











Causes of dog mortality in Paraíba/Brazil: Use of DATASIMA for data diagnosis and mapping¹

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ABSTRACT- Sousa E.S.S., Sousa M.E.S., Pereira M.D.C.A., Negreiros R.A.M., Brasil A.W.L., Clementino I.J., Azevedo S.S. & Lucena R.B. 2024. **Causes of dog mortality in Paraíba/Brazil: Use of DATASIMA for data diagnosis and mapping.** *Pesquisa Veterinária Brasileira* 44:e07453, 2024. Centro de Ciências Médicas, Universidade Federal da Paraíba, Campus I Lot. Cidade Universitária s/n, Cx. Postal 5115, João Pessoa, PB 58051-900, Brazil. E-mail: ricardoandrenegreiros@gmail.com

Analyzing the causes of death in dogs is fundamental for controlling and preventing diseases, thereby promoting greater longevity and quality of life. However, the current literature lacks standardization and uniformity in the diagnostic description, forms, and instruments for collecting data and maintaining dog obituary records. Using data from the Data Platform of the Animal Mortality Information System (DATASIMA), which uses the Declaration of Animal Death and the International Classification of Diseases (ICD-10), the classification of the causes of death of dogs attended by veterinary doctors was conducted at the “Universidade Federal da Paraíba”, from January to December 2022. The causes of death were stratified, promoting their geo-referencing and the characterization of the epidemiological profile of the dogs. A total of 264 cadavers were analyzed, and the most prevalent groups of diseases causing death were pathophysiological disorders (37.87%, n=100), infectious and parasitic diseases (28.4%, n=75), neoplasms (21.59%, n=57), and external causes (12.12%, n=32). The causes of death were categorized according to sex and age range, showing a higher prevalence of pathophysiological disorders and infectious diseases in adults, neoplasms in elderly dogs, and infections and parasitic diseases and pathophysiological disorders in offspring. The findings of this study demonstrate the feasibility of using DATASIMA for the mapping and standardization of data on the causes of animal death, allowing for strategies for intervention in public health, the prevention of zoonoses, the reduction of garbage codes, better and more efficient communication between veterinary doctors, and the possibility of using ICD-10 to classify the causes of animal death.

INDEX TERMS: Dogs, causes of death, epidemiology, health surveillance system, DATASIMA.

RESUMO.- [Causas de morte em cães em Paraíba/Brasil: uso da DATASIMA para diagnóstico e mapeamento de dados.] A análise das causas de morte de cães é fundamental para o controle e prevenção de doenças destes animais, promovendo maior longevidade e qualidade de vida. Entretanto, a literatura atual carece de padronização e uniformidade da

descrição diagnóstica, formas e instrumentos de coleta de dados e manutenção dos registros obituários de cães. Por meio da Plataforma de Dados do Sistema de Informação sobre Mortalidade Animal (DATASIMA), que utiliza a Declaração de Óbito Animal e a Classificação Internacional de Doenças (CID-10), realizou-se a classificação das causas de morte

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de cães atendidos por médicos veterinários no Laboratório de Patologia do Hospital Veterinário de Areia entre janeiro e dezembro de 2022, estratificando-as, promovendo o georreferenciamento dessas causas e caracterizando o perfil epidemiológico dos cães. Analisou-se 264 cadáveres, com os grupos de afecções causadoras de morte mais prevalentes sendo: distúrbios fisiopatológicos (37,87%; n=100), doenças infecto-parasitárias (28,4%; n=75), neoplasias (21,59%; n=57) e causas externas (12,12%; n=32). Categorizou-se as causas de morte de acordo com o sexo e faixa etária, observando-se maior prevalência em adultos de distúrbios fisiopatológicos e afecções infecciosas, neoplasias em cães idosos e doenças infecto-parasitárias e distúrbios fisiopatológicos em filhotes. Os achados do estudo mostram a viabilidade de se utilizar a DATASIMA para o mapeamento e padronização de dados sobre as causas de morte animais, permitindo estratégias de intervenção em saúde pública, prevenção de zoonoses, redução de códigos garbage, melhor e mais eficiente comunicação entre médicos veterinários e a possibilidade de utilização do CID-10 para classificar causas de morte animais.

TERMOS DE INDEXAÇÃO: Cães, causas de morte, epidemiologia, sistema de vigilância em saúde.

