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Occurrence of Canine Visceral Leishmaniasis in the Neighborhoods of Várzea Grande, Mato Grosso: An Analysis from 2018 to 2023

Ocorrência da Leishmaniose Visceral Canina nos bairros de Várzea Grande, Mato Grosso: uma análise de 2018 a 2023

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Abstract

Canine Visceral Leishmaniasis (CVL) is a zoonosis of major public health concern, caused by the protozoan Leishmania infantum and transmitted by sandflies of the genus Lutzomyia. The disease presents a complex epidemiological profile, facilitated by unplanned urbanization, lack of basic sanitation, and abandonment of animals, which create ideal conditions for vector proliferation. This study, conducted in Várzea Grande, Mato Grosso, between 2018 and 2023, aimed to demonstrate the occurrence of CVL, the spatial distribution of cases with emphasis on areas of greater socio-environmental vulnerability, and the progression of the disease over time. Epidemiological data were provided by the Zoonosis Surveillance Unit (UVZ) and included the evaluation of 2,401 dogs from various urban regions of the city. Initial screening was performed using the immunochromatographic DPP® test, which showed 32.53% (781) positive results. These findings were subsequently confirmed by Enzyme-Linked Immunosorbent Assay (ELISA), which confirmed 72.34% (565/781) of the initially positive cases. Spatial analysis revealed a significant concentration of cases in the western and eastern regions, areas marked by poor urban infrastructure. These results highlight the urgent need for control measures such as the use of insecticide collars, educational campaigns, and improvements in sanitation. Furthermore, increased investments in surveillance are essential for continuous monitoring and the development of more effective responses to control this zoonosis, thereby protecting both animal and human health.

Keywords: *Leishmania spp*. Protozoan. Zoonosis. Occurrence.

Resumo

A Leishmaniose Visceral Canina (LVC) é uma zoonose de extrema relevância para a saúde pública, causada pelo protozoário Leishmania infantum e transmitida por flebotomíneos do gênero Lutzomyia. Essa doença assume caráter epidemiológico complexo, favorecida pela urbanização desordenada, falta de saneamento básico e pelo abandono de animais, criando condições que proporcionam o ambiente ideal para a proliferação dos vetores. Este estudo, realizado em Várzea Grande, Mato Grosso, entre 2018 e 2023, objetivou demonstrar a ocorrência da LVC, a concentração espacial dos casos, com ênfase nas áreas de maior vulnerabilidade socioambiental, e a progressão da doença ao longo do período. A pesquisa utilizou dados epidemiológicos fornecidos pela Unidade de Vigilância de Zoonoses (UVZ) e envolveu a avaliação de 2.401 cães provenientes de diversas regiões urbanas da cidade. O diagnóstico inicial foi realizado por meio do teste imunocromatográfico DPP®, que apresentou 32,53% (781) de resultados positivos. Para confirmar esses achados, foi aplicado o Ensaio Imunoenzimático (ELISA), o qual confirmou 72,34% (565/781) dos casos inicialmente detectados. A análise espacial dos dados revelou uma concentração significativa de casos nas regiões oeste e leste, áreas marcadas por condições urbanas precárias. Esses resultados evidenciam a necessidade urgente de medidas de controle, como o uso de coleiras inseticidas, a realização de campanhas educativas e a implementação de melhorias no saneamento. Ademais, o aumento dos investimentos em vigilância é essencial para o monitoramento contínuo e a elaboração de respostas mais eficazes no combate à zoonose, protegendo assim tanto a saúde animal quanto a humana.

Palavras-chave: *Leishamnia spp*. Protozoário. Zoonose. Ocorrência

1 Introduction

Canine Visceral Leishmaniasis (CVL), caused by the protozoan Leishmania infantum and transmitted by the vectors Lutzomyia longipalpis and Lutzomyia cruzi, is a neglected zoonosis of great relevance to public health.

Originally restricted to wild animals, the disease has expanded into urban areas, where dogs serve as the main reservoirs (Dantas-Torres, 2024). This expansion poses a significant risk to both animal and human health, especially in regions with poor sanitation conditions (Brazil, 2014; Gontijo; Melo, 2004). In Brazil, CVL is endemic in several regions, including Várzea Grande (MT), where there is a growing incidence of the disease (Fujimori *et al*., 2016). Factors such as unplanned urbanization, lack of basic sanitation, and the abandonment of animals contribute to the proliferation of vectors and the increase in CVL cases (Mestre; Fontes, 2007). Previous studies in Mato Grosso have reported the presence of the disease in 41 municipalities, suggesting that its spread is linked to migratory flows and disordered land occupation (Mestre; Fontes, 2007).

