* ranges between 15.7–30.0% [38, 341, 351].

Bacterial diseases

Anaplasmosis caused by *A. platys* in dogs is found in all regions according to Dantas-Torres [38] but has only sporadically been published. Molecular prevalences in dogs are ranging between 1.6–48.8% [306, 308, 309, 352, 353]. *Anaplasma phagocytophilum* has been reported at molecular prevalences between 6–7% in dogs [354, 355], 8% in cats [315] and in ixodid ticks [354].

Bartonellosis has been described in dogs and cats in southern Brazil. In sick dogs from southern states, prevalences in dogs of 1.9–3.9% have been reported to infection with *B. vinsonii berkhoffii* and *B. henselae* [324, 356–358]. In addition, *B. vinsonii berkhoffii* and *B. clarridgeiae* were detected by serology in captive wild canids (at seroprevalences ranging between 8–13%) from 19 zoos in São Paulo and Mato Grosso states [359]. In feral cats, the molecular prevalence for *Bartonella* infection can be as high as 17% [360, 361].

Lyme borreliosis has been recognized in humans in Brazil since 1989 [188, 362]. Serological surveys in dogs from Southeast Brazil showed ranges from less than 1% up to 20% [38]; while seroprevalences of up to 51% have been reported from Espirito Santo [188]. The pathogen has been recovered from *Ixodes* spp. (*B. burgdorferi* (*s.l.*) group) and from *D. nitens* ticks (*B. burgdorferi* B31 strain) [185, 363], but the role of the vector and the clinical relevance of the species have yet to be determined.

Ehrlichiosis, due to infection with *E. canis*, was firstly recognized in Brazil in the 1970s, and is prevalent in virtually all regions (for a comprehensive review on ehrlichiosis in Brazil, see Vieira et al. [364]). The seroprevalence of infection varies between the southern, Central-West and northern-northeastern regions of Brazil, but it can be as high as 62.8% in asymptomatic and 78% in symptomatic dogs [38, 306, 309–312, 324, 352, 364–375]. Molecular prevalence for *E. canis* has been found in dogs at a range of 15–88% [316, 364]. Infections in dogs with other *Ehrlichia* species, i.e. *E. chaffeensis* and *E. ewingii*, have also been reported [376]. In cats, *E. canis* or a closely related species have also been reported at a molecular level, with a prevalence ranging between 9.4–20.0% [377, 378].

Hemotropic mycoplasmosis has been recognized in Brazil and has been reported in several wild canids and felids as well as in humans [379–382]. Several species of hemotropic mycoplasmas have been detected in dogs and cats [308, 361, 382–388]. The most predominant species in dogs is *M. haemocanis*, which has been recognized in South and Southeast Brazil. Other species such as *M. haematoparvum*, *M. haemofelis*, *M. turicensis* and *M. haemominutum*, have been detected in neotropical and exotic wild canids and felids from Brazilian zoos, and in feral cats [380]. Molecular prevalence of up to 32% has been reported in cats [315] and prevalences of 7–45% have been reported in dogs [382, 388].

Rickettsiosis due to several species of the spotted fever *Rickettsia* group, has been reported among others in humans and dogs [389–393]. Seroprevalence for *R. rickettsii* in dogs ranges between 2.7–64.0%, while seroprevalence of 2.7–7.3% has been reported for *R. parkeri* [371, 373, 389, 390, 392, 393]. Rickettsial species have also been reported in several tick species of the genera *Amblyomma*, in *R. sanguineus* (*s.l.*), and in cat fleas (e.g. [393–404]).

Caribbean Islands (excluding Cuba, Dominican Republic and Puerto Rico, listed separately)

The information on vector-borne pathogens on the Caribbean Islands in extremely scarce and fragmented.

Parasitic diseases

Babesiosis has been described on several islands. Molecular screening of dogs in St. Kitts showed an overall prevalence of 24% for *Babesia* spp., of which 48% and 40% were due to *B. vogeli* and *B. gibsoni*, respectively, 2% were due to co-infections with both species and in 10% *Babesia* species was unidentified [13]. *Babesia vogeli* was also detected by PCR in 7% of dogs surveyed in Grenada [405] and in dogs in Trinidad [406]. Interestingly, *B. vogeli* infection was also detected in cats in Trinidad by PCR at 6.7% prevalence [406]. Finally, there is anecdotal record on *B. canis* (sp.) infection in dogs in Aruba [407]; *Babesia* infection has been reported by microscopy or serology in dogs visiting the Dutch Antilles [408].

Dirofilariosis has been reported in Turk and Caicos, Curaçao and Grenada. In Grenada, infection with *D. immitis* was documented by microfilarial identification with prevalences ranging between 9.1–26.8% in dogs affected with caval syndrome and submitted for necropsy [409]. Combining the results of four studies on live dogs and five studies on necropsied dogs ($n = 1,245$) between 2002 and 2009, an estimated overall *D. immitis* infection rate of 13.9% is reported [410]. A survey on feral cats, also in Grenada, showed a seroprevalence of 8% for *D. immitis* [411]. In Turk and Caicos, seroprevalence for *D. immitis* was 58% and 8% for feral and pet dogs, respectively [412]. In Curaçao, two canine surveys detected prevalences of 7.2% and 12.8% for female and for male dogs, respectively an overall prevalence of 9.0% (3.4% in feral and 13.5% in pet dogs) [413, 414].

Hepatozoonosis due to *H. canis* was described in St. Kitts at an overall molecular prevalence of 6% [13]. Meanwhile in Grenada, a molecular prevalence of 7% has been reported for dogs [405]. There are also anecdotal data on *H. canis* infection in dogs in Aruba [407].

Leishmaniosis in the Caribbean Islands has been rarely reported in dogs. In Grenada, screening of dogs using antibodies to visceral leishmaniosis failed to detect positives [415]. Nevertheless, leishmaniosis has been described in humans in Martinique [416, 417] and Guadalupe [418].

Trypanosomosis in wild animals and triatomine vectors has been reported since 1960 in Aruba, Curaçao, Jamaica and Trinidad [419, 420]. In Grenada, a seroprevalence of 13.2% and 4.3–6.4% in stray and pet dogs, respectively has been reported [63, 415].

Bacterial diseases

Anaplasmosis was detected in the region at a relatively high prevalence. In St. Kitts, a prevalence of 4% in healthy dogs was reported [13, 421]. In Grenada, prevalences of 19.2% (molecular prevalence) and 24% (seroprevalence) were reported for *Anaplasma* species [405, 422]. *Anaplasma* infections have also been reported in dogs in Trinidad [406].

Bartonellosis in cats and dogs has been reported on a few Caribbean Islands. Infections with *B. henselae*, *B. clarridgeiae*, or both have been reported in 51% of pet cats, and in a range of 52–63% in feral cats from St. Kitts [423]. Similarly, 24% of pet cats and 59% of feral cats were positive for one or both species (*B. henselae* and *B. clarridgeiae*) in Trinidad [424]. In dogs, *Bartonella* species have been also detected at a molecular prevalence of 1.4 % for *B. vinsonii berkhoffii*, and at a seroprevalence of 8.2% for *Bartonella* spp. in Grenada [405].

Ehrlichia infection in the region has also been reported on several islands. In St. Kitts, an overall (serological and/or PCR) prevalence of 24% has been reported in dogs [13]. In Trinidad, 14.1% (molecular prevalence) and 44.6% (seroprevalence) have been reported for *E. canis* in healthy and stray dogs, respectively [406, 425]. Prevalences ranging from 24.7% (molecular prevalence) to 31% (seroprevalence) have been reported for *Ehrlichia* species in dogs from Grenada [405, 422]. In Turk and Caicos, seroprevalences of 71% and 18% were reported for feral and pet dogs, respectively [412]. In Aruba 4 of 7 dogs were reported to be infected with *E. canis* confirmed by microscopy [407]. *Ehrlichia* infection has further been reported by microscopy or serology in dogs visiting the Dutch Antilles [408]. *Ehrlichia canis* has been detected in cats in Trinidad at a molecular prevalence of 6.7% [406].

Hemotropic mycoplasmosis due to *M. haematoparvum* and *M. haemocanis* has been reported in dogs in Trinidad at a prevalence of 8.1% [239]. *Mycoplasma haemofelis* and *M. haemominutum* have been reported in 31.6% and 33.3% of cats in Trinidad [406, 426].

Chile

Parasitic diseases

Dirofilariosis has been described in dogs from a semi-rural district near Santiago. Microscopic and molecular analysis showed that microfilariae, similar to *D. repens*, were present in about 22% of the dogs with (32%) or without (12%) dermatological symptoms or signs compatible with filarial infections [36]. A single human case with a subcutaneous infection of an unidentified *Dirofilaria* sp. is also reported [427].

Hepatozoonosis: There are no reports on dogs or cats, but *Hepatozoon* spp. has been detected in hard and soft ticks from different regions of Chile [428].

Trypanosomosis in people (Chagas disease) has been recognized to exist in seven of the 13 administrative regions of the country [429–443]. The seroprevalence in dogs has been reported to be over 4.6% in the northern areas [430]. In a large periurban survey, 7.9% of cats and 7.0% of dogs were positive by indirect hemagglutination test [439].

Bacterial diseases

Anaplasmosis due to *A. platys* has been reported in sick dogs from Santiago at a molecular prevalence of 20% [444]. Other studies revealed a much higher seroprevalence (69%) against *A. phagocytophilum* in dogs exposed to ticks in the same region [445]. It is not clear whether these results are a consequence of serological cross-reaction with *A. platys*. *Anaplasma* species has been aslo detected in soft ticks in Chile [428].

Bartonellosis has been described in cats but not in dogs from Chile even though *Bartonella* (*B. rochalimae*) has been reported in fleas from dogs [123]. In cats, seroprevalence of *B. henselae* is very high (71–73%) in pet cats [446, 447], and even higher (90%) in stray cats [447]. In addition, *B. henselae* and *B. clarridgeiae* were also reported in fleas from cats [447].

Lyme borreliosis has not been described in dogs, even though there is some debate on Lyme disease in Chile [448, 449]. *Borrelia burgdorferi* (*s.l.*) species have recently been detected in *Ixodes stilesi* ticks [183]. The role of this species in the transmission of Lyme borreliosis has yet to be determined. Different *Borrelia* species, some of them closely related to *Borrelia turicatae* and *Borrelia garinii*, have been detected in hard and soft ticks from different regions of Chile [428].

Ehrlichiosis due to *E. canis* has been reported in single canine cases, confirmed by serology and molecular methods [450] or only by serology [451]. Nevertheless, no data are available for the prevalence and distribution of the disease. Seropositivity in single dogs to *E. chaffeensis* has also been reported [223]. In addition, *Ehrlichia* spp. has been detected in soft ticks from the Chañaral region of Chile [428].

Hemotropic mycoplasmosis due to *M. haemocanis*, *M. haemofelis* and a species closely related to *M. turicensis*, has been reported in wild carnivores (Darwin's foxes) with a prevalence of up to 57% on Chiloé Island [452].

Rickettsiosis due to *R. conorii* has been reported in dogs from Santiago de Chile with a seroprevalence of 35%, but rickettsial species should be confirmed by molecular studies [445]. *Rickettsia felis* has also been reported in wild foxes (Darwin's foxes) from Chiloé, with a prevalence of 3% [452], in *R. sanguineus* (*s.l.*) ticks from dogs [453], as well as in *C. felis* fleas from dogs and cats and *Ctenocephalides canis* fleas from dogs [454].

Colombia

Parasitic diseases

Babesiosis due to *B. vogeli* has been frequently described in Colombia. Seroprevalence in dogs has been reported at 4.8% in Bogota, 58% in Villavicencio and 71.8% in Bucaramanga [455].

Dirofilariosis due to *D. immitis* has been reported at prevalences of 1.6% (seroprevalence) [456], 4.8% (Knott's test) [457], and 3.8% (Knott's test) to 4.6% (Knott's test plus antigen ELISA) [458]. In the Colombian Amazon in two Tikuna Indian communities 53.8% (7/13 dogs) of the tested dogs were positive for *D. immitis* by modified Knott's test [459].

Hepatozoonosis by *H. canis* has been reported in 31.8% of dogs in the central-western region by molecular and/or microscopic methods [460].

Leishmaniosis in dogs has been frequently described in Colombia. Overall prevalence of infection averaging 33.6% has been reported in northern territories [461], while a seroprevalence of 44.1% (by IFA test) to 50.2% (by ELISA) has been reported from Tolima [462]. Interestingly, a very low seroprevalence (1.6%) has been reported in dogs from Bogota using IFA test [325]. Pathogens of cutaneous leishmaniosis (*L. panamensis*, *L. braziliensis*) have been reported in humans in several areas of Colombia [463–471].

Trypanosomosis has been known to be present in Colombia. In dogs, seroprevalence of 71.6% on Margarita Island [338] and molecular prevalence of 31% for *T. cruzi* in dogs from the Northeast has been reported [472].

Bacterial diseases

Anaplasmosis due to *A. platys* has been detected by serology in 53% of dogs from Barranquilla [473]. Additionally, two single *A. phagocytophilum* seropositive dogs have been detected in the same study [473]. Further reports of anaplasmosis due to *A. phagocytophilum* have been published for Colombia at an average seroprevalence of 33% (12% for Medellin, 40% for Barranquilla and 51% for Cartagena) using rapid tests [456]. Nevertheless, caution should be considered regarding cross-reactivity with *A. platys* in this data.

Bartonellosis has been detected at a seroprevalence of 10% in dogs from Bogota testing against *B. vinsonii berkhoffii*, *B. clarridgeiae* and *B. henselae* antigens [356].

Lyme borreliosis has not been detected in dogs [456], even though the disease has been detected in people from rural areas of Colombia [474].

Ehrlichiosis due to *E. canis* has been reported in Colombia at an average seroprevalence of 22% (26% in Medellin, 67% in Bogota, 74–83% in Barranquilla, 80% in Cartagena, 83.9% in Villavicencio and 89.7% in Bucaramanga) [455, 456, 473]. Molecular prevalence for *E. canis* has been reported in Villavicencio at 45.2%, and in Bucaramanga at 59% [455]. Interestingly, a serological survey in rural areas near Bogota showed a 31.8% seroprevalence against *E. chaffeensis* in dogs [475]. Nevertheless, caution should be considered for cross-reactivity with *E. canis*.

Rickettsiosis due to *R. rickettsii* has been reported at a seroprevalence of 18.2% in dogs from rural areas near Bogota [475]. Seropositivity to spotted fever group rickettsiae was also detected in 40.7% of tested dogs in the Caribbean region of Colombia [476]. *Rickettsia amblyommii* respectively "*Candidatus* Rickettsia amblyommii" has been detected by PCR in *Amblyomma cajennense* ticks close to the Colombian border in Panama and in Colombia (Villeta) itself [477, 478], while *R. bellii* and *R. felis* have been detected in *Amblyomma ovale* ticks and in fleas (*C. felis*, *C. canis* and *Pulex irritans*) collected from domestic animals and small mammals [476], respectively, from dogs and cats [479].

Costa Rica

Parasitic diseases

Babesiosis in dogs due to *B. vogeli* was reported at an overall molecular prevalence ranging between 2.4–20.0% [40, 41]. Interestingly, the prevalence varied significantly depending on regions [40]. Babesiosis due to *B. gibsoni* has also been reported in Costa Rica at a molecular prevalence of 5% [41].

Dirofilariosis in dogs due to *D. immitis* infection has been reported at prevalences of 2.3–11.0% (by serology) and 22.6% (by molecular methods) [41, 480–482].

Positive rates were strongly dependent on region, climate, and test system used. The influence of the test system used was especially demonstrated in studies by Rojas et al. [481].

Hepatozoon infection in dogs due to *H. canis* was reported at an overall molecular prevalence ranging between 2.4–37.5% [40, 41] with huge differences between the tested regions [40].

Leishmaniosis has not been detected in surveys of dogs from the regions central, Pacific and Atlantic [40].

Trypanosomosis due to *T. cruzi* has been reported in dogs from Costa Rica at a seroprevalence ranging between 1.6–27.7% [85, 483–485].

Bacterial diseases

Anaplasmosis due to *A. platys* has been reported in Costa Rica at a molecular prevalence ranging between 1–10% in dogs [40, 41, 486–488], with obvious differences between the tested regions [40]. *Anaplasma phagocytophilum* has been reported in single canine cases by PCR [486, 489] and at a seroprevalence of 2.7% [486] and 3.8% [490], with questionable capability to differentiate between the two pathogen species in the latter study. Finally, Montenegro et al. [482] reported an overall seroprevalence in all seven provinces for *Anaplasma* spp. of 6.4%, with no differentiation between the two species due to cross-reactions in the test system used.

Bartonellosis was not reported in dogs or cats in Costa Rica. Nevertheless, *B. clarridgeiae* and *B. henselae* have been detected in cat fleas, whereas *B. vinsonii berkhoffii* and *B. rochalimae* have been detected in dog fleas [491].

Lyme borreliosis in form of seropositivity to *B. burgdorferi* (*s.l.*) antigen has been documented in a single dog from Costa Rica [482] with questionable autochthonous character. A further single seropositive canine case without a proof of an actual infection by PCR has been reported [492].

Ehrlichiosis due to *E. canis* has been reported from Costa Rica at a molecular prevalence ranging between 3.2–50.0% [40, 41, 493, 494]. Interestingly, *E. canis* prevalence varies massively depending on the region [40]. Seroprevalence in dogs for *E. canis* has been reported at a range of 3.5–38.2% [480, 482, 490, 494]. Furthermore, *E. chaffeensis* has been detected at a molecular prevalence of 59% in dogs [495].

Rickettsiosis due to *R. rickettsii*, *R. amblyommii*, *R. felis*, *R. rhipicephali* and *R. parkeri* has been reported at varying seroprevalences in dogs from San Jose [496]. Furthermore, *R. felis* has been detected in cat fleas [497, 498] and *R. amblyommii* has been detected in *A. cajennense* ticks [497].

Cuba

The information on vector-borne pathogens on Cuba is very scarce and fragmented.

Parasitic diseases

Dirofilariosis due to *D. immitis* was reported on Cuba in a range between 6.7–40.0% in dogs [499–501].

Bacterial diseases

Lyme borreliosis: The disease has not been officially reported in Cuba. However, clinical cases resembling Lyme disease and serologically positive cases have been reported in humans [502, 503], but existence of *B. burgdorferi* (*s.l.*) is still much debated [504, 505]. No prevalence data for dogs or cats are available for the region.

Dominican Republic

The information on vector-borne pathogens in the Dominican Republic is extremely scarce or non-existent.

Parasitic diseases

Dirofilariosis by antigen detection or microfilaria evidence in dogs has been reported at a prevalence of 18.2% on Samana Peninsula [506] and at a prevalence of 18% in Santo Domingo [507]. An autochthonous focus for cutaneous leishmaniosis in humans has been described within the last 20 years is the Dominican Republic [508–511]. Nevertheless, no prevalence data for dogs are available.

Ecuador

Parasitic diseases

Babesiosis due to *Babesia* spp. has been reported in dogs from Cuenca (by blood smear analysis) at a prevalence of 40.6% [512]. No *Babesia* spp. antibodies were detected in a screening for different *Babesia* species of dogs on Isabela Island, Galapagos [7].

Dirofilariosis has been reported only on Isabela Island, Galapagos, with 34% seroprevalence in dogs and 2% in cats [7].

Leishmaniosis in dogs was reported on the Pacific coast of Ecuador and in other areas [513, 514]. Seroprevalence of 4% against *L. donovani* was also detected in dogs on Isabela Island, Galapagos [7].

Trypanosomosis in people (Chagas disease) was described in Ecuador in 1930 in the province of Guayas and thereafter in various other provinces [515–522]. A serosurvey on dogs, performed in two towns in Guayas province detected seroprevalences of 9.1% and 14.3%, determined by ELISA [518]. *Trypanosoma* infection was not detected in dogs or cats from Isabela Island, Galapagos [7].

Bacterial diseases

Anaplasmosis due to *A. platys* was reported in a single dog from Isabela Island, Galapagos [7]. *Anaplasma phagocytophilum* was reported by blood smear analysis in Cuenca at a prevalence of 3.1% [512] and by rapid test at different seroprevalences (26–48%) in dogs in Manta and Guyaquil [523], but cross-reaction with *A. platys* especially in the latter survey should be borne in mind. In addition, an *Anaplasma* species closely related to *A. phagocytophilum* was described in *Amblyomma multipunctum* and *Rhipicephalus microplus* ticks collected from the Antisana Ecological Reserve and Cayambe-Coca National Park [524].

Bartonellosis was detected on Isabela Island, Galapagos, at a seroprevalence of 75% in cats, and at a molecular prevalence of 13% in dogs [7]. The most common species identified by DNA amplification in cats were *B. henselae* and *B. clarridgeiae*, while *B. henselae, B. clarridgeiae*, and *B. elizabethae* were detected in dogs [7].

Lyme borreliosis was not detected in dogs surveyed on Isabela Island, Galapagos [7].

Ehrlichiosis due to *E. canis* estimated by blood smear analysis has also been reported from Cuenca at a prevalence of 56.3% [512] and by rapid test at different seroprevalences (66–78%) in dogs in Guyaquil and Manta [523]. *Ehrlichia* infection (determined by IFA test or PCR) was not detected in dogs from Isabela Island, Galapagos [7].

Hemotropic mycoplasmosis has been reported at a molecular prevalence of 2% in cats and of 1% in dogs on Isabela Island, Galapagos [7].

Rickettsiosis has not been reported in dogs or cats, although a *R. felis*-like organism was identified in *C. felis* fleas collected from dogs from Pastaza and Chimborazo provinces [525].

El Salvador

The information on vector-borne pathogens in El Salvador is extremely scarce or non-existent.

Parasitic diseases

Dirofilariosis: Infection with *D. immitis* has been described in dogs from northern El Salvador at a seroprevalence of 3% [526]. In a study performed on dogs from the coastal areas of El Puerto de La Libertad (La Libertad), prevalences ranging between 11–19%, depending on the type of methods used, were detected [527].

Leishmaniosis: The pathogen of visceral leishmaniosis *L. infantum* (syn. *L. chagasi*) has been isolated in a human case of cutaneous leishmaniosis in El Salvador [528], but no data on dogs or cats are available.

Trypanosomosis has been known to be present in El Salvador affecting people as Chagas disease since 1913. In 1976, prevalences (by xenodiagnosis) of 5% and 7.1% were reported for *T. cruzi* and *T. rangeli* in dogs, respectively [529], while prevalence values of 1.4% and 4.2% were reported for the same species, respectively, in cats [529].

French Guiana

As mentioned beforehand to a number of countries, the information on CVBDs in French Guiana is very scarce.

Parasitic diseases

Leishmaniosis has been widely reported in people [530–537]. Only two canine cases (one with questionable autochthonous character) and one clinical case of cutaneous leishmaniosis due to *L. braziliensis* in a domestic cat have been reported [538, 539]. Trypanosomosis has been known to be present in French Guiana affecting people (Chagas disease) [540–546].

Bacterial diseases

Anaplasmosis has been described in dogs from French Guiana at a molecular prevalence for *A. platys* of 15.4% [547]. Ehrlichiosis due to *E. canis* has been reported at a seroprevalence of 6.6% in dogs imported from French Guiana to France [548]. No other data are available for *Ehrlichia* species prevalence in the region.

Guatemala

The state of knowledge is very scarce for CVBDs in Guatemala.

Parasitic diseases

Leishmaniosis has been reported in the Peten Region with a seroprevalence of 28% in dogs [549]. Trypanosomosis has been described in dogs at a seroprevalence of 37% [550].

Bacterial diseases

Bartonellosis due to *Bartonella* species has been reported in cats [551], but not in dogs. Rickettsiosis has not been reported in Guatemala in dogs or cats. Nevertheless, *R. felis* has been reported in cat fleas [498].

Guyana (British Guyana)

The information on vector-borne pathogens in Guyana is extremely scarce or non-existent.

Parasitic diseases

Dirofilariosis by *D. immitis* was reported in 1964 at an overall prevalence of 14.1% in 2135 dogs screened *via* Knott's test [552]. Leishmaniosis in people has been described frequently [553–555], but no published data on dogs or cats are available. Trypanosomosis due to *T. cruzi* has been sporadically reported in humans [542]. No reports on infection or prevalence are available for dogs or cats.

Honduras

Parasitic diseases

Dirofilariosis has been detected and reported in dogs from Roatán, Islas de la Bahía, at a prevalence of 30% (Knott's test) [556].

Leishmaniosis due to *L. donovani* was detected at a seroprevalence of 25% in cats [557] and ranging between 1.4–8.6% in dogs [557–560], but caution should be taken due to cross-reactivity with *T. cruzi*. Visceral and cutaneous leishmaniosis have been reported in humans in Honduras for some time with *L. chagasi* and *L. mexicana* as underlying pathogens [560, 561].

Trypanosomosis in people due to *T. cruzi* and *T. rangeli* is present in Honduras [558, 559]. A study in cats revealed a 16% prevalence rate for *T. cruzi* [557]. Although official reports on trypanosomosis in dogs are not available, apart from a single described canine isolate by Acosta et al. [558], the presence of the disease in dogs has been suggested due to the serological cross-reactivity between *T. cruzi* and *L. donovani* [559].

Bacterial diseases

Lyme borreliosis in form of seropositivity has been detected in cats at 25% prevalence [557]. Ehrlichiosis has been detected in dogs at a molecular prevalence of 23.7% for *E. canis*. Ticks collected from dogs have also been tested positive for *E. canis* [562]. Rickettsiosis due to *R. rickettsii* has been reported in cats at 16% seroprevalence [557].

Mexico

Parasitic diseases

Babesiosis has been described in 3 of 22 sick dogs from Morelos (13.6%), using DNA amplification [563] and in 3 of 30 dogs from Veracruz (10%) using indirect haemagglutination test [564].

Dirofilariosis has been described in dogs from all regions. Prevalence of 1.3% in central Mexico, 60% in Celestum, and 8.3% in Yucatan for *D. immitis* have been reported [565–567]. *Dirofilaria repens* has also been reported in a single dog in Guanajuato [35].

Leishmaniosis was described to affect dogs and cats in several regions. In dogs, seroprevalences ranging between 7.5–32.8% for *L. braziliensis*, 4.7–41.4% for *L. mexicana*, and 6.1–11.9% for *L. infantum*, have been reported in Quintana Roo and the Yucatan peninsula [568–570]. A prevalence of 19% of visceral leishmaniosis has been reported also in dogs from Chiapas [571]. In cats, prevalences of infection with *L. mexicana*, *L. braziliensis* and *L. panamensis* at 10%, 11.6% and 22.1%, respectively, have been reported in Yucatan [569].

Trypanosomosis due to *T. cruzi* has been reported in dogs at seroprevalences of 8.1% in Jalisco, 7.6% in Campeche, between 4.5–42.8% in Chiapas, 20.0–21.3% in Quintana Roo, 21.0–24.5% in Tejupilco, 17.5% in Toluca and 9.8–34.0% in Yucatan [84, 572–579]. In cats, *T. cruzi* infection has been reported at a seroprevalence of 7.4–8.6% in the Yucatan Peninsula [580, 581].

Bacterial diseases

Anaplasmosis due to *A. phagocytophilum* was described in sick dogs from Oaxaca at a seroprevalence of 7.4% [582] and of 3% from Monterrey [583], but potential cross-reactivity in the used test system with *A. platys* antibodies should be borne in mind. *Anaplasma* sp. was also detected in a large countrywide screening at 0.61–16.4% seroprevalences all over the area, depending on the region [186]. A molecular prevalence of 31% for *Anaplasma* sp. was reported for Coahuila and Durango with 3% of the dogs confirmed as *A. platys* infection [584].

Lyme borreliosis in dogs due to *B. burgdorferi* (*s.l.*) is reported in variable range among different regions of Mexico. It was reported in 0.9% of dogs from Nuevo Leon (by PCR), in 16% from Monterrey, in 8.2% from Mexicali, and in 0.23% of dogs including 21 Federate Mexican states (by seroprevalence) [186, 187, 585, 586]. Seroprevalence in humans was 3.4% in Mexico City, 6.2% in northeastern regions, and 0.3% in a nationwide survey [587, 588], with the Northeast considered as a zone where Lyme disease is endemic [589].

Ehrlichiosis due to *E. canis* was reported at a seroprevalence ranging between 8.7–44.1% in dogs from Yucatan [590, 591], a seroprevalence of 74.3% in clinically suspected dogs from Sinaloa [592] and at a molecular prevalence of 45% in shelter dogs from Yucatan [593]. Similarly, a seroprevalence of 37% was reported in sick dogs from Oaxaca [582]. *Ehrlichia canis* was also detected in a large countrywide screening at seroprevalences of 2.4–51%, depending on the region [186].