INTRODUCTION

Dogs are a part of human life. The dog-human connection allows sufficient emotional involvement between species for spontaneous bonding, and dogs can even be perceived as family members (Thielke & Udell 2020, Smith & Van Valkenburgh 2021). Therefore, there has been an effort to trace, diagnose, and treat pathological conditions that may compromise the quality of life of animals. Euthanasia is used only in cases of extreme clinical suffering (Passantino et al. 2006).

Mortality and longevity in dogs and other pets are being investigated (Bonnert et al. 2005, Inoue et al. 2015), and the epidemiological analysis of the main diseases, storage of data that help control and/or eradicate them, and development of new treatments (Cáceres et al. 2020) are fundamental.

Understanding the incidence of diseases that affect animals facilitates the diagnostic identification of specific clinical, laboratory, and pathological manifestations (Figuera et al. 2008). Dogs exhibit variations in life expectancy, common diseases, patterns of behavior, and cognition according to race and demographic conditions (O'Neill et al. 2023, Turcsán & Kubinyi 2024). Therefore, veterinary doctors should be aware of the most common ailments and causes of death in their region of activity.

Veterinarians also play a role in prevention by raising awareness about animal welfare and public health issues in the community (Loss et al. 2012). Such prevention also involves advising future owners about the variations across breeds, genera, sizes, and ages of dogs so that the onset of diseases can be reduced or, at least, delayed (Proschowsky et al. 2003).

The World Animal Health Information System (WAHIS), associated with the World Organisation for Animal Health (WOAH), is a platform that stores and publicizes official data on animal diseases, providing a risk assessment of public health conditions related to animals (Cáceres et al. 2023). The more sources and means of collecting data WAHIS has, the more impact it can have on health management. Systems

such as VetCompass allow the collection and storage of clinical records from medical-veterinary records, mapping useful data for use in international research and collaborations on pet animals. However, the lack of standardization and uniformity of diagnostic criteria, clinical management, and record-keeping can result in biases and incorrect classifications (McGreevy et al. 2017, O'Neill et al. 2022).

Moreover, cause of death records may not be based on post mortem investigations in dog populations, often necessary for proper diagnosis (Mila et al. 2021).

Infectious, traumatic, degenerative, and neoplastic diseases are the main causes of spontaneous death or justifications for euthanasia, of which neoplastic processes are highly prevalent, especially in the geriatric population of domestic animals such as dogs and cats (Figuera et al. 2008, Fleming et al. 2011, Togni et al. 2018, Rafalko et al. 2023). Annual cancer screening of all dogs has been suggested from seven years of age (Rafalko et al. 2023). Mapping the causes of death of dogs in a region may be useful for refining and better characterizing the afflictions of that population, allowing for greater personalization of care strategies.

The "Plataforma de Dados do Sistema de Informação sobre Mortalidade Animal" (Data Platform of the Animal Mortality Information System – DATASIMA) is a free application developed for the use of veterinary doctors for data feeding. Using DATASIMA, this study aimed to analyze the deaths of dogs notified by the Veterinary Pathology Laboratory of the Veterinary Hospital of Areia and stratify and geo-reference the causes of the deaths registered in this service. Thus, the epidemiological profile linked to deaths could be studied in addition to their distribution in urban spaces, along with the application of DATASIMA in the categorization and evaluation of these data, allowing for efficient public health strategies, in the face of reality and the challenges encountered.

MATERIALS AND METHODS

Ethical approval. This study was linked to a project approved by the Research Ethics Committee of the Center for Medical Sciences of the "Universidade Federal da Paraíba" (approval code: CAAE 44552621.0.0000.8069) and follows the determinations of Resolution 196/96 of the National Health Council. All the legal animal owners and veterinary doctors provided informed consent.

Design of the study. This cross-sectional observational epidemiological study was conducted at the "Laboratório de Patologia Veterinária" (Pathology Laboratory) of the Veterinary Hospital of Areia (LPHV), Brejo Paraibano, Brazil. The investigation covered deaths reported and assessed by this service from January to December 2022. All the dogs that underwent necropsy with confirmed diagnoses by histopathological or laboratory analyses were included. This study was conducted following the recommendations of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement (Von Elm et al. 2007, Cuschieri 2019).

