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CANINE BRUCELLOSIS: A NARRATIVE REVIEW OF AN EMERGING ZOONOSIS AND ITS IMPLICATIONS WITHIN THE "ONE HEALTH" CONTEXT

BRUCELOSE CANINA: REVISÃO NARRATIVA DE UMA ZOONOSE EMERGENTE E SUAS IMPLICAÇÕES NO CONTEXTO DE "SAÚDE ÚNICA"

BRUCELOSIS CANINA: REVISIÓN NARRATIVA DE ESTA ZOONOSIS EMERGENTE Y SUS IMPLICACIONES EN EL CONTEXTO DE "UNA SOLA SALUD"

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ABSTRACT

This narrative review synthesizes the etiology, epidemiology, transmission, pathophysiology, clinical presentation, diagnosis, treatment and control of the disease, and discusses its relevance as an emerging zoonosis within the One Health framework. The main pathogen involved in canine brucellosis is B. canis, which is transmitted through contaminated placental remains, aborted fetuses, vaginal secretions, semen, urine, fomites and other routes. This results in significant reproductive damage, including late-term abortion, placental retention, stillbirth, and the birth of weak puppies, as well as epididymitis, orchitis and infertility in males. The zoonotic risk is primarily associated with those who handle the bacteria in laboratories, work in breeding kennels, or are exposed to infected animals and contaminated tools. The main clinical manifestations in humans include sweating, headaches, fatigue, and intermittent fever. Diagnosis requires the combined use of clinical, bacteriological, serological, molecular, and histological methods. Antimicrobial treatment is prolonged and frequently fails to eliminate the agent, so neutering, quarantine of incoming animals, routine testing and environmental disinfection remain the basis of control, while vaccine candidates are still experimental. The designation of canine brucellosis as an emerging zoonosis is supported by its geographic expansion associated with the international movement of dogs, by the growing number of human cases reported in Europe and the Americas, and by improved diagnostic recognition. As a narrative review, this synthesis is subject to selection and interpretation bias.

KEYWORDS: *Brucella canis. Dog diseases. Narrative review. One Health. Zoonoses.*

RESUMO

Esta revisão narrativa sintetiza a etiologia, a epidemiologia, a transmissão, a fisiopatologia, as manifestações clínicas, o diagnóstico, o tratamento e o controle da brucelose canina e discute sua relevância como zoonose emergente no contexto da Saúde Única. O principal agente da brucelose canina é *B. canis*, transmitido por restos placentários contaminados, fetos abortados, secreções vaginais, sêmen, urina e fômites, entre outras vias, o que resulta em prejuízos reprodutivos relevantes, como aborto ao final da gestação, retenção placentária, natimortalidade e nascimento de filhotes fracos, além de epididimite, orquite e infertilidade nos machos. O risco zoonótico está associado principalmente a quem manipula o agente em laboratório, trabalha em canis ou tem contato com animais infectados e utensílios contaminados. Em humanos,

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predominam sinais inespecíficos, como sudorese, cefaleia, fadiga e febre intermitente. O diagnóstico exige a associação de métodos clínicos, bacteriológicos, sorológicos, moleculares e histológicos. O tratamento é prolongado e frequentemente não elimina o agente, de modo que castração, quarentena de animais que ingressam no plantel, testagem rotineira e desinfecção ambiental permanecem como base do controle, enquanto as vacinas seguem em fase experimental. A designação da brucelose canina como zoonose emergente sustenta-se na expansão geográfica associada ao trânsito internacional de cães, no aumento do número de casos humanos relatados na Europa e nas Américas e no aprimoramento do reconhecimento diagnóstico. Por ser narrativa, esta revisão está sujeita a vieses de seleção e de interpretação.

PALAVRAS-CHAVE: *Brucella canis*. Doenças do cão. Revisão narrativa. Saúde Única. Zoonoses.

RESUMEN

Esta revisión narrativa sintetiza la etiología, la epidemiología, la transmisión, la fisiopatología, las manifestaciones clínicas, el diagnóstico, el tratamiento y el control de la brucelosis canina y discute su relevancia como zoonosis emergente en el contexto de Una Sola Salud. El principal agente es B. canis, transmitido por restos placentarios contaminados, fetos abortados, secreciones vaginales, semen, orina y fómites, entre otras vías, lo que ocasiona pérdidas reproductivas importantes, como aborto al final de la gestación, retención placentaria, mortinatalidad y nacimiento de cachorros débiles, además de epididimitis, orquitis e infertilidad en los machos. El riesgo zoonótico se asocia sobre todo con quienes manipulan el agente en el laboratorio, trabajan en criaderos o tienen contacto con animales infectados y utensilios contaminados. En las personas predominan signos inespecíficos, como sudoración, cefalea, fatiga y fiebre intermitente. El diagnóstico requiere la combinación de métodos clínicos, bacteriológicos, serológicos, moleculares e histológicos. El tratamiento es prolongado y con frecuencia no elimina el agente, por lo que la esterilización, la cuarentena de los animales que ingresan, la prueba rutinaria y la desinfección ambiental siguen siendo la base del control, mientras las vacunas permanecen en fase experimental. La designación de la brucelosis canina como zoonosis emergente se sustenta en la expansión geográfica asociada al tránsito internacional de perros, en el aumento del número de casos humanos notificados en Europa y en las Américas y en la mejora del reconocimiento diagnóstico. Por su carácter narrativo, esta revisión está sujeta a sesgos de selección e interpretación.

PALABRAS CLAVE: *Brucella canis. Enfermedades de los perros. Revisión narrativa. Una Sola Salud. Zoonosis.*

1. INTRODUCTION

Canine brucellosis is a widespread zoonotic disease of global significance, considered endemic in several countries, including Brazil. Despite its epidemiological relevance, it remains largely neglected and is not included in the World Organization for Animal Health's (WOAH) list of notifiable diseases. This scenario is heavily driven by frequent underdiagnosis, as clinical suspicion among veterinary professionals and physicians remains low. Reproductive issues and late-term abortions in dogs are frequently overlooked as potential indicators of brucellosis (Schiavo *et al.*, 2024). Canine brucellosis is a primary cause of reproductive dysfunction in dogs,

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resulting in late-term abortions, epididymitis, prostatitis, and infertility. In humans, the infection is similarly underestimated and frequently misdiagnosed due to a wide spectrum of nonspecific symptoms that complicate accurate clinical recognition and laboratory confirmation.

The genus *Brucella* comprises multiple species, with *Brucella canis* representing the principal agent of canine brucellosis. This Gram-negative, facultative intracellular bacterium was first isolated in a Beagle kennel in the United States, in an outbreak of abortions investigated in 1966 (Carmichael, 1966), and was formally described as a new species two years later (Carmichael; Bruner, 1968). In Brazil, Keid *et al.* (2004) recovered *Brucella* spp. from dogs housed in commercial breeding kennels in the state of São Paulo, and Aguiar *et al.* (2005) detected anti-*B. canis* antibodies in dogs from Rondônia. Aside from domestic dogs, *B. canis* has been isolated in various wild canid populations and documented in humans (Bernardino *et al.*, 2021).

In dogs, infection typically causes late-stage pregnancy losses, with live or stillborn fetuses, and is transmitted by direct contact with infected animals, inhalation of contaminated aerosols or ingestion of placental remnants, vaginal secretions and fetal tissues. In people, infection usually arises from occupational exposure in laboratories, contact with infectious secretions or handling of contaminated fomites (Silva *et al.*, 2019).

Human brucellosis, historically known as undulant or Malta fever, is rarely fatal but may compromise the reproductive, musculoskeletal and central nervous systems, often with long-term consequences (Kurmanov *et al.*, 2022). *Brucella canis* enters through the oral, nasal, conjunctival or genital mucosa and can be transmitted venereally in semen; shedding is high during the first eight weeks and may persist intermittently for years, sustaining a continuous source of contagion (Santos *et al.*, 2021).