Rickettsiosis due to *R. felis* or *R. rickettsii* has been reported in people, but not in dogs [594]. Nevertheless, *R. akari* has been reported in a dog from Yucatan, whereas *R. felis* has been reported at a prevalence of 20% in fleas collected from dogs also on the Yucatan Peninsula [595, 596] and *R. rickettsii* has been reported in *A. cajennense* collected from dogs [597].

Nicaragua

Parasitic diseases

Babesiosis in form of *Babesia* spp. infection has been reported in dogs at a molecular prevalence of 26% (10/39), with four dogs being infected with *B. gibsoni* and six being infected with *B. vogeli* [598].

Dirofilariosis due to *D. immitis* has been described in two dogs from Managua [599], but autochthonous character of the two dogs is questionable. In a screening of 329 dogs a seroprevalence of 1.8% was detected. Additionally, in the same study in single dogs microfilariae were detected by microscopy and *D. immitis* infection was confirmed by PCR in two dogs [492].

Hepatozoonosis due to *H. canis* was detected at a molecular prevalence of 51% [598].

Leishmaniosis in different clinical scenarios and caused by different species has been reported in man [600, 601], but no prevalence data in dogs or cats could be found.

Trypanosomosis due to *T. cruzi* has been described in people in Nicaragua [602, 603]. No information about the prevalence of the pathogen is available in dogs or cats.

Bacterial diseases

Anaplasmosis in dogs due to *A. platys* infection has been reported at a molecular prevalence of 13% [598] and at a seroprevalence to *Anaplasma* spp. of 28.6% [492]. In the latter screening, *A. platys* and *A. phagocytophilum* infection could be confirmed on a molecular basis in 21.3% and 18.1% of seropositive dogs, respectively [492].

Lyme borreliosis could not be confirmed in a serosurvey of 329 dogs [492].

Ehrlichiosis in dogs has been found at a molecular prevalence of 56% [598] and at a seroprevalence of 63% for *E. canis* [604] and 62.9% for *Ehrlichia* spp. [492]. In the last study, 58.5% of all seropositive dogs were confirmed to be infected with *E. canis* by molecular methods [492].

Rickettsiosis due to *R. felis* has been reported at a molecular prevalence of 5% in dogs [598]. Additionally, *R. amblyommii* could be detected in *A. ovale* [605].

Panama

Parasitic diseases

Leishmaniosis was detected in dogs by microscopic examination at prevalences ranging between 3.0–15.4% [606–609]. A seroprevalence as high as 47% in dogs has also been reported in endemic regions [610]. Trypanosomosis has been reported at an overall infection index of 16.2% in dogs, with a seroprevalence of 11.1% for *T. cruzi* and at an infection rate (determined by PCR and blood culture) of 5.1% for *T. rangeli* [611].

Bacterial diseases

Anaplasmosis due to *A. platys* has been detected at a molecular prevalence of 21.4% in dogs [612]. *Anaplasma phagocytophilum* has been identified in ticks collected from a cow [613]. Ehrlichiosis due to *E. canis* infection has been detected at a molecular prevalence of 64.2% in dogs [612]. Other *Ehrlichia* spp. have been detected in ticks from horses and cattle [477, 613]. Rickettsiosis has been reported in dogs at a seroprevalence of 55% for *R. amblyommii*, 20% for *R. rickettsii*, 5% for *R. bellii*, 25% for *R. rhipicephali*, 10% for *R. parkeri* and 15% for *R. felis* [614]. Similarly, *R. felis* and *R. amblyommii*/"*Candidatus* R. amblyommii" have been detected in fleas and ticks, respectively, from dogs and cats [477, 614–617].

Paraguay

The information on vector-borne pathogens in Paraguay is extremely scarce or non-existent.

Parasitic diseases

Babesiosis in domestic dogs has been detected at an overall prevalence of 6% from 384 animals surveyed from Asunción, with *B. vogeli* being the most predominat piroplasmid species [618]. Dirofilariosis by *D. immitis* has been reported by necropsy in eight dogs of 200 street animals [619]. Leishmaniosis has been reported at seroprevalences ranging between 6.6–69.0% in dogs [620–622]. Trypanosomosis was detected in dogs at seroprevalences of 36.4% and 38% [623, 624] and in cats at 37.5% [624].

Bacterial diseases

Anaplasmosis has been detected in a larger population of dogs ($n = 384$) sampled from Asunción; *A. platys* was detected and identified at a molecular prevalence 10.67% [625]. Ehrlichiosis has been reported in the same population of dogs ($n = 384$) from Asunción with *E. canis* detected and identified at a molecular prevalence of 10.41% [625].

Peru

Parasitic diseases

Dirofilariosis due to *D. immitis* has been reported at a seroprevalence of 4.4% in dogs from Lima [626, 627] and ranging between 0–12.8% seroprevalence in further studies from Lima [628–630].

Leishmaniosis has been reported in Peru at molecular prevalences ranging between 5.4–7.6% in asymptomatic and 18–45% in symptomatic dogs [631–634]. Prevalence was highly dependent on the detection method [631], as well as on the type of sample and the molecular target used for testing [632, 635].

Trypanosomosis due to *T. cruzi* infection in dogs has been reported in southern Peru at a seroprevalence of 12.3% [636], while in northern Peru seroprevalences ranged between 19.8–40.0% [637, 638].

Bacterial diseases

Anaplasmosis due to *A. phagocytophilum* infection has been reported in a single dog from Lima [639]. Caution should be enforced due to potential cross-reactivity of the used test with *A. platys*. *Anaplasma platys* infection as suggested by inclusion bodies in platelets, was identified in 29.2% of pet dogs from Lima, and a prevalence of 1.4% for *A. platys* was detected by molecular methods in the same dog population [640].

Bartonellosis due to infection with *B. rochalimae* or *B. vinsonii berkhoffii* was detected by molecular methods in 10% of asymptomatic dogs [641]. The same survey also showed a seroprevalence of 62% for *B. rochalimae* and of 40% for *B. vinsonii berkhoffii*. Infection with *Bartonella* species in cats has been reported [642], but no prevalence values are available.

Lyme borreliosis has been reported in people in Peru [643, 644]. Furthermore, potential vectors have been detected [643], but information is scarce. Seropositivity has been reported in two dogs from Lima one of which was suspected to be of autochthonous character [639].

Ehrlichiosis has been reported in dogs [626, 645] as well as in humans, here in form of seropositivity to *E. canis* and *E. chaffeensis* [222, 645, 646]. A survey of a small cohort of dogs showed a molecular prevalence of 44% for *E. canis* [645] and a seroprevalence of 16.5% for *E. canis* in a population of 140 dogs [626].

Rickettsiosis in Peru has been reported in people and vectors [647]. A seroprevalence of 59.2% in dogs and of 7.7% in cats has been reported for spotted fever group rickettsiae [647]. Similarly, *R. felis* and *R. parkeri* have been detected in fleas and ticks from domestic animals [648].

Puerto Rico

The information on vector-borne pathogens in Puerto Rico is scarce.

Parasitic diseases

Dirofilariosis due to *D. immitis* in dogs has been detected at a seroprevalence of 19% in 123 dogs tested from Guaynabo and Ponce regions [649] and of 6.7% in 1,723 dogs with massively varying prevalences (up to 20.4%) in the different tested locations on the island using Knott's test [650]. A seroepidemiological study in humans revealed 2.66% *D. immitis* seropositives [651].

Bacterial diseases

Anaplasmosis due to *A. phagocytophilum*, showed a seroprevalence of 30.9% for 123 dogs from Ponce, Guaynabo and Vieques Island [649], but caution should be considered due to cross-reactivity with *A. platys* antibodies in the used test system. Lyme borreliosis in dogs has not been detected by a serological survey in Guaynabo, Ponce or Vieques Island [649]. Ehrlichiosis due to *E. canis* has been detected at a seroprevalence of 45.5% in dogs [649].

Suriname

The information on vector-borne pathogens in Suriname is extremely scarce or non-existent.

Parasitic diseases

Dirofilariosis in dogs by *D. immitis* infection has been reported in old dissection studies [652–655] and by Panday et al. [656] detecting 26% of positive dogs using modified Knott's test and 5.7% of seropositive dogs using IFA test. Leishmaniosis in form of human cutaneous leishmaniosis is endemic in the hinterland [657–661] and has been detected in a population of 47 dogs with a seroprevalence of 4.3% [662, 663]. Trypanosomosis suspected to be caused by *T. evansi* has been reported in four single cases in hunting dogs [664] and due to *T. cruzi* is reported in people [665].

Uruguay

Parasitic diseases

Leishmaniosis has recently been reported in 11/45 dogs by serology in Salto, Uruguay. Typing revealed *L. infantum* as corresponding pathogen. Additionally, *Leishmania* DNA was also detected in sand flies [666]. Trypanosomosis has been described in people in Uruguay [667–670], but no reports or prevalence data are available for dogs or cats.

Bacterial diseases

Anaplasmosis due to *A. platys* infection has been reported in 4.2% of dogs surveyed in northwestern Uruguay [671]. Bartonellosis was not reported in dogs or cats, but has been described in children [672, 673]. Lyme borreliosis was not described in people, dogs or cats. Nevertheless, *B. burgdorferi* (*s.l.*) genospecies have been detected in *Ixodes pararicinus* (*I. ricinus* complex group) ticks in the region [182]. Rickettsiosis due to seroreactivitiy against antigens of *R. felis*, *R. parkeri* and *R. rhipicephali* has been described in dogs at an overall seroprevalence of 20.3% [674]. From that study, it is estimated that at least 14% of dogs were seropositive for *R. parkeri*, or a *R. parkeri*-like organism. *Rickettsia* *parkeri* and *R. felis* have furthermore been detected in ticks and/or fleas [674–678], and there have been reports on *R. conorii* infections in humans [679, 680], but with some debate on cross-reactivity [678].

Venezuela

Parasitic diseases

Babesiosis due to *B. vogeli* has been reported at a molecular prevalence of 2.2% in dogs [681].

Dirofilariosis has been reported using modified Knott's test at a prevalence of 15.8% in dogs from Sucre [682] and, using ELISA, at a prevalence of 13% in Barquisimeto [683] and of 44.9% in Maracaibo [684]. D'Alessandro [685] reported an overall prevalence of 28.9% in dogs from Aragua using microscopic blood examination; the author detected a higher prevalence in hunting dogs (58.5%) compared to shelter or owned dogs (11.7%). Furthermore, there are also single feline case reports published for Venezuela [686–688].

Hepatozoon infection in dogs due to *H. canis* has been reported at a prevalence of 44.8% [681].

Leishmaniosis in dogs has been reported at prevalences ranging between 3–57%, depending on the region, the year and the type of test [323, 689–692]. On Margarita Island, seroprevalences of 21.0–33.1% have also been reported for dogs [693].

Trypanosomosis has been reported in dogs at seroprevalences ranging between 6.4–67.6% [694–698].

Bacterial diseases

Anaplasmosis in dogs due to *A. platys* has been reported [699, 700], and in one study even a prevalence of 16% by PCR was documented [701]. Lyme borreliosis has been described in humans [702, 703], but no reports on dogs or cats are available. Ehrlichiosis due to *E. canis* infection has been reported at a molecular prevalence of 31% in dogs [704]. A co-infection in a dog with *E. canis* and *E. chaffeensis* has been also reported [705].

Summary and priorities in companion vector-borne disease management

As illustrated by the prevalence data presented in this review, vector-borne pathogens are ubiquitous in LATAM, and represent a challenge for animal and, due to the zoonotic character of several of them, public health systems in both, urban and rural environments.

Unfortunately, diagnosis of VBDs as well as the system of VBD surveillance, reporting, prevention and control in the region is relatively weak, very limited, and in most cases inexistent.

During the last ten years, significant improvements in vector control and surveillance, clinical diagnosis, and medical practices have been achieved in the area of VBDs globally, but this seems not be the case for several areas in LATAM. Regrettably, LATAM is characterized by an expanding human population with marked social, cultural and economic inequalities. Several factors have created conditions for the emergence and persistence of previously unrecognized vector-borne and zoonotic diseases in most of the countries of the region [11, 38, 706], such as drastic changes in economic development and land use; poor waste disposal management practices (conducing to an uncontrolled growth of feral dog and cat populations); absence of responsible pet ownership; lack of awareness of animal welfare and disease prevention; restricted economic constrains to proper veterinary care; and extremely limited access to technological advances in diagnostic tools. Under these circumstances, it is clear that one of the most important steps towards control of CVBDs is prevention. In this context, companion animals, often having higher exposure and risk factors to VBDs than humans, could play a valuable role in minimizing the zoonotic potential of CVBDs by controlling this reservoir through proper prevention.

Prevention of infection should be based on actions aimed at averting infection in three main areas: vector control through use of repellent ectoparasiticides/insecticides and through environmental control (control of water accumulation, waste management, insecticidal treatment, mosquito screens etc.), vaccination, where applicable, and behavioral prophylaxis (cleaning of animals' residues, avoidance of daily phases with high vector activity like e.g. twilight, no abandonment of pets etc.).

Several previously unrecognized or overshadowed vector-borne pathogens that affect companion animals are present in LATAM. Most, if not all of the diseases presented here are zoonotic, which not only represents a concrete risk for pet animals, but also for people. Unfortunately, the information to the veterinary, public and medical community is either very scarce, limited, inexistent or not accessed and due to non-awareness in the people concerned.

In order to address the challenges that CVBDs impose to the region, some of the following priorities should be considered:

- Availability of affordable diagnostic techniques with solid interpretation and easy access to diagnostic reference laboratories in order to maintain consistent methodologies and updated diagnostic techniques.
- Easy access to formal (i.e. scientific and medical journals) and informal (i.e. conference and meeting proceedings, white papers, etc.) information regarding occurrence of VBDs, new or improved diagnostic tools, clinical findings, treatment protocols, and

options of prevention aimed at veterinarians and medical professionals.
- Creation of cooperative extension services and outreach programs fostering the collaboration between veterinarians, physicians, scientists, health workers, social workers, educators and farm communities.
- Development of impactful educational programs aiming at pet owners, farmers, and the general public regarding responsible pet ownership, vector control and VBD prophylaxis.
- Development of VBD surveillance network systems in collaboration with state and local health departments.

For veterinarians these priorities can be expanded into concrete actions as summarized also in Baneth et al. in a similar way [707]:

- Forget about exotic diseases as any disease can occur in the practice.
- Stay informed with up-to-date research data *via* diverse channels.
- Prevent transmission as best approach to CVBD management.
- Include fleas onto the list of potential vectors.
- Consider non-vectorial transmission in the case of leishmaniosis, *Bartonella* and hemotropic mycoplasmas.
- Check for the patients' travel schedule.
- Inform yourself on proper diagnostic methods.
- Consider treatment not necessarily as end of an infection.
- Inform and keep in touch with your clients.
- Alert public health authorities where appropriate.

VBDs are among the most complex of all infectious diseases and may pose a challenge to mitigate, control and prevent. A true One Health approach is required to respond to the current challenges presented by these diseases in both humans and animals. In LATAM, the actions towards mitigating the impact that CVBDs impose to both animal welfare and public health are intimately tied to the economic, social, and political values of the people in the region.

An interdisciplinary cooperation between professionals in human and animal medicine, scientists, ecologists and sociologists, a truly One Health approach, should be encouraged to ensure that surveillance is linked to actions. The creation of extension services at community levels providing culturally and economical acceptable veterinary services, including access to information, prevention, diagnosis and treatment to underserved regions, will be the key to minimize the impact of these diseases in the region. For the start, as preventing is always preferable to curing, the presumably easiest action to be taken here is a strong call for year-round prevention of pets with suitable and highly effective ectoparasiticides and microfilaricides (and where applicable also vaccines).

Conclusions

VBDs in companion animals possess a wide distribution in LATAM. But in contrast to this wide distribution, data availability and accessibility on the occurrence of the different diseases are very different for the individual countries of LATAM and often scarce. Some countries, e.g. Argentina and Brazil, possess profound data availability, whereas especially in some of the smaller ones international accessible data is missing. Generally, none of the examined LATAM countries is completely free f the listed pathogens in companion animals. The fact that some of the discussed diseases and pathogens possess zoonotic character demands for a strong call for disease prevention in companion animals by repellent ectoparasiticidal/insecticidal control, environmental control, vaccination, where applicable, and behavioral prophylaxis. Behavioral priorities especially also for veterinarians and a One Health approach are needed for the region.

Abbreviations

AHS: American Heartworm Society; CVBD: companion vector-borne disease; LATAM: Latin America; LB: Lyme borreliosis; TroCCAP: Tropical Council of Companion Animal Parasites; VBD: vector-borne disease.

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Availability of data and materials

The datasets supporting the conclusions of this article are included within the article.

Authors' contributions

RM and FK both gathered corresponding publications and data, generated the table and drafted the manuscript. Both authors read and approved the final manuscript.

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The authors declare that they have no competing interests.

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References

1. Jackman J, Rowan A. Free-roaming dogs in developing countries: the benefits of capture, neuter, and return programs. In: Salem DJ, Rowan AN, editors. The state of the animals 2007. Washington, DC: Humane Society Press; 2007. p. 55–78.
2. Hartwell S. The indoor outdoor debate. 2008. http://messybeast.com/indooroutdoor.htm. Accessed 1 Feb 2018.
3. Ryan MP, Adley CC. *Sphingomonas paucimobilis*: a persistent Gram-negative nosocomial infectious organism. J Hosp Infect. 2010;75:153–7.
4. Biondo AW, Dos Santos AP, Guimaraes AMS, Vieira RF, Vidotto O, Macieira DB, et al. A review of the occurrence of hemoplasmas (hemotrophic mycoplasmas) in Brazil. Rev Bras Parasitol Vet. 2009;18:1–7.
5. Fung HL, Calzada J, Saldana A, Santamaria AM, Pineda V, Gonzalez K, et al. Domestic dog health worsens with socio-economic deprivation of their home communities. Acta Trop. 2014;135:67–74.
6. Jenkins EJ, Schurer JM, Gesy KM. Old problems on a new playing field: helminth zoonoses transmitted among dogs, wildlife, and people in a changing northern climate. Vet Parasitol. 2011;182:54–69.
7. Levy JK, Crawford PC, Lappin MR, Dubovi EJ, Levy MG, Alleman R, et al. Infectious diseases of dogs and cats on Isabela Island. Galapagos. J Vet Intern Med. 2008;22:60–5.
8. Trotman M. Regional realities: Impact of stray dogs and cats on the community impact on economy, including tourism impact on livestock, wildlife and the environment. 2006. http://www.hsi.org/assets/pdfs/regional_realities.pdf. Accessed 1 Feb 2018.
9. Weston MA, Fitzsimons JA, Wescott G, Miller KK, Ekanayake KB, Schneider T. Bark in the park: a review of domestic dogs in parks. Environ Manage. 2014;54:373–82.
10. Woodroffe R, Prager KC, Munson L, Conrad PA, Dubovi EJ, Mazet JAK. Contact with domestic dogs increases pathogen exposure in endangered African wild dogs (*Lycaon pictus*). PLoS One. 2012;7:e30099.
11. Dantas-Torres F, Figueredo LA. Canine babesiosis: a Brazilian perspective. Vet Parasitol. 2006;141:197–203.
12. Eiras DF, Basabe J, Mesplet M, Schnittger L. First molecular characterization of *Babesia vogeli* in two naturally infected dogs of Buenos Aires, Argentina. Vet Parasitol. 2008;157:294–8.
13. Kelly PJ, Xu C, Lucas H, Loftis A, Abete J, Zeoli F, et al. Ehrlichiosis, babesiosis, anaplasmosis and hepatozoonosis in dogs from St Kitts. West Indies. PLoS One. 2013;8:e53450.
14. Irwin PJ. Canine babesiosis: from molecular taxonomy to control. Parasit Vectors. 2009;2(Suppl. 1):S4.
15. Birkenheuer AJ, Correa MT, Levy MG, Breitschwerdt EB. Geographic distribution of babesiosis among dogs in the United States and association with dog bites: 150 cases (2000–2003). J Am Vet Med Assoc. 2005;227:942–7.
16. Jefferies R, Ryan UM, Jardine J, Broughton DK, Robertson ID, Irwin PJ. Blood, bull terriers and babesiosis: further evidence for direct transmission of *Babesia gibsoni* in dogs. Aust Vet J. 2007;85:459–63.
17. Stegeman JR, Birkenheuer AJ, Kruger JM, Breitschwerdt EB. Transfusion-associated *Babesia gibsoni* infection in a dog. J Am Vet Med Assoc. 2003;222:959–63.
18. Fukumoto S, Suzuki H, Igarashi I, Xuan X. Fatal experimental transplacental *Babesia gibsoni* infections in dogs. Int J Parasitol. 2005;35:1031–5.
19. Dantas-Torres F, Otranto D. Dirofilariosis in the Americas: a more virulent *Dirofilaria immitis*? Parasit Vectors. 2013;6:288.
20. Torres-Chable OM, Baak-Baak CM, Cigarroa-Toledo N, Blitvich BJ, Brito-Argaez LG, Alvarado-Kantun YN, et al. Molecular detection of *Dirofilaria immitis* in dogs and mosquitoes in Tabasco, Mexico. J Vector Borne Dis. 2018;55:151–8.
21. Cuervo PF, Fantozzi MC, Cataldo S, Cringoli G, Sierra R, Rinaldi L. Analysis of climate and extrinsic incubation of *Dirofilaria immitis* in southern South America. Geospat Health. 2013;8:175–81.
22. Atkins CE, La Keene BW, McGuirk SM. Pathophysiologic mechanism of cardiac dysfunction in experimentally induced heartworm caval syndrome in dogs: an echocardiographic study. Am J Vet Res. 1988;49:403–10.
23. Calvert CA, Rawlings CA. Pulmonary manifestations of heartworm disease. Vet Clin North Am Small Anim Pract. 1985;15:991–1009.
24. Venco L, Mihaylova L, Boon JA. Right Pulmonary Artery Distensibility Index (RPAD Index). A field study of an echocardiographic method to detect early development of pulmonary hypertension and its severity even in the absence of regurgitant jets for Doppler evaluation in heartworm-infected dogs. Vet Parasitol. 2014;206:60–6.
25. American Heartworm Society (AHS). Current Canine Guidelines for the Prevention, Diagnosis, and Management of Heartworm (*Dirofilaria immitis*) Infection in Dogs. 2014. https://www.heartwormsociety.org/images/pdf/2014-AHS-Canine-Guidelines.pdf Accessed 19 Jul 2018.
26. Tropical Council of Companion Animal Parasites (TroCCAP). Heartworm. http://www.troccap.com/canine-guidelines/vector-borne-parasites/heartworm/ Accessed 19 July 2018.
27. Grandi G, Morchon R, Kramer L, Kartashev V, Simon F. *Wolbachia* in *Dirofilaria repens*, an agent causing human subcutaneous dirofilariasis. J Parasitol. 2008;94:1421–3.
28. Bredal WP, Gjerde B, Eberhard ML, Aleksandersen M, Wilhelmsen DK, Mansfield LS. Adult *Dirofilaria repens* in a subcutaneous granuloma on the chest of a dog. J Small Anim Pract. 1998;39:595–7.
29. Hargis AM, Lewis TP, Duclos DD, Loeffler DG, Rausch RL. Dermatitis associated with microfilariae (Filarioidea) in 10 dogs. Vet Dermatol. 1999;10:95–107.
30. Baneth G, Volansky Z, Anug Y, Favia G, Bain O, Goldstein RE, Harrus S. *Dirofilaria repens* infection in a dog: diagnosis and treatment with melarsomine and doramectin. Vet Parasitol. 2002;105:173–8.
31. Hermosilla C, Pantchev N, Dyachenko V, Gutmann M, Bauer C. First autochthonous case of canine ocular *Dirofilaria repens* infection in Germany. Vet Rec. 2006;158:134–5.
32. Tarello W. Clinical aspects of dermatitis associated with *Dirofilaria repens* in pets: a review of 100 canine and 31 feline cases (1990–2010) and a report of a new clinic case imported from Italy to Dubai. J Parasitol Res. 2011;2011:578385.
33. Genchi C, Kramer LH, Rivasi F. Dirofilarial infections in Europe. Vector Borne Zoonotic Dis. 2011;11:1307–17.
34. Simón F, Siles-Lucas M, Morchon R, Gonzalez-Miguel J, Mellado I, Carreton E, Montoya-Alonso JA. Human and animal dirofilariasis: the emergence of a zoonotic mosaic. Clin Microbiol Rev. 2012;25:507–44.
35. Ramos-Lopez S, León-Galván MF, Salas-Alatorre M, Lechuga-Arana AA, Valencia-Posadas M, Gutiérrez-Chávez AJ. First molecular identification of *Dirofilaria repens* in a dog blood sample from Guanajuato, Mexico. Vector Borne Zoonotic Dis. 2016;16:734–6.
36. López J, Valiente-Echeverria F, Carrasco M, Mercado R, Abarca K. Identificación morfológica y molecular de filarias caninas en una comuna semi-rural de la Región Metropolitana, Chile. Rev Chilena Infectol. 2012;29:284–9.
37. Canestri Trotti G, Pampiglione S, Rivasi F. The species of the genus *Dirofilaria*, Railliet & Henry, 1911. Parassitologia. 1997;39:369–74.
38. Dantas-Torres F. Canine vector-borne diseases in Brazil. Parasit Vectors. 2008;1:25.
39. de Miranda RL, O'Dwyer LH, de Castro JR, Metzger B, Rubini AS, Mundim AV, et al. Prevalence and molecular characterization of *Hepatozoon canis* in dogs from urban and rural areas in Southeast Brazil. Res Vet Sci. 2014;97:325–8.
40. Rojas A, Rojas D, Montenegro V, Gutierrez R, Yasur-Landau D, Baneth G. Vector-borne pathogens in dogs from Costa Rica: first molecular description of *Babesia vogeli* and *Hepatozoon canis* infections with a high prevalence of monocytic ehrlichiosis and the manifestations of co-infection. Vet Parasitol. 2014;199:121–8.
41. Wei L, Kelly P, Ackerson K, El-Mahallawy HS, Kaltenboeck B, Wang C. Molecular detection of *Dirofilaria immitis*, *Hepatozoon canis*, *Babesia* spp., *Anaplasma platys* and *Ehrlichia canis* in dogs on Costa Rica. Acta Parasitol. 2015;60:21–5.