The Data Platform of the Animal Mortality Information System (DATASIMA) and data collection procedure. The data were stored and mapped using DATASIMA (Sousa et al. 2023), a free online software⁷ developed in Brazil to notify animal deaths, facilitate epidemiological surveillance, and prevent health problems. This system is fed exclusively by veterinary doctors

⁷ Available at <<https://datasima.com.br>> Accessed on Jul. 2, 2024.

through the completion and validation of the “Declaração de Óbito Animal” (Declaration of Animal Death - DOA), a document that standardizes notification and categorizes the primary causes of death using the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) (WHO 2004). The completion of DOA involved 48 fields of the population divided into six blocks, including I) identification of the person responsible, II) identification of the animal, III) identification of the occurrence, IV) likely circumstances of death, V) conditions and causes of death, and VI) conclusion. In the fields involving conditions and causes of death, up to four cause-of-death codes and two pre-existing disease codes that may have contributed to the death can be assigned. The system is monitored to preserve the privacy of the guardians and animals, and it allows full data access only to the local and regional health authorities.

All dog deaths reported over a year were analyzed in this cross-sectional study. Cases were excluded if the cause of death could not be determined due to advanced autolysis, absence of lesions, or lack of clinical data indicating the cause of death. The variables examined included sex, estimated age, guardian address, cause of death, and characteristics of death. Age was stratified by: newborn (up to two weeks old), puppies (up to one year old), adults (one to nine years old), elderly (ten years old or more) and indeterminate (Figuera et al. 2008). Data was retrieved from DATASIMA through the “Notification and Search Reports” function built into the application for audit purposes.

Causes of death were classified into (I) infectious and parasitic, (II) neoplasms, (III) external causes, and (IV) pathophysiological disorders.

Statistical analysis. Data were extracted in the .CSV format from DATASIMA and stored in spreadsheets. Qualitative data were presented as absolute and relative frequencies. Geo-referencing generated by the system was performed using frequency maps with variations in color from beige to red according to the prevalence of events occurring in each notification municipality.

RESULTS

A total of 270 deaths were recorded and analyzed using DATASIMA. After excluding six cases where the cause of death could not be determined, the analysis included 264 valid cases. Table 1 presents the distribution of the causes of death according to the pathological categories. Figure 1 shows the most frequent ICD-10 codes observed in this study. The sampling percentages for each pathological category are shown in Figure 2.

Deaths classified as Pathophysiological disorders were the most prevalent, accounting for 37.87% (n=100) of all deaths. The most prevalent codes were R57.0 “Cardiogenic shock” (4.17%, n=11) and “Unspecified bronchopneumonia” (3.79%, n=10).

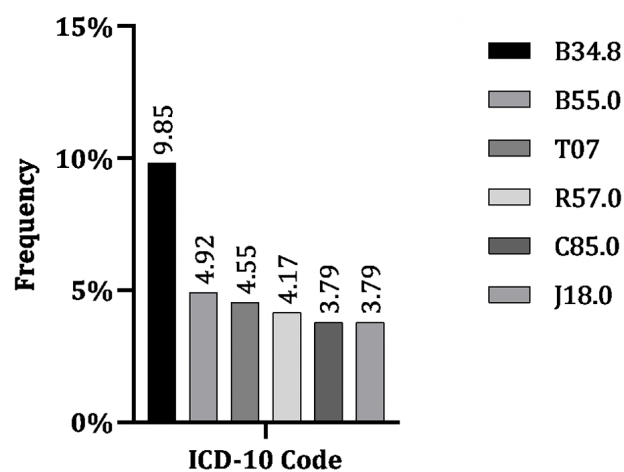
Infectious and parasitic diseases (28.4%; n=75) had a high prevalence of ICD-10 code B34.8 “Other virus infections of unspecified location” (9.85%; n=26), but all cases included in this code had the histopathological diagnosis of canine distemper, a condition not described by ICD-10. Zoonoses “Visceral leishmaniasis” (4.92%, n=13) and “Canine ehrlichiosis” (2.27%, n=6) were the most frequent conditions.

Under Neoplasms (21.59%; n=57), the most prevalent conditions were “Lymphosarcoma” (3.79%, n=10), “Malignant nipple and areola neoplasia” (2.65%, n=7), and “Malignant kidney neoplasia except renal pelvis” (2.65%, n=7).

The ICD-10 T07 “Unspecified multiple injuries” classification (4.55%, n=12), in which all the cases involved a hit, was the most prevalent code under External causes (12.12%, n=32). The next most prevalent code was “Injury of blood vessels of head, not elsewhere classified” (1.52%, n=4).