The description of canine brucellosis as an emerging zoonosis adopted here does not rest on worldwide distribution and underdiagnosis alone, which by themselves do not demonstrate an increase in occurrence. Three converging lines of evidence support the term. First, geographic expansion linked to the international movement of dogs: autochthonous infection and imported cases have been documented in countries with no previous record of the agent, such as the United Kingdom, in a dog imported from Romania (Escauriaza *et al.*, 2021), and Germany (Aurich *et al.*, 2023), and transnational exposure events have been described during commercial air transport of pregnant bitches (Williams *et al.*, 2024). Second, an increase in reported human infections and in the recognition of *B. canis* as a public health problem in Europe and the Americas (Marzetti *et al.*, 2013; Djokic *et al.*, 2023; Weese; Weese, 2025; Fica *et al.*, 2025; Storoni *et al.*, 2026). Third, greater diagnostic sensitivity and availability of molecular tools, which raise the proportion of infections that are actually identified; the recent global meta-analysis by Dadar *et al.*

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(2025) shows how strongly the estimated frequency depends on the diagnostic technique used. The relative weight of a true increase in incidence and of better detection cannot be separated with the available evidence, and this distinction is made explicit throughout the text.

Canine brucellosis is a contagious, chronic and highly zoonotic disease that causes persistent reproductive failure in animals and raises public health concerns, so that understanding its transmission dynamics, pathophysiology and distribution is essential. The justification for this study lies in the need to synthesize current knowledge on the epidemiology, the diagnostic challenges and the zoonotic risk of the disease.

This review aims to synthesize the literature on canine brucellosis, with emphasis on its etiology, its global and regional distribution in South America and Brazil, its transmission routes, pathophysiology and clinical manifestations, and its diagnosis, treatment and control. The specific objectives are to characterize *B. canis* and the other species affecting canids and their host range; to analyze the epidemiological distribution of the disease worldwide and mainly in Brazil; to describe the routes of animal-to-animal and zoonotic transmission and the occupational and household risk factors; to examine host invasion, intracellular survival and the resulting pathophysiology in dogs and in people; to compile the reproductive and systemic clinical signs that should raise clinical suspicion; to appraise the diagnostic methods available and the therapeutic and control measures reported, together with their limitations; and to discuss the practical implications of the One Health approach for surveillance and control.

2. METHODOLOGY

This study is a narrative review of the literature on canine brucellosis, focused on the etiology, global and regional distribution, transmission dynamics, pathophysiology, diagnosis, treatment, control and clinical manifestations of the disease, with a particular emphasis on its zoonotic impact and occurrence in Brazil. The narrative design was chosen deliberately. Accordingly, no protocol was registered, no formal risk-of-bias instrument was applied, and no pooled measure was calculated. The review was nevertheless conducted with an explicit and reproducible search, which is described below, and its limitations are stated in section 3.9.

2.1. Information sources and search strategy

A comprehensive bibliographic search was carried out across major scientific databases, including PubMed/MEDLINE, Web of Science, Scopus, SciELO and LILACS, through the Virtual Health Library portal. The key terms selected for retrieval included *“canine brucellosis”*, *“Brucella*

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canis", *"zoonosis"*, *"seroprevalence"*, *"epidemiology"*, *"pathophysiology"*, *"clinical signs"*, *"Brazil"*, and *"One Health"*, together with their equivalents in Portuguese and Spanish.

The strategy applied in PubMed/MEDLINE was: ("*Brucella canis*"(Title/Abstract) OR "canine brucellosis"(*Title/Abstract*) OR ("*Brucella*"(Title/Abstract) AND (dog*(Title/Abstract) OR canine*(Title/Abstract)))) AND (epidemiolog*(Title/Abstract) OR seroprevalen*(Title/Abstract) OR transmission(Title/Abstract) OR pathogenes*(Title/Abstract) OR diagnos*(Title/Abstract) OR treatment(Title/Abstract) OR control(Title/Abstract) OR zoonos*(Title/Abstract) OR "One Health"(Title/Abstract)). Equivalent syntax was adapted to each of the remaining databases. Publications in English, Portuguese and Spanish were accepted, and no additional language filter was applied. The reference lists of the retrieved reviews were hand-searched for further eligible studies, and this procedure is the source of part of the Brazilian regional surveys included here, which are not consistently indexed in the international databases.

The searches were carried out between October and December 2024. A small number of publications released after that period were incorporated during the revision of the manuscript in 2026, at the request of the reviewers, as stated in section 2.2.

2.2. Inclusion and Exclusion Criteria and time frame

The inclusion criteria comprised original research articles, case reports, epidemiological surveys and systematic or narrative reviews published in peer-reviewed journals between 1994 and 2026. Studies were eligible when they reported microbiological, molecular or serological characteristics of the *Brucella* species affecting canids, frequencies of infection, the performance of the diagnostic methods described in section 3.6, transmission routes and occupational or household exposures, mechanisms of host invasion and intracellular survival, or the reproductive and extra-genital clinical manifestations in dogs and in humans, with particular attention to the regional distribution in South America and Brazil. Duplicated articles, works not subjected to peer review, opinion pieces and studies restricted to non-canine hosts without relevance to canine infection or to comparative pathogenesis were excluded.

The lower limit of 1994 was kept because the classical clinical syntheses of human brucellosis and the serological techniques that remain in routine use in Latin America were consolidated in the mid-1990s; earlier publications were not excluded on principle, but none was judged indispensable to the question posed. The upper limit, originally set at 2024, was extended to 2026 so that publications released during the editorial process could be incorporated, namely Djokic *et al.* (2023), Dadar *et al.* (2025), Fica *et al.* (2025), Weese and Weese (2025) and Storoni

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et al. (2026), all of which bear directly on the emergence of the agent and on its global epidemiology.

2.3. Study selection

Records retrieved from the databases were exported to a single file and duplicates were removed. Titles and abstracts were then screened against the eligibility criteria, and the publications retained at this stage were read in full; the selection was carried out by two of the authors, and disagreements were resolved by consensus with a third. Consistently with the narrative design, the selection was purposive rather than exhaustive: publications were retained for their relevance to each of the thematic axes derived from the guiding question, and retrieval continued, axis by axis, until additional studies no longer altered the synthesis. The most frequent reasons for exclusion were the absence of data on canids, the absence of primary data or of a critical synthesis, and publication outside the accepted languages.

No quantitative flow of records retrieved, duplicated and excluded is reported here, and no flow diagram is presented. That flow is the instrument by which a systematic review demonstrates that its search was reproducible and exhaustive, two properties that the present work does not claim; reporting such counts would suggest a degree of exhaustiveness that the method adopted does not support and would give an appearance of systematization to a selection that is, by design, interpretative. What is offered in its place, and what allows the reader to judge the selection, is the explicit statement of the databases consulted, of the search strategy and the fields searched, of the languages and of the eligibility criteria.

2.4. Data Extraction and Synthesis

Scientific references were selected and critically analyzed, and the data were organized into the thematic sections presented in section 3: etiology and characterization of the agent, worldwide and Brazilian distribution, transmission routes, pathophysiology, clinical signs, diagnosis, treatment and control, and the articulation of the disease with the One Health approach. For each epidemiological study, the population studied, the sampling frame, the diagnostic technique and the reported frequency were extracted, so that the figures could be compared in the light of these characteristics rather than read as interchangeable prevalence estimates. The synthesis was qualitative and thematic, and the statements made in each section are attributed to the studies that support them.

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3. RESULTS AND DISCUSSION

3.1. Etiology

In 1887, Sir David Bruce identified the etiological agent of brucellosis, *Micrococcus melitensis*, in the liver of a soldier who had died on the island of Malta. The disease is today classified as the most widely distributed zoonosis, the leading laboratory-acquired infection worldwide and one of the most neglected (Hull; Schumaker, 2018).