42. Sherding RG. Toxoplasmosis and other systemic protozoal infections. In: Birchard SJ, Sherding RG, editors. Saunders manual of small animal practice. 3rd ed. St. Louis: Elsevier Saunders; 2006. p. 219–29.
43. Baneth G. Perspectives on canine and feline hepatozoonosis. Vet Parasitol. 2011;181:3–11.
44. Sasanelli M, Paradies P, Greco B, Eyal O, Zaza V, Baneth G. Failure of imidocarb dipropionate to eliminate *Hepatozoon canis* in naturally infected dogs based on parasitological and molecular evaluation methods. Vet Parasitol. 2010;171:194–9.
45. Dantas-Torres F. Canine leishmaniosis in South America. Parasit Vectors. 2009;2(Suppl. 1):S1.
46. Tolezano JE, Uliana SR, Taniguchi HH, Araújo MF, Barbosa JA, Barbosa JE, et al. The first records of *Leishmania* (*Leishmania*) *amazonensis* in dogs (*Canis familiaris*) diagnosed clinically as having canine visceral leishmaniasis from Araçatuba County, São Paulo State, Brazil. Vet Parasitol. 2007;149:280–4.
47. Reithinger R, Davies CR. Is the domestic dog (*Canis familiaris*) a reservoir host of American cutaneous leishmaniasis? A critical review of the current evidence. Am J Trop Med Hyg. 1999;61:530–41.
48. Akhoundi M, Kuhls K, Cannet A, Votýpka J, Marty P, Delaunay P, et al. A historical overview of the classification, evolution, and dispersion of *Leishmania* parasites and sandflies. PLoS Negl Trop Dis. 2016;10:e0004349.
49. Young DG, Duncan MA. Guide to the Identification and Geographic Distribution of Lutzomyia Sandflies in Mexico, the West Indies, Central and South America (Diptera: Psychodidae). Memoirs of the American Entomological Institute no. 54. Gainesville: Associate Publishers; 1994. p. 881.
50. Solano-Gallego L, Koutinas A, Miro G, Cardoso L, Pennisi MG, Ferrer L, et al. Directions for the diagnosis, clinical staging, treatment and prevention of canine leishmaniosis. Vet Parasitol. 2009;165:1–18.
51. Solano-Gallego L, Miro G, Koutinas A, Cardoso L, Pennisi MG, Ferrer L, et al. LeishVet guidelines for the practical management of canine leishmaniosis. Parasit Vectors. 2011;4:86.
52. Pennisi M-G, Cardoso L, Baneth G, Bourdeau P, Koutinas A, Miro G, et al. LeishVet update and recommendations on feline leishmaniosis. Parasit Vectors. 2015;8:302.
53. Baneth G, Koutinas AF, Solano-Gallego L, Bourdeau P, Ferrer L. Canine leishmaniosis - new concepts and insights on an expanding zoonosis: part one. Trends Parasitol. 2008;24:324–30.
54. Solano-Gallego L, Rodriguez-Cortes A, Trotta M, Zampieron C, Razia L, Furlanello T, et al. Detection of *Leishmania infantum* DNA by fret-based real-time PCR in urine from dogs with natural clinical leishmaniosis. Vet Parasitol. 2007;147:315–9.
55. Solano-Gallego L, Villanueva-Saz S, Carbonell M, Trotta M, Furlanello T, Natale A. Serological diagnosis of canine leishmaniosis: comparison of three commercial ELISA tests (Leiscan®, ID Screen® and *Leishmania* 96®), a rapid test (Speed Leish K®) and an in-house IFAT. Parasit Vectors. 2014;7:111.
56. Solano-Gallego L, Di Filippo L, Ordeix L, Planellas M, Roura X, Altet L, et al. Early reduction of *Leishmania infantum*-specific antibodies and blood parasitemia during treatment in dogs with moderate or severe disease. Parasit Vectors. 2016;9:560.
57. Dantas-Torres F, Brandão-Filho SP. Visceral leishmaniasis in Brazil: revisiting paradigms of epidemiology and control. Rev Inst Med Trop Sao Paulo. 2006;48:151–6.
58. Moreira ED, Souza VM, Sreenivasan M, Nascimento EG, Carvalho L. Assessment of an optimized dog-culling program in the dynamics of canine *Leishmania* transmission. Vet Parasitol. 2004;122:245–52.
59. Nunes CM, Lima VM, Paula HB, Perri SH, Andrade AM, Dias FE, et al. Dog culling and replacement in an area endemic for visceral leishmaniasis in Brazil. Vet Parasitol. 2008;153:19–23.
60. Brazil - Ministério da Agricultura, Pecuária e Abastecimento. Nota Técnica Nº 11/2016/CPV/DFIP/SDA/GM/MAPA. 2016. http://www.sbmt.org.br/portal/wp-content/uploads/2016/09/nota-tecnica.pdf. Accessed 1 Mar 2019.
61. Regina-Silva S, Feres AMLT, Franca-Silva JC, Dias ES, Michalsky EM, de Andrade HM, et al. Field randomized trial to evaluate the efficacy of the Leish-Tec® vaccine against canine visceral leishmaniasis in an endemic area of Brazil. Vaccine. 2016;34:2233–9.
62. World Health Organization (WHO). The global burden of disease. update. Geneva: WHO Press; 2004. p. 2008.
63. Chikweto A, Kumthekar S, Chawla P, Tiwari KP, Perea LM, Paterson T, Sharma RN. Seroprevalence of *Trypanosoma cruzi* in stray and pet dogs in Grenada, West Indies. Trop Biomed. 2014;31:347–50.
64. Lee BY, Bacon KM, Bottazzi ME, Hotez PJ. Global economic burden of Chagas disease: a computational simulation model. Lancet Infect Dis. 2013;13:342–8.
65. Rassi A, Rassi A, Marin-Neto JA. Chagas disease. Lancet. 2010;375:1388–402.
66. Hotez PJ, Dumonteil E, Heffernan MJ, Bottazzi ME. Innovation for the 'bottom 100 million': eliminating neglected tropical diseases in the Americas. Adv Exp Med Biol. 2013;764:1–12.
67. Hotez PJ, Dumonteil E, Woc-Colburn L, Serpa JA, Bezek S, Edwards MS, et al. Chagas disease: "the new HIV/AIDS of the Americas". PLoS Negl Trop Dis. 2012;6:e1498.
68. Esch KJ, Petersen CA. Transmission and epidemiology of zoonotic protozoal diseases of companion animals. Clin Microbiol Rev. 2013;26:58–85.
69. Desquesnes M, Dargantes A, Lai DH, Lun ZR, Holzmuller P, Jittapalapong S. *Trypanosoma evansi* and surra: a review and perspectives on transmission, epidemiology and control, impact, and zoonotic aspects. Bio Med Res Int. 2013;2013:321237.
70. Hoare CA. The trypanosomes of mammals: a zoological monograph. Oxford: Blackwell Scientific Publications; 1972. p. 749.
71. Barr SC. Canine Chagas' disease (American trypanosomiasis) in North America. Vet Clin North Am Small Anim Pract. 2009;39:1055–64.
72. Mahmoud MM, Gray AR. Trypanosomiasis due to Trypanosoma evansi (Steel, 1885) Balbiani, 1888. A review of recent research. Trop Anim Health Prod. 1980;12:35–47.
73. Antoine-Moussiaux M, Desmecht D. Epidémiologie de l'infection par *Trypanosoma evansi*. Ann Méd Vét. 2008;152:191–201.
74. Andrade JP, Marin Neto JA, Paola AA, Vilas-Boas F, Oliveira GMM, Bacal F, et al. I Latin American Guidelines for the diagnosis and treatment of Chagas' heart disease. Executive summary. Arq Bras Cardiol. 2011;96:434–42.
75. MPPS - Ministerio del Poder Popular para la Salud de Venezuela. Guía para el diagnóstico, atención y manejo clínico de la enfermedad de Chagas en Venezuela. 2014. http://svmi.web.ve/wh/documentos/Guia_Chagas_2015.pdf Accessed 1 Feb 2018.
76. Gascon J, Grupo de Trabajo del Taller «Enfermedad de Chagas: ¿un nuevo reto de Salud Pública?». Diagnóstico y tratamiento de la Enfermedad de Chagas importada. Med Clin (Barc). 2005;125:230–5.
77. MS/SVS - Ministério da Saúde/Secretaria de Vigilância em Saúde. Consenso brasileiro em doenca de chagas. Rev Soc Bras Med. 2005;38:7–29.
78. OPS/MSF - Organización Panamericana de la Salud/Medicos sin fronteras. Consulta técnica regional OPS/MSF sobre organização e estrutura da atenção médica do doente e infectado por *Trypanosoma cruzi*/doença de Chagas. Rev Soc Bras Med Trop. 2005;38:538–41.
79. Bern C, Montgomery SP, Herwaldt BL, Rassi A, Marin-Neto JA, Dantas RO, et al. Evaluation and treatment of chagas disease in the United States: a systematic review. J Am Med Assoc. 2007;298:2171–81.
80. MINSAL - Ministerio de Salud de El Salvador. Norma técnica para prevención y control de la enfermedad de Chagas. El Salvador: Ministerio de Salud, Dirección de Regulación y Legislación en Salud, Unidad de Salud Ambiental; 2011.
81. MINSAL-Ministerio de Salud de Chile. Guías clínicas de la enfermedad de Chagas 2006: Parte V Diagnóstico de laboratorio. Rev Chilena Infectol. 2008;25:379–83.
82. Brasil PEAA do, Castro R, Castro L de. Commercial enzyme-linked immunosorbent assay versuspolymerase chain reaction for the diagnosis of chronic Chagas disease: a systematic review and meta-analysis. Mem Inst Oswaldo Cruz. 2016;111:1–19.
83. Enriquez GF, Cardinal MV, Orozco MM, Schijman AG, Gurtler RE. Detection of *Trypanosoma cruzi* infection in naturally infected dogs and cats using serological, parasitological and molecular methods. Acta Trop. 2013;126:211–7.
84. Martinez I, Martinez-Ibarra A, Arce-Fonseca M, Rodriguez-Morales O, Perez-Morales D, Reyes Lopez PA, et al. Seroprevalence and major antigens recognized by sera from *Trypanosoma cruzi*-infected dogs from Jalisco, Mexico. Rev Argent Microbiol. 2014;46:85–90.

85. Lizundia R, Picado A, Cordero M, Calderon A, Deborggraeve S, Montenegro VM, et al. Molecular and serological rapid tests as markers of *Trypanosoma cruzi* infection in dogs in Costa Rica. Trop Parasitol. 2014;4:111–4.
86. Floridia-Yapur N, Monje Rumi M, Ragone P, Lauthier JJ, Tomasini N, Alberti D'Amato A, et al. The TcTASV proteins are novel promising antigens to detect active *Trypanosoma cruzi* infection in dogs. Parasitology. 2016;143:1382–9.
87. Jimenez-Coello M, Shelite T, Castellanos-Gonzalez A, Saldarriaga O, Rivero R, Ortega-Pacheco A, et al. Efficacy of recombinase polymerase amplification to diagnose *Trypanosoma cruzi* infection in dogs with cardiac alterations from an endemic area of Mexico. Vector Borne Zoonotic Dis. 2018;18:417–23.
88. Cimino RO, Diosque P, López Quiroga IR, Gil JF, Nasser JR. Evaluación inmunoenzimática del antígeno recombinante SAPA en perros infectados naturalmente por *Trypanosoma cruzi*. Rev Argent Microbiol. 2012;44:177–81.
89. Croft SL, Barrett MP, Urbina JA. Chemotherapy of trypanosomiases and leishmaniasis. Trends Parasitol. 2005;21:508–12.
90. Petersen C, Grinnage-Pulley TL. Trypanosomiasis. In: Aiello SE, Moses MA, eds. The Merck Veterinary Manual. Kenilworth, NJ, USA: Merck & Co.; 2018. http://www.merckvetmanual.com/circulatory-system/blood-parasites/trypanosomiasis Accessed 6 Feb 2018.
91. Chomel B. Tick-borne infections in dogs - an emerging infectious threat. Vet Parasitol. 2011;179:294–301.
92. Greig B, Asanovich KM, Armstrong PJ, Dumler JS. Geographic, clinical, serologic, and molecular evidence of granulocytic ehrlichiosis, a likely zoonotic disease, in Minnesota and Wisconsin dogs. J Clin Microbiol. 1996;34:44–8.
93. Poitout FM, Shinozaki JK, Stockwell PJ, Holland CJ, Shukla SK. Genetic variants of *Anaplasma phagocytophilum* infecting dogs in western Washington State. J Clin Microbiol. 2005;43:796–801.
94. Kohn B, Galke D, Beelitz P, Pfister K. Clinical features of canine granulocytic anaplasmosis in 18 naturally infected dogs. J Vet Intern Med. 2008;22:1289–95.
95. Skotarczak B, Adamska M, Rymaszewska A, Supron M, Sawczuk M, Maciejewska A. *Anaplasma phagocytophila* and protozoans of *Babesia* genus in dogs from endemic areas of Lyme disease in north-western Poland. Wiad Parazytol. 2004;50:555–61 (In Polish).
96. Bouzouraa T, Rene-Martellet M, Chene J, Attipa C, Lebert I, Chalvet-Monfray K, et al. Clinical and laboratory features of canine *Anaplasma platys* infection in 32 naturally infected dogs in the Mediterranean basin. Ticks Tick Borne Dis. 2016;7:1256–64.
97. Harrus S, Aroch I, Lavy E, Bark H. Clinical manifestations of infectious canine cyclic thrombocytopenia. Vet Rec. 1997;141:247–50.
98. Sainz A, Roura X, Miro G, Estrada-Pena A, Kohn B, Harrus S, Solano-Gallego L. Guideline for veterinary practitioners on canine ehrlichiosis and anaplasmosis in Europe. Parasit Vectors. 2015;8:75.
99. Shaw SE, Binns SH, Birtles RJ, Day MJ, Smithson R, Kenny MJ. Molecular evidence of tick-transmitted infections in dogs and cats in the United Kingdom. Vet Rec. 2005;157:645–8.
100. Carrade DD, Foley JE, Borjesson DL, Sykes JE. Canine granulocytic anaplasmosis: a review. J Vet Intern Med. 2009;23:1129–41.
101. Inokuma H, Raoult D, Brouqui P. Detection of *Ehrlichia platys* DNA in brown dog ticks (*Rhipicephalus sanguineus*) in Okinawa Island, Japan. J Clin Microbiol. 2000;38:4219–21.
102. Motoi Y, Satoh H, Inokuma H, Kiyuuna T, Muramatsu Y, Ueno H, et al. First detection of *Ehrlichia platys* in dogs and ticks in Okinawa, Japan. Microbiol Immunol. 2001;45:89–91.
103. Parola P, Cornet JP, Sanogo YO, Miller RS, Thien HV, Gonzalez JP, et al. Detection of *Ehrlichia* spp., *Anaplasma* spp., *Rickettsia* spp., and other eubacteria in ticks from the Thai-Myanmar border and Vietnam. J Clin Microbiol. 2003;41:1600–8.
104. Sanogo YO, Davoust B, Inokuma H, Camicas JL, Parola P, Brouqui P. First evidence of *Anaplasma platys* in *Rhipicephalus sanguineus* (Acari: Ixodida) collected from dogs in Africa. Onderstepoort J Vet Res. 2003;70:205–12.
105. Kim CM, Yi YH, Yu DH, Lee MJ, Cho MR, Desai AR, et al. Tick-borne rickettsial pathogens in ticks and small mammals in Korea. Appl Environ Microbiol. 2006;72:5766–76.
106. Kempf VAJ, Krämer F. The role of *Bartonella* spp. in veterinary and human medicine. EJCAP. 2008;18:274–9.
107. Maggi RG, Balakrishnan N, Bradley JM, Breitschwerdt EB. Infection with *Bartonella henselae* in a Danish family. J Clin Microbiol. 2015;53:1556–61.
108. Leulmi H, Bitam I, Berenger JM, Lepidi H, Rolain JM, Almeras L, et al. Competence of *Cimex lectularius* bed bugs for the transmission of *Bartonella quintana*, the agent of trench fever. PLoS Negl Trop Dis. 2015;9:e0003789.
109. Maggi RG, Ericson M, Mascarelli PE, Bradley JM, Breitschwerdt EB. *Bartonella henselae* bacteremia in a mother and son potentially associated with tick exposure. Parasit Vectors. 2013;6:101.
110. Melter O, Arvand M, Votýpka J, Hulínská D. *Bartonella quintana* transmission from mite to family with high socioeconomic status. Emerg Infect Dis. 2012;18:163–5.
111. Tsai Y-L, Lin C-C, Chomel BB, Chuang S-T, Tsai K-H, Wu W-J, et al. *Bartonella* infection in shelter cats and dogs and their ectoparasites. Vector Borne Zoonotic Dis. 2011;11:1023–30.
112. Tsai K-H, Huang C-G, Fang C-T, Shu P-Y, Huang J-H, Wu W-J. Prevalence of *Rickettsia felis* and the first identification of *Bartonella henselae* Fizz/CAL-1 in cat fleas (Siphonaptera: Pulicidae) from Taiwan. J Med Entomol. 2011;48:445–52.
113. Reis C, Cote M, Le Rhun D, Lecuelle B, Levin ML, Vayssier-Taussat M, Bonnet SI. Vector competence of the tick *Ixodes ricinus* for transmission of *Bartonella birtlesii*. PLoS Negl Trop Dis. 2011;5:e1186.
114. Morick D, Krasnov BR, Khokhlova IS, Gottlieb Y, Harrus S. Investigation of *Bartonella* acquisition and transmission in *Xenopsylla ramesis* fleas (Siphonaptera: Pulicidae). Mol Ecol. 2011;20:2864–70.
115. Mokhtar AS, Tay ST. Molecular detection of *Rickettsia felis*, *Bartonella henselae*, and *B. clarridgeiae* in fleas from domestic dogs and cats in Malaysia. Am J Trop Med Hyg. 2011;85:931–3.
116. Kabeya H, Inoue K, Izumi Y, Morita T, Imai S, Maruyama S. *Bartonella* species in wild rodents and fleas from them in Japan. J Vet Med Sci. 2011;73:1561–7.
117. Billeter SA, Cáceres AG, Gonzales-Hidalgo J, Luna-Caypo D, Kosoy MY. Molecular detection of *Bartonella* species in ticks from Peru. J Med Entomol. 2011;48:1257–60.
118. Angelakis E, Rolain J-M, Raoult D, Brouqui P. *Bartonella quintana* in head louse nits. FEMS Immunol Med Microbiol. 2011;62:244–6.
119. Oliveira AM, Maggi RG, Woods CW, Breitschwerdt EB. Suspected needle stick transmission of *Bartonella vinsonii* subspecies *berkhoffii* to a veterinarian. J Vet Intern Med. 2010;24:1229–32.
120. Kernif T, Parola P, Ricci JC, Raoult D, Rolain JM. Molecular detection of *Bartonella alsatica* in rabbit fleas, France. Emerg Infect Dis. 2010;16:2013–4.
121. Dietrich F, Schmidgen T, Maggi RG, Richter D, Matuschka F-R, Vonthein R, et al. Prevalence of *Bartonella henselae* and *Borrelia burgdorferi sensu lato* DNA in *Ixodes ricinus* ticks in Europe. Appl Environ Microbiol. 2010;76:1395–8.
122. Adamska M. *Bartonella* spp. as a zoonotic pathogens transmitting by blood-feeding arthropods. Wiad Parazytol. 2010;56:1–9 (In Polish).
123. Perez-Martinez L, Venzal JM, Gonzalez-Acuna D, Portillo A, Blanco JR, Oteo JA. *Bartonella rochalimae* and other *Bartonella* spp. in fleas. Chile. Emerg Infect Dis. 2009;15:1150–2.
124. Gabriel MW, Henn J, Foley JE, Brown RN, Kasten RW, Foley P, Chomel BB. Zoonotic *Bartonella* species in fleas collected on gray foxes (*Urocyon cinereoargenteus*). Vector Borne Zoonotic Dis. 2009;9:597–602.
125. Just FT, Gilles J, Pradel I, Pfalzer S, Lengauer H, Hellmann K, Pfister K. Molecular evidence for *Bartonella* spp in cat and dog fleas from Germany and France. Zoonoses Public Health. 2008;55:514–20.
126. Billeter SA, Levy MG, Chomel BB, Breitschwerdt EB. Vector transmission of *Bartonella* species with emphasis on the potential for tick transmission. Med Vet Entomol. 2008;22:1–15.
127. Reeves WK, Rogers TE, Dasch GA. *Bartonella* and *Rickettsia* from fleas (Siphonaptera: Ceratophyllidae) of prairie dogs (*Cynomys* spp.) from the western United States. J Parasitol. 2007;93:953–5.
128. Podsiadly E, Chmielewski T, Sochon E, Tylewska-Wierzbanowska S. *Bartonella henselae* in *Ixodes ricinus* ticks removed from dogs. Vector Borne Zoonotic Dis. 2007;7:189–92.
129. Li DM, Liu QY, Yu DZ, Zhang JZ, Gong ZD, Song XP. Phylogenetic analysis of *Bartonella* detected in rodent fleas in Yunnan, China. J Wildl Dis. 2007;43:609–17.

130. Breitschwerdt EB, Maggi RG, Sigmon B, Nicholson WL. Isolation of *Bartonella quintana* from a woman and a cat following putative bite transmission. J Clin Microbiol. 2007;45:270–2.
131. Breitschwerdt EB, Maggi RG, Duncan AW, Nicholson WL, Hegarty BC, Woods CW. *Bartonella* species in blood of immunocompetent persons with animal and arthropod contact. Emerg Infect Dis. 2007;13:938–41.
132. Psarros G, Riddell J, Gandhi T, Kauffman CA, Cinti SK. *Bartonella henselae* infections in solid organ transplant recipients: report of 5 cases and review of the literature. Medicine (Baltimore). 2012;91:111–21.
133. Mosepele M, Mazo D, Cohn J. *Bartonella* infection in immunocompromised hosts: immunology of vascular infection and vasoproliferation. Clin Dev Immunol. 2012;2012:612809.
134. Atamanyuk I, Raja SG, Kostolny M. *Bartonella henselae* endocarditis of percutaneously implanted pulmonary valve: a case report. J Heart Valve Dis. 2011;20:94–7.
135. Lienhardt B, Irani S, Gaspert A, Weishaupt D, Boehler A. Disseminated infection with *Bartonella henselae* in a lung transplant recipient. J Heart Lung Transplant. 2009;28:736–9.
136. Vassallo C, Ardig M, Brazzelli V, Zecca M, Locatelli F, Alessandrino PE, et al. *Bartonella*-related pseudomembranous angiomatous papillomatosis of the oral cavity associated with allogeneic bone marrow transplantation and oral graft-*versus*-host disease. Br J Dermatol. 2007;157:174–8.
137. Bonatti H, Mendez J, Guerrero I, Krishna M, Ananda-Michel J, Yao J, et al. Disseminated *Bartonella* infection following liver transplantation. Transpl Int. 2006;19:683–7.
138. Humar A, Salit I. Disseminated *Bartonella* infection with granulomatous hepatitis in a liver transplant recipient. Liver Transpl Surg. 1999;5:249–51.
139. Pawson R, Virchis A, Potter M, Prentice HG. Absence of *Bartonella*-like inclusions in microangiopathy after transplantation. Lancet. 1998;351:831–2.
140. Ahsan N, Holman MJ, Riley TR, Abendroth CS, Langhoff EG, Yang HC. Peloisis hepatis due to *Bartonella henselae* in transplantation: a hemato-hepato-renal syndrome. Transplantation. 1998;65:1000–3.
141. Bruckert F, de Kerviler E, Zagdanski AM, Molina JM, Casin I, Guermazi A, et al. Sternal abscess due to *Bartonella* (Rochalimaea) henselae in a renal transplant patient. Skeletal Radiol. 1997;26:431–3.
142. Diniz PPV, Velho PENF, Pitassi LHU, Drummond MR, Lania BG, Barjas-Castro ML, et al. Risk factors for *Bartonella* species infection in blood donors from Southeast Brazil. PLoS Negl Trop Dis. 2016;10:e0004509.
143. Maggi RG, Mascarelli PE, Balakrishnan N, Rohde CM, Kelly CM, Ramaiah L, et al. "*Candidatus* Mycoplasma haemomacaque" and *Bartonella quintana* bacteremia in cynomolgus monkeys. J Clin Microbiol. 2013;51:1408–11.
144. Maggi RG, Mascarelli PE, Pultorak EL, Hegarty BC, Bradley JM, Mozayeni BR, Breitschwerdt EB. *Bartonella* spp. bacteremia in high-risk immunocompetent patients. Diagn Microbiol Infect Dis. 2011;71:430–7.
145. Oskouizadeh K, Zahraei-Salehi T, Aledavood S. Detection of *Bartonella henselae* in domestic cats' saliva. Iran J Microbiol. 2010;2:80–4.
146. Westling K, Farra A, Jorup C, Nordenberg A, Settergren B, Hjelm E. *Bartonella henselae* antibodies after cat bite. Emerg Infect Dis. 2008;14:1943–4.
147. Pitassi LHU, Diniz PPV, Scorpio DG, Drummond MR, Lania BG, Barjas-Castro ML, et al. *Bartonella* spp bacteremia in blood donors from Campinas. Brazil. PLoS Negl Trop Dis. 2015;9:e0003467.
148. Ruiz J, Silva W, Pons MJ, Valle LJ, Tinco CR, Casabona VD, et al. Long time survival of *Bartonella bacilliformis* in blood stored at 4 degrees C. A risk for blood transfusions. Blood Transfus. 2012;10:563–4.
149. Magalhães RF, Cintra ML, Barjas-Castro ML, Del Negro GMB, Okay TS, Velho PENF. Blood donor infected with *Bartonella henselae*. Transfus Med. 2010;20:280–2.
150. Magalhães RF, Pitassi LHU, Salvadego M, de Moraes AM, Barjas-Castro ML, Velho PENF. *Bartonella henselae* survives after the storage period of red blood cell units: Is it transmissible by transfusion? Transfus Med. 2008;18:287–91.
151. Balakrishnan N, Ericson M, Maggi R, Breitschwerdt EB. Vasculitis, cerebral infarction and persistent *Bartonella henselae* infection in a child. Parasit Vectors. 2016;9:254.
152. Maggi RG, Mozayeni BR, Pultorak EL, Hegarty BC, Bradley JM, Correa M, Breitschwerdt EB. *Bartonella* spp bacteremia and rheumatic symptoms in patients from Lyme disease-endemic region. Emerg Infect Dis. 2012;18:783–91.
153. Yamada Y, Ohkusu K, Yanagihara M, Tsuneoka H, Ezaki T, Tsuboi J, et al. Prosthetic valve endocarditis caused by *Bartonella quintana* in a patient during immunosuppressive therapies for collagen vascular diseases. Diagn Microbiol Infect Dis. 2011;70:395–8.
154. Myint KSA, Gibbons RV, Iverson J, Shrestha SK, Pavlin JA, Mongkolsirichaikul D, Kosoy MY. Serological response to *Bartonella* species in febrile patients from Nepal. Trans R Soc Trop Med Hyg. 2011;105:740–2.
155. Karris MY, Litwin CM, Dong HS, Vinetz J. *Bartonella henselae* infection of prosthetic aortic valve associated with colitis. Vector Borne Zoonotic Dis. 2011;11:1503–5.
156. Kalogeropoulos C, Koumpoulis I, Mentis A, Pappa C, Zafeiropoulos P, Aspiotis M. *Bartonella* and intraocular inflammation: a series of cases and review of literature. Clin Ophthalmol. 2011;5:817–29.
157. Breitschwerdt EB, Blann KR, Stebbins ME, Muñana KR, Davidson MG, Jackson HA, Willard MD. Clinicopathological abnormalities and treatment response in 24 dogs seroreactive to *Bartonella vinsonii* (*berkhoffii*) antigens. J Am Anim Hosp Assoc. 2004;40:92–101.
158. Breitschwerdt EB, Maggi RG, Lantos PM, Woods CW, Hegarty BC, Bradley JM. *Bartonella vinsonii* subsp. *berkhoffii* and *Bartonella henselae* bacteremia in a father and daughter with neurological disease. Parasit Vectors. 2010;3:29.
159. Breitschwerdt EB, Mascarelli PE, Schweickert LA, Maggi RG, Hegarty BC, Bradley JM, Woods CW. Hallucinations, sensory neuropathy, and peripheral visual deficits in a young woman infected with *Bartonella koehlerae*. J Clin Microbiol. 2011;49:3415–7.
160. Donnio A, Jean-Charles A, Merle H. Macular hole following *Bartonella henselae* neuroretinitis. Eur J Ophthalmol. 2008;18:456–8.
161. Schaller JL, Burkland GA, Langhoff PJ. Do *Bartonella* infections cause agitation, panic disorder, and treatment-resistant depression? MedGenMed. 2007;9:54.
162. Chomel BB, Wey AC, Kasten RW. Isolation of *Bartonella washoensis* from a dog with mitral valve endocarditis. J Clin Microbiol. 2003;41:5327–32.
163. Pérez Vera C, Diniz PPVP, Pultorak EL, Maggi RG, Breitschwerdt EB. An unmatched case controlled study of clinicopathologic abnormalities in dogs with *Bartonella* infection. Comp Immunol Microbiol Infect Dis. 2013;36:481–7.
164. Duncan AW, Marr HS, Birkenheuer AJ, Maggi RG, Williams LE, Correa MT, Breitschwerdt EB. *Bartonella* DNA in the blood and lymph nodes of Golden Retrievers with lymphoma and in healthy controls. J Vet Intern Med. 2008;22:89–95.
165. Morales SC, Breitschwerdt EB, Washabau RJ, Matise I, Maggi RG, Duncan AW. Detection of *Bartonella henselae* DNA in two dogs with pyogranulomatous lymphadenitis. J Am Vet Med Assoc. 2007;230:681–5.
166. Michau TM, Breitschwerdt EB, Gilger BC, Davidson MG. *Bartonella vinsonii* subspecies *berkhoffi* as a possible cause of anterior uveitis and choroiditis in a dog. Vet Ophthalmol. 2003;6:299–304.
167. Gillespie TN, Washabau RJ, Goldschmidt MH, Cullen JM, Rogala AR, Breitschwerdt EB. Detection of *Bartonella henselae* and *Bartonella clarridgeiae* DNA in hepatic specimens from two dogs with hepatic disease. J Am Vet Med Assoc. 2003;222:35.
168. Vermeulen MJ, Rutten GJ, Verhagen I, Peeters MF, van Dijken PJ. Transient paresis associated with cat-scratch disease: case report and literature review of vertebral osteomyelitis caused by *Bartonella henselae*. Pediatr Infect Dis J. 2006;25:1177–81.
169. Besada E, Woods A, Caputo M. An uncommon presentation of *Bartonella*-associated neuroretinitis. Optom Vis Sci. 2002;79:479–88.
170. Vera CP, Maggi RG, Woods CW, Mascarelli PE, Breitschwerdt EB. Spontaneous onset of complex regional pain syndrome Type I in a woman infected with *Bartonella koehlerae*. Med Microbiol Immunol. 2014;203:101–7.
171. Balakrishnan N, Cherry NA, Linder KE, Pierce E, Sontakke N, Hegarty BC, et al. Experimental infection of dogs with *Bartonella henselae* and *Bartonella vinsonii* subsp. *berkhoffii*. Vet Immunol Immunopathol. 2013;156:153–8.
172. Pérez C, Maggi RG, Diniz PPVP, Breitschwerdt EB. Molecular and serological diagnosis of *Bartonella* infection in 61 dogs from the United States. J Vet Intern Med. 2011;25:805–10.