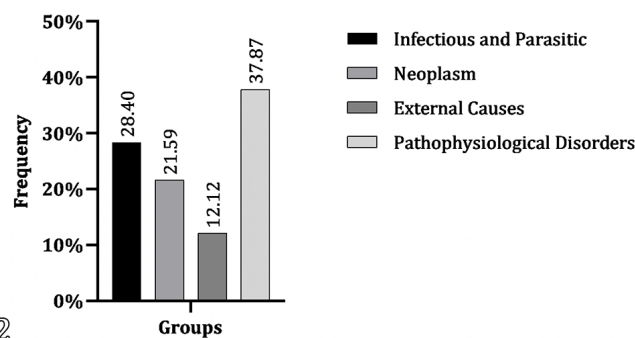
The causes of canine death according to pathological groups were distributed according to sex and age group (Fig.3 and 4, Table 2). In both male and female dogs, the most frequent cause of death was Pathophysiological disorders, and the least frequent was External causes, with a higher incidence of male dogs dying by External causes than female dogs. The leading causes of death in newborn and adult dogs were Pathophysiological disorders, whereas those in dogs with indeterminate age and puppies were Infectious and parasitic. Conversely, malignancies were the most frequent cause of death among elderly dogs.

Figure 5 presents geo-referencing through frequency maps, highlighting the city of origin in the state of Paraíba with higher case-record densities and animal deaths.



1

Fig.1. Main ICD-10 codes for canine causes of death mapped by DATASIMA. B34.8 = Other viral infections of unspecified site, B55.0 = Visceral leishmaniasis, T07 = Unspecified multiple injuries, R57.0 = Cardiogenic shock, C85.0 = Lymphosarcoma, J18.0 = Bronchopneumonia, unspecified.



2

Fig.2. Frequency of deaths in dogs distributed according to pathological categories of death.

Table 1. Causes of dog's death coded according to ICD-10 and classified by pathological groups

ICD-10 code	Number of cases	Frequency
Infectious and parasitic	75	28.41%
A04.7 – Enterocolitis due to <i>Clostridium difficile</i>	1	0.38%
A09.0 – Other and unspecified gastroenteritis and colitis of infectious origin	4	1.52%
A27.0 – Leptospirosis icterohaemorrhagica	3	1.14%
A77.4 – Ehrlichiosis	6	2.27%
A82.0 – Sylvatic rabies	1	0.38%
B19.0 – Unspecified viral hepatitis with hepatic coma	4	1.52%
B34.8 – Other viral infections of unspecified site	26	9.85%
B45.0 – Pulmonary cryptococcosis	1	0.38%
B55.0 – Visceral leishmaniasis	13	4.92%
B58 – Toxoplasmosis	1	0.38%
B60.0 – Babesiosis	2	0.76%
C84.0 – Mycosis fungoides	1	0.38%
G04.0 – Acute disseminated encephalitis	4	1.52%
G04.2 – Bacterial meningoenzephalitis and meningomyelitis, not elsewhere classified	3	1.14%
I33.0 – Acute and subacute infective endocarditis	5	1.89%
Neoplasm	57	21.59%
C22.1 – Intrahepatic bile duct carcinoma	3	1.14%
C25 – Malignant neoplasm of pancreas	4	1.52%
C34 – Malignant neoplasm of bronchus and lungs	3	1.14%
C41.0 – Malignant neoplasm of bones of skull and face	1	0.38%
C43.5 – Malignant melanoma of trunk	1	0.38%
C47.0 – Malignant neoplasm of peripheral nerves of head, face and neck	1	0.38%
C49.0 – Malignant neoplasm of connective and soft tissue of head, face and neck	3	1.14%
C50 – Malignant neoplasm of breast	7	2.65%
C55 – Malignant neoplasm of uterus	2	0.76%
C57.7 – Malignant neoplasm of other specified female genital organs	2	0.76%
C61 – Malignant neoplasm of prostate	2	0.76%
C64 – Malignant neoplasm of kidney, except renal pelvis	7	2.65%
C71.9 – Malignant neoplasm of brain, unspecified	1	0.38%
C72.9 – Malignant neoplasm of Central nervous system, unspecified	1	0.38%
C73 – Malignant neoplasm of thyroid gland	2	0.76%
C74.0 – Malignant neoplasm of cortex of adrenal gland	1	0.38%
C75.5 – Malignant neoplasm of aortic body and other paraganglia	2	0.76%
C76.0 – Malignant neoplasm of head, face and neck	3	1.14%
C85.0 – Lymphosarcoma	10	3.79%
D17.0 – Benign lipomatous neoplasm of skin and subcutaneous tissue of head, face and neck	1	0.38%
External causes	32	12.12%
A05.2 – Foodborne <i>Clostridium perfringens</i> (<i>Clostridium welchii</i>) poisoning	1	0.38%
T63.0 – Toxic effect of snake venom	1	0.38%
T64 – Toxic effect of aflatoxin and other mycotoxin food contaminants	1	0.38%
Y19.0 – Poisoning by and exposure to other and unspecified chemicals and noxious substances, undetermined intent	2	0.76%
S09.0 – Injury of blood vessels of head, not elsewhere classified	4	1.52%
S24.1 – Other and unspecified injuries of thoracic spinal cord	1	0.38%
S32.0 – Fracture of lumbar vertebra	2	0.76%
S37.0 – Injury of kidney	1	0.38%
S82.0 – Fracture of patella	1	0.38%
T07 – Unspecified multiple injuries	12	4.55%
T17.9 – Foreign body in respiratory tract, part unspecified	1	0.38%
T18.0 – Foreign body in mouth	2	0.76%
W54.0 – Bitten or struck by dog	1	0.38%
W79.0 – Inhalation and ingestion of food causing obstruction of respiratory tract	1	0.38%
W87.0 – Exposure to unspecified electric current	1	0.38%