The genus *Brucella* affects several mammalian species: *B. melitensis* in sheep and goats, *B. abortus* in cattle and *B. suis* in pigs, besides species described more recently, such as *B. ceti* in cetaceans, *B. ovis* in sheep, *B. pinnipedialis* in pinnipeds, *B. microti* in voles (*Microtus arvalis*) and foxes, *B. inopinata*, *B. papionis* in baboons and *B. vulpis* in red foxes (Carvalho *et al.*, 2023). Reptiles, amphibians and fish are described as atypical hosts (Eisenberg *et al.*, 2020). *B. canis* has a limited host range, dogs and wild canids being the only significant hosts, whereas cattle, sheep and pigs are highly resistant; cats, guinea pigs, mice, rats and non-human primates are susceptible under experimental conditions (De Massis *et al.*, 2022).

Bacteria of the genus *Brucella* are known for their morphology as short, Gram-negative coccobacilli. They are facultative intracellular, lacking capsules, endospores, and plasmids. They are aerobic and non-motile. A distinction that matters for both pathogenesis and diagnosis must be made at this point: most species of the genus, including *B. abortus*, *B. melitensis* and *B. suis*, express a complete smooth lipopolysaccharide with an O-chain, whereas *B. canis* and *B. ovis* are naturally rough, because they lack that O-chain. Roughness is therefore a characteristic of *B. canis* and not of the genus as a whole, and it is the reason why the serological reagents used for smooth species do not detect *B. canis* (Kurmanov *et al.*, 2022; Carvalho *et al.*, 2023). *Brucella* replicate within monocytes and macrophages (Kurmanov *et al.*, 2022). These bacteria preferentially infect the mature reproductive tract because of the tropism that microorganisms exhibit for steroid-synthesizing tissues. However, they can also be found in the liver, spleen, eyes, lymph nodes, and spinal cord (De Souza *et al.*, 2018).

In fetuses and neonatal canines, the organs most frequently infected by *B. canis* are the liver (92%), lungs (85%), lymph nodes (69%) and spleen (62%), as well as the stomach, intestines, kidneys, nervous system and umbilical cord. *B. canis* has a pantropic distribution and has been detected in macrophages, epithelial and endothelial cells, renal tubules, choroid plexus and several other cell types (De Souza *et al.*, 2018).

Under favorable conditions of high humidity, low temperature and absence of direct sunlight, the agent remains viable for months in water, feces, aborted fetal material, clothing and

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instruments, and resists freezing and thawing, although it is inactivated by heat, light and common disinfectants (Bernardino *et al.*, 2021). In dogs, the reported frequency of infection varies with the region studied, the diagnostic method, reproductive activity and contact with infected animals, and serological surveys indicate higher occurrence where animal density and free circulation are greater (Hafemann *et al.*, 2018).

Although *B. canis* is the usual agent, dogs may be infected by other species of the genus, particularly *B. suis*. Kneipp *et al.* (2023) described three hunting dogs with *B. suis* infection, a bitch with dystocia, abortion and mastitis and two males with septic arthritis, osteomyelitis and lymphadenitis, with isolation of the agent from milk and lymph nodes. In 2023, *B. suis* biovar 1 was reported in Germany in a dog with orchitis, fever, testicular swelling, spermatic cord abscess, peritonitis and anorexia; most such cases are associated with exposure to wild boars through hunting or the consumption of raw meat, although in that report the source could not be determined (Aurich *et al.*, 2023).

A further illustration comes from the United States, where a one-year-old male Pit Bull with fever and enlarged testicles and prostate was negative in the rapid slide agglutination test for *B. canis* but positive in the card agglutination test for the smooth species; vaginal swabs from the two bitches in the same household yielded isolates identified as *B. suis* biovar 1 (Landis; Rogovskyy, 2022). A negative rough-antigen test therefore does not exclude infection by a smooth species, and handling an infected dog or its clinical specimens is a recognized route of exposure for owners and veterinary staff.

3.2. Worldwide distribution, South America and Brazil

Brucellosis occurs worldwide, but the natural hosts of each *Brucella* species vary by region: cattle for *B. abortus* in North America, goats and sheep for *B. melitensis* in the Mediterranean (Piampiano *et al.*, 2000). Canine brucellosis, caused mainly by *B. canis*, is reported in many countries at varying levels, and domestic dogs are the main source of human infection (Boeri *et al.*, 2023). The agent has been isolated in Argentina, Canada, the United States, Chile, China, Italy, the United Kingdom and Germany, and is also reported in Africa and Asia (Cosford, 2018; Galarce *et al.*, 2020; Zhong *et al.*, 2020; Escauriaza *et al.*, 2021; De Massis *et al.*, 2022; Boeri *et al.*, 2023; Pinn-Woodcock *et al.*, 2023). Table 1 summarizes the studies that document the occurrence of *B. canis* outside Brazil.

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Table 1. Selected studies documenting the occurrence of *Brucella* species in dogs and humans outside Brazil

Reference	Country	Population	Method	Main finding
Nabeshima *et al.* (2011)	Japan	Dogs	Tube agglutination	Seroprevalence of 2.9% in the companion group, 3.6% in the stray group, and 7.9% in the shelter group. Rearing in a group under poor hygienic conditions may lead to a risk of exposure to *B. canis*
Marzetti *et al.* (2013)	Argentina	Human cases	Isolation, serology	Three clinical cases of *B. canis* infection were identified; of 97 neighborhood dogs tested, 29 (29.9%) were positive by RSAT and IELISA. Of 69 persons in the same neighborhood, 13 (18.6%) tested positive. Laboratory personnel exposure resulted in 3 of 5 workers developing anti-*B. canis* antibodies
Zavala; Morales (2016)	Peru	Dogs, district of Pucusana, Lima	Serology	21.3% of prevalence; association with sex (female)
Whitten *et al.* (2019)	USA	Shelter dogs, Minnesota	Serology	Only one dog (0.11%; 95% CI, 0.02% to 0.60%) was confirmed positive
Galarce *et al.* (2020)	Chile	Kennel, household and stray dogs	Isolation, genomics	Seropositivity of 6.6%, isolation rate of *B. canis* (1.3%); the probability of infection was higher for household dogs (8%) than stray (5%) and kennel dogs (2%). No significant effects were obtained for sex and age
Zhong *et al.* (2020)	China	Pet dogs, Sichuan Province	Isolation, molecular	First to report the isolation of two *B. canis* strains from pet dogs in Sichuan province, southwestern China
Daly *et al.* (2020)	USA	3,898 rescued dogs, South Dakota	Serology	Overall apparent *B. canis* seroprevalence of 6.8% (adjusted estimated true prevalence of 29.4%). The results suggest a high risk of infection, particularly among older and unneutered dogs
Escauriaza *et al.* (2021)	United Kingdom	Dog imported from Romania	Clinical and laboratory	Discospondylitis in a dog
Aurich *et al.* (2023)	Germany	Dog with orchitis	Isolation, typing	First notified *B. suis* infection in a dog in Germany
Boeri *et al.* (2023)	Argentina	Isolates from dogs	MLVA-16, PCR	The results showed that the MLVA-16 assay exhibited the highest diversity, and group 2 of B. canis was the only one found among the studied strains.

Source: Prepared by the authors (2026), from the studies cited.

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Genetic and serological surveillance of *B. canis* is central to the prevention and control of the infection across Latin America, together with hygiene and biosecurity in kennels and awareness among those who work with dogs. Several of the surveys summarized above associate free-roaming management and high animal density with seropositivity, which makes it plausible that populations with a large number of unowned dogs sustain the infection more easily; this inference, however, rests on cross-sectional associations and not on longitudinal data, and should be read as a hypothesis rather than as a demonstrated causal relationship.

The Brazilian studies are summarized in Table 2, which covers the Southeast, Northeast, Midwest and North regions and reports, for each survey, the population examined, the diagnostic method and the frequency found. Comparative genomics places the Brazilian isolates in this wider picture: Ferreira Vicente *et al.* (2018) analysed *Brucella canis* genomes from several continents and found that the Brazilian strains do not form a single local lineage, which is compatible with repeated introductions through the movement of breeding animals rather than with one endemic focus.