173. Mexas AM, Hancock SI, Breitschwerdt EB. *Bartonella henselae* and *Bartonella elizabethae* as potential canine pathogens. J Clin Microbiol. 2002;40:4670–4.
174. Labarthe NV, Pereira Paiva J, Reifur L, Mendes-de-Almeida F, Merlo A, Carvalho Pinto CJ, et al. Updated canine infection rates for *Dirofilaria immitis* in areas of Brazil previously identified as having a high incidence of heartworm-infected dogs. Parasit Vectors. 2014;7:13.
175. Berkowitz ST, Gannon KM, Carberry CA, Cortes Y. Resolution of spontaneous hemoabdomen secondary to peliosis hepatis following surgery and azithromycin treatment in a *Bartonella* species infected dog. J Vet Emerg Crit Care (San Antonio). 2016;26:851–7.
176. Rossi MA, Balakrishnan N, Linder KE, Messa JB, Breitschwerdt EB. Concurrent *Bartonella henselae* infection in a dog with panniculitis and owner with ulcerated nodular skin lesions. Vet Dermatol. 2015;26:60–3.
177. Breitschwerdt EB, Broadhurst JJ, Cherry NA. *Bartonella henselae* as a cause of acute-onset febrile illness in cats. J Feline Med Surg Open Rep. 2015;1:2055116915600454.
178. Tucker MD, Sellon RK, Tucker RL, Wills TB, Simonsen A, Maggi RG, Breitschwerdt EB. Bilateral mandibular pyogranulomatous lymphadenitis and pulmonary nodules in a dog with *Bartonella henselae* bacteremia. Can Vet J. 2014;55:970–4.
179. Lösch B, Wank R. Life-threatening angioedema of the tongue: the detection of the RNA of *B henselae* in the saliva of a male patient and his dog as well as of the DNA of three *Bartonella* species in the blood of the patient. BMJ Case Rep. 2014;2014:bcr2013203107.
180. Drut A, Bublot I, Breitschwerdt EB, Chabanne L, Vayssier-Taussat M, Cadoré J-L. Comparative microbiological features of *Bartonella henselae* infection in a dog with fever of unknown origin and granulomatous lymphadenitis. Med Microbiol Immunol. 2014;203:85–91.
181. Bradley JM, Mascarelli PE, Trull CL, Maggi RG, Breitschwerdt EB. *Bartonella henselae* infections in an owner and two Papillon dogs exposed to tropical rat mites (*Ornithonyssus bacoti*). Vector Borne Zoonotic Dis. 2014;14:703–9.
182. Barbieri AM, Venzal JM, Marcili A, Almeida AP, Gonzalez EM, Labruna MB. *Borrelia burgdorferi sensu lato* infecting ticks of the *Ixodes ricinus* complex in Uruguay: first report for the Southern Hemisphere. Vector Borne Zoonotic Dis. 2013;13:147–53.
183. Ivanova LB, Tomova A, Gonzalez-Acuna D, Murua R, Moreno CX, Hernandez C, et al. *Borrelia chilensis*, a new member of the *Borrelia burgdorferi sensu lato* complex that extends the range of this genospecies in the Southern Hemisphere. Environ Microbiol. 2014;16:1069–80.
184. Nava S, Barbieri AM, Maya L, Colina R, Mangold AJ, Labruna MB, Venzal JM. *Borrelia* infection in *Ixodes pararicinus* ticks (Acari: Ixodidae) from northwestern Argentina. Acta Trop. 2014;139:1–4.
185. Goncalves DD, Carreira T, Nunes M, Benitez A, Lopes-Mori FMR, Vidotto O, et al. First record of *Borrelia burgdorferi* B31 strain in *Dermacentor nitens* ticks in the northern region of Parana (Brazil). Braz J Microbiol. 2013;44:883–7.
186. Movilla R, García C, Siebert S, Roura X. Countrywide serological evaluation of canine prevalence for *Anaplasma* spp., *Borrelia burgdorferi* (*sensu lato*), *Dirofilaria immitis* and *Ehrlichia canis* in Mexico. Parasit Vectors. 2016;9:421.
187. Salinas-Melendez JA, Avalos-Ramirez R, Riojas-Valdez VM, Martinez-Munoz A. Serological survey of canine borreliosis. Rev Latinoam Microbiol. 1999;41:1–3.
188. Spolidorio MG, Labruna MB, Machado RZ, Moraes-Filho J, Zago AM, Donatele DM, et al. Survey for tick-borne zoonoses in the state of Espirito Santo, southeastern Brazil. Am J Trop Med Hyg. 2010;83:201–6.
189. Krupka I, Straubinger RK. Lyme borreliosis in dogs and cats: background, diagnosis, treatment and prevention of infections with *Borrelia burgdorferi sensu stricto*. Vet Clin North Am Small Anim Pract. 2010;40:1103–19.
190. Appel MJ, Allan S, Jacobson RH, Lauderdale TL, Chang YF, Shin SJ, et al. Experimental Lyme disease in dogs produces arthritis and persistent infection. J Infect Dis. 1993;167:651–64.
191. Levy SA, Magnarelli LA. Relationship between development of antibodies to *Borrelia burgdorferi* in dogs and the subsequent development of limb/joint borreliosis. J Am Vet Med Assoc. 1992;200:344–7.
192. Magnarelli LA, Anderson JF, Schreier AB, Ficke CM. Clinical and serologic studies of canine borreliosis. J Am Vet Med Assoc. 1987;191:1089–94.
193. Cohen ND, Carter CN, Thomas MA, Angulo AB, Eugster AK. Clinical and epizootiologic characteristics of dogs seropositive for *Borrelia burgdorferi* in Texas: 110 cases (1988). J Am Vet Med Assoc. 1990;197:893–8.
194. Hutton TA, Goldstein RE, Njaa BL, Atwater DZ, Chang Y-F, Simpson KW. Search for *Borrelia burgdorferi* in kidneys of dogs with suspected "Lyme nephritis". J Vet Intern Med. 2008;22:860–5.
195. Magnarelli LA, Anderson JF, Levine HR, Levy SA. Tick parasitism and antibodies to *Borrelia burgdorferi* in cats. J Am Vet Med Assoc. 1990;197:63–6.
196. Levy SA, O'Connor TP, Hanscom JL, Shields P. Evaluation of a canine C6 ELISA Lyme disease test for the determination of the infection status of cats naturally exposed to *Borrelia burgdorferi*. Vet Ther. 2003;4:172–7.
197. Peterhans E, Peterhans E. "Lyme disease" as a possible cause for lameness in the cat. Schweiz Arch Tierheilkd. 2010;152:295–7 (In German).
198. Pantchev N, Vrhovec MG, Pluta S, Straubinger RK. Seropositivity of *Borrelia burgdorferi* in a cohort of symptomatic cats from Europe based on a C6-peptide assay with discussion of implications in disease aetiology. Berl Munch Tierarztl Wochenschr. 2016;129:333–9.
199. Leschnik MW, Kirtz G, Khanakah G, Duscher G, Leidinger E, Thalhammer JG, et al. Humoral immune response in dogs naturally infected with *Borrelia burgdorferi sensu lato* and in dogs after immunization with a *Borrelia* vaccine. Clin Vaccine Immunol. 2010;17:828–35.
200. Krimer PM, Miller AD, Li Q, Grosenbaugh DA, Susta L, Schatzberg SJ. Molecular and pathological investigations of the central nervous system in *Borrelia burgdorferi*-infected dogs. J Vet Diagn Invest. 2011;23:757–63.
201. Susta L, Uhl EW, Grosenbaugh DA, Krimer PM. Synovial lesions in experimental canine Lyme borreliosis. Vet Pathol. 2012;49:453–61.
202. Steere AC, McHugh G, Damle N, Sikand VK. Prospective study of serologic tests for Lyme disease. Clin Infect Dis. 2008;47:188–95.
203. Littman MP. Canine borreliosis. Vet Clin North Am Small Anim Pract. 2003;33:827–62.
204. Littman MP, Goldstein RE, Labato MA, Lappin MR, Moore GE. ACVIM small animal consensus statement on Lyme disease in dogs: diagnosis, treatment, and prevention. J Vet Intern Med. 2006;20:422–34.
205. Greene CE, Straubinger RK. Borreliosis. In: Greene CE, editor. Infectious diseases of the dog and cat. 3rd ed. St. Louis: Elsevier Saunders; 2006. p. 417–35.
206. Wright CL, Gaff HD, Hynes WL. Prevalence of *Ehrlichia chaffeensis* and *Ehrlichia* ewingii in *Amblyomma americanum* and *Dermacentor variabilis* collected from southeastern Virginia, 2010–2011. Ticks Tick Borne Dis. 2014;5:978–82.
207. Gaines DN, Operario DJ, Stroup S, Stromdahl E, Wright C, Gaff H, et al. *Ehrlichia* and spotted fever group Rickettsiae surveillance in *Amblyomma americanum* in Virginia through use of a novel six-plex real-time PCR assay. Vector Borne Zoonotic Dis. 2014;14:307–16.
208. Tomassone L, Nunez P, Gurtler RE, Ceballos LA, Orozco MM, Kitron UD, Farber M. Molecular detection of *Ehrlichia chaffeensis* in *Amblyomma parvum* ticks, Argentina. Emerg Infect Dis. 2008;14:1953–5.
209. Allison RW, Little SE. Diagnosis of rickettsial diseases in dogs and cats. Vet Clin Pathol. 2013;42:127–44.
210. Mylonakis ME, Koutinas AF, Billinis C, Leontides LS, Kontos V, Papadopoulos O, et al. Evaluation of cytology in the diagnosis of acute canine monocytic ehrlichiosis (*Ehrlichia canis*): a comparison between five methods. Vet Microbiol. 2003;91:197–204.
211. Little SE. Ehrlichiosis and anaplasmosis in dogs and cats. Vet Clin North Am Small Anim Pract. 2010;40:1121–40.
212. Harrus S, Alleman AR, Bark H, Mahan SM, Waner T. Comparison of three enzyme-linked immunosorbant assays with the indirect immunofluorescent antibody test for the diagnosis of canine infection with *Ehrlichia canis*. Vet Microbiol. 2002;86:361–8.
213. Waner T, Harrus S, Jongejan F, Bark H, Keysary A, Cornelissen AW. Significance of serological testing for ehrlichial diseases in dogs with special emphasis on the diagnosis of canine monocytic ehrlichiosis caused by *Ehrlichia canis*. Vet Parasitol. 2001;95:1–15.
214. Maggi RG, Birkenheuer AJ, Hegarty BC, Bradley JM, Levy MG, Breitschwerdt EB. Comparison of serological and molecular panels for diagnosis of vector-borne diseases in dogs. Parasit Vectors. 2014;7:127.
215. Nicholson WL, Allen KE, McQuiston JH, Breitschwerdt EB, Little SE. The increasing recognition of rickettsial pathogens in dogs and people. Trends Parasitol. 2010;26:205–12.

216. Neer TM, Breitschwerdt EB, Greene RT, Lappin MR. Consensus statement on ehrlichial disease of small animals from the infectious disease study group of the ACVIM. J Vet Intern Med. 2002;16:309–15.
217. Perez M, Rikihisa Y, Wen B. *Ehrlichia canis*-like agent isolated from a man in Venezuela: antigenic and genetic characterization. J Clin Microbiol. 1996;34:2133–9.
218. Calic SB, Galvao MAM, Bacellar F, Rocha CMBM, Mafra CL, Leite RC, Walker DH. Human ehrlichioses in Brazil: first suspect cases. Braz J Infect Dis. 2004;8:259–62.
219. da Costa PSG, Brigatte ME, Greco DB. Antibodies to *Rickettsia rickettsii*, *Rickettsia typhi*, *Coxiella burnetii*, *Bartonella henselae*, *Bartonella quintana*, and *Ehrlichia chaffeensis* among healthy population in Minas Gerais, Brazil. Mem Inst Oswaldo Cruz. 2005;100:853–9.
220. Costa PSG, Valle LMC, Brigatte ME, Greco DB. More about human monocytotropic ehrlichiosis in Brazil: serological evidence of nine new cases. Braz J Infect Dis. 2006;10:7–10.
221. Ripoll CM, Remondegui CE, Ordonez G, Arazamendi R, Fusaro H, Hyman MJ, et al. Evidence of rickettsial spotted fever and ehrlichial infections in a subtropical territory of Jujuy, Argentina. Am J Trop Med Hyg. 1999;61:350–4.
222. Moro PL, Shah J, Li O, Gilman RH, Harris N, Moro MH. Short report: serologic evidence of human ehrlichiosis in Peru. Am J Trop Med Hyg. 2009;80:242–4.
223. López J, Rivera M, Concha JC, Gatica S, Loeffeholz M, Barriga O. Ehrlichiosis humana en Chile, evidencia serológica. Rev Méd Chile. 2003;131:67–70.
224. Gary AT, Richmond HL, Tasker S, Hackett TB, Lappin MR. Survival of *Mycoplasma haemofelis* and "*Candidatus* Mycoplasma haemominutum" in blood of cats used for transfusions. J Feline Med Surg. 2006;8:321–6.
225. Willi B, Boretti FS, Baumgartner C, Tasker S, Wenger B, Cattori V, et al. Prevalence, risk factor analysis, and follow-up of infections caused by three feline hemoplasma species in cats in Switzerland. J Clin Microbiol. 2006;44:961–9.
226. Taroura S, Shimada Y, Sakata Y, Miyama T, Hiraoka H, Watanabe M, et al. Detection of DNA of "*Candidatus* Mycoplasma haemominutum" and *Spiroplasma* sp. in unfed ticks collected from vegetation in Japan. J Vet Med Sci. 2005;67:1277–9.
227. Tateno M, Sunahara A, Nakanishi N, Izawa M, Matsuo T, Setoguchi A, Endo Y. Molecular survey of arthropod-borne pathogens in ticks obtained from Japanese wildcats. Ticks Tick Borne Dis. 2015;6:281–9.
228. Assarasakorn S, Veir JK, Hawley JR, Brewer MM, Morris AK, Hill AE, Lappin MR. Prevalence of *Bartonella* species, hemoplasmas, and *Rickettsia felis* DNA in blood and fleas of cats in Bangkok, Thailand. Res Vet Sci. 2012;93:1213–6.
229. Barrs VR, Beatty JA, Wilson BJ, Evans N, Gowan R, Baral RM, et al. Prevalence of *Bartonella* species, *Rickettsia felis*, haemoplasmas and the *Ehrlichia* group in the blood of cats and fleas in eastern Australia. Aust Vet J. 2010;88:160–5.
230. Hornok S, Meli ML, Perreten A, Farkas R, Willi B, Beugnet F, et al. Molecular investigation of hard ticks (Acari: Ixodidae) and fleas (Siphonaptera: Pulicidae) as potential vectors of rickettsial and mycoplasmal agents. Vet Microbiol. 2010;140:98–104.
231. Lappin MR, Griffin B, Brunt J, Riley A, Burney D, Hawley J, et al. Prevalence of *Bartonella* species, haemoplasma species, *Ehrlichia* species, *Anaplasma phagocytophilum*, and *Neorickettsia risticii* DNA in the blood of cats and their fleas in the United States. J Feline Med Surg. 2006;8:85–90.
232. Chalker VJ. Canine mycoplasmas. Res Vet Sci. 2005;79:1–8.
233. Messick JB. New perspectives about hemotrophic mycoplasma (formerly, *Haemobartonella* and *Eperythrozoon* species) infections in dogs and cats. Vet Clin North Am Small Anim Pract. 2003;33:1453–65.
234. Tasker S, Helps CR, Day MJ, Gruffydd-Jones TJ, Harbour DA. Use of real-time PCR to detect and quantify *Mycoplasma haemofelis* and "*Candidatus* Mycoplasma haemominutum" DNA. J Clin Microbiol. 2003;41:439–41.
235. Willi B, Filoni C, Catao-Dias JL, Cattori V, Meli ML, Vargas A, et al. Worldwide occurrence of feline hemoplasma infections in wild felid species. J Clin Microbiol. 2007;45:1159–66.
236. Willi B, Meli ML, Lüthy R, Honegger H, Wengi N, Hoelzle LE, et al. Development and application of a universal hemoplasma screening assay based on the SYBR green PCR principle. J Clin Microbiol. 2009;47:4049–54.
237. Peters IR, Helps CR, Willi B, Hofmann-Lehmann R, Tasker S. The prevalence of three species of feline haemoplasmas in samples submitted to a diagnostics service as determined by three novel real-time duplex PCR assays. Vet Microbiol. 2008;126:142–50.
238. Wengi N, Willi B, Boretti FS, Cattori V, Riond B, Meli ML, et al. Real-time PCR-based prevalence study, infection follow-up and molecular characterization of canine hemotropic mycoplasmas. Vet Microbiol. 2008;126:132–41.
239. Barker EN, Tasker S, Day MJ, Warman SM, Woolley K, Birtles R, et al. Development and use of real-time PCR to detect and quantify *Mycoplasma haemocanis* and "*Candidatus* Mycoplasma haematoparvum" in dogs. Vet Microbiol. 2010;140:167–70.
240. Willi B, Novacco M, Meli M, Wolf-Jackel G, Boretti F, Wengi N, et al. Haemotropic mycoplasmas of cats and dogs: transmission, diagnosis, prevalence and importance in Europe. Schweiz Arch Tierheilkd. 2010;152:237–44.
241. Childs JE, Paddock CD. Rocky Mountain spotted fever. In: Raoult D, Parola P, editors. Rickettsial Diseases. New York: Informa Healthcare; 2007. p. 97–116.
242. Rovery C, Raoult D. *Rickettsia conorii* infections (Mediterranean spotted fever, Israeli spotted fever, Indian tick typhus, Astrakhan fever) In: Raoult D, Parola P, editors. Rickettsial Diseases. New York: Informa Healthcare; 2007. p. 125–37.
243. Raoult D, Parola P. Rickettsial diseases. New York: Informa Healthcare; 2007. p. 379.
244. Greene CE. Breitschwerdt EB Rocky Mountain spotted fever, murine typhuslike disease, rickettsialpox, typhus, and Q fever. In: Greene CE, editor. Infectious diseases of the dog and cat. 3rd ed. St. Louis: Elsevier Saunders; 2006. p. 232–45.
245. Breitschwerdt EB, Meuten DJ, Walker DH, Levy M, Kennedy K, King M, et al. Canine rocky mountain spotted fever: a kennel epizootic. Am J Vet Res. 1985;46:2124–8.
246. Dantas-Torres F. Rocky mountain spotted fever. Lancet Infect Dis. 2007;7:724–32.
247. Demma LJ, Traeger M, Blau D, Gordon R, Johnson B, Dickson J, et al. Serologic evidence for exposure to *Rickettsia rickettsii* in eastern Arizona and recent emergence of Rocky Mountain spotted fever in this region. Vector Borne Zoonotic Dis. 2006;6:423–9.
248. Centers for Disease Control and Prevention (CDC). Fatal cases of Rocky Mountain spotted fever in family clusters-three states, 2003. MMWR Morb Mortal Wkly Rep. 2004;53:407–10.
249. Beall MJ, Chandrashekar R, Eberts MD, Cyr KE, Diniz PPVP, Mainville C, et al. Serological and molecular prevalence of *Borrelia burgdorferi*, *Anaplasma phagocytophilum*, and *Ehrlichia* species in dogs from Minnesota. Vector Borne Zoonotic Dis. 2008;8:455–64.
250. Krupka I, Pantchev N, Lorentzen L, Weise M, Straubinger RK. Tick-transmitted bacterial infections in dogs: seroprevalences of *Anaplasma phagocytophilum*, *Borrelia burgdorferi sensu lato* and *Ehrlichia canis* in Germany. Prakt Tierarzt. 2007;88:776–88 **(In German)**.
251. Eiras DF, Craviotto MB, Vezzani D, Eyal O, Baneth G. First description of natural *Ehrlichia canis* and *Anaplasma platys* infections in dogs from Argentina. Comp Immunol Microbiol Infect Dis. 2013;36:169–73.
252. Mascarelli PE, Tartara GP, Pereyra NB, Maggi RG. Detection of *Mycoplasma haemocanis*, *Mycoplasma haematoparvum*, *Mycoplasma suis* and other vector-borne pathogens in dogs from Córdoba and Santa Fé, Argentina. Parasit Vectors. 2016;9:642.
253. Millán J, Travaini A, Cevidanes A, Sacristán I, Rodríguez A. Assessing the natural circulation of canine vector-borne pathogens in foxes, ticks and fleas in protected areas of Argentine Patagonia with negligible dog participation. Int J Parasitol Parasites Wildl. 2018;8:63–70.
254. Vezzani D, Carbajo AE. Spatial and temporal transmission risk of *Dirofilaria immitis* in Argentina. Int J Parasitol. 2006;36:1463–72.
255. Vezzani D, Carbajo AE, Fontanarrosa MF, Scodellaro CF, Basabe J, Cangiano G, Eiras DF. Epidemiology of canine heartworm in its southern distribution limit in South America: risk factors, inter-annual trend and spatial patterns. Vet Parasitol. 2011;176:240–9.
256. Vezzani D, Eiras DF, Wisnivesky C. Dirofilariasis in Argentina: historical review and first report of *Dirofilaria immitis* in a natural mosquito population. Vet Parasitol. 2006;136:259–73.

257. Cuervo PF, Sierra R, Waisman V, Gerbeno L, Sidoti L, Albonico F, et al. Detection of *Dirofilaria immitis* in mid-western arid Argentina. Acta Parasitologica. 2013;58:612–4.
258. Vezzani D, Mesplet M, Eiras DF, Fontanarrosa MF, Schnittger L. PCR detection of *Dirofilaria immitis* in *Aedes aegypti* and *Culex pipiens* from urban temperate Argentina. Parasitol Res. 2011;108:985–9.
259. Rosa A, Ribicich M, Betti A, Kistermann JC, Cardillo N, Basso N, Hallu R. Prevalence of canine dirofilariosis in the City of Buenos Aires and its outskirts (Argentina). Vet Parasitol. 2002;109:261–4.
260. Eiras DF, Basabe J, Scodellaro CF, Banach DB, Matos ML, Krimer A, Baneth G. First molecular characterization of canine hepatozoonosis in Argentina: evaluation of asymptomatic *Hepatozoon canis* infection in dogs from Buenos Aires. Vet Parasitol. 2007;149:275–9.
261. Giannitti F, Diab SS, Uzal FA, Fresneda K, Rossi D, Talmi-Frank D, Baneth G. Infection with a *Hepatozoon* sp. closely related to *Hepatozoon felis* in a wild Pampas gray fox (*Lycalopex-Pseudalopex-gymnocercus*) co-infected with canine distemper virus. Vet Parasitol. 2012;186:497–502.
262. Esarte MS, Dodino ML, Duchene A, Iazbik MC, Salaj JF. Hepatozoonosis canina en la zona oeste del Gran Buenos Aires. Selecciones Vet. 1999;7:260–4.
263. Padilla AM, Marco JD, Diosque P, Segura MA, Mora MC, Fernandez MM, et al. Canine infection and the possible role of dogs in the transmission of American tegumentary leishmaniosis in Salta, Argentina. Vet Parasitol. 2002;110:1–10.
264. Marco JD, Padilla AM, Diosque P, Fernandez MM, Malchiodi EL, Basombrio MA. Force of infection and evolution of lesions of canine tegumentary leishmaniasis in northwestern Argentina. Mem Inst Oswaldo Cruz. 2001;96:649–52.
265. Marco JD, Barroso PA, Calvopina M, Kumazawa H, Furuya M, Korenaga M, et al. Species assignation of *Leishmania* from human and canine American tegumentary leishmaniasis cases by multilocus enzyme electrophoresis in North Argentina. Am J Trop Med Hyg. 2005;72:606–11.
266. Cruz I, Acosta L, Gutierrez MN, Nieto J, Canavate C, Deschutter J, Bornay-Llinares FJ. A canine leishmaniasis pilot survey in an emerging focus of visceral leishmaniasis: Posadas (Misiones, Argentina). BMC Infect Dis. 2010;10:342.
267. Barroso PA, Nevot MC, Hoyos CL, Locatelli FM, Lauthier JJ, Ruybal P, et al. Genetic and clinical characterization of canine leishmaniasis caused by *Leishmania* (*Leishmania*) *infantum* in northeastern Argentina. Acta Trop. 2015;150:218–23.
268. Barroso PA, Marco JD, Locatelli FM, Cardozo RM, Hoyos CL, Mora MC, et al. Visceral leishmaniasis caused by *Leishmania infantum* in Salta, Argentina: possible reservoirs and vectors. Am J Trop Med Hyg. 2015;93:334–9.
269. Acardi SA, Liotta DJ, Santini MS, Romagosa CM, Salomon OD. Detection of *Leishmania infantum* in naturally infected *Lutzomyia longipalpis* (Diptera: Psychodidae: Phlebotominae) and *Canis familiaris* in Misiones, Argentina: the first report of a PCR-RFLP and sequencing-based confirmation assay. Mem Inst Oswaldo Cruz. 2010;105:796–9.
270. Gould IT, Perner MS, Santini MS, Saavedra SB, Bezzi G, Maglianese MI, et al. Leishmaniasis visceral en la Argentina: notificacion y situacion vectorial (2006–2012). Medicina (B Aires). 2013;73:104–10.
271. Cardinal MV, Lauricella MA, Ceballos LA, Lanati L, Marcet PL, Levin MJ, et al. Molecular epidemiology of domestic and sylvatic *Trypanosoma cruzi* infection in rural northwestern Argentina. Int J Parasitol. 2008;38:1533–43.
272. Cardinal MV, Orozco MM, Enriquez GF, Ceballos LA, Gaspe MS, Alvarado-Otegui JA, et al. Heterogeneities in the ecoepidemiology of *Trypanosoma cruzi* infection in rural communities of the Argentinean Chaco. Am J Trop Med Hyg. 2014;90:1063–73.
273. Castanera MB, Lauricella MA, Chuit R, Gurtler RE. Evaluation of dogs as sentinels of the transmission of *Trypanosoma cruzi* in a rural area of north-western Argentina. Ann Trop Med Parasitol. 1998;92:671–83.
274. Gurtler RE, Cecere MC, Lauricella MA, Cardinal MV, Kitron U, Cohen JE. Domestic dogs and cats as sources of *Trypanosoma cruzi* infection in rural northwestern Argentina. Parasitology. 2007;134:69–82.
275. Gurtler RE, Cecere MC, Petersen RM, Rubel DN, Schweigmann NJ. Chagas disease in north-west Argentina: Association between *Trypanosoma cruzi* parasitaemia in dogs and cats and infection rates in domestic *Triatoma infestans*. Trans R Soc Trop Med Hyg. 1993;87:12–5.
276. Gurtler RE, Cecere MC, Rubel DN, Petersen RM, Schweigmann NJ, Lauricella MA, et al. Chagas disease in north-west Argentina: infected dogs as a risk factor for the domestic transmission of *Trypanosoma cruzi*. Trans R Soc Trop Med Hyg. 1991;85:741–5.
277. Petersen RM, Gurtler RE, Cecere MC, Rubel DN, Lauricella MA, Hansen D, Carlomagno MA. Association between nutritional indicators and infectivity of dogs seroreactive for *Trypanosoma cruzi* in a rural area of northwestern Argentina. Parasitol Res. 2001;87:208–14.
278. Monje-Rumi MM, Brandan CP, Ragone PG, Tomasini N, Lauthier JJ, Damato AM, et al. *Trypanosoma cruzi* diversity in the Gran Chaco: mixed infections and differential host distribution of TcV and TcVI. Infect Genet Evol. 2015;29:53–9.
279. Cicuttin GL, Vidal P, Salvo M, Beltran FJ, Gury Dohmen FE. Detección molecular de *Rickettsia massiliae* y *Anaplasma platys* en garrapatas *Rhipicephalus sanguineus* y caninos domésticos del municipio de Bahía Blanca (Argentina). Rev Chilena Infectol. 2014;31:563–8.
280. Cicuttin GL, Brambati DF, Rodriguez Eugui JI, Lebrero CG, de Salvo MN, Beltran FJ, et al. Molecular characterization of *Rickettsia massiliae* and *Anaplasma platys* infecting *Rhipicephalus sanguineus* ticks and domestic dogs, Buenos Aires (Argentina). Ticks Tick Borne Dis. 2014;5:484–8.
281. Cicuttin GL, Tarragona EL, de Salvo MN, Mangold AJ, Nava S. Infection with *Ehrlichia canis* and *Anaplasma platys* (Rickettsiales: Anaplasmataceae) in two lineages of *Rhipicephalus sanguineus sensu lato* (Acari: Ixodidae) from Argentina. Ticks Tick Borne Dis. 2015;6:724–9.
282. Cicuttin GL, Brambati DF, de Gennaro MF, Carmona F, Isturiz ML, Pujol LE, et al. *Bartonella* spp. in cats from Buenos Aires. Argentina. Vet Microbiol. 2014;168:225–8.
283. Stanchi NO, Balague LJ. Lyme disease: antibodies against *Borrelia burgdorferi* in farm workers in Argentina. Rev Saude Publica. 1993;27:305–7.
284. Romer Y, Nava S, Govedic F, Cicuttin G, Denison AM, Singleton J, et al. *Rickettsia parkeri* rickettsiosis in different ecological regions of Argentina and its association with *Amblyomma tigrinum* as a potential vector. Am J Trop Med Hyg. 2014;91:1156–60.
285. Romer Y, Seijo AC, Crudo F, Nicholson WL, Varela-Stokes A, Lash RR, Paddock CD. *Rickettsia parkeri* rickettsiosis, Argentina. Emerg Infect Dis. 2011;17:1169–73.
286. Paddock CD, Fernandez S, Echenique GA, Sumner JW, Reeves WK, Zaki SR, Remondegui CE. Rocky Mountain spotted fever in Argentina. Am J Trop Med Hyg. 2008;78:687–92.
287. Nava S, Elshenawy Y, Eremeeva ME, Sumner JW, Mastropaolo M, Paddock CD. *Rickettsia parkeri* in Argentina. Emerg Infect Dis. 2008;14:1894–7.
288. Oscherov EB, Milano A, Lobo B, Anda P, Escudero R. Detection of *Anaplasma platys* and other pathogens in ectoparasites from urban hosts in Northeast Argentine. Rev Ibero-Latinoam Parasitol. 2011;70:42–8.
289. Hepburn NC, Tidman MJ, Hunter JA. Cutaneous leishmaniasis in British troops from Belize. Br J Dermatol. 1993;128:63–8.
290. Lainson R. Cutaneous leishmaniasis in Belize, Central America, and identity of the causative parasite. Trans R Soc Trop Med Hyg. 1984;78:851–2.
291. Schnedl J, Auer H, Fischer M, Tomaso H, Pustelnik T, Mooseder G. Cutaneous leishmaniasis - an import from Belize. Wien Klin Wochenschr. 2007;119:102–5 (In German).
292. van Thiel PPAM, Zeegelaar JE, van Gool T, Faber WR, Kager PA. Cutaneous leishmaniasis in three Dutch military cohorts following jungle training in Belize. Travel Med Infect Dis. 2011;9:153–60.
293. Vinetz JM, Soong L. *Leishmania mexicana* infection of the eyelid in a traveler to Belize. Braz J Infect Dis. 2007;11:149–52.
294. Weinrauch L. Cutaneous leishmaniasis in Belize. Int J Dermatol. 1989;28:620.
295. Williams P. Phlebotomine sandflies and leishmaniasis in British Honduras (Belize). Trans R Soc Trop Med Hyg. 1970;64:317–68.
296. Jaramillo R, Bryan JP, Schur J, Pan AA. Prevalence of antibody to *Trypanosoma cruzi* in three populations in Belize. Am J Trop Med Hyg. 1997;57:298–301.
297. Polonio R, Ramirez-Sierra MJ, Dumonteil E. Dynamics and distribution of house infestation by *Triatoma dimidiata* in central and southern Belize. Vector Borne Zoonotic Dis. 2009;9:19–24.
298. Polsomboon S, Hoel DF, Murphy JR, Linton YM, Motoki M, Robbins RG, et al. Molecular detection and identification of *Rickettsia* species in ticks (Acari: Ixodidae) collected from Belize, Central America. J Med Entomol. 2017;54:1718–26.