In Várzea Grande, although research has already been conducted on the disease vectors and its occurrence in humans (Missawa *et al*., 2008; Missawa; Borba, 2009), there is a need to deepen the understanding of CVL in urban areas. Therefore, this study aimed to demonstrate the occurrence of CVL in Várzea Grande, Mato Grosso, between 2018 and 2023, in order to identify the most affected regions and analyze the temporal evolution of the zoonosis.

2 Material and Methods

The study was conducted in the municipality of Várzea Grande, in the state of Mato Grosso, located at coordinates 15°32'30" South latitude and 56°17'18" West longitude. The region covers an area of 724.279 km² and is composed of 25 neighborhoods distributed across five major administrative regions (Complementary Law No. 3,625, June 30, 2011). The resident population is 300,078 inhabitants, with an estimated ratio of one dog for every five residents, corresponding to approximately 15% of the total population (IBGE, 2022).

Data collection was carried out at the Zoonosis Surveillance Unit (UVZ) of Várzea Grande (CNES 2898489), Mato Grosso, and consisted of a review of records of dogs screened for Canine Visceral Leishmaniasis (CVL). Samples for this screening, obtained through canine surveys and/or spontaneous demand, were initially tested using the Dual Path Platform (DPP® CVL, Bio-Manguinhos/FIOCRUZ) rapid immunochromatographic test, and positive cases were subsequently confirmed by Enzyme-Linked Immunosorbent Assay (ELISA CVL, Bio-Manguinhos/FIOCRUZ).

The study covered the period from 2018 to 2023 and was based on original records organized in handwritten files, containing information on 2,401 dogs screened by the UVZ, including place of origin, owner's name, contact phone number, dog's name, date of investigation, sample number, and result of the rapid test.

Additionally, a Microsoft Office Excel® spreadsheet extracted from the Laboratory Environment Manager (GAL) system was provided, containing data on samples sent for ELISA confirmation during this period. This spreadsheet presented similar information to the handwritten files, with the addition of ELISA test results.

The screening records were manually transcribed from the paper files into a Microsoft Office Excel® spreadsheet to allow for data organization and analysis. To complement the analysis, the ELISA confirmatory test results were integrated into the spreadsheet, enabling the creation of a complete database for further analysis.

A descriptive analysis of the data was performed, with emphasis on the spatial distribution of CVL cases across the neighborhoods of Várzea Grande. To this end, tables were prepared based on frequencies calculated from the diagnostic test results. The frequency of dogs reactive to the DPP® rapid test was obtained using the formula:

x = (number of reactive dogs in the neighborhood/total number of dogs screened by DPP®)×100.

Similarly, the frequency of dogs confirmed with CVL by the ELISA test was determined using the formula:

x = (number of confirmed dogs in the neighborhood/total number of samples analyzed)×100.

The application of these calculations made it possible to highlight the neighborhoods with the highest number of cases over the years, enabling the identification of areas with greater disease concentration and relevant epidemiological patterns.

3 Results and Discussion

From January 2018 to December 2023, CVL was detected in 32.53% (781/2,401) of the dogs evaluated using the DPP® test in the municipality of Várzea Grande, as shown in Table 1.

Table 1 - Number of dogs screened and reactive in the Dual Path Platform (DPP®) test

Items	2018	2019	2020	2021	2022	2023	Total	
Total number of dogs screened (DPP®)	203	306	214	448	475	755	2,401	
Total number of reactive dogs	6	30	54	26	223	442	781	

Source: Zoonosis Surveillance Unit.

During the analyzed period, CVL was found to be present in 100% (25/25) of the neighborhoods, with the highest frequencies of positive cases recorded in the neighborhoods of Paiaguás (5.91%; 142/2,401), Marajoara (3.12%; 75/2,401), São Matheus (2.96%; 71/2,401), Canelas (2.67%; 64/2,401), Parque do Lago (1.83%; 44/2,401), and Cristo Rei (1.79%; 43/2,401), as shown in Table 2.