Table 2. Studies on the occurrence of *Brucella canis* in dogs in Brazil, by region

Reference	Region / state	Population	Method	Main finding
Keid *et al.* (2004)	Southeast / SP	Commercial kennels	Serology, culture	*Brucella* spp. were detected in blood specimens of 24 animals (14.62%), 58 (33.91%) were AGID positive and 39 (22.80%) presented clinical signs of the disease.
Cavalcanti *et al.* (2006)	Northeast / BA	85 dogs, Salvador	AGID	5.88% frequency
Dorneles *et al.* (2011)	North / TO	374 sera, Araguaína	AGID; BAPA/AAT; FPA	44.53%; no risk factors associated with seropositivity
Fernandes *et al.* (2011)	Northeast / PB	Clinic dogs, Patos	AGID, isolation, PCR	3.11%; isolated from bone marrow; lack of environmental cleanliness was associated as a risk factor for brucellosis positivity
Silva *et al.* (2012)	Midwest / MT	Dogs, Cuiabá	PCR	The occurrence of *B. canis* was 24.1%. The statistical analysis showed association of conjunctivitis and keratitis with the positivity of *B. canis*
Fernandes *et al.* (2013b)	Northeast / RN	Seropositive dogs, Natal	PCR, blood and vaginal or preputial swabs	DNA amplified in 7.5%
Furtado *et al.* (2015)	Several biomes	168 sera	BAPA/AAT	Two positive by BAPA/AAT, in the Pantanal; the test detects smooth *Brucella* and is not a test for *B. canis*

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Reference	Region / state	Population	Method	Main finding
Paz *et al.* (2015)	North / PA	Dogs	Serology	One animal was reactant to the AGID and non-reactant to the AGID-2ME
Mascolli *et al.* (2016)	Southeast / SP	570 dogs, Ibiúna	Blood culture	1.05%; free roaming as risk factor
Keid *et al.* (2017)	Southeast / SP	753 dogs (183 males and 570 females)	Blood culture	166 (22.0%) had at least one clinical sign suggestive of brucellosis and 158 (20.9%) had positive blood cultures
De Oliveira *et al.* (2019)	Midwest / Pantanal	Stray dogs	AGID	7.8% for canine brucellosis in stray dogs in the Pantanal region
Petry *et al.* (2019)	Midwest / MT	Rural dairy farm dogs	AGID; BAPA/AAT	4.34%; none for *B. abortus*
Silva *et al.* (2019)	Midwest / MT	Dogs, Sinop	AGID	11.29%; associated factors were mixed-breed, intact, over 1 year
Bernardino *et al.* (2021)	Northeast / PB	Dogs, Mata Atlântica	AGID, AGID+2ME; BAPA/AAT	12.6% for *B. canis*; 22.8% for *B. abortus*; factors associated were age >10 y, backyard rearing
Boechat *et al.* (2021)	Southeast / RJ	106 dogs with *Leishmania infantum*	AGID	6.6% (7/106)

Source: Prepared by the authors (2026), from the studies cited.

Taken together, the Brazilian figures range from 1.05% to 44.53%, and this dispersion cannot be read as a gradient of real occurrence across the country. Three sources of heterogeneity account for most of it. The first is the population sampled: surveys carried out in free-roaming or shelter dogs (Mascolli *et al.*, 2016; De Oliveira *et al.*, 2019) are not comparable with surveys in animals attended at veterinary clinics (Fernandes *et al.*, 2011) or in commercial breeding kennels (Keid *et al.*, 2004, 2017), where reproductive activity and animal density differ substantially. The second is the outcome measured: serological positivity by AGID indicates exposure and may persist for up to three years after bacteraemia has ceased, molecular detection indicates the presence of bacterial DNA in a given sample at a given moment, and isolation demonstrates viable bacteria; these three measures answer different questions and should not be pooled as equivalent estimates of prevalence, as the global meta-analysis of Dadar *et al.* (2025) also emphasizes. The third is the sample size and the sampling design: several of the Brazilian studies are convenience samples of fewer than two hundred animals, which yields wide confidence intervals and makes extreme values particularly fragile. In addition, the absence of confirmation by isolation or PCR and the known limitations of the specificity of screening tests make an overestimate plausible. The reasonable conclusion from this body of evidence is therefore that *B. canis* circulates in all the Brazilian regions in which it has been investigated, and not that any single published figure represents the national prevalence.

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The Brazilian studies relied mainly on agar gel immunodiffusion (AGID, in Portuguese IDGA) for the detection of antibodies against the rough species, complemented by treatment of the sera with 2-mercaptoethanol (2ME) to increase specificity, whereas the buffered acidified plate antigen test (BAPA/AAT) was used in parallel to investigate exposure to the smooth species, and not as a test for *B. canis*. Blood culture was used for bacterial isolation and PCR as the molecular method, on blood, serum and vaginal or preputial swabs.

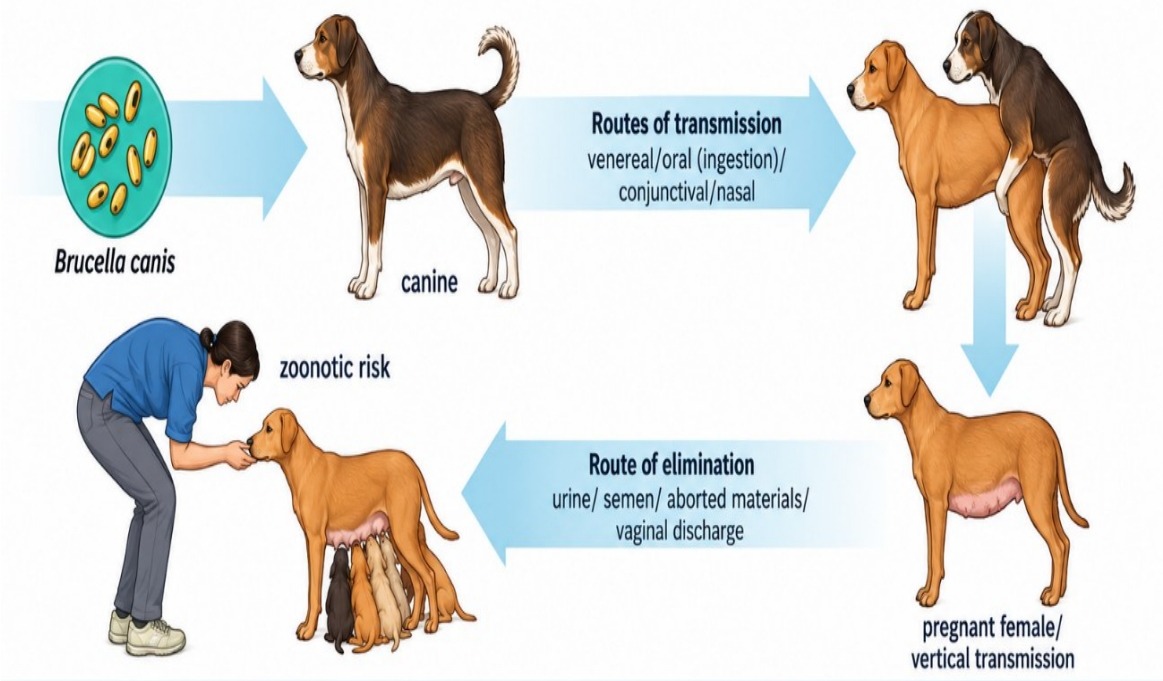
Taken together, the two bodies of evidence summarized in Tables 1 and 2 support that *B. canis* was detected in different countries surveyed, from Japan and China to Peru, Chile, Argentina, the United States and the United Kingdom, and in every Brazilian region investigated. In both sets of studies the highest frequencies come from dogs kept in groups, in commercial kennels, shelters or free-roaming conditions (Nabeshima *et al.*, 2011; Dorneles *et al.*, 2011; Keid *et al.*, 2004, 2017; Daly *et al.*, 2020), which is consistent with density and contact as the determinants of transmission. Additionally, when people in contact with infected dogs were tested, seropositive individuals were found (Marzetti *et al.*, 2013; Fica *et al.*, 2025), which sustains the zoonotic relevance of the agent while leaving its real incidence unknown. For the Brazilian studies, it is important to note that the studies rest largely on single screening tests applied to convenience samples, whereas the studies from other countries more often used isolation, genomic typing or serology with confirmatory testing. The conclusion that the two sets of studies jointly warrant is that canine brucellosis can be endemic and underdetected, and that what prevents its quantification is the absence of standardized and validated diagnosis rather than the absence of surveys.