299. Bronson E, Emmons LH, Murray S, Dubovi EJ, Deem SL. Serosurvey of pathogens in domestic dogs on the border of Noel Kempff Mercado National Park, Bolivia. J Zoo Wildl Med. 2008;39:28–36.
300. Fiorello CV, Noss AJ, Deem SL. Demography, hunting ecology, and pathogen exposure of domestic dogs in the Isoso of Bolivia. Conserv Biol. 2006;20:762–71.
301. Parrado R, Rojas E, Delgado R, Torrico MC, Reithinger R, Garcia AL. Prevalence of *Leishmania* spp. infection in domestic dogs in Chapare. Bolivia. Vet Parasitol. 2011;177:171–4.
302. Guarachi F, Cruz PJ. Seroprevalencia del mal de Chagas en canes del area urbana de Lagunillas. Vet Med Thesis, Univ Autónoma Gabriel Rene Moreno, Santa Cruz de la Sierra, Bolivia; 2006.
303. Ciceroni L, Bartoloni A, Ciarrocchi S, Pinto A, Guglielmetti P, Valdez Vasquez C, et al. Serologic survey for antibodies to *Borrelia burgdorferi* in sheep, goats and dogs in Cordillera Province, Bolivia. Zentralblatt Veterinarmedizin Reihe B. 1997;44:133–7.
304. Ciceroni L, Bartoloni A, Guglielmetti P, Paradisi F, Barahona HG, Roselli M, et al. Prevalence of antibodies to *Borrelia burgdorferi*, *Borrelia parkeri* and *Borrelia turicatae* in human settlements of the Cordillera Province, Bolivia. J Trop Med Hyg. 1994;97:13–7.
305. Tomassone L, Conte V, Parrilla G, de Meneghi D. *Rickettsia* infection in dogs and *Rickettsia parkeri* in *Amblyomma tigrinum* ticks, Cochabamba Department, Bolivia. Vector Borne Zoonotic Dis. 2010;10:953–8.
306. de Sousa KCM, Andre MR, Herrera HM, de Andrade GB, Jusi MMG, dos Santos LL, et al. Molecular and serological detection of tick-borne pathogens in dogs from an area endemic for *Leishmania infantum* in Mato Grosso do Sul, Brazil. Rev Bras Parasitol Vet. 2013;22:525–31.
307. O'Dwyer LH, Massard CL, Souza JC. *Hepatozoon canis* infection associated with dog ticks of rural areas of Rio de Janeiro State, Brazil. Vet Parasitol. 2001;94:143–50.
308. Ramos R, Ramos C, Araujo F, Oliveira R, Souza I, Pimentel D, et al. Molecular survey and genetic characterization of tick-borne pathogens in dogs in metropolitan Recife (north-eastern Brazil). Parasitol Res. 2010;107:1115–20.
309. Santos F, Coppede JS, Pereira ALA, Oliveira LP, Roberto PG, Benedetti RBR, et al. Molecular evaluation of the incidence of *Ehrlichia canis*, *Anaplasma platys* and *Babesia* spp in dogs from Ribeirao Preto, Brazil. Vet J. 2009;179:145–8.
310. Spolidorio MG, Minervino AHH, Valadas SYOB, Soares HS, Neves KAL, Labruna MB, et al. Serosurvey for tick-borne diseases in dogs from the eastern Amazon, Brazil. Rev Bras Parasitol Vet. 2013;22:214–9.
311. Trapp SM, Dagnone AS, Vidotto O, Freire RL, Amude AM, de Morais HSA. Seroepidemiology of canine babesiosis and ehrlichiosis in a hospital population. Vet Parasitol. 2006;140:223–30.
312. Vieira TSWJ, Vieira RFC, Nascimento DAG, Tamekuni K, Toledo RS, Chandrashekar R, et al. Serosurvey of tick-borne pathogens in dogs from urban and rural areas from Parana State, Brazil. Rev Bras Parasitol Vet. 2013;22:104–9.
313. Krawczak FS, Reis IA, Silveira JA, Avelar DM, Marcelino AP, Werneck GL, et al. *Leishmania*, *Babesia* and *Ehrlichia* in urban pet dogs: co-infection or cross-reaction in serological methods? Rev Soc Bras Med Trop. 2015;48:64–8.
314. Paulan SC, Lins AGS, Tenorio MS, Silva DT, Pena HFJ, Machado RZ, et al. Seroprevalence rates of antibodies against *Leishmania infantum* and other protozoan and rickettsial parasites in dogs. Rev Bras Parasitol Vet. 2013;22:162–6.
315. Andre MR, Denardi NC, Sousa KC, Goncalves LR, Henrique PC, Ontivero CR, et al. Arthropod-borne pathogens circulating in free-roaming domestic cats in a zoo environment in Brazil. Ticks Tick Borne Dis. 2014;5:545–51.
316. Andre MR, Herrera HM, Fernandes SJ, de Sousa KCM, Goncalves LR, Domingos IH, et al. Tick-borne agents in domesticated and stray cats from the city of Campo Grande, state of Mato Grosso do Sul, midwestern Brazil. Ticks Tick Borne Dis. 2015;6:779–86.
317. Ramos RAN, Rêgo AG, Firmino ED, Ramos CA, Carvalho GA, Dantas-Torres F, et al. Filarioids infecting dogs in northeastern Brazil. Vet Parasitol. 2016;226:26–9.
318. Alves LC, Almeida Silva LV, Faustino MA, McCall JW, Supakonderj P, Labarthe NW, et al. Survey of canine heartworm in the city of Recife, Pernambuco, Brazil. Mem Inst Oswaldo Cruz. 1999;94:587–90.
319. Ogawa GM, da Cruz EN, Cunha PNA, Camargo LMA. Canine heartworm disease in Porto Velho: first record, distribution map and occurrence of positive mosquitoes. Rev Bras Parasitol Vet. 2013;22:559–64.
320. Reifur L, Thomaz-Soccol V, Montiani-Ferreira F. Epidemiological aspects of filariosis in dogs on the coast of Paraná state, Brazil: with emphasis on *Dirofilaria immitis*. Vet Parasitol. 2004;122:273–86.
321. Harvey TV, Guedes PEB, Oliveira TNA, Assunção MS, Carvalho FS, Albuquerque GR, et al. Canine hepatozoonosis in southeastern Bahia, Brazil. Genet Mol Res. 2016;15:15038623.
322. Spolidorio MG, Labruna MB, Zago AM, Donatele DM, Caliari KM, Yoshinari NH. *Hepatozoon canis* infecting dogs in the State of Espírito Santo, southeastern Brazil. Vet Parasitol. 2009;163:357–61.
323. Aguilar CM, Rangel EF, Garcia L, Fernandez E, Momen H, Grimaldi Filho G, de Vargas Z. Zoonotic cutaneous leishmaniasis due to *Leishmania* (*Viannia*) *braziliensis* associated with domestic animals in Venezuela and Brazil. Mem Inst Oswaldo Cruz. 1989;84:19–28.
324. Paiva Diniz PPV, de Schwartz DS, de Morais HSA, Breitschwerdt EB. Surveillance for zoonotic vector-borne infections using sick dogs from southeastern Brazil. Vector Borne Zoonotic Dis. 2007;7:689–97.
325. Rosypal AC, Cortes-Vecino JA, Gennari SM, Dubey JP, Tidwell RR, Lindsay DS. Serological survey of *Leishmania infantum* and *Trypanosoma cruzi* in dogs from urban areas of Brazil and Colombia. Vet Parasitol. 2007;149:172–7.
326. Tartarotti AL, Donini MA, dos Anjos C, Ramos RR. Vigilância de reservatórios caninos. Boletim Epidemilógico. 2011;13:5–6.
327. Barbosa GMS, Marzochi MCA, Massard CL, Lima GPS, Confort EM. Epidemiological aspects of canine American tegumentary leishmaniasis in the Municipality of Paraty, State of Rio de Janeiro, Brazil. Cad Saude Publica. 1999;15:641–6.
328. Castro EA, Thomaz-Soccol V, Augur C, Luz E. *Leishmania* (*Viannia*) *braziliensis*: epidemiology of canine cutaneous leishmaniasis in the state of Paraná (Brazil). Exp Parasitol. 2007;117:13–21.
329. Dantas-Torres F, Paiva-Cavalcanti M, Figueredo LA, Melo MF, Silva FJ, Silva AL, et al. Cutaneous and visceral leishmaniosis in dogs from a rural community in northeastern Brazil. Vet Parasitol. 2010;170:313–7.
330. Falqueto A, Coura JR, Barros GC, Grimaldi G, Sessa PA, Carias VRD, et al. Participação do cão no ciclo de transmissão da leishmaniose tegumentar no Município de Viana, Estado do Espírito Santo, Brasil. Mem Inst Oswaldo Cruz. 1986;81:155–63.
331. Leça Junior NF, Guedes PEB, Santana LN, Almeida VA, Carvalho FS, Albuquerque GR, et al. Epidemiology of canine leishmaniasis in southern Bahia, Brazil. Acta Trop. 2015;148:115–9.
332. Oliveira-Neto MP, Pirmez C, Rangel E, Schubach A, Grimaldi G. An outbreak of American cutaneous leishmaniasis (*Leishmania braziliensis braziliensis*) in a periurban area of Rio de Janeiro city, Brazil: clinical and epidemiological aspects. Mem Inst Oswaldo Cruz. 1988;83:427–35.
333. Passos VMA, Andrade AC, Silva ES, Figueiredo EM, Falcão AL. Inquérito canino em foco recente de leishmaniose tegumentar no Município de Sabará, região metropolitana de Belo Horizonte. Rev Soc Bras Med Trop. 1996;29:323–9.
334. Serra CMB, Leal CA, Figueiredo F, Schubach TM, Duarte R, Uchôa CMA, et al. Canine tegumentary leishmaniasis in Morada das Aguias (Serra da Tiririca), Maricá, Rio de Janeiro, Brazil. Cad Saude Publica. 2003;19:1877–80.
335. Soccol VT, Castro EA, Schühli G, Carvalho Y, Marques E, Pereira EF, Alcântara A, et al. A new focus of cutaneous leishmaniasis in the central area of Paraná State, southern Brazil. Acta Trop. 2009;111:308–15.
336. Silveira FT, Carneiro LA, Ramos PKS, Chagas EJ, Lima LVR, Campos MB, et al. A cross-sectional study on canine *Leishmania* (*L.*) *infantum chagasi* infection in Amazonian Brazil ratifies a higher prevalence of specific IgG-antibody response than delayed-type hypersensitivity in symptomatic and asymptomatic dogs. Parasitol Res. 2012;111:1513–22.
337. Bezerra CM, Cavalcanti LPG, Souza RCM, Barbosa SE, Xavier SCC, Jansen AM, et al. Domestic, peridomestic and wild hosts in the transmission of *Trypanosoma cruzi* in the Caatinga area colonised by *Triatoma brasiliensis*. Mem Inst Oswaldo Cruz. 2014;109:887–98.
338. Cantillo-Barraza O, Garces E, Gomez-Palacio A, Cortes LA, Pereira A, Marcet PL, et al. Eco-epidemiological study of an endemic Chagas disease region in northern Colombia reveals the importance of *Triatoma maculata* (Hemiptera: Reduviidae), dogs and *Didelphis marsupialis* in *Trypanosoma cruzi* maintenance. Parasit Vectors. 2015;8:482.

339. Constantino C, Pellizzaro M, Paula EFE, Vieira TSWJ, Brando APD, Ferreira F, et al. Serosurvey for *Leishmania* spp, *Toxoplasma gondii*, *Trypanosoma cruzi* and *Neospora caninum* in neighborhood dogs in Curitiba-Paraná, Brazil. Rev Bras Parasitol Vet. 2016;25:504–10.
340. Perez TD, Figueiredo FB, Junior AAMV, Silva VL, Madeira MF, Brazil RP, Coura JR. Prevalence of American trypanosomiasis and leishmaniases in domestic dogs in a rural area of the municipality of São João do Piauí, Piauí State, Brazil. Rev Inst Med Trop Sao Paulo. 2016;58:79.
341. Franke CR, Greiner M, Mehlitz D. Investigations on naturally occurring *Trypanosoma evansi* infections in horses, cattle, dogs and capybaras (*Hydrochaeris hydrochaeris*) in Pantanal de Pocone (Mato Grosso, Brazil). Acta Trop. 1994;58:159–69.
342. Colpo CB, Monteiro SG, Stainki DR, Colpo ETB, Henriques GB. Infecção natural por *Trypanosoma evansi* em cães. Ciênc Rural. 2005;35:717–9.
343. Dávila AM, Herrera HM, Schlebinger T, Souza SS, Traub-Cseko YM. Using PCR for unraveling the cryptic epizootiology of livestock trypanosomosis in the Pantanal, Brazil. Vet Parasitol. 2003;117:1–13.
344. Franciscato C, Lopes STA, Teixeira MMG, Monteiro SG, Garmatz BC, Paim CB. Cão naturalmente infectado por *Trypanosoma evansi* em Santa Maria, RS, Brasil. Ciênc Rural. 2007;37:288–91.
345. Herrera HM, Dávila AM, Norek A, Abreu UG, Souza SS, Dandrea PS, Jansen AM. Enzootiology of *Trypanosoma evansi* in Pantanal, Brazil. Vet Parasitol. 2004;125:263–75.
346. Herrera HM, Norek A, Freitas TP, Rademaker V, Fernandes O, Jansen AM. Domestic and wild mammals infection by *Trypanosoma evansi* in a pristine area of the Brazilian Pantanal region. Parasitol Res. 2005;96:121–6.
347. Queiroz AO, Cabello PH, Jansen AM. Biological and biochemical characterization of isolates of *Trypanosoma evansi* from Pantanal of Matogrosso-Brazil. Vet Parasitol. 2000;92:107–18.
348. Savani ESMM, Nunes VL, Galati EA, Castilho TM, Araujo FS, Ilha IM, Camargo MCGO, Dauria SRN, Floeter-Winter LM. Occurrence of co-infection by *Leishmania* (*Leishmania*) *chagasi* and *Trypanosoma* (*Trypanozoon*) *evansi* in a dog in the state of Mato Grosso do Sul, Brazil. Mem Inst Oswaldo Cruz. 2005;100:739–41.
349. Silva AS, Zanette RA, Colpo CB, Santurio JM, Monteiro SG. Sinais clínicos em cães naturalmente infectados por *Trypanosoma evansi* (Kinetoplastida: Trypanosomatidae) no RS. Clín Vet. 2008;13:66–8.
350. Stevens JR, Nunes VL, Lanham SM, Oshiro ET. Isoenzyme characterization of *Trypanosoma evansi* isolated from capybaras and dogs in Brazil. Acta Trop. 1989;46:213–22.
351. Greiner M, Franke CR, Bohning D, Schlattmann P. Construction of an intrinsic cut-off value for the sero-epidemiological study of *Trypanosoma evansi* infections in a canine population in Brazil: a new approach towards an unbiased estimation of prevalence. Acta Trop. 1994;56:97–109.
352. Lasta CS, Dos Santos AP, Messick JB, Oliveira ST, Biondo AW, Vieira RFC, et al. Molecular detection of *Ehrlichia canis* and *Anaplasma platys* in dogs in southern Brazil. Rev Bras Parasitol Vet. 2013;22:360–6.
353. Ferreira RF, Cerqueira AMF, Pereira AM, Guimarães CM, Sá AG, Abreu FS, et al. *Anaplasma platys* diagnosis in dogs: comparison between morphological and molecular tests. Int J Appl Res Vet Med. 2007;5:113–9.
354. Santos HA, Thome SMG, Baldani CD, Silva CB, Peixoto MP, Pires MS, et al. Molecular epidemiology of the emerging zoonosis agent *Anaplasma phagocytophilum* (Foggie, 1949) in dogs and ixodid ticks in Brazil. Parasit Vectors. 2013;6:348.
355. Santos HA, Pires MS, Vilela JAR, Santos TM, Faccini JLH, Baldani CD, et al. Detection of *Anaplasma phagocytophilum* in Brazilian dogs by real-time polymerase chain reaction. J Vet Diagn Invest. 2011;23:770–4.
356. Brenner EC, Chomel BB, Singhasivanon O-U, Namekata DY, Kasten RW, Kass PH, et al. *Bartonella* infection in urban and rural dogs from the tropics: Brazil, Colombia, Sri Lanka and Vietnam. Epidemiol Infect. 2013;141:54–61.
357. Diniz PPVP, Maggi RG, Schwartz DS, Cadenas MB, Bradley JM, Hegarty B, Breitschwerdt EB. Canine bartonellosis: serological and molecular prevalence in Brazil and evidence of co-infection with *Bartonella henselae* and *Bartonella vinsonii* subsp. *berkhoffii*. Vet Res. 2007;38:697–710.
358. Lamas C, Curi A, Boia M, Lemos E. Human bartonellosis: seroepidemiological and clinical features with an emphasis on data from Brazil - a review. Mem Inst Oswaldo Cruz. 2008;103:221–35.
359. Fleischman DA, Chomel BB, Kasten RW, Andre MR, Goncalves LR, Machado RZ. *Bartonella clarridgeiae* and *Bartonella vinsonii* subsp. *berkhoffii* exposure in captive wild canids in Brazil. Epidemiol Infect. 2015;143:573–7.
360. Staggemeier R, Venker CA, Klein DH, Petry M, Spilki FR, Cantarelli VV. Prevalence of *Bartonella henselae* and *Bartonella clarridgeiae* in cats in the south of Brazil: a molecular study. Mem Inst Oswaldo Cruz. 2010;105:873–8.
361. Miceli NG, Gavioli FA, Goncalves LR, Andre MR, Sousa VRF, Sousa KCM, Machado RZ. Molecular detection of feline arthropod-borne pathogens in cats in Cuiaba, state of Mato Grosso, central-western region of Brazil. Rev Bras Parasitol Vet. 2013;22:385–90.
362. Goncalves DD, Moura RA, Nunes M, Carreira T, Vidotto O, Freitas JC, Vieira ML. *Borrelia burgdorferi sensu lato* in humans in a rural area of Parana State, Brazil. Braz J Microbiol. 2015;46:571–5.
363. Abel IS, Marzagão G, Yoshinari NH, Schumaker TT. *Borrelia burgdorferi*-like spirochetes recovered from ticks and small mammals collected in the Atlantic Forest Reserve, Cotia county, State of São Paulo, Brazil. Mem Inst Oswaldo Cruz. 2000;95:621–4.
364. Vieira RFC, Biondo AW, Guimaraes AMS, Dos Santos AP, Santos RP, Dutra LH, et al. Ehrlichiosis in Brazil. Rev Bras Parasitol Vet. 2011;20:1–12.
365. Aguiar DM, Cavalcante GT, Pinter A, Gennari SM, Camargo LMA, Labruna MB. Prevalence of *Ehrlichia canis* (Rickettsiales: Anaplasmataceae) in dogs and *Rhipicephalus sanguineus* (Acari: Ixodidae) ticks from Brazil. J Med Entomol. 2007;44:126–32.
366. Costa LM Jr, Rembeck K, Ribeiro MFB, Beelitz P, Pfister K, Passos LMF. Sero-prevalence and risk indicators for canine ehrlichiosis in three rural areas of Brazil. Vet J. 2007;174:673–6.
367. Dagnone AS, de Morais HSA, Vidotto MC, Jojima FS, Vidotto O. Ehrlichiosis in anemic, thrombocytopenic, or tick-infested dogs from a hospital population in South Brazil. Vet Parasitol. 2003;117:285–90.
368. Labarthe N, de Campos Pereira M, Barbarini O, McKee W, Coimbra CA, Hoskins J. Serologic prevalence of *Dirofilaria immitis*, *Ehrlichia canis*, and *Borrelia burgdorferi* infections in Brazil. Vet Ther. 2003;4:67–75.
369. Labruna MB, McBride JW, Camargo LMA, Aguiar DM, Yabsley MJ, Davidson WR, et al. A preliminary investigation of *Ehrlichia* species in ticks, humans, dogs, and capybaras from Brazil. Vet Parasitol. 2007;143:189–95.
370. Macieira DB, Messick JB, Cerqueira AMF, Freire IMA, Linhares GFC, Almeida NKO, Almosny NRP. Prevalence of *Ehrlichia canis* infection in thrombocytopenic dogs from Rio de Janeiro, Brazil. Vet Clin Pathol. 2005;34:44–8.
371. Melo ALT, Martins TF, Horta MC, Moraes-Filho J, Pacheco RC, Labruna MB, Aguiar DM. Seroprevalence and risk factors to *Ehrlichia* spp. and *Rickettsia* spp. in dogs from the Pantanal Region of Mato Grosso State, Brazil. Ticks Tick Borne Dis. 2011;2:213–8.
372. Mundim AV, Morais IA, Tavares M, Cury MC, Mundim MJS. Clinical and hematological signs associated with dogs naturally infected by *Hepatozoon* sp. and with other hematozoa: a retrospective study in Uberlandia, Minas Gerais, Brazil. Vet Parasitol. 2008;153:3–8.
373. Saito TB, Cunha-Filho NA, Pacheco RC, Ferreira F, Pappen FG, Farias NAR, et al. Canine infection by rickettsiae and ehrlichiae in southern Brazil. Am J Trop Med Hyg. 2008;79:102–8.
374. Santos LGF, Melo ALT, Moraes-Filho J, Witter R, Labruna MB, Aguiar DM. Molecular detection of *Ehrlichia canis* in dogs from the Pantanal of Mato Grosso State, Brazil. Rev Bras Parasitol Vet. 2013;22:114–8.
375. Dantas-Torres F, da Silva YY, Miranda DE, Sales KG, Figueredo LA, Otranto D. *Ehrlichia* spp infection in rural dogs from remote indigenous villages in north-eastern Brazil. Parasit Vectors. 2018;11:139.
376. Oliveira LS, Oliveira KA, Mourao LC, Pescatore AM, Almeida MR, Conceicao LG, et al. First report of *Ehrlichia ewingii* detected by molecular investigation in dogs from Brazil. Clin Microbiol Infect. 2009;15(Suppl. 2):55–6.
377. Braga ÍA, Santos LGF, Ramos DGS, Melo ALT, Mestre GLC, Aguiar DM. Detection of *Ehrlichia canis* in domestic cats in the central-western region of Brazil. Braz J Microbiol. 2014;45:641–5.
378. de Oliveira LS, Mourao LC, Oliveira KA, da Matta Agostini M, de Oliveira AC, de Almeida MR, et al. Molecular detection of *Ehrlichia canis* in cats in Brazil. Clin Microbiol Infect. 2009;15(Suppl. 2):53–4.
379. Andre MR, Adania CH, Allegretti SM, Machado RZ. Hemoplasmas in wild canids and felids in Brazil. J Zoo Wildl Med. 2011;42:342–7.
380. Filoni C, Catao-Dias JL, Cattori V, Willi B, Meli ML, Correa SHR, et al. Surveillance using serological and molecular methods for the detection