In addition, the presence of dogs with no recorded location was noted, classified as "No Location" (3.71%; 89/2,401), as well as animals originating from neighboring cities, including Nossa Senhora do Livramento (0.42%; 10/2,401) and Cuiabá (0.12%; 3/2,401).

Table 2 - Frequency of reactive dogs in the Dual Path Platform (DPP®) test by neighborhood in Várzea Grande

Locations (Neighborhood)	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**	**%**
Paiaguás	0	4	4	3	58	73	142	5.91%
Marajoara	0	1	4	5	19	46	75	3.12%
São Matheus	0	4	12	2	18	35	71	2.96%
Canelas	1	2	2	3	14	42	64	2.67%
Parque do Lago	2	3	3	3	17	16	44	1.83%
Cristo Rei	0	3	5	1	10	24	43	1.79%
Glória	1	1	4	0	10	17	33	1.37%
Petrópolis	0	2	2	6	6	11	27	1.12%
São Simão	0	0	1	0	12	11	24	1.00%
Mapim	1	1	1	1	6	8	18	0.75%
Centro Sul	0	1	1	0	6	8	16	0.67%
Santa Izabel	0	1	0	0	7	8	16	0.67%
Costa Verde	0	2	0	0	2	11	15	0.62%

Ikaray	0	0	0	0	7	8	15	0.62%
Jardim dos Estados	1	1	2	0	3	8	15	0.62%
Novo Mundo	0	0	4	0	0	7	11	0.46%
Primavera	0	0	0	0	8	3	11	0.46%
Centro Norte	0	3	1	1	0	2	7	0.29%
Ponte Nova	0	1	1	0	0	5	7	0.29%
Vitória Régia	0	0	0	0	2	5	7	0.29%
Capão do Pequi	0	0	0	0	5	1	6	0.25%
Pai André District	0	0	0	0	3	2	5	0.21%
Pari	0	0	0	0	1	3	4	0.17%
Formigueiro District	0	0	2	0	0	0	2	0.08%
23 de Setembro	0	0	0	0	0	1	1	0.04%
No locations	0	0	0	1	2	86	89	3.71%
Total	6	30	49	26	216	441	768	31.99%
Municipalities others								
Nª Srª do Livramento City	0	0	5	0	4	1	10	0.42%
Cuiabá City	0	0	0	0	3	0	3	0.12%
Total	0	0	5	0	7	1	13	0.54%

Source: Zoonosis Surveillance Unit.

Regarding the results of the confirmatory ELISA test, it was found that 72.34% (565/781) of the samples analyzed from 2018 to 2023 tested positive, as shown in Table 3.

Table 3 - Number of samples analyzed and confirmed by the enzyme-linked immunosorbent assay (ELISA)

Items	2018	2019	2020	2021	2022	2023	Total
Total number of samples analyzed by ELISA	6	30	54	26	223	442	781
Total number of confirmed samples	6	26	32	25	176	300	565

Source: Zoonosis Surveillance Unit (UVZ).

Regarding the distribution of these cases across neighborhoods, the results showed a higher concentration in the Paiaguás neighborhood (12.80%; 100/781), followed by Marajoara (7.68%; 60/781), São Matheus (7.17%; 56/781), Canelas (7.17%; 56/781), Cristo Rei (4.74%; 37/781), and Parque do Lago (4.61%; 36/781), as shown in Table 4.

Table - 4 Frequency of dogs confirmed for CVL in Várzea Grande through the enzyme-linked immunosorbent assay (ELISA)