3.3. Transmission

The transmission of canine brucellosis occurs both from animal to animal and from animals to humans (zoonosis), and infection can take place through direct transmission, where there is direct contact with the bacterium, or indirect transmission, where contact is made with fomites, contaminated food, or water carrying the agent (Figure 1).

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Figure 1. Transmission pathways of canine brucellosis



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B. canis is acquired through the oral, venereal, conjunctival or nasal routes: ingestion of contaminated tissues, inhalation of aerosols from placental residues, fetal remains and vaginal discharges, and natural mating or insemination with contaminated semen (Monteiro; Melo, 2020). Semen and vaginal discharge are the main sources, with about one million organisms per mL, and an infected dog keeps shedding the agent in seminal fluid for up to two years; infection requires about 10^6 bacteria/mL orally or 10^4 to 10^5 bacteria/mL by the conjunctival route (Cosford, 2018; Wanke, 2004).

Healthy dogs become infected on contact with infected animals, which is why neutering infected dogs reduces sources of infection. Transmission through the milk of an infected bitch is described but debated, since puppies may acquire the infection in utero, by transplacental exposure or during the neonatal period; saliva, nasal and ocular secretions, feces, blood transfusion and contaminated syringes are additional routes among animals previously in contact with an infected dog (Makloski, 2011; Costa *et al.*, 2017; Kneipp *et al.*, 2023).

The agent is eliminated chiefly in material from bitches that have aborted, such as fetuses, placenta and vaginal discharges, which remain infective for up to six weeks. Infected males harbor

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the agent in the prostate and may shed it in the urine months or years after bacteremia has ceased (Rodrigues *et al.*, 2016).

In people, infection occurs through the digestive tract (ingestion of unpasteurized milk or contaminated meat), direct contact with infected tissues and secretions through conjunctiva or broken skin, and inhalation of aerosols from laboratory and clinical isolates (Trujillo *et al.*, 1994). Laboratory accidents and the handling of contaminated utensils make it an occupational disease of veterinarians, kennel workers and laboratory technicians (Sánchez-Jiménez *et al.*, 2013). Household transmission, however, is not a marginal route: in the human case series reported by Marzetti *et al.* (2013) and in the scoping review of Weese and Weese (2025), contact with a pet dog, and particularly with a whelping bitch, accounted for a substantial proportion of the infections, including cases in children. Fomites are also relevant, since the agent remains viable for long periods under favorable conditions, and shedding is greatest while bacteremia is established (Santos *et al.*, 2021; Santos *et al.*, 2017). Among the risk factors for infection, the coexistence of healthy and infected animals is significant, and urine is a relevant source of infection, with a higher bacterial load in males (Volkweis *et al.*, 2020). The clinical presentation of human infection is described in section 3.5.

Pereira *et al.* (2018) note that the risk is higher for owners who assist whelping at home without personal protective equipment, through contact with placenta, meconium, saliva, urine and milk, during the assistance itself or afterwards, as a consequence of poor hygiene, for instance by eating or touching the mouth with unwashed hands. Laboratory-acquired infection follows the handling of cultures or clinical specimens containing *B. canis*. Two episodes illustrate these routes. In New York, *B. canis* was isolated from the blood of a hospitalized three-year-old child and from the family dog, with genetically similar isolates, and exposed laboratory workers received post-exposure prophylaxis (Dentinger *et al.*, 2015). In Canada, an adult who had transported a bitch that aborted in his car developed infection ten weeks later, and a member of the investigating team seroconverted three months after a high-risk exposure despite three weeks of prophylaxis (Ahmed-Bentley *et al.*, 2021).

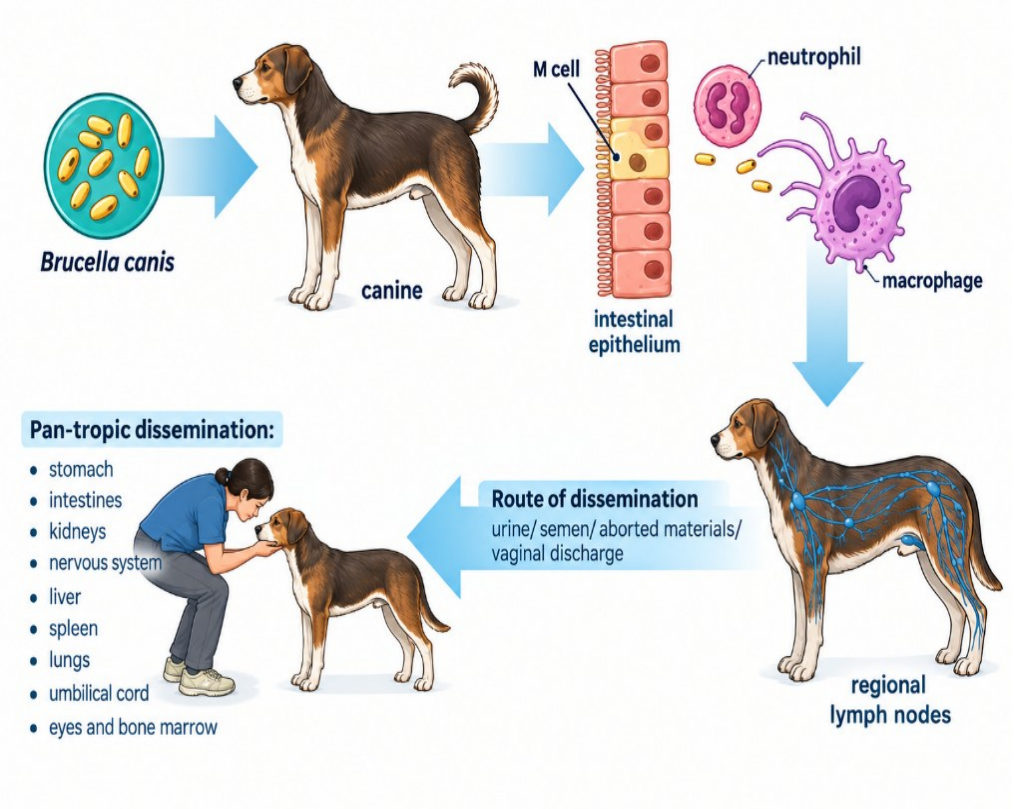
3.4. Pathophysiology

The genus *Brucella* does not rely on plasmids, capsules, pili or exotoxins, and its lipopolysaccharide, although present and essential, has a markedly lower endotoxic activity than the LPS of enterobacteria, which is one of the mechanisms by which the bacterium elicits a weak innate inflammatory response and establishes a chronic infection (Głowacka *et al.*, 2018; Carvalho *et al.*, 2023).

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Brucella survives and multiplies in both phagocytic and non-phagocytic cells, persisting for up to 72 hours in the latter while it crosses the epithelial barrier. Inside macrophages, trophoblasts and dendritic cells it activates signaling pathways and is carried to the regional lymph nodes, where it replicates (Głowacka *et al.*, 2018) (Figure 2).