ICD-10 code	Number of cases	Frequency
Pathophysiological disorders	100	37.88%
D65 – Disseminated intravascular coagulation [defibrination syndrome]	2	0.76%
E75.1 – Other gangliosidosis	3	1.14%
E85.9 – Amyloidosis, unspecified	1	0.38%
I42.0 – Dilated cardiomyopathy	2	0.76%
I50.0 – Congestive heart failure	2	0.76%
I78.8 – Other diseases of capillaries	1	0.38%
I87.1 – Compression of vein	1	0.38%
J18.0 – Bronchopneumonia, unspecified	10	3.79%
J43.0 – MacLeod syndrome	2	0.76%
J69.0 – Pneumonitis due to food and vomit	1	0.38%
J84.0 – Alveolar and parietoalveolar conditions	6	2.27%
J98.4 – Other disorders of lung	1	0.38%
K25.0 – Gastric ulcer acute with hemorrhage	1	0.38%
K31.0 – Acute dilatation of stomach	1	0.38%
K44.0 – Diaphragmatic hernia with obstruction, without gangrene	3	1.14%
K52.9 – Noninfective gastroenteritis and colitis, unspecified	7	2.65%
K59.3 – Megacolon, not elsewhere classified	2	0.76%
K63.0 – Abscess of intestine	1	0.38%
K72.0 – Acute and subacute hepatic failure	2	0.76%
K74.0 – Hepatic fibrosis	1	0.38%
K85.8 – Other acute pancreatitis	1	0.38%
K85.9 – Acute pancreatitis, unspecified	1	0.38%
K92.2 – Gastrointestinal hemorrhage, unspecified	1	0.38%
M80.0 – Postmenopausal osteoporosis with pathological fracture	1	0.38%
M86.0 – Acute hematogenous osteomyelitis	1	0.38%
M91.0 – Juvenile osteochondrosis of pelvis	8	3.03%
M91.2 – Coxa plana	1	0.38%
N00.2 – Acute nephritic syndrome - Diffuse membranous glomerulonephritis	6	2.27%
N11.0 – Nonobstructive reflux-associated chronic pyelonephritis	1	0.38%
N17.0 – Acute renal failure with tubular necrosis	2	0.76%
N18.5 – Chronic kidney disease, stage 5	8	3.03%
N71.0 – Acute inflammatory disease of uterus	4	1.52%
Q37.0 – Cleft hard palate with bilateral cleft lip	1	0.38%
R41.0 – Disorientation, unspecified	1	0.38%
R57.0 – Cardiogenic shock	11	4.17%
R57.1 – Hypovolaemic shock	2	0.76%
TOTAL	264	100.00%

DISCUSSION

DATASIMA is a versatile tool for recording and grouping the causes of death in necropsied dogs in LPHV. Our findings allowed us to classify the main pathologies according to ICD-10 and geographically locate them in Paraíba's Agreste and Mata mesoregions, verifying the high prevalence of infections and parasitic diseases, neoplasms, and pathophysiological disorders. The epidemiological data facilitated the identification of the most prevalent causes of death according to sex and age group, enabling screening and preventative care in populations at risk.

The mapping of infectious and parasitic diseases, especially zoonoses, made possible by DATASIMA, is important for protecting species and implementing health interventions. Animal health information systems are used to develop predictive models and assess health risks of interest, providing important contributions to veterinary services (Cáceres et

al. 2023). DATASIMA can also contribute to supplying large data platforms on animal diseases.