Locations (Neighborhood)	2018	2019	2020	2021	2022	2023	Total	%
Paiaguás	0	4	3	3	38	52	100	12.80%
Marajoara	0	0	1	4	16	39	60	7.68%
São Matheus	0	4	6	2	15	29	56	7.17%
Canelas	1	2	1	3	12	37	56	7.17%
Cristo Rei	0	3	4	1	9	20	37	4.74%
Parque do Lago	2	2	2	3	15	12	36	4.61%
Glória	1	1	3	0	10	14	29	3.71%
São Simão	0	0	0	1	12	11	24	3.07%
Petrópolis	0	1	1	6	4	9	21	2.69%
Mapim	1	0	0	1	6	7	15	1.92%
Ikaray	0	0	0	0	5	8	13	1.66%
Jardim dos Estados	1	1	0	0	3	8	13	1.66%
Costa Verde	0	2	0	0	2	8	12	1.54%
Santa Izabel	0	1	0	0	5	5	11	1.41%
Centro Sul	0	1	0	0	5	5	11	1.41%
Novo Mundo	0	0	4	0	0	6	10	1.28%
Primavera	0	0	0	0	5	3	8	1.02%
Vitória Régia	0	0	0	0	2	5	7	0.90%
Centro Norte	0	3	1	0	0	1	5	0.64%
Pai André District	0	0	0	0	3	2	5	0.64%
Ponte Nova	0	1	1	0	0	3	5	0.64%
Pari	0	0	0	0	1	3	4	0.51%
Capão do Pequi	0	0	0	0	2	1	3	0.38%
Formigueiro Discrict	0	0	1	0	0	0	1	0.13%
23 de Setembro	0	0	0	0	0	1	1	0.13%
No locations	0	0	0	1	1	10	12	1.54%
Total	6	26	28	25	171	299	555	71.06%
Municipalities others								
Nª Srª do Livramento City	0	0	4	0	3	1	8	1.02%
Cuiabá City	0	0	0	0	2	0	2	0.26%
Total	0	0	4	0	5	1	10	1.28%

Source: Zoonosis Surveillance Unit.

The administrative organization of the municipality is composed of five distinct regions, encompassing 25 neighborhoods, 23 residential areas, and a total of 192 officially recognized subdivisions. However, many residents refer to these areas by informal names, which can create some confusion regarding their classification and geographic location. When analyzing the distribution of VL (visceral leishmaniasis) cases in Várzea Grande, it was observed that six neighborhoods present the highest disease incidence.

The Paiaguás neighborhood, located in the western region of the municipality, stands out for

being bordered to the west by the Rodovia dos Imigrantes (Highway of the Immigrants) and to the north by Filinto Müller Avenue. In addition to being a residential area, the neighborhood hosts the Várzea Grande Zoonosis Surveillance Unit (UVZ) and leads in the number of VL cases among the neighborhoods.

Another neighborhood in the western region is Marajoara, located north of Paiaguás and connected by Governador Júlio Domingos de Campos Avenue and Filinto Müller Avenue. The neighborhood also features the Bernardo Berneck Environmental Park, an important ecological area.

The São Matheus neighborhood, also located in the western region and bordered to the east by the Rodovia dos Imigrantes, is a peripheral area that reflects the socioeconomic characteristics of such regions. Although the Canelas neighborhood is closer to the central area of Várzea Grande, it is also part of the western region and borders Paiaguás, highlighting the interconnectedness between neighborhoods.

In the eastern region are the Cristo Rei and Parque do Lago neighborhoods, adjacent to each other and located west of Marechal Rondon International Airport. These neighborhoods, which have high population density and urbanization, are important routes for those traveling toward the Beira Rio area in Cuiabá via the Sérgio Motta Bridge and toward downtown Várzea Grande via the main avenues Prefeito Murilo Domingos and Avenida da FEB.

This study demonstrates a significant presence of dogs positive for VL in Várzea Grande. Previous studies on this topic have already been carried out in other municipalities of the Cuiabá lowlands, such as Barão de Melgaço, which confirmed the presence of VL in rural and urban areas (Dias et al., 2021; Melo et al., 2017), Nossa Senhora do Livramento (Carvalho et al., 2020), Poconé (Melo et al., 2017), Santo Antônio de Leverger (Melo et al., 2017), Rondonópolis (De Carvalho et al., 2018; Guimarães et al., 2015), Cuiabá (Almeida et al., 2012; Menegatti et al., 2020), and also in the city of Várzea Grande itself (Missawa; Borba, 2009; Missawa, Lorosa; Dias, 2008; Missawa et al., 2010).

When analyzing the distribution of positive cases in the study area, a wide incidence was found in several neighborhoods, with particular emphasis on the Paiaguás neighborhood, which recorded the highest number of cases. This may be due to a combination of factors, such as easy access for residents of neighboring neighborhoods, since most samples were obtained through spontaneous demand. Another factor may be the high number of abandoned dogs, partly due to the proximity of the UVZ, as well as the location near major thoroughfares, such as the Rodovia dos Imigrantes and the extensive Filinto Müller Avenue, which cuts through much of the urban area of the city.