Figure 2. *Brucella* invasion and dissemination in the canine host



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As the molecular mechanisms of pathogenesis are highly conserved within the genus (Eckstein *et al.*, 2020), part of what follows applies to *Brucella* as a whole and not only to *B. canis*. Once internalized, *Brucella* is not destroyed by the phagocyte: it diverts the maturation of the phagosome, avoids fusion with the lysosome and establishes a replicative niche associated with the endoplasmic reticulum, which allows it to persist inside macrophages and to be carried to the regional lymph nodes (Głowacka *et al.*, 2018; Carvalho *et al.*, 2023). Control of the infection depends predominantly on a Th1-type response: IFN-γ, produced mainly by CD4+ T lymphocytes and NK cells, activates the bactericidal mechanisms of the macrophage, and TNF-α contributes to this activation, while cytotoxic CD8+ T lymphocytes eliminate infected cells. Regulatory and

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Th2-associated cytokines, in particular IL-10, dampen macrophage activation and favor intracellular persistence of the bacterium. Antibodies produced by B lymphocytes contribute to opsonization and are useful as markers of exposure, but they do not by themselves confer protection against an intracellular pathogen, which is one of the reasons why serological conversion after vaccination cannot be taken as evidence of protection. The balance between these responses therefore influences the outcome of the infection (Głowacka *et al.*, 2018; Santos *et al.*, 2021).

Within 1 to 4 weeks post-infection, the agent reaches the circulatory system, causing bacteremia, which can last from six months to up to five years in dogs (Hull; Schumaker, 2018). At a more advanced stage, the bacteria can reach the spleen, liver, lymph nodes and bone marrow, and may also be found in the meninges and eyes (Rodrigues *et al.*, 2016; Silva *et al.*, 2019). Bacteremia may reach tissues rich in mononuclear phagocytes, such as liver, spleen and lymph nodes, and cause diskitis, glomerulonephritis, uveitis and meningoencephalitis, with reticuloendothelial hyperplasia and hyperglobulinaemia (Rodrigues *et al.*, 2016; Santos *et al.*, 2021). Because the agent has a predilection for the reproductive tract, its target is the regional lymph nodes of the genital system; in pregnant bitches the supramammary lymph nodes and the uterus are affected, and infection of the placental trophoblasts causes loss of placental integrity and abortion, or the birth of weak puppies (Pereira *et al.*, 2018).

Brucella can penetrate the intact intestinal epithelium through M cells without activating the host's innate immune response. In addition, rough strains tend to penetrate host cells more efficiently than smooth strains; however, they survive for a shorter time inside these cells (Santos *et al.*, 2021). In people, the agent enters by inhalation, through contaminated mucous membranes or by inoculation, has an incubation period of 10 days to 12 months, lodges in the mononuclear phagocytic system and is followed by mild bacteremia, while limiting its exposure to innate and adaptive immune responses (Hull; Schumaker, 2018).

3.5. Clinical signs

Canine brucellosis is considered the main disease related to reproductive disorders in dogs. *B. canis* can migrate to the epididymis and prostate regions and, in more advanced cases, can cause infertility in males. Unlike males, female dogs are more commonly asymptomatic, but when clinical signs are present, they are mainly related to the reproductive system (Monteiro; Melo, 2020).

Gestation in infected bitches usually proceeds normally until abortion in the final third, typically between 45 and 60 days, often with fetal autolysis and dark or greenish serosanguineous

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vaginal discharge. Puppies born alive rarely survive long. Retained placenta, embryonic death, stillbirth, the birth of weak or nonviable puppies and infertility are also described (Machado, 2024).

Although *B. canis* is the main *Brucella* species found in dogs, *B. melitensis*, *B. abortus* and *B. suis* may also infect dogs in contact with goats, cattle and pigs, or fed raw pork, producing very similar signs, including reproductive failure and testicular and prostatic enlargement; the contact history and the geographical setting should therefore guide the choice of diagnostic tests (Monteiro; Melo, 2020; Landis; Rogovskyy, 2022). In males, epididymitis and orchitis may be the first and, for a time, the only sign, as in the young dog described in Switzerland whose infection presented as epididymitis and orchitis (Egloff *et al.*, 2018).

Subcutaneous edema, congestion and hemorrhage in the abdominal region may also be found, along with nonspecific signs such as discospondylitis, osteomyelitis, prostatitis, visceral abscesses, multifocal pyogranulomatous dermatitis, meningoencephalitis, glomerulonephritis, ocular lesions, epididymitis, fatigue, exercise intolerance and uveitis (Costa *et al.*, 2017).

The main clinical manifestations not associated with the reproductive system in animals infected with *B. canis* include discospondylitis, chronic uveitis, and endophthalmitis (Cosford, 2018). A study conducted in 33 dogs positive for *B. canis* identified a total of 109 abnormalities in the vertebral column, with approximately 66% of the lesions involving the vertebral endplates and the intervertebral disc region (Long *et al.*, 2022).

Inflammation of the uveal tract was observed in 12.5% of dogs infected with *Brucella canis* (Mosallanejad *et al.*, 2014); this figure comes from a case series of limited size and should be read as indicative rather than as a frequency estimate. Ocular lesions are usually unilateral and include anterior uveitis, hyphema, hypopyon, synechiae, aqueous flare, blepharospasm, secondary glaucoma, retinal detachment, chorioretinitis, vitreous opacification, optic neuritis, endophthalmitis and corneal edema (Cosford, 2018; Vinayak *et al.*, 2004).

The main clinical manifestations associated with *B. canis* in humans are nonspecific. Acutely, symptoms include sweating, chills, fatigue, headaches, back pain, loss of appetite, and intermittent fever. Severe forms of *B. canis* infection have been associated with endocarditis, aneurysm, peritonitis, arthritis, osteomyelitis, and epidural abscesses (Santos *et al.*, 2021). In the scoping review of Weese and Weese (2025), which gathered the human cases attributed to *B. canis* published to date, most patients presented a self-limited febrile illness and responded to antimicrobial treatment, so the prognosis should not be described as unfavorable as a rule; the severe presentations are the exception and are concentrated in patients with comorbidities or immunosuppression. Neurobrucellosis, typically associated with *B. melitensis*, has been reported

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rarely with *B. canis*, as has Guillain-Barré syndrome. Comorbidities and immunosuppression complicate the course of the disease in people (Santos *et al.*, 2021).

3.6. Diagnosis

Clinical diagnosis is difficult, because the signs are not specific and many infected dogs show none. A history of abortion or reproductive failure, or contact with an infected dog, justifies laboratory investigation by culture, serology and PCR (Keid *et al.*, 2017).

Bacterial culture is the reference method, since it identifies the agent with high specificity, but a negative result does not rule out infection: intermittent shedding, errors in collection or preservation and previous antimicrobial treatment reduce its sensitivity (Machado, 2024).

The sample to be collected depends on the method. For bacterial isolation and for PCR, which look for the agent or its DNA, the useful materials are whole blood collected with anticoagulant, semen, vaginal secretion, urine, aqueous humor in cases of uveitis, bone marrow aspirate, fetal membranes and tissues of stillborn fetuses; at necropsy, lymph nodes, liver, spleen and genital organs are added. These samples should be kept refrigerated between 2 and 8 °C and processed as soon as possible, ideally within 72 hours, or frozen at −20 °C or below when PCR is intended. For serology, which looks for antibodies and includes AGID, RSAT, 2ME-RSAT and ELISA, the material is serum obtained from clotted blood, also kept refrigerated for short periods or frozen for longer storage (Santos *et al.*, 2021; Kurmanov *et al.*, 2022).

The rapid slide agglutination test (RSAT) is used for screening, with an antigen produced from *B. ovis* strains stained with rose bengal. Its sensitivity is high enough to detect antibodies in recent infections, but its specificity is low and false positives are frequent (Machado, 2024). Blood culture should not be used alone, since bacteremia may be absent or intermittent in chronically infected animals, although isolation confirms the diagnosis. Culture is restricted to biosafety level 3 facilities, which makes bacteriological diagnosis available in few laboratories (Machado, 2024; Fernandes *et al.*, 2013b).