Standardized systems that monitor disease status, such as SisLeish, are known to have great potential for growth and utility but have critical internal and external limitations (Maia-Elkhoury et al. 2017), including the lack of systematic documentation, homogeneity of data collection, and standardization of the terminology used (Bisdorff et al. 2017). To mitigate such problems, DATASIMA proposed the use of the ICD-10 classification for clearly defining criteria and correctly identifying health conditions.

Unlike systems such as VetCompass, DATASIMA aims to collect data about the causes of animal death and the identification of the responsible person, animal, and place of occurrence (Sousa et al. 2023), presenting the data in a standardized and objective manner without access to clinical records and divergences in the data collection method (McGreevy et al.

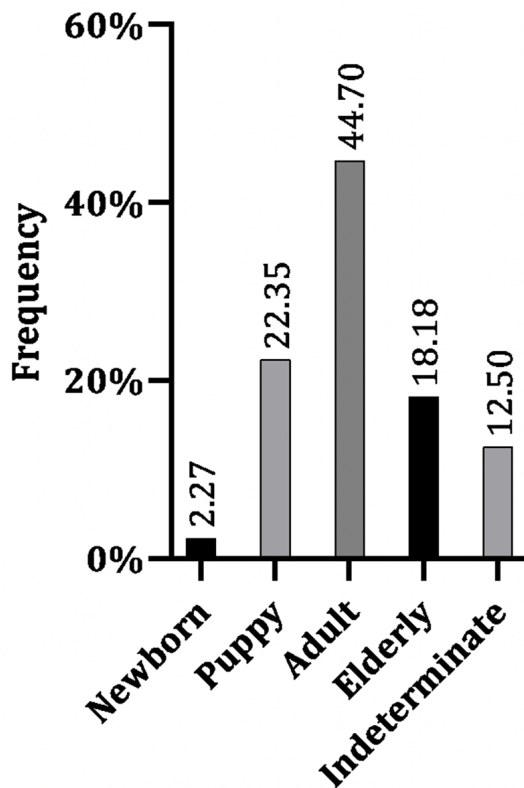
2017). In this sense, it is a simple-to-use tool whose purpose is directly fulfilled.

The mortality of dogs is influenced by several factors, many of which are associated with age (Dias-Pereira 2022). The analysis of these factors may represent advances in studies on human aging, as dogs represent a model with several similarities to man, such as increased frailty with age (Banzato et al. 2019).

In a study conducted in the United States, the aging of animals considering the causes of death, quality of life *perimortem*, and reasons for euthanasia were investigated. However, it used an instrument filled by the animal's tutor and the causes of

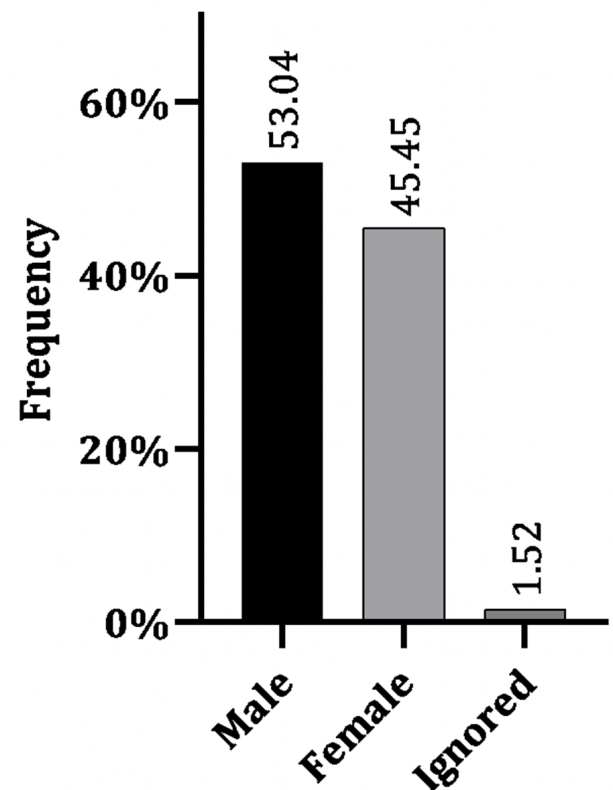
death were classified as nonspecific findings, such as "disease or illness" and "senility" (McNulty et al. 2023).