of infectious agents in captive Brazilian neotropic and exotic felids. J Vet Diagn Invest. 2012;24:166–73.
381. Guimaraes AMS, Javorouski ML, Bonat M, Lacerda O, Balbinotti B, Queiroz LGPB, et al. Molecular detection of "*Candidatus* Mycoplasma haemominutum" in a lion (*Panthera leo*) from a Brazilian zoological garden. Rev Inst Med Trop Sao Paulo. 2007;49:195–6.
382. Vieira RFC, Vidotto O, Vieira TSWJ, Guimaraes AMS, Santos AP, Nascimento NC, et al. Molecular investigation of hemotropic mycoplasmas in human beings, dogs and horses in a rural settlement in southern Brazil. Rev Inst Med Trop Sao Paulo. 2015;57:353–7.
383. Braga MSCO, Andre MR, Freschi CR, Teixeira MCA, Machado RZ. Molecular detection of hemoplasma infection among cats from Sao Luis island, Maranhao, Brazil. Braz J Microbiol. 2012;43:569–75.
384. de Bortoli CP, Andre MR, Seki MC, Pinto AA, Machado STZ, Machado RZ. Detection of hemoplasma and *Bartonella* species and co-infection with retroviruses in cats subjected to a spaying/neutering program in Jaboticabal, SP, Brazil. Rev Bras Parasitol Vet. 2012;21:219–23.
385. Maia LMP, Cerqueira AMF, de Macieira D, de Souza AM, Moreira NS, da Silva AV, et al. *Cytauxzoon felis* and "*Candidatus* Mycoplasma haemominutum" coinfection in a Brazilian domestic cat (*Felis catus*). Rev Bras Parasitol Vet. 2013;22:289–91.
386. de Santis ACGA, Herrera HM, de Sousa KCM, Goncalves LR, Denardi NCB, Domingos IH, et al. Molecular detection of hemotrophic mycoplasmas among domiciled and free-roaming cats in Campo Grande, state of Mato Grosso do Sul, Brazil. Rev Bras Parasitol Vet. 2014;23:231–6.
387. dos Santos AP, Conrado FO, Messick JB, Biondo AW, de Oliveira ST, Guimaraes AMS, et al. Hemoplasma prevalence and hematological abnormalities associated with infection in three different cat populations from southern Brazil. Rev Bras Parasitol Vet. 2014;23:428–34.
388. Valle SF, Messick JB, Dos Santos AP, Kreutz LC, Duda NCB, Machado G, et al. Identification, occurrence and clinical findings of canine hemoplasmas in southern Brazil. Comp Immunol Microbiol Infect Dis. 2014;37:259–65.
389. Batista FG, Silva DM, Green KT, Tezza LBL, Vasconcelos SP, Carvalho SGS, et al. Serological survey of *Rickettsia* sp. in horses and dogs in an non-endemic area in Brazil. Rev Bras Parasitol Vet. 2010;19:205–9.
390. Pinter A, Horta MC, Pacheco RC, Moraes-Filho J, Labruna MB. Serosurvey of *Rickettsia* spp. in dogs and humans from an endemic area for Brazilian spotted fever in the State of Sao Paulo, Brazil. Cad Saude Publica. 2008;24:247–52.
391. Toledo RS, Tamekuni K, de Filho M, Haydu VB, Pacheco RC, Labruna MB, et al. Study of infection by rickettsiae of the spotted fever group in humans and ticks in an urban park located in the city of Londrina, State of Parana, Brazil. Rev Soc Bras Med Trop. 2011;44:313–7.
392. Toledo RS, Tamekuni K, Filho MFS, Haydu VB, Barbieri ARM, Hiltel AC, et al. Infection by spotted fever rickettsiae in people, dogs, horses and ticks in Londrina, Parana State, Brazil. Zoonoses Public Health. 2011;58:416–23.
393. Silveira I, Martins TF, Olegario MM, Peterka C, Guedes E, Ferreira F, Labruna MB. Rickettsial infection in animals, humans and ticks in Pauliceia, Brazil. Zoonoses Public Health. 2015;62:525–33.
394. Alves ADS, Melo ALT, Amorim MV, Borges AMCM, Silva L, Martins TF, et al. Seroprevalence of *Rickettsia* spp in equids and molecular detection of "*Candidatus* Rickettsia amblyommii" in *Amblyomma cajennense sensu lato* ticks from the Pantanal Region of Mato Grosso, Brazil. J Med Entomol. 2014;51:1242–7.
395. Horta MC, Scott FB, Correia TR, Fernandes JI, Richtzenhain LJ, Labruna MB. *Rickettsia felis* infection in cat fleas *Ctenocephalides felis felis*. Braz J Microbiol. 2010;41:813–8.
396. Labruna MB, Whitworth T, Horta MC, Bouyer DH, McBride JW, Pinter A, et al. *Rickettsia* species infecting *Amblyomma cooperi* ticks from an area in the state of Sao Paulo, Brazil, where Brazilian spotted fever is endemic. J Clin Microbiol. 2004;42:90–8.
397. Matias J, Garcia MV, Cunha RC, Aguirre AAR, Barros JC, Csordas BG, Andreotti R. Spotted fever group *Rickettsia* in *Amblyomma dubitatum* tick from the urban area of Campo Grande, Mato Grosso do Sul, Brazil. Ticks Tick Borne Dis. 2015;6:107–10.
398. Medeiros AP, Souza AP, Moura AB, Lavina MS, Bellato V, Sartor AA, et al. Spotted fever group *Rickettsia* infecting ticks (Acari: Ixodidae) in the state of Santa Catarina, Brazil. Mem Inst Oswaldo Cruz. 2011;106:926–30.
399. Melo ALT, Alves AS, Nieri-Bastos FA, Martins TF, Witter R, Pacheco TA, et al. *Rickettsia parkeri* infecting free-living *Amblyomma triste* ticks in the Brazilian Pantanal. Ticks Tick Borne Dis. 2015;6:237–41.
400. Ogrzewalska M, Martins T, Capek M, Literak I, Labruna MB. A *Rickettsia parkeri*-like agent infecting *Amblyomma calcaratum* nymphs from wild birds in Mato Grosso do Sul, Brazil. Ticks Tick Borne Dis. 2013;4:145–7.
401. Ogrzewalska M, Pacheco RC, Uezu A, Richtzenhain LJ, Ferreira F, Labruna MB. Rickettsial infection in *Amblyomma nodosum* ticks (Acari: Ixodidae) from Brazil. Ann Trop Med Parasitol. 2009;103:413–25.
402. Pacheco RC, Arzua M, Nieri-Bastos FA, Moraes-Filho J, Marcili A, Richtzenhain LJ, et al. Rickettsial infection in ticks (Acari: Ixodidae) collected on birds in southern Brazil. J Med Entomol. 2012;49:710–6.
403. Ramos DGS, Melo ALT, Martins TF, Alves ADS, Pacheco TA, Pinto LB, et al. Rickettsial infection in ticks from wild birds from Cerrado and the Pantanal region of Mato Grosso, midwestern Brazil. Ticks Tick Borne Dis. 2015;6:836–42.
404. Szabo MPJ, Nieri-Bastos FA, Spolidorio MG, Martins TF, Barbieri AM, Labruna MB. *In vitro* isolation from *Amblyomma ovale* (Acari: Ixodidae) and ecological aspects of the Atlantic rainforest *Rickettsia*, the causative agent of a novel spotted fever rickettsiosis in Brazil. Parasitology. 2013;140:719–28.
405. Yabsley MJ, McKibben J, Macpherson CN, Cattan PF, Cherry NA, Hegarty BC, et al. Prevalence of *Ehrlichia canis*, *Anaplasma platys*, *Babesia canis vogeli*, *Hepatozoon canis*, *Bartonella vinsonii berkhoffii*, and *Rickettsia* spp. in dogs from Grenada. Vet Parasitol. 2008;151:279–85.
406. Georges K, Ezeokoli CD, Newaj-Fyzul A, Campbell M, Mootoo N, Mutani A, Sparagano OAE. The application of PCR and reverse line blot hybridization to detect arthropod-borne hemopathogens of dogs and cats in Trinidad. Ann NY Acad Sci. 2008;1149:196–9.
407. Bool PH, Sutmöller P. *Ehrlichia canis* infections in dogs on Aruba (Netherlands Antilles). J Am Vet Med Assoc. 1957;130:418–20.
408. Zandvliet MMJM, Teske E, Piek CJ. *Ehrlichia* and *Babesia* infections in dogs in The Netherlands. Tijdschr Diergeneeskd. 2004;129:740–5 (In Dutch).
409. Chikweto A, Bhaiyat MI, Lanza-Perea M, Veytsman S, Tiwari K, de Allie C, Sharma RN. Retrospective study of canine heartworm disease with caval syndrome in Grenada, West Indies. Vet Parasitol. 2014;205:721–4.
410. Coomansingh C-M, Yabsley M, Wagner N, Pinckney R, Bhaiyat MI, Chikweto A, et al. Meta-analysis of the prevalence of *Dirofilaria immitis* in dogs from Grenada, West Indies. Int J Vet Med Res Rep. 2015;2015:429690.
411. Fernandez C, Chikweto A, Mofya S, Lanum L, Flynn P, Burnett JP, et al. A serological study of *Dirofilaria immitis* in feral cats in Grenada, West Indies. J Helminthol. 2010;84:390–3.
412. Hoff B, McEwen B, Peregrine AS. A survey for infection with *Dirofilaria immitis*, *Ehrlichia canis*, *Borrelia burgdorferi*, and *Babesia canis* in feral and client-owned dogs in the Turks and Caicos Islands, British West Indies. Can Vet J. 2008;49:593–4.
413. Hesselink JW. Prevalence of heartworm (*Dirofilaria immitis*) in dogs on Curaçao. Tijdschr Diergeneeskd. 1988;113:853–9 (In Dutch).
414. Saleh FC, Kirkpatrick CE, de Haseth O, Lok JB. Occurrence of some blood and intestinal parasites in dogs in Curacao, Netherlands Antilles. Trop Geogr Med. 1988;40:318–21.
415. Rosypal AC, Tripp S, Kinlaw C, Sharma RN, Stone D, Dubey JP. Seroprevalence of canine leishmaniasis and American trypanosomiasis in dogs from Grenada, West Indies. J Parasitol. 2010;96:228–9.
416. Liautaud B, Vignier N, Miossec C, Plumelle Y, Kone M, Delta D, et al. First case of visceral leishmaniasis caused by *Leishmania martiniquensis*. Am J Trop Med Hyg. 2015;92:317–9.
417. Noyes H, Pratlong F, Chance M, Ellis J, Lanotte G, Dedet JP. A previously unclassified trypanosomatid responsible for human cutaneous lesions in Martinique (French West Indies) is the most divergent member of the genus *Leishmania s.s*. Parasitology. 2002;124:17–24.
418. Cnudde F, Raccurt C, Boulard F, Terron-Aboud B, Nicolas M, Juminer B. Diffuse cutaneous leishmaniasis with visceral dissemination in an AIDS patient in Guadeloupe, West Indies. AIDS. 1994;8:559–60.
419. Petana WB. American trypanosomiasis (Chagas' disease) in the Caribbean. Bull Pan Am Health Organ. 1978;12:45–50.
420. Omah-Maharaj I. Studies on vectors of *Trypanosoma cruzi* in Trinidad, West Indies. Med Vet Entomol. 1992;6:115–20.

421. Loftis AD, Kelly PJ, Freeman MD, Fitzharris S, Beeler-Marfisi J, Wang C. Tick-borne pathogens and disease in dogs on St. Kitts, West Indies. Vet Parasitol. 2013;196:44–9.
422. Qurollo BA, Chandrashekar R, Hegarty BC, Beall MJ, Stillman BA, Liu J, et al. A serological survey of tick-borne pathogens in dogs in North America and the Caribbean as assessed by *Anaplasma phagocytophilum*, *A. platys*, *Ehrlichia canis*, E *chaffeensis*, *E. ewingii*, and *Borrelia burgdorferi* species-specific peptides. Infect Ecol Epidemiol. 2014;4:24699.
423. Kelly PJ, Moura L, Miller T, Thurk J, Perreault N, Weil A, et al. Feline immunodeficiency virus, feline leukemia virus and *Bartonella* species in stray cats on St Kitts, West Indies. J Feline Med Surg. 2010;12:447–50.
424. Rampersad JN, Watkins JD, Samlal MS, Deonanan R, Ramsubeik S, Ammons DR. A nested-PCR with an internal amplification control for the detection and differentiation of *Bartonella henselae* and *B. clarridgeiae*: an examination of cats in Trinidad. BMC Infect Dis. 2005;5:63.
425. Asgarali Z, Pargass I, Adam J, Mutani A, Ezeokoli C. Haematological parameters in stray dogs seropositive and seronegative to *Ehrlichia canis* in North Trinidad. Ticks Tick Borne Dis. 2012;3:207–11.
426. Georges K, Ezeokoli C, Auguste T, Seepersad N, Pottinger A, Sparagano O, Tasker S. A comparison of real-time PCR and reverse line blot hybridization in detecting feline haemoplasmas of domestic cats and an analysis of risk factors associated with haemoplasma infections. BMC Vet Res. 2012;8:103.
427. Pérez LC, Arce JD. Nódulos parasitarios cutáneos: estudio ultrasonográfico de tres casos poco frecuentes en la edad pediátrica. Rev Chilena Radiol. 2007;13:163–8.
428. Muñoz-Leala S, Lopes MG, Marcili A, Martins TF, González-Acuñac D, Labruna MB. Anaplasmataceae, *Borrelia* and *Hepatozoon* agents in ticks (Acari: Argasidae, Ixodidae) from Chile. Acta Trop. 2019;2019(192):91–103.
429. Bertoglia J, Rodriguez J, Gordillo N, Mendoza J, Contreras MC, Rojas J, et al. Epidemiologia de la enfermedad de Chagas en Chile. Sectores rurales. Infeccion de mamiferos domesticos por *Trypanosoma cruzi* y nuevas contribuciones al conocimiento de la infestacion triatomidea domiciliaria en III Region, Chile (1982–1983). Bol Chil Parasitol. 1984;39:20–3.
430. Burchard L, Caceres J, Sagua H, Ines Bahamonde M, Neira I, Araya J, Goycolea M. Estado actual de la seroprevalencia de la infeccion chagasica humana y canina en la comuna de San Pedro de Atacama, II Region de Antofagasta, Chile, 1995. Bol Chil Parasitol. 1996;51:76–9.
431. Burchard L, Cornejo J, Cruz L, Contreras MC, Vargas L, Villarroel F, et al. Epidemiologia de la enfermedad de Chagas en Chile. Sectores rurales. Infestacion triatomidea domiciliaria e infestacion por *Trypanosoma cruzi* del vector y de los mamiferos domesticos de la II Region (1983). Bol Chil Parasitol. 1984;39:17–9.
432. Correa V, Briceno J, Zuniga J, Aranda JC, Valdes J, Contreras MC, et al. Infeccion por *Trypanosoma cruzi* en animales domesticos de sectores rurales de la IV Region, Chile. Bol Chil Parasitol. 1982;37:27–8.
433. Correa V, Zuniga J, Briceno J, Contreras MC, Aranda JC, Valdes J, et al. Epidemiologia de la enfermedad de Chagas en Chile. Sectores rurales. Infestacion domiciliaria por triatominos, tasas de infeccion de estos por *Trypanosoma cruzi* y nuevos aportes al conocimiento de la infeccion chagasica en mamiferos domesticos de la IV region (1982–1983). Bol Chil Parasitol. 1984;39:24–7.
434. Flores B, Hernandez G, Lepe A, Contreras MC, Sandoval L, Villarroel F, et al. Epidemiologia de la enfermedad de Chagas en Chile. Sectores rurales. Infestacion triatomidea domiciliaria e infeccion por *Trypanosoma cruzi* del vector y de mamiferos domesticos de la V Region, 1983. Bol Chil Parasitol. 1984;39:62–5.
435. Gonzalez CR, Reyes C, Canals A, Parra A, Munoz X, Rodriguez K. An entomological and seroepidemiological study of the vectorial-transmission risk of Chagas disease in the coast of northern Chile. Med Vet Entomol. 2015;29:387–92.
436. Martinez R, Ahumada C, Contreras MC, Villarroel F, Rojas A, Schenone H. Enfermedad de Chagas en Chile. Sectores rurales. Infestacion triatomidea domiciliaria e infeccion por *Trypanosoma cruzi* del vector y mamiferos de la I Region (1982–1983). Bol Chil Parasitol. 1983;38:70–2.
437. Schenone H, Rojas A. Algunos datos y observaciones pragmaticas en relacion a la epidemiologia de la enfermedad de Chagas. Bol Chil Parasitol. 1989;44:66–86.
438. Schenone H, Christensen HA, de Vasquez AM, Gonzalez C, Mendez E, Rojas A, Villarroel F. Fuentes de alimentacion de triatomas domesticos y su implicancia epidemiologica en relacion a enfermedad de Chagas en areas rurales de siete regiones de Chile. Bol Chil Parasitol. 1985;40:34–8.
439. Schenone H, Contreras MC, Borgono JM, Maturana R, Salinas P, Sandoval L, et al. Panorama general de la epidemiologia de la enfermedad de Chagas en Chile. Bol Chil Parasitol. 1991;46:19–30.
440. Schenone H, Villarroel F, Contreras MC, Borgono JM, Sandoval L, Rojas A, et al. Enfermedad de Chagas en Chile. Sectores rurales y periurbanos. Tasas de positividad de la reaccion de hemaglutinacion indirecta (RHAI) para el diagnostico de la parasitosis segun el numero de personas examinadas por vivienda. Bol Chil Parasitol. 1986;41:27–30.
441. Venegas L, Rojas A, Villarroel F, Contreras MC, Sandoval L, Schenone H. Epidemiologia de la enfermedad de Chagas en Chile. Sectores rurales. Infestacion triatomidea domiciliaria e infeccion por *Trypanosoma cruzi* del vector y mamiferos domesticos de la VI Region del Libertador General Bernardo O'Higgins, 1983. Bol Chil Parasitol. 1984;39:69–72.
442. Villarroel F, Rojas A, Contreras MC, Schenone H. Epidemiologia de la enfermedad de Chagas en Chile. Sectores rurales. Infestacion triatomidea domiciliaria e infeccion por *Trypanosoma cruzi* de los vectores y mamiferos domesticos de la region metropolitana, 1982–1984. Bol Chil Parasitol. 1984;39:65–8.
443. Villarroel F, Schenone H, Contreras MC, Rojas A, Hernandez E. Enfermedad de Chagas en el Altiplano chileno Aspectos epidemiologicos, parasitologicos y clinicos. Bol Chil Parasitol. 1991;46:61–9.
444. Abarca K, Lopez J, Perret C, Guerrero J, Godoy P, Veloz A, et al. *Anaplasma platys* in dogs, Chile. Emerg Infect Dis. 2007;13:1392–5.
445. Del López PJ, Abarca VK, Azocar AT. Evidencia clínica y serológica de rickettsiosis canina en Chile. Rev Chilena Infectol. 2007;24:189–93.
446. Zaror L, Ernst S, Navarette M, Ballesteros A, Boroscheck D, Ferres M, Thibaut J. Detección serológica de *Bartonella henselae* en gatos en la ciudad de Valdivia, Chile. Arch Med Vet. 2002;34:103–10.
447. Ferres M, Abarca K, Godoy P, Garcia P, Palavecino E, Mendez G, et al. Presencia de *Bartonella henselae* en gatos: cuantificación del reservorio natural y riesgo de exposición humana de esta zoonosis en Chile. Rev Méd Chile. 2005;133:1465–71.
448. Abarca K, Ribera M, Prado P, Lobos T, Palacios O, Ferres M, et al. Neuroborreliosis en Chile. Caso pediatrico de probable adquisicion por mascotas importadas. Rev Méd Chile. 1996;124:975–9.
449. Neira O, Cerda C, Alvarado MA, Palma S, Abumohor P, Wainstein E, et al. Enfermedad de Lyme en Chile. Estudio de prevalencia en grupos. Rev Méd Chile. 1996;124:537–44.
450. López J, Abarca K, Mundaca MI, Caballero C, Valiente-Echeverría F. Identificación molecular de *Ehrlichia canis* en un canino de la ciudad de Arica, Chile. Rev Chilena Infectol. 2012;29:527–30.
451. López J, Castillo A, Muñoz O, Hildebrandt S. Hallazgo de *Ehrlichia canis* en Chile, informe preliminar. Arch Med Vet (Valdivia). 1999;31:211–4.
452. Cabello J, Altet L, Napolitano C, Sastre N, Hidalgo E, Davila JA, Millan J. Survey of infectious agents in the endangered Darwin's fox (*Lycalopex fulvipes*): high prevalence and diversity of hemotrophic mycoplasmas. Vet Microbiol. 2013;167:448–54.
453. Abarca K, Lopez J, Acosta-Jamett G, Martinez-Valdebenito C. *Rickettsia felis* in *Rhipicephalus sanguineus* from two distant Chilean cities. Vector Borne Zoonotic Dis. 2013;13:607–9.
454. Poo-Muñoz DA, Elizondo-Patrone C, Escobar LE, Astorga F, Bermúdez SE, Martínez-Valdebenito C, et al. Fleas and ticks in carnivores from a domestic-wildlife interface: implications for public health and wildlife. J Med Entomol. 2016;53:1433–43.
455. Vargas-Hernandez G, Andre MR, Faria JLM, Munhoz TD, Hernandez-Rodriguez M, Machado RZ, Tinucci-Costa M. Molecular and serological detection of *Ehrlichia canis* and *Babesia vogeli* in dogs in Colombia. Vet Parasitol. 2012;186:254–60.
456. McCown ME, Monterroso VH, Cardona W. Surveillance for *Ehrlichia canis*, *Anaplasma phagocytophilum*, *Borrelia burgdorferi*, and *Dirofilaria immitis* in dogs from three cities in Colombia. J Spec Oper Med. 2014;14:86–90.
457. Guerrero J, Genchi C, Vezzoni A, Ducos de Lahitte J, Bussieras J, Rojo FA, et al. Distribution of *Dirofilaria immitis* in selected areas of Europe and South America. In: Otto GF, editor. In: Proceedings of the Heartworm Symposium '89. Washington, DC: American Heartworm Society; 1989. p 13–8.

458. Guerrero J, Ducos de la Hitte J, Genchi C, Rojo F, Gomez-Bautista M, Carvalho Varela M, et al. Update on the distribution of *Dirofilaria immitis* in dogs from southern Europe and Latin America. In: Soll M, editor. In: Proceedings of the Heartworm Symposium '92. Batavia: American Heartworm Society; 1992. p 31–7.
459. Vieira C, Velez ID, Montoya MN, Agudelo S, Alvarez MI, Genchi C, Simon F. *Dirofilaria immitis* in Tikuna Indians and their dogs in the Colombian Amazon. Ann Trop Med Parasitol. 1998;92:123–5.
460. Vargas-Hernandez G, Andre MR, Munhoz TD, Faria JML, Machado RZ, Tinucci-Costa M. Molecular characterization of *Hepatozoon canis* in dogs from Colombia. Parasitol Res. 2012;110:489–92.
461. Paternina Gómez M, Díaz-Olmos Y, Paternina LE, Bejarano EE. Alta prevalencia de infeccion por *Leishmania* (Kinetoplastidae: Trypanosomatidae) en perros del norte de Colombia. Biomedica. 2013;33:375–82.
462. Romero M, Lopez M, Echeverry M, Rivas F. Leishmaniasis visceral canina: pruebas diagnósticas no identifican Estados Reales de la infección. Rev Salud Pública. 2008;10:290–8.
463. Blanco VM, Cossio A, Martinez JD, Saravia NG. Clinical and epidemiologic profile of cutaneous leishmaniasis in Colombian children: considerations for local treatment. Am J Trop Med Hyg. 2013;89:359–64.
464. Martínez LP, Rebollo JA, Luna AL, Cochero S, Bejarano EE. Molecular identification of the parasites causing cutaneous leishmaniasis on the Caribbean coast of Colombia. Parasitol Res. 2010;106:647–52.
465. Patiño-Londoño SY, Salazar LM, Acero CT, Bernal IDV. Aspectos sociodemiológicos y culturales de la leishmaniasis cutánea: concepciones, actitudes y prácticas en las poblaciones de Tierralta y Valencia, (Córdoba, Colombia). Salud Colect. 2017;13:123–38.
466. Pérez-Flórez M, Ocampo CB, Valderrama-Ardila C, Alexander N. Spatial modeling of cutaneous leishmaniasis in the Andean region of Colombia. Mem Inst Oswaldo Cruz. 2016;111:433–42.
467. Rincon MY, Silva SY, Duenas RE, Lopez-Jaramillo P. Leishmaniasis cutánea diseminada: reporte de dos casos en Santander, Colombia. Rev Salud Pública. 2009;11:145–50.
468. Rodríguez-Barraquer I, Góngora R, Prager M, Pacheco R, Montero LM, Navas A, et al. Etiologic agent of an epidemic of cutaneous leishmaniasis in Tolima, Colombia. Am J Trop Med Hyg. 2008;78:276–82.
469. Rosales-Chilama M, Gongora RE, Valderrama L, Jojoa J, Alexander N, Rubiano LC, et al. Parasitological confirmation and analysis of *Leishmania* diversity in asymptomatic and subclinical infection following resolution of cutaneous leishmaniasis. PLoS Negl Trop Dis. 2015;9:e0004273.
470. Vélez ID, Carrillo LM, López L, Rodríguez E, Robledo SM. An epidemic outbreak of canine cutaneous leishmaniasis in Colombia caused by *Leishmania braziliensis* and *Leishmania panamensis*. Am J Trop Med Hyg. 2012;86:807–11.
471. Vélez ID, Jiménez A, Vásquez D, Robledo SM. Disseminated cutaneous leishmaniasis in Colombia: report of 27 cases. Case Rep Dermatol. 2015;7:275–86.
472. Ramírez JD, Turriago B, Tapia-Calle G, Guhl F. Understanding the role of dogs (*Canis lupus familiaris*) in the transmission dynamics of *Trypanosoma cruzi* genotypes in Colombia. Vet Parasitol. 2013;196:216–9.
473. McCown ME, Alleman A, Sayler KA, Chandrashekar R, Thatcher B, Tyrrell P, et al. Point prevalence survey for tick-borne pathogens in military working dogs, shelter animals, and pet populations in northern Colombia. J Spec Oper Med. 2014;14:81–5.
474. Miranda J, Mattar S, Perdomo K, Palencia L. Seroprevalencia de borreliosis, o enfermedad de Lyme, en una población rural expuesta de Córdoba, Colombia. Rev Salud Pública. 2009;11:480–9.
475. Hidalgo M, Vesga JF, Lizarazo D, Valbuena G. A survey of antibodies against *Rickettsia rickettsii* and *Ehrlichia chafeensis* in domestic animals from a rural area of Colombia. Am J Trop Med Hyg. 2009;80:1029–30.
476. Londoño AF, Acevedo-Gutiérrez LY, Marín D, Contreras V, Díaz FJ, Valbuena G, et al. Wild and domestic animals likely involved in rickettsial endemic zones of northwestern Colombia. Ticks Tick Borne Dis. 2017;8:887–94.
477. Bermúdez SE, Eremeeva ME, Karpathy SE, Samudio F, Zambrano ML, Zaldivar Y, et al. Detection and identification of rickettsial agents in ticks from domestic mammals in eastern Panama. J Med Entomol. 2009;46:856–61.
478. Faccini-Martínez ÁA, Ramírez-Hernández A, Forero-Becerra E, Cortés-Vecino JA, Escandón P, Rodas JD, et al. Molecular evidence of different *Rickettsia* species in Villeta, Colombia. Vector Borne Zoonotic Dis. 2016;16:85–7.
479. Ramirez-Hernandez A, Montoya V, Martinez A, Perez JE, Mercado M, La Ossa A, et al. Molecular detection of *Rickettsia felis* in different flea species from Caldas, Colombia. Am J Trop Med Hyg. 2013;89:453–9.
480. Scorza AV, Duncan C, Miles L, Lappin MR. Prevalence of selected zoonotic and vector-borne agents in dogs and cats in Costa Rica. Vet Parasitol. 2011;183:178–83.
481. Rojas A, Rojas D, Montenegro VM, Baneth G. Detection of *Dirofilaria immitis* and other arthropod-borne filarioids by an HRM real-time qPCR, blood-concentrating techniques and a serological assay in dogs from Costa Rica. Parasit Vectors. 2015;8:170.
482. Montenegro VM, Bonilla MC, Kaminsky D, Romero-Zúñiga JJ, Siebert S, Krämer F. Serological detection of antibodies to *Anaplasma* spp., *Borrelia burgdorferi sensu lato* and *Ehrlichia canis* and of *Dirofilaria immitis* antigen in dogs from Costa Rica. Vet Parasitol. 2017;236:97–107.
483. Reyes L, Silesky E, Cerdas C, Chinchilla M, Guerrero O. Presencia de anticuerpos contra *Trypanosoma cruzi* en perros de Costa Rica. Parasitol Latinoam. 2002;57:66–8.
484. Zeledon R, Solano G, Burstin L, Swartzwelder JC. Epidemiological pattern of Chagas' disease in an endemic area of Costa Rica. Am J Trop Med Hyg. 1975;24:214–25.
485. Montenegro VM, Jimenez M, Dias JCP, Zeledon R. Chagas disease in dogs from endemic areas of Costa Rica. Mem Inst Oswaldo Cruz. 2002;97:491–4.
486. Bonilla MC. Prevalencia de *Anaplasma phagocytophilum* y *Anaplasma platys* en sangre y garrapatas de perros que visitan parques públicos de Costa Rica. Vet Med Thesis, Univ Nacional Costa Rica, Heredia, Costa Rica. 2014.
487. Ábrego L, Dolz G, Romero JJ, Vargas B, Meneses A. Detección molecular de *Anaplasma platys* en perros de Costa Rica. Cienc Vet. 2009;27:71–80.
488. Ábrego Sánchez L, Romero Zuñiga JJ, Vargas Leitón B, Meneses Guevara A, Dolz G. Detección molecular de *Anaplasma platys* en perros de Costa Rica. Acta Med Costarric. 2013;55:89, B-8.
489. Campos L, Salazar L, Dolz G. Detección molecular del agente zoonótico *Anaplasma phagocytophilum* en muestras de sangre de caballos, sangre y garrapatas de perros de Costa Rica. Acta Med Costarric. 2013;55:91, B-12.
490. Barrantes-González A, Bonilla MC, Jiménez-Rocha AE, Montenegro VM, Romero-Zuñiga JJ, Dolz G. Seroprevalencia de *Ehrlichia canis* y *Anaplasma phagocytophilum* en perros que visitan parques recreativos de Costa Rica - estudios preliminares. Acta Med Costarric. 2013;55:68.
491. Rojas N, Troyo A, Castillo D, Gutierrez R, Harrus S. Molecular detection of *Bartonella* species in fleas collected from dogs and cats from Costa Rica. Vector Borne Zoonotic Dis. 2015;15:630–2.
492. Schicht S, Montenegro VM, Pantchev N, Siebert S, Balzer J, Strube C. Vektoren-übertragene Erkrankungen bei Hunden aus Costa Rica und Nicaragua. In: Proceedings Tagung DVG-Fachgruppe "Parasitologie und parasitäre Krankheiten". Berlin, Germany, 2–4 May, 2016. Gießen, Germany: DVG Service GmbH; 2016. p 32–4.
493. Romero LE, Meneses AI, Salazar L, Jiménez M, Romero JJ, Aguiar DM, et al. First isolation and molecular characterization of *Ehrlichia canis* in Costa Rica, Central America. Res Vet Sci. 2011;91:95–7.
494. Barrantes-González AV, Jiménez-Rocha AE, Romero-Zuñiga JJ, Dolz G. Serology, molecular detection and risk factors of *Ehrlichia canis* infection in dogs in Costa Rica. Ticks Tick Borne Dis. 2016;7:1245–51.
495. Meneses-Guevara A, Bouza-Mora L, Huertas-Segura RM, Jiménez-Soto M. Identificación molecular de *Ehrlichia chaffeensis* en perros y animales silvestres de Costa Rica. Acta Med Costarric. 2013;55:67.
496. Moreira-Soto A, Taylor-Castillo L, Calderón-Arguedas O, Hun L, Troyo A. *Rickettsia* spp. del grupo fiebres manchadas asociadas con perros (*Canis lupus familiaris*) de sitios urbanos con casos de fiebre manchada de las Montañas Rocosas en San José, Costa Rica. Acta Med Costarric. 2013;55:65.
497. Hun L, Troyo A, Taylor L, Barbieri AM, Labruna MB. First report of the isolation and molecular characterization of *Rickettsia amblyommii* and *Rickettsia felis* in Central America. Vector Borne Zoonotic Dis. 2011;11:1395–7.
498. Troyo A, Alvarez D, Taylor L, Abdalla G, Calderon-Arguedas O, Zambrano ML, et al. *Rickettsia felis* in *Ctenocephalides felis* from Guatemala and Costa Rica. Am J Trop Med Hyg. 2012;86:1054–6.