Compared with the serological diagnosis of the smooth species, which affect farm animals, the detection of *B. canis* is more difficult and less accessible; serology remains the most used approach in dogs because it is practical and allows many samples to be examined at once (De Souza *et al.*, 2018). The serological tests most used are RSAT, the tube agglutination test, AGID and ELISA. Because *B. canis* and *B. ovis* share antigens, reagents produced from either agent can be used interchangeably. AGID detects circulating antibodies for up to 36 months after bacteremia has ceased, which allows the diagnosis of chronic infections, but antibodies appear

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only 8 to 12 weeks after infection, so recent infections may yield false-negative results (Kurmanov *et al.*, 2022).

The role of 2-mercaptoethanol must be stated precisely, because the three procedures involved are distinct. RSAT uses a rough antigen in a slide agglutination format and serves as a screening test, with high sensitivity and low specificity. In 2ME-RSAT, the serum is treated with 2-mercaptoethanol, which dissociates IgM, the class largely responsible for non-specific agglutination, so that the reaction depends mainly on IgG; the result is a gain in specificity, usually accompanied by some loss of sensitivity, particularly in very recent infections, and the two effects should not be presented as if specificity improved at no cost. AGID, in turn, uses cytoplasmic or lipopolysaccharide antigens in an immunodiffusion format and is employed as a confirmatory test, with higher specificity than the agglutination tests. In the Brazilian comparison of Moraes *et al.* (2009), the agreement between RSAT and AGID was only partial, which reinforces that these tests measure different antibody responses and that a serological diagnosis of canine brucellosis should rest on a sequence of tests rather than on any single result (Moraes *et al.*, 2009; Kurmanov *et al.*, 2022).

Polymerase Chain Reaction (PCR) is a rapid, sensitive, and specific diagnostic test for the detection of *Brucella* compared to bacterial culture, and it does not require the bacterium to be viable. Molecular techniques are not, however, uniformly robust: inhibitors present in blood, urine and tissues can reduce or abolish amplification, degraded DNA and inadequate preservation of the sample lower sensitivity, and carry-over contamination can generate false positives, so each assay requires internal controls and local analytical validation before its performance can be assumed. Some PCR protocols can distinguish *B. canis* from other species using vaginal swabs from female dogs, aborted fetuses, and whole blood, demonstrating high sensitivity (Santos *et al.*, 2021). Molecular detection of *B. canis* DNA in Brazilian dogs has been reported by Fernandes *et al.* (2013a, 2013b) and by Silva *et al.* (2012).

Histopathology shows focal necrosis of the chorionic villi and uterine glandular hypertrophy with lymphocytic infiltration and granuloma formation; in orchitis and epididymitis, pyogranulomatous inflammation with macrophages and multinucleated giant cells. Severely coiled tails and sperm agglutination impair reproductive function. Immunohistochemistry is useful for detecting the agent in the canine placenta, where infection is associated with metritis, placentitis and abortion, with numerous bacteria within trophoblasts (Machado, 2024; Santos *et al.*, 2021).

The diagnosis of *B. canis* infection in humans is difficult. Serological assays using rough antigens have been used in reference and research laboratories, including the surveys of Marzetti

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et al. (2013) in Argentina and Fica *et al.* (2025) in Chile; what is lacking is a standardized, commercially available and validated test for routine human use. Most of the serological tests employed in human brucellosis diagnosis rely on smooth *Brucella* antigens, which do not detect antibodies against *B. canis*, so a negative conventional serology does not exclude the infection. The diagnosis of *B. canis* in humans therefore relies on a positive blood culture, which is more likely to be detected in the early stages of infection, although it can still be negative even in infected individuals (Williams *et al.*, 2024). These constraints, together with the low index of clinical suspicion, result in the underdiagnosis of the disease and in the general neglect of its public health significance (Santos *et al.*, 2021; Weese; Weese, 2025).

3.7. Treatment, prevention and control

Minocycline, tetracycline, doxycycline, dihydrostreptomycin, gentamicin, sulfadiazine, trimethoprim, enrofloxacin and rifampicin have been reported as active against the bacteremia caused by *B. canis*, at doses adjusted to the weight of the animal and to the tissues involved (Santos *et al.*, 2021).

A therapeutic protocol based on a combination of antibiotics can be used, consisting of high doses of tetracycline, aminoglycoside, and tetracycline with quinolone, administered in cycles of 30 to 90 days in three phases. One of the protocols described in the Brazilian literature combines doxycycline at 10 mg/kg orally, once or twice daily, for 28 days, with dihydrostreptomycin at 10 mg/kg intramuscularly three times daily during the first and fourth weeks of therapy (Crivellenti; Borin-Crivellenti, 2015 *apud* Rodrigues *et al.*, 2016). The thrice-daily interval is nevertheless unusual for an aminoglycoside: the concentration-dependent activity of this class, and its nephrotoxic and ototoxic potential, generally favor a single daily administration, and no pharmacokinetic study in dogs infected with *B. canis* was found that supports the fractionated schedule. The regimen is therefore presented as an empirical protocol described in the national literature, and not as a validated recommendation.

Enrofloxacin monotherapy at 5 mg/kg orally every 12 hours for 30 days was used in twelve positive dogs of a single kennel; all litters born during treatment were negative and three puppies born to positive dams became negative after puberty (Wanke *et al.*, 2006). The small number of animals and the single setting do not support this regimen as a general recommendation.

The association of an oral tetracycline (tetracycline hydrochloride, doxycycline or minocycline) with a parenteral aminoglycoside (dihydrostreptomycin, streptomycin or gentamicin) is superior to the use of a tetracycline alone, but relapses after discontinuation are frequent, because of the intracellular location of the agent and its intermittent bacteremia (Cosford, 2018; Landis; Rogovskyy, 2022).

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After a treatment protocol has been completed, the animal should be retested. Follow-up, however, cannot be based on the simple rule of continuing antimicrobials until a negative result is obtained, because serological reversion and the elimination of the agent are not interchangeable endpoints: antibodies detected by AGID may persist for up to three years after bacteremia has ceased, so a persistently positive serology does not necessarily indicate active infection, whereas a negative serology does not guarantee that the bacterium has been eliminated, since shedding is intermittent and relapses after discontinuation are frequent. Follow-up should therefore combine repeated serology with attempts at isolation or molecular detection, at intervals of 6 to 12 months, and the animal should continue to be managed as a potential source of infection even after apparent cure (Cosford, 2018; Santos *et al.*, 2021; Machado, 2024). Despite the use of antibiotic protocols, persistent infections are common, and in the USA, euthanasia often becomes a frequent choice for pet owners (Pinn-Woodcock *et al.*, 2023).

A recent experiment conducted by researchers at the Federal University of Minas Gerais evaluated the *B. ovis* ΔabcBA vaccine strain encapsulated in alginate, and the results of the two phases of that work should be distinguished. In mice, the candidate vaccine conferred protection against experimental challenge with *B. canis*. In dogs, what was demonstrated was safety and immunogenicity: the encapsulated vaccine was not shed in semen or urine, no clinical signs were observed, local reactions at the inoculation site resolved within four weeks and seroconversion against *Brucella* was detected in 80% of the animals (4/5) by the fourth week after immunization. Protective efficacy against infection has not been demonstrated in dogs, and seroconversion cannot be taken as a surrogate of protection for an intracellular pathogen (Eckstein *et al.*, 2020; Santos *et al.*, 2021). Currently, there is no commercially available vaccine for the prevention of canine brucellosis. Control measures include screening tests for suspected dogs and kennels, treatment or, in defined situations, euthanasia of infected dogs, and disinfection of the environment (Machado, 2024).

Because the agent is intracellular and highly resistant, no protocol is entirely effective, and treatment is long and costly. In commercial kennels the diagnosis ends the reproductive life of the animal, and castration, treatment and adoption are recommended; in pet dogs, castration and treatment are the preferred option. Neutering removes the main reproductive routes of shedding, but it does not eliminate the infection and treated and neutered dogs may continue to shed the agent in urine and other secretions, so it reduces, and does not abolish, the zoonotic risk. In both situations owners should be informed that this is a zoonosis of public health relevance (Santos *et al.*, 2021).