The Marajoara neighborhood, in the western region, presented the second highest number of cases. It is characterized by the presence of the Bernardo Berneck Environmental Park, an urban park

with approximately 280,000 m² of preserved area within the city, with extensive forest cover and the presence of stray dogs and wild animals. Certainly, the presence of a preserved area within the city deserves attention, as a study conducted in the "Parque Estadual do Prosa" (PEP) and the residential area "Vila da Base Aérea" (VBA) in Campo Grande, Mato Grosso do Sul, detected infection by L. infantum in carnivores of the species Nasua nasua from those areas (De Macedo et al., 2023). Additionally, there is evidence that the cerrado biome offers climatic conditions more favorable for the survival of sandflies, with ecosystem characteristics that promote their proliferation. This is due to the presence of synanthropic, wild, domestic, and farm animals, especially birds (Menegatti et al., 2020).

Still in this region, the São Matheus neighborhood ranks third in number of cases. It is a peripheral area marked by disordered settlement, low socioeconomic indices, destruction of wild ecotopes, poor basic sanitation, and the presence of forested areas around it. The neighborhood also connects with the Rodovia dos Imigrantes and the Paiaguás neighborhood to the east. These characteristics are often associated with regions requiring greater attention (Cesse et al., 2001; Missawa; Borba, 2009). Additionally, studies conducted between 2004 and 2006 had already pointed to the abundance of vectors in the neighborhood, with the capture of 420 specimens of L. longipalpis, of which 0.71% were infected, corresponding to three infected females (Missawa; Dias, 2007).

Regarding the Canelas neighborhood, western region, it is a more densely populated and urbanized area, serving as a connection route to central regions. With the urbanization process, VL has undergone a significant shift in its epidemiological profile, no longer being predominantly rural. Environmental changes, global warming, human activity, and population movement have all contributed to this transformation (Madeira et al., 2000; Osaki et al., 2021). Moreover, the spread of infected dogs and changes in vector ecology have facilitated the establishment of the disease in urban areas (Dantas-Torres; De Brito; Brandão-Filho, 2006; Osaki et al., 2021).

In the eastern region of Várzea Grande, the Cristo Rei and Parque do Lago neighborhoods stood out for confirmed VL cases. They are very close to Marechal Rondon International Airport and, like the Bernardo Berneck Environmental Park, this area has extensive vegetation cover. However, there is no presence of stray dogs, although reservoirs of the disease may still exist in its sylvatic cycle (De Macedo et al., 2023).

These neighborhoods are bordered by the Cuiabá River and the municipality of Cuiabá on the opposite bank, and are characterized as densely populated and urbanized areas. This same characteristic is observed in the Canelas neighborhood, showing a strong relationship with the change in the disease's epidemiological profile, which has shifted from being predominantly rural to also affecting urban environments (Madeira et al., 2000; Osaki et al., 2021).

Therefore, it is important to highlight that the implementation of prophylactic actions, such as urban cleaning of plots, public squares, gardens, roads, and others, and the proper disposal of organic waste, contributes to disease prevention, as it hinders the formation of vector breeding sites (Brazil, 2014).

Previous studies conducted in Várzea Grande, between January 2004 and June 2006, using CDC (Centers for Disease Control and Prevention) light traps, recorded the capture of 2,376 female L. longipalpis. These sandflies fed predominantly on birds (30.8%) and rodents (21.2%), but females with human, opossum, cattle, horse, and dog blood were also identified. This behavior, which connects the domestic and sylvatic cycles, can increase the risk of canine infection by up to 2.6 times (Missawa et al., 2008).

The data presented indicate an increase in infected dogs, particularly in the western and eastern regions of the city. The high number of infected animals and the poor infrastructure in some neighborhoods may contribute to the disease's occurrence (Cesse et al., 2001).

This study clearly shows that the number of confirmed VL cases in the municipality increased alarmingly during the analyzed period, signaling a rapid spread of the disease among the local canine population. In addition, a remarkable 733% increase in positive cases was observed in 2022. This sharp rise highlights the alarming spread of the disease, though signs of deceleration were seen in the following year.