499. Sotolongo Guerra F. Incidencia de la *Dirofilaria immitis* en los perros de la ciudad de La Habana. Rev Cubana Med Trop. 1977;29:9–12.
500. Dumenigo Ripoll B, Aguiar Prieto PH, Galvez MD. Prevalencia de *Dirofilaria immitis* en perros de Ciudad de la Habana. Rev Cubana Med Trop. 1982;34:262–8.
501. Perez O, Lastre M, Aguiar PM, Galvez M. Busqueda de Dirofilaria immitis en perros en la provincia Ciudad de La Habana. Rev Cubana Med Trop. 1985;37:174–7.
502. Rodriguez I, Fernandez C, Cinco M, Pedroso R, Fuentes O. Do antiborrelial antibodies suggest Lyme disease in Cuba? Emerg Infect Dis. 2004;10:1698–700.
503. Rodriguez I, Fernandez C, Sanchez L, Martinez B, Siegrist HH, Lienhard R. Prevalence of antibodies to *Borrelia burgdorferi sensu stricto* in humans from a Cuban village. Braz J Infect Dis. 2012;16:82–5.
504. Rodríguez I, Fernández C, Sánchez L, Martínez B, Siegrist HH, Lienhard R. Serological evidences suggest *Borrelia burgdorferi sensu lato* infection in Cuba. Braz J Infect Dis. 2012;16:405–6.
505. Dessau RB. Infection due to *Borrelia burgdorferi* most likely does not occur in Cuba. Braz J Infect Dis. 2012;16:404 (Author reply: 405–6).
506. Duran-Struuck R, Jost C, Hernandez AH. *Dirofilaria immitis* prevalence in a canine population in the Samana Peninsula (Dominican Republic)- June 2001. Vet Parasitol. 2005;133:323–7.
507. Manda JA. Transplacental migration of *Dirofilaria immitis* microfilariae. Comp Anim Pract. 1989;19:18–20.
508. Johnson RN, Young DG, Butler JF, Bogaert-Diaz H. Possible determination of the vector and reservoir of leishmaniasis in the Dominican Republic. Am J Trop Med Hyg. 1992;46:282–7.
509. Schnur LF, Walton BC, Bogaert-Diaz H. On the identity of the parasite causing diffuse cutaneous leishmaniasis in the Dominican Republic. Trans R Soc Trop Med Hyg. 1983;77:756–62.
510. Shaw J, Pratlong F, Floeter-Winter L, Ishikawa E, El Baidouri F, Ravel C, Dedet J-P. Characterization of *Leishmania* (*Leishmania*) *waltoni* n. sp. (Kinetoplastida: Trypanosomatidae), the parasite responsible for diffuse cutaneous leishmaniasis in the Dominican Republic. Am J Trop Med Hyg. 2015;93:552–8.
511. Bogaert Díaz H, Martínez D, Quiñones M, de Estévez FN. Leishmaniose anérgica na República Dominicana Estudo de 20 casos. An Bras Dermatol. 1985;60:229–36.
512. Dominguez-Alvarez GG. Prevalencia e identificación de hemoparásitos (*Ehrlichia canis*, *Babesia canis* y *Anaplasma phagocytophilum*) en perros de la ciudad de Cuenca. Vet Med Thesis, Univ de Cuenca, Facul Cienc Agropec, Esc Med Vet Zootecn, Cuenca, Ecuador. 2011, pp 164.
513. Bañuls AL, Jonquieres R, Guerrini F, Le Pont F, Barrera C, Espinel I, et al. Genetic analysis of *Leishmania* parasites in Ecuador: are *Leishmania* (*Viannia*) *panamensis* and *Leishmania* (*V.*) *guyanensis* distinct taxa? Am J Trop Med Hyg. 1999;61:838–45.
514. Dereure J, Espinel I, Barrera C, Guerrini F, Martini A, Echeverria R, et al. Leishmaniose en Equateur 4 Infestation naturelle du chien par *Leishmania panamensis*. Ann Soc Belg Med Trop. 1994;74:29–33.
515. Carrera Vargas C, Narváez AO, Muzzio Aroca J, Shiguango G, Robles LM, Herrera C, Dumonteil E. Seroprevalence of *Trypanosoma cruzi* infection in schoolchildren and in pregnant women from an Amazonian region in Orellana Province, Ecuador. Am J Trop Med Hyg. 2015;93:774–8.
516. Costales JA, Sánchez-Gómez A, Silva-Aycaguer LC, Cevallos W, Tamayo S, Yumiseva CA, et al. A national survey to determine prevalence of *Trypanosoma cruzi* infection among pregnant women in Ecuador. Am J Trop Med Hyg. 2015;92:807–10.
517. Dumonteil E, Herrera C, Martini L, Grijalva MJ, Guevara AG, Costales JA, et al. Chagas disease has not been controlled in Ecuador. PLoS One. 2016;11:e0158145.
518. Giraldo-Ordonez CJ, Tamayo-Nunez MJ. Determinación de la presencia de anticuerpos anti-*Trypanozoma cruzi* en caninos en zonas endémicas para enfermedad de Chagas de la provincia del Guayas: Canton General Villamil Playas-Posorja. Vet Med Thesis, Univ Central del Ecuador, Facul Med Vet Zootecn, Quito, Ecuador; 2012.
519. Grijalva MJ, Escalante L, Paredes RA, Costales JA, Padilla A, Rowland EC, et al. Seroprevalence and risk factors for *Trypanosoma cruzi* infection in the Amazon region of Ecuador. Am J Trop Med Hyg. 2003;69:380–5.
520. Guevara AG, Atherton RD, Wauters MA, Vicuña Y, Nelson M, Prado J, et al. Seroepidemiological study of Chagas disease in the southern Amazon region of Ecuador. Trop Med Health. 2013;41:21–5.
521. Nieto-Sanchez C, Baus EG, Guerrero D, Grijalva MJ. Positive deviance study to inform a Chagas disease control program in southern Ecuador. Mem Inst Oswaldo Cruz. 2015;110:299–309.
522. Quinde-Calderón L, Rios-Quituizaca P, Solorzano L, Dumonteil E. Ten years (2004–2014) of Chagas disease surveillance and vector control in Ecuador: successes and challenges. Trop Med Int Health. 2016;21:84–92.
523. McCown M, Monterroso VH, Grzeszak B. Surveillance of zoonotic and infectious diseases in Ecuador: implications for special operations forces medical operations, personnel, and canines. J Spec Oper Med. 2011;11:61–5.
524. Pesquera C, Portillo A, Palomar AM, Oteo JA. Investigation of tick-borne bacteria (*Rickettsia* spp., *Anaplasma* spp., *Ehrlichia* spp. and *Borrelia* spp.) in ticks collected from Andean tapirs, cattle and vegetation from a protected area in Ecuador. Parasit Vectors. 2015;8:46.
525. Oteo JA, Portillo A, Portero F, Zavala-Castro J, Venzal JM, Labruna MB. "*Candidatus* Rickettsia asemboensis" and *Wolbachia* spp in *Ctenocephalides felis* and *Pulex irritans* fleas removed from dogs in Ecuador. Parasit Vectors. 2014;7:455.
526. Conde Landaverde IM, Escobar Rodriguez AM, Gómez Vides WM. Determinación de la presencia del antígeno de *Dirofilaria inmitis* por inmunocromatografía en pacientes caninos de cinco clínicas veterinarias en la zona norte de San Salvador. Vet Med Thesis, Univ El Salvador, Facul Agron Sci, Dep Zootecn, San Salvador, El Salvador; 2005.
527. Alvarado Sorto JM, Orellana Menjívar SE, Pichinte Gálvez LA. Determinación de presencia del gusano del corazón (*Dirofilaria immitis*) en perros domésticos (*Canis lupus familiaris*) en El Puerto de La Libertad, Departamento de La Libertad y Suchitoto, Departamento de Cuscatlán, El Salvador. Vet Med Thesis, Univ El Salvador, Facul Agron Sci, Dep Med Vet, San Salvador, El Salvador; 2013.
528. Melby PC, Kreutzer RD, McMahon-Pratt D, Gam AA, Neva FA. Cutaneous leishmaniasis: review of 59 cases seen at the National Institutes of Health. Clin Infect Dis. 1992;15:924–37.
529. Cedillos RA, Warren M, Wilton DP, Jeffery GM, Sauerbrey M. Estudio epidemiológico del *Trypanosoma cruzi* en El Salvador. Rev Inst Invest Med El Salvador. 1976;5:119–30.
530. Dedet JP. Cutaneous leishmaniasis in French Guiana: a review. Am J Trop Med Hyg. 1990;43:25–8.
531. Dedet JP, Pradinaud R, Gay F. Epidemiological aspects of human cutaneous leishmaniasis in French Guiana. Trans R Soc Trop Med Hyg. 1989;83:616–20.
532. Martin-Blondel G, Iriart X, El Baidouri F, Simon S, Mills D, Demar M, et al. Outbreak of *Leishmania braziliensis* cutaneous leishmaniasis, Saül, French Guiana. Emerg Infect Dis. 2015;21:892–4.
533. Pajot FX, Le Pont F, Gentile B, Besnard R. Epidemiology of leishmaniasis in French Guiana. Trans R Soc Trop Med Hyg. 1982;76:112–3.
534. Raccurt CP, Pratlong F, Moreau B, Pradinaud R, Dedet JP. French Guiana must be recognized as an endemic area of *Leishmania* (*Viannia*) *braziliensis* in South America. Trans R Soc Trop Med Hyg. 1995;89:372.
535. Simon S, Nacher M, Carme B, Basurko C, Roger A, Adenis A, et al. Cutaneous leishmaniasis in French Guiana: revising epidemiology with PCR-RFLP. Trop Med Health. 2017;45:5.
536. Rotureau B, Joubert M, Clyti E, Djossou F, Carme B. Leishmaniasis among gold miners, French Guiana. Emerg Infect Dis. 2006;12:1169–70.
537. Rotureau B, Ravel C, Nacher M, Couppié P, Curtet I, Dedet J-P, Carme B. Molecular epidemiology of *Leishmania* (*Viannia*) *guyanensis* in French Guiana. J Clin Microbiol. 2006;44:468–73.
538. Rotureau B, Ravel C, Aznar C, Carme B, Dedet J-P. First report of *Leishmania infantum* in French Guiana: canine visceral leishmaniasis imported from the Old World. J Clin Microbiol. 2006;44:1120–2.
539. Rougeron V, Catzeflis F, Hide M, de Meeûs T, Bañuls A-L. First clinical case of cutaneous leishmaniasis due to *Leishmania* (*Viannia*) *braziliensis* in a domestic cat from French Guiana. Vet Parasitol. 2011;181:325–8.
540. Aznar C, Ruche G, Laventure S, Carme B, Liegeard P, Hontebeyrie M. Seroprevalence of *Trypanosoma cruzi* infection in French Guiana. Mem Inst Oswaldo Cruz. 2004;99:805–8.
541. Blanchet D, Brenière SF, Schijman AG, Bisio M, Simon S, Véron V, et al. First report of a family outbreak of Chagas disease in French Guiana and posttreatment follow-up. Infect Genet Evol. 2014;28:245–50.
542. Bwititi PT, Browne J. Seroprevalence of *Trypanosoma cruzi* in blood donors at the National Blood Transfusion Services - Guyana. West Indian Med J. 2012;61:559–63.

543. Carme B, Aune I, Nguyen G, Aznar C, Beaudet B. Four cases of acute chagasic myocarditis in French Guiana. Am J Trop Med Hyg. 2001;64:162–3.
544. Esterre P, Dedet JP. Current status of Chagas disease in French Guiana. Rev Soc Bras Med Trop. 1987;20:139–42.
545. Raccurt CP. *Trypanosoma cruzi* en Guyane Francaise: revue des donnees accumulees depuis. Med Trop (Mars). 1996;56:79–87.
546. Raccurt CP. Résurgence de la maladie de Chagas en Guyane française: Un défi a relever. Med Trop (Mars). 1999;59:99.
547. Dahmani M, Marie J-L, Mediannikov O, Raoult D, Davoust B. First identification of *Anaplasma platys* in the blood of dogs from French Guiana. Vector Borne Zoonotic Dis. 2015;15:170–2.
548. Davoust B, Keundjian A, Rous V, Maurizi L, Parzy D. Validation of chemoprevention of canine monocytic ehrlichiosis with doxycycline. Vet Microbiol. 2005;107:279–83.
549. Ryan PR, Arana BA, Ryan JR, Wirtz RA, Wortmann GW, Rizzo NR. The domestic dog, a potential reservoir for *Leishmania* in the Peten region of Guatemala. Vet Parasitol. 2003;115:1–7.
550. Bustamante DM, de Urioste-Stone SM, Juarez JG, Pennington PM. Ecological, social and biological risk factors for continued *Trypanosoma cruzi* transmission by *Triatoma dimidiata* in Guatemala. PLoS One. 2014;9:e104599.
551. Bai Y, Rizzo MF, Alvarez D, Moran D, Peruski LF, Kosoy M. Coexistence of *Bartonella henselae* and *B clarridgeiae* in populations of cats and their fleas in Guatemala. J Vector Ecol. 2015;40:327–32.
552. Orihel TC. Canine filariasis in British Guiana. J Parasitol. 1964;50:33 (abstract 55).
553. Low-A-Chee RM, Rose P, Ridley DS. An outbreak of cutaneous leishmaniasis in Guyana: epidemiology, clinical and laboratory aspects. Ann Trop Med Parasitol. 1983;77:255–60.
554. Rawlins SC, Tiwari T, Chadee DD, Validum L, Alexander H, Nazeer R, Rawlins SR. American cutaneous leishmaniasis in Guyana, South America. Ann Trop Med Parasitol. 2001;95:245–51.
555. Thierry J, Borel E, Courrier PL, Courtois D, Mojon M. Leishmaniose cutanee sud-americaine Diagnostic parasitologique et serologique par immunofluorescence indirecte (IFI) et enzyme linked immuno assay (ELISA). A propos de 94 cas. Med Trop (Mars). 1991;51:43–8.
556. Soto Castro SJ. Determinación de la incidencia de la *Dirofilaria immitis* por medio del método de Knott, en el municipio de Roatán, Islas de la Bahía. Vet Med Thesis, Univ San Carlos de Guatemala, Facul Vet Med and Zootecn, Guatemala, Guatemala; 2007.
557. McCown M, Grzeszak B. Zoonotic and infectious disease surveillance in Central America: Honduran feral cats positive for *Toxoplasma*, *Trypanosoma*, *Leishmania*, *Rickettsia*, and Lyme disease. J Spec Oper Med. 2010;10:41–3.
558. Acosta L, Romanha AJ, Cosenza H, Krettli AU. Trypanosomatid isolates from Honduras: differentiation between *Trypanosoma cruzi* and *Trypanosoma rangeli*. Am J Trop Med Hyg. 1991;44:676–83.
559. Navin TR, Sierra M, Custodio R, Steurer F, Porter CH, Ruebush TK. Epidemiologic study of visceral leishmaniasis in Honduras, 1975–1983. Am J Trop Med Hyg. 1985;34:1069–75.
560. Noyes H, Chance M, Ponce C, Ponce E, Maingon R. *Leishmania chagasi*: genotypically similar parasites from Honduras cause both visceral and cutaneous leishmaniasis in humans. Exp Parasitol. 1997;85:264–73.
561. Ponce C, Ponce E, Morrison A, Cruz A, Kreutzer R, McMahon-Pratt D, Neva F. *Leishmania donovani chagasi*: new clinical variant of cutaneous leishmaniasis in Honduras. Lancet. 1991;337:67–70.
562. Sosa-Ochoa W, Bonilla E, Fontecha G. Caracterización molecular de especies de *Ehrlichia* en perros, Distrito Central, Honduras. Acta Med Costarric. 2013;55:86, B-2.
563. Lira-Amaya JJ, Comas-González AG, Álvarez-Martínez JA, Rojas-Martínez C, Figueroa-Millán JV. Detección molecular en perros de co-infección múltiple con patógenos transmitidos por garrapatas. Primer reporte en México. Actualidad Med Vet Zootecn Mexico. 2013;5:30–5.
564. Osorno BM, Ristic M. *Babesia canis* en perros de México. Rev Mex Cienc Pecuarias. 1974;26:1–5.
565. Bolio-Gonzalez ME, Rodriguez-Vivas RI, Sauri-Arceo CH, Gutierrez-Blanco E, Ortega-Pacheco A, Colin-Flores RF. Prevalence of the *Dirofilaria immitis* infection in dogs from Merida, Yucatan, Mexico. Vet Parasitol. 2007;148:166–9.
566. Caro-Gonzalez JA, Bolio-Gonzalez ME, Escobedo-Ortegon FJ, Manrique-Saide P, Rodriguez-Vivas RI, Rodriguez-Buenfil JC, Sauri-Arceo CH. Prevalence of *Dirofilaria immitis* infection in dogs from Celestun, Mexico, using polymerase chain reaction test. Vector Borne Zoonotic Dis. 2011;11:193–6.
567. Cruz-Chan JV, Quijano-Hernandez I, Ramirez-Sierra MJ, Dumonteil E. *Dirofilaria immitis* and *Trypanosoma cruzi* natural co-infection in dogs. Vet J. 2010;186:399–401.
568. Arjona-Jiménez G, Villegas N, López-Céspedes A, Marín C, Longoni SS, Bolio-González ME, et al. Prevalence of antibodies against three species of *Leishmania* (*L. mexicana, L. braziliensis, L. infantum*) and possible associated factors in dogs from Merida, Yucatan, Mexico. Trans R Soc Trop Med Hyg. 2012;106:252–8.
569. López Céspedes Á. Fe-SODe: Diagnóstico y seroprevalencia de la leishmaniasis y la enfermedad de Chagas en Mexico. Thesis: Univ de Granada, Facul Cienc, Dep Parasitol, Granada, Spain; 2013.
570. López-Céspedes A, Longoni SS, Sauri-Arceo CH, Sanchez-Moreno M, Rodriguez-Vivas RI, Escobedo-Ortegon FJ, et al. *Leishmania* spp epidemiology of canine leishmaniasis in the Yucatan Peninsula. Sci World J. 2012;2012:945871.
571. Pastor-Santiago JA, Chavez-Lopez S, Guzman-Bracho C, Flisser A, Olivo-Diaz A. American visceral leishmaniasis in Chiapas, Mexico. Am J Trop Med Hyg. 2012;86:108–14.
572. Balan LU, Yerbes IM, Pina MAN, Balmes J, Pascual A, Hernandez O, et al. Higher seroprevalence of *Trypanosoma cruzi* infection in dogs than in humans in an urban area of Campeche, Mexico. Vector Borne Zoonotic Dis. 2011;11:843–4.
573. Barbabosa-Pliego A, Gil PC, Hernandez DO, Aparicio-Burgos JE, de Oca-Jimenez RM, Martinez-Castaneda JS, et al. Prevalence of *Trypanosoma cruzi* in dogs (*Canis familiaris*) and triatomines during 2008 in a sanitary region of the State of Mexico, Mexico. Vector Borne Zoonotic Dis. 2011;11:151–6.
574. Estrada-Franco JG, Bhatia V, Diaz-Albiter H, Ochoa-Garcia L, Barbabosa A, Vazquez-Chagoyan JC, et al. Human *Trypanosoma cruzi* infection and seropositivity in dogs, Mexico. Emerg Infect Dis. 2006;12:624–30.
575. Jiménez-Coello M, Guzman-Marin E, Ortega-Pacheco A, Acosta-Viana KY. Serological survey of American trypanosomiasis in dogs and their owners from an urban area of Merida Yucatan, Mexico. Transbound Emerg Dis. 2010;57:33–6.
576. Jimenez-Coello M, Ortega-Pacheco A, Guzman-Marin E, Guiris-Andrade DM, Martinez-Figueroa L, Acosta-Viana KY. Stray dogs as reservoirs of the zoonotic agents *Leptospira interrogans*, *Trypanosoma cruzi*, and *Aspergillus* spp. in an urban area of Chiapas in southern Mexico. Vector Borne Zoonotic Dis. 2010;10:135–41.
577. Jimenez-Coello M, Poot-Cob M, Ortega-Pacheco A, Guzman-Marin E, Ramos-Ligonio A, Sauri-Arceo CH, Acosta-Viana KY. American trypanosomiasis in dogs from an urban and rural area of Yucatan, Mexico. Vector Borne Zoonotic Dis. 2008;8:755–61.
578. Longoni SS, Marin C, Sauri-Arceo CH, Lopez-Cespedes A, Rodriguez-Vivas RI, Villegas N, et al. An iron-superoxide dismutase antigen-based serological screening of dogs indicates their potential role in the transmission of cutaneous leishmaniasis and trypanosomiasis in Yucatan, Mexico. Vector Borne Zoonotic Dis. 2011;11:815–21.
579. López-Cespedes A, Longoni SS, Sauri-Arceo CH, Rodriguez-Vivas RI, Villegas N, Escobedo-Ortegon J, et al. Seroprevalence of antibodies against the excreted antigen superoxide dismutase by *Trypanosoma cruzi* in dogs from the Yucatan Peninsula (Mexico). Zoonoses Public Hlth. 2013;60:277–83.
580. Jiménez-Coello M, Acosta-Viana KY, Guzman-Marin E, Gomez-Rios A, Ortega-Pacheco A. Epidemiological survey of *Trypanosoma cruzi* infection in domestic owned cats from the tropical southeast of Mexico. Zoonoses Public Hlth. 2012;59(Suppl 2):102–9.
581. Longoni SS, López-Cespedes A, Sánchez-Moreno M, Bolio-Gonzalez ME, Sauri-Arceo CH, Rodríguez-Vivas RI, Marín C. Detection of different *Leishmania* spp. and *Trypanosoma cruzi* antibodies in cats from the Yucatan Peninsula (Mexico) using an iron superoxide dismutase excreted as antigen. Comp Immunol Microbiol Infect Dis. 2012;35:469–76.
582. Silva AB, Canseco S, Torre MDP, Mayoral Silva A, Mayoral MA, Mayoral L, et al. Infeccion humana asintomatica por contacto con perros. Un caso de ehrlichiosis humana. Gac Med Mex. 2014;150:171–4.