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The recommendation of euthanasia must be read in context. In the report of Landis and Rogovskyy (2022), from which that recommendation is often quoted, the agent involved was *B. suis*, a smooth species of swine origin for which eradication programmes and notification obligations exist in several countries, and the authors discuss euthanasia in that regulatory and epidemiological setting. For *B. canis* in companion animals, the published guidance is not uniform: euthanasia is considered where the agent is subject to official control, where the dog cannot be kept isolated from susceptible animals or from vulnerable people, or where treatment and neutering are not feasible, while in many settings treatment combined with neutering and lifelong monitoring is regarded as an acceptable alternative (De Massis *et al.*, 2022; Djokic *et al.*, 2023; Storoni *et al.*, 2026). Euthanasia should therefore be presented as a decision that depends on the *Brucella* species involved, on the local epidemiological and legal context and on the circumstances of the household or kennel, and not as a universal recommendation.

In commercial kennels, incoming animals should be isolated and tested, positive cases excluded from breeding and routine testing maintained; in pet dogs, neutering associated with treatment and follow-up is the recommended approach. The environment of a positive animal can be disinfected with 2.5% sodium hypochlorite, 5% cresols or 1% phenol for at least 60 minutes. Since fomites, nasal and ocular secretions, feces, urine, blood transfusion and artificial insemination are also sources of transmission, all contaminated objects must be disinfected (Rodrigues *et al.*, 2016).

3.8. Canine brucellosis in the One Health context

Canine brucellosis is not notifiable in most countries and is absent from the WOAH list, so the detection of an infected dog produces no automatic consequence in the human health system, and the diagnosis of a human case rarely triggers the investigation of the dogs in contact. The European experience of Djokic *et al.* (2023) and the Chilean survey of Fica *et al.* (2025) both arose where the two sectors communicated, which suggests that the recognized burden of the disease depends directly on that communication.

Once an infected dog or patient is identified, a defined group of contacts can be delimited: household members, especially children and immunosuppressed or pregnant people, veterinary staff who handled the animal and laboratory workers who processed the samples (Dentinger *et al.*, 2015; Ahmed-Bentley *et al.*, 2021; Williams *et al.*, 2024). In the Canadian case a team member seroconverted despite post-exposure prophylaxis, which indicates that follow-up should be serological and prolonged, and not limited to prophylaxis.

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B. canis grows in routine blood culture media and is frequently unexpected, which makes it a recurrent cause of laboratory-acquired infection, and most of the exposure events described occurred in laboratories that had not been informed of the clinical suspicion. The practical implication is simple and rarely implemented: the request form should state the suspicion of brucellosis, so that the material is processed under biosafety level 3 conditions, and the laboratory should report back to both the veterinary and the human health services (Dentinger *et al.*, 2015; Ahmed-Bentley *et al.*, 2021; Weese; Weese, 2025).

Gloves and eye protection when assisting parturition, the prohibition of handling aborted material without protection, quarantine and testing of animals entering a kennel and the exclusion of positive dogs from breeding depend on the owner and the breeder being informed, and it is here that the veterinarian acts as the main link of the One Health chain (Pereira *et al.*, 2018; De Massis *et al.*, 2022). The agent remains viable for months in water, feces and aborted material under humid, cold and shaded conditions, which justifies the disinfection protocols of section 3.7 and the careful disposal of reproductive material. On a larger scale, infection in dogs imported between countries and exposure during air transport show that the international movement of animals is itself a mechanism of dissemination, and that health requirements for the transit and adoption of dogs across borders are a legitimate instrument of control (Escauriaza *et al.*, 2021; Aurich *et al.*, 2023; Williams *et al.*, 2024; Storoni *et al.*, 2026).

3.9. Limitations of this review

This is a narrative review, and three limitations follow from that design. The selection of the literature, although guided by an explicit search strategy, was not governed by a registered protocol and did not include a duplicate, blinded screening of all records, so the omission of relevant studies cannot be excluded; the inclusion of Brazilian regional surveys retrieved by hand-searching reference lists, in particular, introduces a selection that favors the literature already cited in previous reviews. No formal appraisal of the methodological quality of the included studies was performed, which means that surveys with convenience samples and without confirmatory testing appear alongside studies with probabilistic sampling and bacteriological confirmation. Finally, the frequencies reported in the primary studies were not pooled, because the diagnostic techniques and the populations are not comparable, so this review does not provide a prevalence estimate for any region. For a quantitative synthesis, the meta-analysis of Dadar *et al.* (2025) should be consulted, and its own stratification by diagnostic method confirms that such heterogeneity is a property of this body of evidence and not an artefact of the present selection.

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4. FINAL CONSIDERATIONS

Infected dogs are frequently asymptomatic, which, together with diagnostic failures, results in reproductive losses and economic damage, particularly in commercial breeding. Given the geographic occurrence of the disease and the potential for human infection, studies on its occurrence remain necessary, as do diagnostic tests validated for routine use and vaccines, neither of which is currently available. Greater awareness among human health professionals would improve the understanding of human brucellosis associated with *B. canis* and allow appropriate therapeutic intervention.

The strength of the evidence underlying these statements is uneven, and this should be made explicit. That *B. canis* circulates in dogs in every Brazilian region investigated, and that it causes reproductive disease in the species, is supported by consistent serological, bacteriological and molecular evidence. That the agent causes disease in humans is supported by documented case series with isolation of the bacterium, although the real incidence remains unknown. That the occurrence of the disease is increasing rather than merely being better detected is, by contrast, a plausible inference and not a demonstrated fact, since the published evidence does not allow the two phenomena to be separated. And the comparative efficacy of the therapeutic protocols, as well as the protective efficacy of the vaccine candidates in dogs, remains undetermined.

The studies compiled here also indicate where action is most likely to be effective. The highest frequencies of infection, in Brazil and elsewhere, were obtained in dogs kept in groups, in commercial kennels, shelters and free-roaming populations (Keid *et al.*, 2004, 2017; Nabeshima *et al.*, 2011; Dorneles *et al.*, 2011; Mascolli *et al.*, 2016; De Oliveira *et al.*, 2019; Daly *et al.*, 2020). The frequency obtained depends on the test employed, so screening should be organized as a sequence, in which a reactive rough-antigen test is confirmed, whenever feasible, by isolation or molecular detection, and in which a reactive smooth-antigen test is not reported as canine brucellosis (Furtado *et al.*, 2015; Whitten *et al.*, 2019; Bernardino *et al.*, 2021; Dadar *et al.*, 2025). Seropositive people were found in every study that looked for them among contacts of infected dogs (Marzetti *et al.*, 2013; Dentinger *et al.*, 2015; Ahmed-Bentley *et al.*, 2021; Fica *et al.*, 2025), which makes the delimitation of household, veterinary and laboratory contacts, and the declaration of the clinical suspicion on the laboratory request form, the two measures of immediate practical consequence after a canine diagnosis. Finally, the agent was introduced into countries with no previous record through the movement of dogs (Escauriaza *et al.*, 2021; Aurich *et al.*, 2023; Williams *et al.*, 2024; Storoni *et al.*, 2026), so quarantine and testing of animals

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entering a kennel and health requirements for the transit and adoption of dogs are control points with demonstrated epidemiological justification.

B. canis plays a relevant role in the context of One Health due to its zoonotic nature, its impact on animal and reproductive health, and the need for control measures to protect both humans and animals. Collaboration between veterinarians, healthcare professionals, and environmental experts is essential to prevent its spread and establish preventive measures aimed at eliminating sources of infection and controlling the transmission and spread of the disease. Three priorities emerge from this review: including canine brucellosis in animal health surveillance systems, with communication to the human health sector; developing and validating serological tests with rough antigens for routine use in people; and conducting studies with probabilistic sampling and confirmatory diagnosis, which would allow the actual occurrence of the disease to be estimated instead of described. It is worth noting that treatment, when applied to companion animals, should be rigorously monitored by a veterinarian.

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