The hypothesis raised is that the COVID-19 pandemic period in 2021 acted as a constraint on surveillance and control actions, which may have contributed to the backlog of cases and delayed detection of the disease. As a result, there was a sharp increase in cases in 2022 when the accumulated cases finally became evident. However, signs of VL expansion had already been observed in previous years, albeit less expressively. This situation is supported by a study that identified several municipalities in Mato Grosso showing signs of neglect regarding the disease even before the COVID-19 pandemic (Menegatti; Dias, 2024).

However, according to UVZ itself (informal communication, May 31, 2024), this increase may be related to a considerable rise in demand from dog owners taking their animals to be tested for VL—suggesting an apparent growth in public awareness about the disease and the importance of investigating it in dogs. Since this is a zoonosis, it is essential for the population to become increasingly informed. As shown in a study carried out in the neighboring municipality of Nossa Senhora do Livramento, where interviews were conducted with dog owners, 68.9% had heard of VL, while only 31% were unaware of the disease (Carvalho et al., 2020).

Nonetheless, intensifying control measures is necessary, particularly in the most affected neighborhoods. The use of prophylactic measures, such as repellent collars and the implementation

of sanitation and public cleaning programs, are recommended methods for controlling the spread of the disease in the canine population (Moreira, 2013; Sevá et al., 2016). Furthermore, it is important to highlight the need for more effective municipal-level surveillance activities, requiring greater investment, technological updates, and the provision of better resources so that professionals can perform their duties more efficiently. This also includes proper case recording and appropriate notification, as evidenced in a comprehensive study using VL data from across the state of Mato Grosso (Menegatti; Dias, 2024).

Similarly, Technical Report No. 05169/2024/SUVSA/SES showed that the municipality of Várzea Grande has not met or achieved the target set for canine and census sample surveys for several years. In 2018 and 2019, the goal was 500 rapid tests for VL per year. However, due to difficulties faced by the municipality, this goal was revised and, by mutual agreement, reduced to 250 rapid tests per year—a figure that remains in place to this day but still has not been met (Technical Report No. 05169/2024/SUVSA/SES, 2024).

According to the Ministry of Health's Manual for the Surveillance and Control of Visceral Leishmaniasis, there are guidelines for VL surveillance, prevention, and control (Brazil, 2014). However, it seems that the measures taken in Várzea Grande are not sufficient to contain the spread of the disease. Therefore, it is essential to conduct educational campaigns to inform the population about the dangers of visceral leishmaniasis (VL) and methods of prevention, such as the use of insecticidal collars on dogs and the importance of responsible pet ownership (Matsumoto et al., 2022; Zahid; Kribs, 2020).

In addition, early diagnosis and mandatory case reporting are essential for disease surveillance. To ensure the rapid and effective detection and management of cases, it is crucial to increase access to diagnostic tests such as DPP® and ELISA (Brazil, 2014).

Finally, the rise in VL cases in Várzea Grande represents a public health problem, highlighting structural challenges in urban planning, unregulated urbanization, lack of basic sanitation, and the abandonment of animals, which create an environment conducive to the spread of the disease (Cesse et al., 2001; Missawa; Borba, 2009).

4 Conclusion

The analysis of case records, screened using the rapid test (DPP®) and confirmed by ELISA, made it possible to identify the neighborhoods and regions with occurrences of visceral leishmaniasis (VL), highlighting those with the highest relative prevalence over the analyzed period.

The disease is widely spread in Várzea Grande, with greater concentration in the western and eastern zones. Neighborhoods such as Paiaguás, Marajoara, São Matheus, and Canelas, located in the

western region, are the most affected. Factors such as unregulated urbanization, lack of basic sanitation, and the abandonment of animals significantly contribute to the spread of VL.

Although each neighborhood with high prevalence presents specific characteristics, these conditions have already been widely recognized in previous studies on the disease. Containing the advance of VL in the municipality depends on joint action between health authorities, the community, and pet owners, involving both preventive measures and educational initiatives.

To effectively address this scenario, it is essential to intensify disease control strategies, expand awareness campaigns, and adopt preventive practices such as the use of insecticidal collars. In addition, it is crucial to promote responsible dog ownership by guiding the population on the necessary care to prevent the spread of the disease. Moreover, increasing public investment in surveillance is imperative in order to improve the quality of services provided and ensure a more efficient response in disease control.

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