583. Salinas Meléndez JA, Hernández Escareño JJ, Riojas Valdés VM, Avalos Ramírez R, Zarate Ramos JJ, Zamora Ávila DE, et al. Prevalencia de *Anaplasma phagocytophilum* en caninos de Monterrey; 2011. In: Proceedings XXVI Congreso Nacional de Investigación en Medicina. Cintermex, Monterrey, Nuevo Léon, Mexico, 22–24 September, 2011.
584. Almazán C, González-Álvarez VH, Mera IG, Cabezas-Cruz A, Rodríguez-Martínez R, La Fuente J. Molecular identification and characterization of *Anaplasma platys* and *Ehrlichia canis* in dogs in Mexico. Ticks Tick Borne Dis. 2016;7:276–83.
585. Galaviz-Silva L, Perez-Trevino KC, Molina-Garza ZJ. Distribution of ixodid ticks on dogs in Nuevo Leon, Mexico, and their association with *Borrelia burgdorferi sensu lato*. Exp Appl Acarol. 2013;61:491–501.
586. Tinoco-Gracia L, Quiroz-Romero H, Quintero-Martinez MT, Renteria-Evangelista TB, Barreras-Serrano A, Lopez-Valencia G, et al. Seroprevalence of *Borrelia burgdorferi* in dogs from a Mexico-US border desert region: pilot study. J Anim Vet Adv. 2007;6:787–9.
587. Gordillo G, Torres J, Solorzano F, Cedillo-Rivera R, Tapia-Conyer R, Muñoz O. Serologic evidences suggesting the presence of *Borrelia burgdorferi* infection in Mexico. Arch Med Res. 1999;30:64–8.
588. Gordillo-Perez G, Torres J, Solorzano-Santos F, Garduno-Bautista V, Tapia-Conyer R, Munoz O. Estudio seroepidemiologico de borreliosis de Lyme en la Ciudad de Mexico y el noreste de la Republica Mexicana. Salud Publica Mex. 2003;45:351–5.
589. Gordillo-Pérez G, Vargas M, Solórzano-Santos F, Rivera A, Polaco OJ, Alvarado L, et al. Demonstration of *Borrelia burgdorferi sensu stricto* infection in ticks from the northeast of Mexico. Clin Microbiol Infect. 2009;15:496–8.
590. Jiménez-Coello M, Perez-Osorio C, Vado-Solis I, Rodriguez-Buenfil JC, Ortega-Pacheco A. Serological survey of *Ehrlichia canis* in stray dogs from Yucatan, Mexico, using two different diagnostic tests. Vector Borne Zoonotic Dis. 2009;9:209–12.
591. Rodriguez-Vivas RI, Albornoz REF, Bolio GME. *Ehrlichia canis* in dogs in Yucatan, Mexico: seroprevalence, prevalence of infection and associated factors. Vet Parasitol. 2005;127:75–9.
592. Sosa-Gutierrez CG, Quintero Martinez MT, Gaxiola Camacho SM, Cota Guajardo S, Esteve-Gassent MD, Gordillo-Perez M-G. Frequency and clinical epidemiology of canine monocytic ehrlichiosis in dogs infested with ticks from Sinaloa, Mexico. J Vet Med. 2013;2013:797019.
593. Pat-Nah H, Rodriguez-Vivas RI, Bolio-Gonzalez ME, Villegas-Perez SL, Reyes-Novelo E. Molecular diagnosis of *Ehrlichia canis* in dogs and ticks *Rhipicephalus sanguineus* (Acari: Ixodidae) in Yucatan, Mexico. J Med Entomol. 2015;52:101–4.
594. Álvarez-Hernández G, Roldán JFG, Milan NSH, Lash RR, Behravesh CB, Paddock CD. Rocky Mountain spotted fever in Mexico: past, present, and future. Lancet Infect Dis. 2017;17:e189–96.
595. Zavala-Velazquez JE, Zavala-Castro JE, Vado-Solis I, Ruiz-Sosa JA, Moron CG, Bouyer DH, Walker DH. Identification of *Ctenocephalides felis* fleas as a host of *Rickettsia felis*, the agent of a spotted fever rickettsiosis in Yucatan, Mexico. Vector Borne Zoonotic Dis. 2002;2:69–75.
596. Zavala-Castro JE, Zavala-Velazquez JE, del Rosario Garcia M, Leon JJA, Dzul-Rosado KR. A dog naturally infected with *Rickettsia akari* in Yucatan, Mexico. Vector Borne Zoonotic Dis. 2009;9:345–7.
597. Dzul-Rosado K, López Ávila K, Reyes-Novelo E, Sauri-Arceo C, Zavala-Castro J. Rickettsia spp en ectoparásitos de perros de una comunidad rural de Yucatán. México. Acta Med Costarric. 2013;55:80, A-13.
598. Wei L, Kelly P, Ackerson K, Zhang J, El-Mahallawy HS, Kaltenboeck B, Wang C. First report of *Babesia gibsoni* in Central America and survey for vector-borne infections in dogs from Nicaragua. Parasit Vectors. 2014;7:126.
599. Rimbaud E, Mayorga M, Molina L, Sandoval ML. Primer diagnóstico de *Dirofilaria immitis* afectando caninos en Managua, Nicaragua. Bol Parasitol UNA Costa Rica. 2009;10:1–4.
600. Belli A, García D, Palacios X, Rodriguez B, Valle S, Videa E, et al. Widespread atypical cutaneous leishmaniasis caused by *Leishmania* (*L.*) *chagasi* in Nicaragua. Am J Trop Med Hyg. 1999;61:380–5.
601. Belli AA, Miles MA, Kelly JM. A putative *Leishmania panamensis*/*Leishmania braziliensis* hybrid is a causative agent of human cutaneous leishmaniasis in Nicaragua. Parasitology. 1994;109:435–42.
602. Oca NV, Alonso C, Martinez R, Francisco N, Perez Insueta O. Estudio serologico para el diagnostico de la enfermedad de Chagas en estudiantes nicaraguenses de la Isla de la Juventud. Rev Cubana Med Trop. 1989;41:405–12.
603. Palacios X, Belli A, Espino AM. Deteccion de anticuerpos contra *Trypanosoma cruzi* en Somoto, Nicaragua, mediante ELISA indirecto e IFI en muestras de sangre en papel de filtro. Rev Panam Salud Publica. 2000;8:411–7.
604. Rivas Lara V, Molina Arancibia D, Saenz M, Bonilla JL. Hallazgo de ehrlichiosis canina causada por *E. canis* en una comunidad del Municipio de León, Nicaragua. Rev Electr Vet (REDVET) 1695–7504. 2010;11:1–10.
605. Schicht S, Montenegro VM, Wölfel S, Schaper SR, Chitimia-Dobler L, Siebert S, et al. Nachweis von *Rickettsia monacensis* und *Rickettsia amblyommii* in Zecken aus Mittelamerika. In: Proceedings Tagung DVG-Fachgruppe "Parasitologie und parasitäre Krankheiten". Hannover, Germany, 12–14 June, 2017. Gießen, Germany: DVG Service GmbH; 2017. p. 159–61.
606. Herrer A, Christensen HA. Epidemiological patterns of cutaneous leishmaniasis in Panama. I. Epidemics among small groups of settlers. Ann Trop Med Parasitol. 1976;70:59–65.
607. Herrer A, Christensen HA. Natural cutaneous leishmaniasis among dogs in Panama. Am J Trop Med Hyg. 1976;25:59–63.
608. Herrer A, Christensen HA. Epidemiological patterns of cutaneous leishmaniasis in Panama. III. Endemic persistence of the disease. Am J Trop Med Hyg. 1976;25:54–8.
609. Herrer A, Christensen HA, Beumer RJ. Epidemiological patterns of cutaneous leishmaniasis in Panama. II. Incidental occurrence of cases in non-endemic settlements. Ann Trop Med Parasitol. 1976;70:67–71.
610. Calzada JE, Saldana A, Gonzalez K, Rigg C, Pineda V, Santamaria AM, et al. Cutaneous leishmaniasis in dogs: is high seroprevalence indicative of a reservoir role? Parasitology. 2015;142:1202–14.
611. Pineda V, Saldana A, Monfante I, Santamaria A, Gottdenker NL, Yabsley MJ, et al. Prevalence of trypanosome infections in dogs from Chagas disease endemic regions in Panama, Central America. Vet Parasitol. 2011;178:360–3.
612. Santamaria A, Calzada JE, Saldana A, Yabsley MJ, Gottdenker NL. Molecular diagnosis and species identification of *Ehrlichia* and *Anaplasma* infections in dogs from Panama, Central America. Vector Borne Zoonotic Dis. 2014;14:368–70.
613. Eremeeva ME, Karpathy SE, Levin ML, Caballero CM, Bermudez S, Dasch GA, Motta JA. Spotted fever rickettsiae, *Ehrlichia* and *Anaplasma*, in ticks from peridomestic environments in Panama. Clin Microbiol Infect. 2009;15(Suppl. 2):12–4.
614. Bermúdez CSE, Zaldivar AY, Spolidorio MG, Moraes-Filho J, Miranda RJ, Caballero CM, et al. Rickettsial infection in domestic mammals and their ectoparasites in El Valle de Anton, Cocle, Panama. Vet Parasitol. 2011;177:134–8.
615. Bermúdez S, Miranda R, Zaldivar Y, Gonzalez P, Berguido G, Trejos D, et al. Deteccion de *Rickettsia* spp. en ectoparasitos de animales domesticos y silvestres de la Reserva Natural Privada Cerro Chucanti y comunidades aledanas, Panama, 2007–2010. Biomedica. 2012;32:189–95.
616. Bermúdez SE, Castro AM, Trejos D, García GG, Gabster A, Miranda RJ, et al. Distribution of spotted fever group rickettsiae in hard ticks (Ixodida: Ixodidae) from Panamanian urban and rural environments (2007–2013). EcoHealth. 2016;13:274–84.
617. Ferrell AM, Brinkerhoff RJ, Bernal J, Bermúdez SE. Ticks and tick-borne pathogens of dogs along an elevational and land-use gradient in Chiriquí Province, Panamá. Exp Appl Acarol. 2017;71:371–85.
618. Inácio EL, Pérez-Macchi S, Alabi A, Bittencourt P, Müller A. Prevalence and molecular characterization of piroplasmids in domestic dogs from Paraguay. Ticks Tick Borne Dis. 2019;10:321–7.
619. Masi Pallares R, Rojas E, Usher C, Vergara G. Helmintiosis en perros de Asunción (Paraguay). Rev Parag Microbiol. 1967;2:67–70.
620. Canese A. Leishmaniosis visceral canina en el area metropolitana de la "Gran Asunción", Paraguay. Medicina (Buenos Aires). 2000;60(Suppl. 3):65.
621. Miret J, Medina M, Velázquez AL, Sosa L, Castagnino M. Leishmaniosis visceral en caninos errantes en la ciudad de Asunción, Paraguay. Rev Parag Epidemiol. 2011;2:13–22.
622. Sosa L, Castagnino M, Miret J, Páez M. Prevalencia de leishmaniosis visceral canina a partir de intervenciones de focos de leishmaniosis visceral humana, en la ciudad de San Lorenzo (Paraguay), año 2009. Rev Parag Epidemiol. 2011;2:23–32.

623. Chapman MD, Baggaley RC, Godfrey-Fausset PF, Malpas TJ, White G, Canese J, Miles MA. *Trypanosoma cruzi* from the Paraguayan Chaco: isoenzyme profiles of strains isolated at Makthlawaiya. J Protozool. 1984;31:482–6.
624. Fujita O, Sanabria L, Inchaustti A, de Arias AR, Tomizawa Y, Oku Y. Animal reservoirs for *Trypanosoma cruzi* infection in an endemic area in Paraguay. J Vet Med Sci. 1994;56:305–8.
625. Pérez-Macchi S, Pedrozo R, Bittencourt P, Müller A. Prevalence, molecular characterization and risk factor analysis of *Ehrlichia canis* and *Anaplasma platys* in domestic dogs from Paraguay. Comp Immunol Microbiol Infect Dis. 2019;62:31–9.
626. Adrianzén JG, Chávez AV, Casas EA, Li OE. Seroprevalencia de la dirofilariosis y ehrlichiosis canina en tres distritos de Lima. Rev Invest Vet Perú. 2003;14:43–8.
627. Labarthe N, Guerrero J. Epidemiology of heartworm: what is happening in South America and Mexico? Vet Parasitol. 2005;133:149–56.
628. Acuña PU, Chávez AV. Determinación de la prevalencia de *Dirofilaria immitis* en los distritos de San Martín de Porres, Rímac y Cercado de Lima. Rev Invest Vet Perú. 2002;13:108–10.
629. Bravo RM, Chávez AV, Casas EA, Suárez FA. Dirofilariosis canina en los distritos colindantes con la ribera del río Lurín. Rev Invest Vet Perú. 2002;13:80–3.
630. Chipana CQ, Chávez AV, Casas EA, Suárez FA. Estudio de la dirofilariosis canina en la ribera del río Chillón, Lima. Rev Invest Vet Perú. 2002;13:72–6.
631. Llanos-Cuentas EA, Roncal N, Villaseca P, Paz L, Ogusuku E, Perez JE, et al. Natural infections of *Leishmania peruviana* in animals in the Peruvian Andes. Trans R Soc Trop Med Hyg. 1999;93:15–20.
632. Reithinger R, Lambson BE, Barker DC, Davies CR. Use of PCR to detect *Leishmania* (*Viannia*) spp in dog blood and bone marrow. J Clin Microbiol. 2000;38:748–51.
633. Reithinger R, Espinoza JC, Davies CR. The transmission dynamics of canine American cutaneous leishmaniasis in Huanuco, Peru. Am J Trop Med Hyg. 2003;69:473–80.
634. Reithinger R, Canales Espinoza J, Llanos-Cuentas A, Davies CR. Domestic dog ownership: a risk factor for human infection with *Leishmania* (*Viannia*) species. Trans R Soc Trop Med Hyg. 2003;97:141–5.
635. Reithinger R, Davies CR. American cutaneous leishmaniasis in domestic dogs: an example of the use of the polymerase chain reaction for mass screening in epidemiological studies. Trans R Soc Trop Med Hyg. 2002;96(Suppl. 1):S123–6.
636. Castillo-Neyra R, Chou Chu L, Quispe-Machaca V, Ancca-Juarez J, Malaga Chavez FS, Bastos Mazuelos M, et al. The potential of canine sentinels for reemerging *Trypanosoma cruzi* transmission. Prev Vet Med. 2015;120:349–56.
637. Alroy KA, Huang C, Gilman RH, Quispe-Machaca VR, Marks MA, Ancca-Juarez J, et al. Prevalence and transmission of *Trypanosoma cruzi* in people of rural communities of the high jungle of northern Peru. PLoS Negl Trop Dis. 2015;9:e0003779.
638. García JM, Lázaro LM, Chía JP, Escalante MA. Frecuencia de pobladores y animales domésticos del caserío de Chirinos (Piura) con anticuerpos a *Trypanosoma cruzi* entre abril a diciembre del 2000. Rev Peru Parasitol. 2002;16:35–40.
639. Rubio A, Salas E, Gómez G. Presencia de anticuerpos contra *Borrelia burgdorferi* y *Anaplasma* sp. en canes de la ciudad de Lima. Rev Invest Vet Perú. 2011;22:233–8.
640. Tateishi VT, Lí OE, Hoyos LS, Rivera HG, Manchego AS, Barrios LA, More JB. Identificación hematológica y molecular de *Anaplasma platys* en caninos domésticos de Lima Metropolitana con signos clínicos compatibles con anaplasmosis. Rev Invest Vet Perú. 2015;26:111–8.
641. Diniz PPVP, Morton BA, Tngrian M, Kachani M, Barron EA, Gavidia CM, et al. Infection of domestic dogs in peru by zoonotic *Bartonella* species: a cross-sectional prevalence study of 219 asymptomatic dogs. PLoS Negl Trop Dis. 2013;7:e2393.
642. Rizzo MF, Billeter SA, Osikowicz L, Luna-Caipo DV, Caceres AG, Kosoy M. Fleas and flea-associated *Bartonella* species in dogs and cats from Peru. J Med Entomol. 2015;52:1374–7.
643. Glenny MA, Mendoza LU, Falconí ER. Detección de anticuerpos contra *Borrelia burgdorferi* e identificación de garrapatas ixodidas en Piura Y Amazonas, Perú. Rev Peru Med Exp Salud Publica. 2004;20:23–7.
644. Macedo SA, Cuadra ALK, Cáceres I, Elliot A, Avila G, Arévalo JA, et al. Diagnóstico serológico (ELISA) de borreliosis de Lyme en un grupo humano de riesgo, Piura-Perú. Rev Peru Med Trop. 1992;6:31–7.
645. Vinasco J, Li O, Alvarado A, Diaz D, Hoyos L, Tabachi L, et al. Molecular evidence of a new strain of *Ehrlichia canis* from South America. J Clin Microbiol. 2007;45:2716–9.
646. Barrios LA, Lí OE, Suárez FA, Manchego AS, Hoyos LS. Evidencia hematológica y serológica de *Ehrlichia* spp. en propietarios de caninos domésticos con antecedentes de ehrlichiosis en Lima Metropolitana. Rev Invest Vet Perú. 2013;24:64–71.
647. Forshey BM, Stewart A, Morrison AC, Galvez H, Rocha C, Astete H, et al. Epidemiology of spotted fever group and typhus group rickettsial infection in the Amazon basin of Peru. Am J Trop Med Hyg. 2010;82:683–90.
648. Flores-Mendoza C, Florin D, Felices V, Pozo EJ, Graf PCF, Burrus RG, Richards AL. Detection of *Rickettsia parkeri* from within Piura, Peru, and the first reported presence of *Candidatus* Rickettsia andeanae in the tick *Rhipicephalus sanguineus*. Vector Borne Zoonotic Dis. 2013;13:505–8.
649. McCown ME, Opel T, Grzeszak B. Vector-borne disease surveillance in Puerto Rico: pathogen prevalence rates in canines-implications for public health and the U.S. Military-applying the One Health concept. J Spec Oper Med. 2013;13:59–63.
650. Kozek WJ, Vazquez AE, Gonzalez C Jr, Iguina J, Sanchez E, Jesus F de, et al. Prevalence of canine filariae in Puerto Rico and the Caribbean. In: Soll MD, Knight DH, editors. In: Proceedings of the Heartworm Symposium '95. Batavia, IL, USA: American Heartworm Society; 1995. p. 55–64.
651. Villanueva EJ, Rodriguez-Perez J. Immunodiagnosis of human dirofilariasis in Puerto Rico. Am J Trop Med Hyg. 1993;48:536–41.
652. Frickers J. Het voorkomen van *Dipylidium caninum* (Linné 1758); *Toxocara canis* (Werner 1782); *Ancylostoma caninum* (Ercolani 1859); *Dirofilaria immitis* (Leydi 1856); en *Spirocerca sanquinolenta* (Rudolphi 1819) bij den hond (*Canis familiaris*) in Suriname. Tijdschr Diergeneeskd. 1938;65:921–4.
653. Langeler J. Aantekeningen bij de in Suriname meest voorkomende ziekten van huisdieren. Tijdschr Diergeneeskd. 1956;81:417–29.
654. Rep BH. Hook worms and other helminths in dogs, cats and man in Surinam. Trop Geogr Med. 1968;20:262–70.
655. Rep BH, Heinemann DW. Changes in hookworm distribution in Surinam. Trop Geogr Med. 1976;28:104–10.
656. Panday RS, Joe RG, Moll KF, Oemrawsingh I. *Dirofilaria* in dogs of Surinam. Vet Q. 1981;3:25–30.
657. Hu RVPF, Kent AD, Adams ER, van der Veer C, Sabajo LOA, Mans DRA, et al. First case of cutaneous leishmaniasis caused by *Leishmania* (*Viannia*) *braziliensis* in Suriname. Am J Trop Med Hyg. 2012;86:825–7.
658. Lai A, Fat EJ, Vrede MA, Soetosenojo RM, Lai A, Fat RFM. Pentamidine, the drug of choice for the treatment of cutaneous leishmaniasis in Surinam. Int J Dermatol. 2002;41:796–800.
659. van der Meide W, de Vries H, Pratlong F, van der Wal A, Sabajo L. *Leishmania* (*Leishmania*) *amazonensis* infection, Suriname. Emerg Infect Dis. 2008;14:857–9.
660. Meide WF, Jensema AJ, Akrum RAE, Sabajo LOA, Lai A, Fat RFM, Lambregts L, et al. Epidemiology of cutaneous leishmaniasis in Suriname: a study performed in 2006. Am J Trop Med Hyg. 2008;79:192–7.
661. van Thiel P-P, van Gool T, Kager PA, Bart A. First cases of cutaneous leishmaniasis caused by *Leishmania* (*Viannia*) *naiffi* infection in Surinam. Am J Trop Med Hyg. 2010;82:588–90.
662. Kent A, Ramkalup P, Mans D, Schallig H. Is the dog a possible reservoir for cutaneous leishmaniasis in Suriname? J Trop Med. 2013;1:324140.
663. Kent AD, Dos Santos TV, Gangadin A, Samjhawan A, Mans DRA, Schallig HDFH. Studies on the sand fly fauna (Diptera: Psychodidae) in high-transmission areas of cutaneous leishmaniasis in the Republic of Suriname. Parasit Vectors. 2013;6:318.
664. Bansse-Issa L, Lieuw-A-Joe R, Rozenblad E. *Trypanosoma* in hunting dogs: a case study. In: Vokaty S, Desquesnes M, editors. In: Proceedings of First Symposium on New World Trypanosomes; 1999. p. 75.
665. Oostburg BF, Anijs JE, Oehlers GP, Hiwat HO, Burke-Hermelijn SM. Case report: the first parasitologically confirmed autochthonous case of acute Chagas disease in Suriname. Trans R Soc Trop Med Hyg. 2003;97:166–7.

666. Satragno D, Faral-Tello P, Canneva B, Verger L, Lozano A, Vitale E, et al. Autochthonous outbreak and expansion of canine visceral leishmaniasis, Uruguay. Emerg Infect Dis. 2017;23:536–8.
667. Moncayo A, Ortiz Yanine MI. An update on Chagas disease (human American trypanosomiasis). Ann Trop Med Parasitol. 2006;100:663–77.
668. Salvatella R, Calegari L, Casserone S, Civila E, Carbajal S, Perez G, et al. Seroprevalencia de anticuerpos contra *Trypanosoma cruzi* en 13 departamentos del Uruguay. Bol Oficina Sanit Panam. 1989;107:108–17.
669. Schmunis GA. Prevention of transfusional *Trypanosoma cruzi* infection in Latin America. Mem Inst Oswaldo Cruz. 1999;94(Suppl. 1):93–101.
670. Schofield CJ, Dias JC. The Southern Cone Initiative against Chagas disease. Adv Parasitol. 1999;42:1–27.
671. Carvalho L, Armua-Fernandez MT, Sosa N, Félix ML, Venzal JM. *Anaplasma platys* in dogs from Uruguay. Ticks Tick Borne Dis. 2017;8:241–5.
672. Medici Olaso C, García Gariglio L, Ferreira García MI, Giachetto Larraz G, Gutierrez Bottino MC, Pírez García MC. Enfermedad por arañazo de gato: características clínicas en niños hospitalizados. An Pediatr (Barc). 2011;74:42–6.
673. Rodríguez CM, Giachetto LG, Cuneo EA, Gutiérrez BMC, Shimchack RM, Pírez GMC. Enfermedad por arañazo de gato con compromiso óseo: una forma atípica de presentación clínica. Rev Chilena Infectol. 2009;26:363–9.
674. Lado P, Costa FB, Verdes JM, Labruna MB, Venzal JM. Seroepidemiological survey of *Rickettsia* spp. in dogs from the endemic area of *Rickettsia parkeri* rickettsiosis in Uruguay. Acta Trop. 2015;146:7–10.
675. Lado P, Castro O, Labruna MB, Venzal JM. First molecular detection of *Rickettsia parkeri* in *Amblyomma tigrinum* and *Amblyomma dubitatum* ticks from Uruguay. Ticks Tick Borne Dis. 2014;5:660–2.
676. Venzal JM, Estrada-Pena A, Portillo A, Mangold AJ, Castro O, Souza CGD, et al. *Rickettsia parkeri*: a rickettsial pathogen transmitted by ticks in endemic areas for spotted fever rickettsiosis in southern Uruguay. Rev Inst Med Trop Sao Paulo. 2012;54:131–4.
677. Venzal JM, Perez-Martinez L, Felix ML, Portillo A, Blanco JR, Oteo JA. Prevalence of *Rickettsia felis* in *Ctenocephalides felis* and *Ctenocephalides canis* from Uruguay. Ann NY Acad Sci. 2006;1078:305–8.
678. Díaz IAC. Rickettsiosis caused by *Rickettsia conorii* in Uruguay. Ann NY Acad Sci. 2003;990:264–6.
679. Díaz I, Rubio I, Somma Moreira RE, Pérez Bormida G. Rickettsiosis cutáneo-ganglionar por *Rickettsia* conorii en el Uruguay. Rev Inst Med Trop Sao Paulo. 1990;22:313–8.
680. Pedreira W, Mazini A, Di Lorenzo S, Medrano O Fiebre botonosa del Mediterráneo. Primer foco endémico en las Américas. In: Libro de resúmenes: Congreso Interamericano de Infectología 1. Córdoba: Sociedad de Infectología de Córdoba; 1994. p. 220.
681. Criado-Fornelio A, Rey-Valeiron C, Buling A, Barba-Carretero JC, Jefferies R, Irwin P. New advances in molecular epizootiology of canine hematic protozoa from Venezuela, Thailand and Spain. Vet Parasitol. 2007;144:261–9.
682. Del Valle G, Gómez E, El Hen F, Guzmán R. Aspectos epidemiológicos, clínicos y hematológicos de le dirofilariosis canina, municipio Sucre, estado Sucre, Venezuela. In: Proceedings XIX Congreso Latinoamericano de Parasitologia. Asunción, Paraguay, 22–24 October, 2009. p. 291.
683. Bastidas Z, Colmenarez D, García M, Saldivia J, Perdomo C, León L. *Dirofilaria immitis* en caninos del Barrio "Las Clavellinas" en Barquisimeto-estado Lara. Rev Colegio Méd Vet Estado Lara. 2017;13:39–46.
684. Montaño JM, de Alvarado S, María C, Morillo MA, Martínez JE. Diagnóstico de dirofilariosis canina: un estudio comparativo usando las pruebas de ELISA y de Woo. Rev Cient FCV-LUZ. 2002;12:351–7.
685. D'Alessandro AL. Prevalencia de *Dirofilaria immitis* (Leidy, 1856) en perros de caza del estado Aragua. Rev Med Vet Parasitol. 1971;24:109–30.
686. Gallo P, Vogelsang EG. Nosografia veterinaria venezolana. Rev Med Vet Parasitol. 1951;10:3–47.
687. Vogelsang EG. Filariasis de los animales domésticos observadas en Venezuela. Rev Med Vet Parasitol. 1955;14:123–6.
688. Zeuss SM. Un caso de dirofilariasis felina. Cienc Vet (Maracaibo). 1973;3:187–205.
689. Aguilar CM, Fernandez E, de Fernandez R, Deane LM. Study of an outbreak of cutaneous leishmaniasis in Venezuela. The role of domestic animals. Mem Inst Oswaldo Cruz. 1984;79:181–95.
690. Cardenas R, Sandoval CM, Rodriguez-Morales AJ, Bendezu H, Gonzalez A, Briceno A, et al. Epidemiology of American tegumentary leishmaniasis in domestic dogs in an endemic zone of western Venezuela. Bull Soc Pathol Exot. 2006;99:355–8.
691. Delgado O, Feliciangeli MD, Gomez B, Alvarado J, Garcia L, Bello C. The re-emergence of American visceral leishmaniasis in an old focus in Venezuela: present situation of human and canine infections. Parasite. 1998;5:317–23.
692. Feliciangeli MD, Delgado O, Suarez B, Chiurillo MA. The burden of the *Leishmania chagasi*/*infantum* infection in a closed rural focus of visceral leishmaniasis in Lara state, west-central Venezuela. Trop Med Int Health. 2005;10:444–9.
693. Zerpa O, Ulrich M, Negron E, Rodriguez N, Centeno M, Rodriguez V, et al. Canine visceral leishmaniasis on Margarita Island (Nueva Esparta, Venezuela). Trans R Soc Trop Med Hyg. 2000;94:484–7.
694. Berrizbeitia M, Concepción JL, Carzola V, Rodríguez J, Cáceres A, Quiñones W. Seroprevalence of *T. cruzi* infection in *Canis familiaris*, Sucre state, Venezuela. Biomedica. 2013;33:214–25.
695. Bonfante-Cabarcas R, Rodriguez-Bonfante C, Vielma BO, Garcia D, Saldivia AM, Aldana E, Curvelo JLC. Seroprevalence for *Trypanosoma cruzi* infection and associated factors in an endemic area of Venezuela. Cad Saude Publica. 2011;27:1917–29.
696. Carrasco HJ, Torrellas A, Garcia C, Segovia M, Feliciangeli MD. Risk of *Trypanosoma cruzi* I (Kinetoplastida: Trypanosomatidae) transmission by *Panstrongylus geniculatus* (Hemiptera: Reduviidae) in Caracas (Metropolitan District) and neighboring States, Venezuela. Int J Parasitol. 2005;35:1379–84.
697. Crisante G, Rojas A, Teixeira MMG, Anez N. Infected dogs as a risk factor in the transmission of human *Trypanosoma cruzi* infection in western Venezuela. Acta Trop. 2006;98:247–54.
698. Rojas ME, Varquez P, Villarreal MF, Velandia C, Vergara L, Moran-Borges YH, et al. Estudio seroepidemiologico y entomologico sobre la enfermedad de Chagas en un area infestada por *Triatoma maculata* (Erichson, 1848) en el centro-occidente de Venezuela. Cad Saude Publica. 2008;24:2323–33.
699. Arraga-Alvarado C, Palmar M, Parra O, Salas P. *Ehrlichia platys* (*Anaplasma platys*) in dogs from Maracaibo, Venezuela: an ultrastructural study of experimental and natural infections. Vet Pathol. 2003;40:149–56.
700. Suksawat J, Pitulle C, Arraga-Alvarado C, Madrigal K, Hancock SI, Breitschwerdt EB. Coinfection with three *Ehrlichia* species in dogs from Thailand and Venezuela with emphasis on consideration of 16S ribosomal DNA secondary structure. J Clin Microbiol. 2001;39:90–3.
701. Huang H, Unver A, Perez MJ, Orellana NG, Rikihisa Y. Prevalence and molecular analysis of *Anaplasma platys* in dogs in Lara, Venezuela. Braz J Microbiol. 2005;36:211–6.
702. Arocha-Sandoval F, Amesty-Valbuena A, Urbina M, Durango AI, Vargas-Montiel H. Detection of *Borrelia burgdorferi* antibodies in a population sample of the state of Zulia. Invest Clin. 1994;35:91–104.
703. Espinoza-León F, Hassanhi-Hassanhi M, Arocha-Sandoval F, Urbina-López M. Absence of *Borrelia burgdorferi* antibodies in the sera of Venezuelan patients with localized scleroderma (morphea). Invest Clin. 2006;47:283–8.
704. Unver A, Perez M, Orellana N, Huang H, Rikihisa Y. Molecular and antigenic comparison of *Ehrlichia canis* isolates from dogs, ticks, and a human in Venezuela. J Clin Microbiol. 2001;39:2788–93.
705. Gutierrez CN, Martinez M, Sanchez E, de Vera M, Rojas M, Ruiz J, Triana-Alonso FJ. Cultivation and molecular identification of *Ehrlichia canis* and *Ehrlichia chaffeensis* from a naturally co-infected dog in Venezuela. Vet Clin Pathol. 2008;37:258–65.
706. Gebreyes WA, Dupouy-Camet J, Newport MJ, Oliveira CJB, Schlesinger LS, Saif YM, et al. The global one health paradigm: challenges and opportunities for tackling infectious diseases at the human, animal, and environment interface in low-resource settings. PLoS Negl Trop Dis. 2014;8:e3257.

707. Baneth G, Bourdeau P, Bourdoiseau G, Bowman D, Breitschwerdt E, Capelli G, et al. Vector-borne diseases–constant challenge for practicing veterinarians: recommendations from the CVBD World Forum. Parasit Vectors. 2012;5:55.
708. World Health Organization (WHO). Status of endemicity of visceral leishmaniasis. Data by country. 2017. http://apps.who.int/gho/data/node.main.NTDLEISHVEND?lang=en. Accessed 19 July 2018.
709. World Health Organization (WHO). Status of endemicity of cutaneous leishmaniasis. Data by country. 2017. http://apps.who.int/gho/data/node.main.NTDLEISHCEND?lang=en. Accessed 19 July 2018.
710. World Health Organization (WHO). Vector borne diseases (VBD) in the region of the Americas. http://ais.paho.org/phip/viz/cha_cd_vectorborndiseases.asp. Accessed 19 July 2018.