When it comes to human health, such cataloging can be framed as garbage codes, as they would be intermediate causes that could be unspecific within a larger group of diseases or not the underlying cause of death (Naghavi et al. 2010). The correct use of ICD-10 codes, in turn, can reduce the number of garbage codes and make the assessment of causes of death more complete (Park & Kim 2022). One of the advantages of DATASIMA is the implementation of the ICD-10 for the completion of DOA by the veterinary surgeon, increasing the usefulness of the data for identifying health problems.



3

Fig.3. Frequency of deaths in dogs distributed according to age group.



4

Fig.4. Frequency of deaths in dogs distributed according to sex.

Table 2. Causes of dog's death according to age group and sex arranged by pathological groups

Variables	Total		Infectious and parasitic		Neoplasm		External causes		Pathophysiological disorders	
	Number of cases	Frequency	Number of cases	Frequency	Number of cases	Frequency	Number of cases	Frequency	Number of cases	Frequency
Age group										
Newborn	6	2.27%	0	0.00%	1	16.67%	1	16.67%	4	66.67%
Puppy	59	22.35%	26	44.07%	1	1.69%	7	11.86%	25	42.37%
Adult	118	44.70%	30	25.42%	25	21.19%	16	13.56%	47	39.83%
Elderly	48	18.18%	8	16.67%	24	50.00%	2	4.17%	14	29.17%
Indeterminate	33	12.50%	11	33.33%	6	18.18%	6	18.18%	10	30.30%
Sex										
Male	140	53.03%	41	29.29%	27	19.29%	21	15.00%	51	36.43%
Female	120	45.45%	34	28.33%	29	24.17%	10	8.33%	47	39.17%
Ignored	4	1.52%	0	0.00%	1	25.00%	1	25.00%	2	50.00%

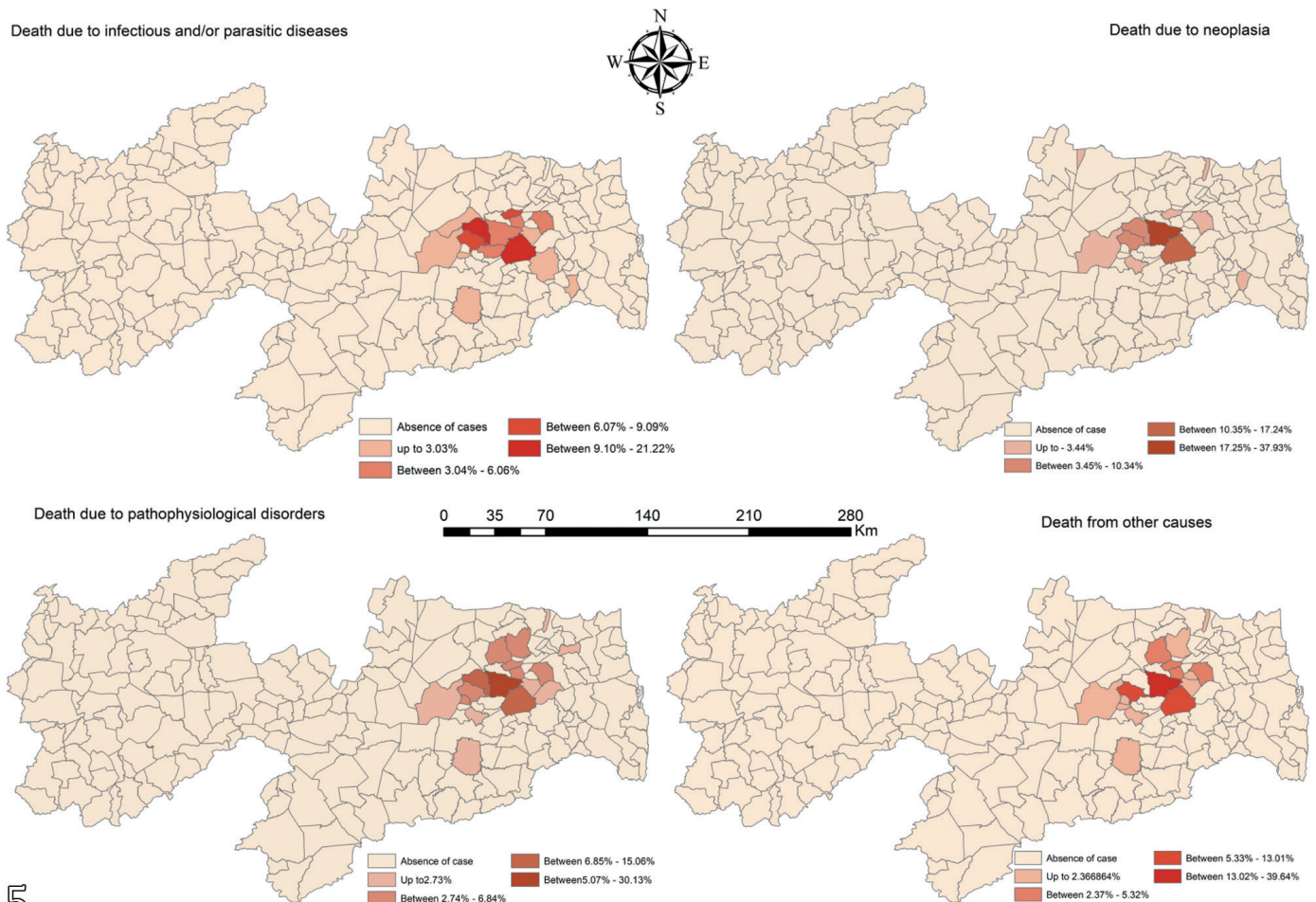
Furthermore, using ICD-10 can also facilitate the assessment of Garbage Codes in veterinary medicine.

The findings about the main causes of death are confluent with the literature in pointing out the high frequency of neoplastic causes but differ from other studies in that they do not verify causes such as “senility” or “behavior,” which can be considered biased, given the method of collection by means of questionnaires to the guardians of the dead animals (Bonnett et al. 2005, Mandigers et al. 2006, Adams et al. 2010). Causes such as senility appear as the most prevalent in studies about dead dogs (Inoue & Sugiura 2021); however, it is necessary to reinforce that this descriptor would be considered a garbage code because it is a factor that may contribute to the death of the animal, but not the direct underlying cause (Naghavi et al. 2010).

A high prevalence of pathophysiological disorders has also been frequently reported in the literature, with a high prevalence of groups that verify the causes of cardiovascular and pulmonary death, in addition to the effects on multiple organs or systems (Adams et al. 2010, Eleni et al. 2014, O’Neill et al. 2014, Huang et al. 2017, Inoue & Sugiura 2021). However, most studies classify these causes of death only in relation to the affected system, often without performing a necropsy or specifying the primary diagnosis.

Infectious and parasitic causes of death accounted for a large proportion of our sample, although the literature shows these causes are usually the most prevalent (Bentubo et al. 2007, Figuera et al. 2008, Trapp et al. 2010). An important finding was the high prevalence of Canine distemper, a cause widely reported in the literature (Figuera et al. 2008, Trapp et al. 2010). However, the findings on zoonotic diseases, especially leishmaniasis and ehrlichiosis, are not diagnoses with high prevalence rates in the studies, highlighting the differences observed in our sample in northeastern Brazil.

The limitations of this study include the short period of data collection, the low number of professionals willing to learn and use DATASIMA, and the collection of data from only one animal species and a single point of care. Furthermore, DATASIMA is available only in Portuguese. These conditions make the study a regional cutoff with a low number of animals evaluated. Another limitation is the impossibility of discriminating the causes of death by breed, given the multiple possibilities of mixed breeds, which could constitute a confounding bias, and further studies are recommended only with pedigree dogs. There are also intrinsic limitations to the use of ICD-10 as a tool for classifying causes of death in animals, as it was necessary to adapt the health conditions of dogs to those of humans since many diseases that affect dogs are not contemplated. Future studies should be conducted



5

Fig.5. Geo-referencing the prevalence of canine deaths according to city of origin and cause of death.

with a larger population and number of animals, offering expanded surveillance and useful data for taking actions that transcend regional spheres.

We also recommend creating a classification system for the diseases and pathologies seen in veterinary medicine or adapting the ICD-10 to better understand the diseases affecting animals. In this context, we also endorse the study and compilation of conditions or codes that could be considered Garbage Codes in veterinary medicine.

CONCLUSIONS

The findings of the study corroborate the literature's findings by identifying a high prevalence of causes of death as "Pathophysiological disorders" and "Neoplasms," besides identifying and mapping zoonoses such as leishmaniasis and ehrlichiosis within the group of Infectious and parasite diseases.

We also verified the feasibility of using DATASIMA for the mapping and standardization of data on the causes of animal death in that it is a free tool, easy to use and access, and allows for the generation of reports that make it possible to implement strategies for intervention in public health and the prevention of zoonoses.

With the dissemination of DATASIMA, it will be possible to reduce Garbage Codes, facilitate better and more efficient communication between veterinarians, and use the ICD-10 to classify the causes of animal death.

Conflict of interest statement.- The authors declare that there are no conflicts of interest.

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