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REVISITING THE ONE HEALTH APPROACH IN THE CONTEXT OF TUBERCULOSIS: A LOOK INTO THE PARALLELISM BETWEEN THE EPIDEMIOLOGICAL ASPECTS OF HUMAN AND BOVINE TUBERCULOSIS IN BRAZIL

Vinícius José de Oliveira[1*], Maria Victória Pereira de Souza[2], Fernanda Vianna Borges[2], Lucas Maurício Lopes Navasquez[3], Amanda de Paula Paim[2], Heitor Leocádio de Souza Rodrigues[3], Wytter Rodrigues Velasco Gomes[2], Maria Vitória Gilvan da Silva[2], Samantha Luiza Soriano da Fonseca[2], Pedro Barros Araújo[2], Alessandro Sousa Correa[4]andDouglas Alves Pereira[5]

[1]PhD student in Applied Immunology and Parasitology; Specialist in Zoonosis and Public Health; Veterinary Medicine student; Member of the Tutorial Education Program (TEP) of the Veterinary Medicine graduation, Federal University of Uberlândia, Uberlândia, Minas Gerais, Brazil; [2]Veterinary Medicine Student; Member of the Tutorial Education Program (TEP) of the Veterinary Medicine graduation, Federal University of Uberlândia, Uberlândia, Minas Gerais, Brazil; [3]Veterinary Medicine student, Federal University of Uberlândia, Uberlândia, Minas Gerais, Brazil; [4]PhD Student in Applied Immunology and Parasitology, Federal University of Uberlândia, Uberlândia, Minas Gerais, Brazil

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Corresponding author:
Vinícius José de Oliveira

ABSTRACT

Tuberculosis is one of the oldest diseases of humankind, caused by bacteria belonging to the Mycobacterium tuberculosis complex. It affects several animal species, with an emphasis on humans and cattle. Given this premise, this study aims to describe the epidemiological aspects of human and bovine tuberculosis in Brazil and to foster discussion of the variables analyzed from a One Health perspective. Data were collected from Brazil's platforms of compulsory infection notification for both species. The data are expressed in tables and figures, and the discussion is based on international scientific literature. Finally, it is possible to understand the importance of the Veterinarian within the One Health approach in diagnosing and controlling the infection.

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INTRODUCTION

Tuberculosis is one of humanity's oldest diseases. *Mycobacterium* originated 150 million years ago and possibly decimated more people than any other pathogenic microorganism. There are records of the disease in Egyptian mummies, excerpts from Biblical Hebrew books, ancient Chinese writings, and Hippocratic studies in ancient Greece, revealing the lethal presence of the pathogen in major civilizations (VERONESI & FOCACCIA, 2010). It is an infectious disease with a zoonotic character, caused by aerobic mycobacteria, being the species of importance to man the *Mycobacterium tuberculosis*, *M. bovis, M.microti*, and *M. canettii*, of these, only *M. bovis* is of great significance in the bovine sector (RUGGIERO *et al*., 2022). The bacillus that causes the disease is resistant to disinfectants and heat, besides remaining viable in manure for up to 2 years, one year in water, and ten months in products of animal origin (ROXO, 1996). Susceptibility is universal, but the risk is related to the degree of exposure (KRITSKI *et al*., 2018; CHAKAYA *et al*., 2021). Infection in humans can occur through the consumption of infected raw meat and milkderivatives, mainly from clandestine slaughters and dairy products, without supervision. However, there is a worldwide concern with occupational transmission for farmers, slaughterhouse workers, Veterinarians, and butchers (TELES; KARVAT & PEDRASSANI, 2022). In addition, the disease can also be transmitted through the respiratory system. After inhalation of the bacillus, countless nonspecific mechanical barriers will act against infection. In the failure of these barriers, arriving in the lung alveoli, they will encounter macrophages that will phagocytize the pathogen. After phagocytosis, caseous nodules will form in the lung parenchyma. If

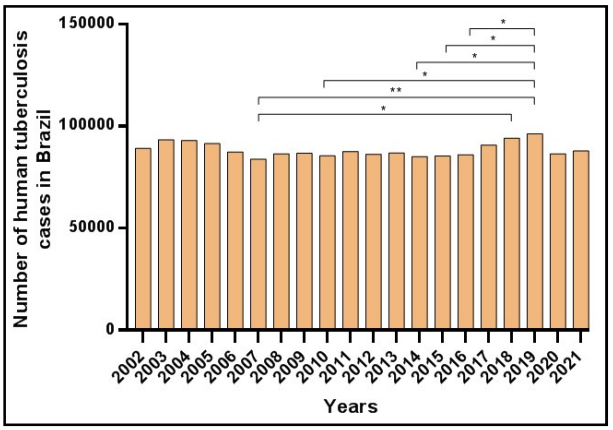
the agent enters the bloodstream, its dissemination, and the formation of metastases in other organs will be possible (ROXO, 1996; MCCLEAN & TOBIN, 2016). These aspects are characteristic of human and bovine tuberculosis.There is a widely used analogy when talking about tuberculosis: iceberg. Infected individuals can act as a reservoir for the disease and be a source of infection when the active form occurs (ORCAU; CAYLÀ & MARTÍNEZ, 2011). It is understood that patients with clinical symptomatology are the exposed tip due to their detection by diagnostic strategies. All other infected people without clinical symptomatology (reservoirs) would be the non-visible part of the iceberg (PETERS *et al*., 2019). Tuberculosis case detection exhibits a prevalence among people living in urban areas, drug-resistant, vulnerable populations - those infected with the HIV/AIDS virus, drug users, homeless, malnourished or undernourished, children, or individuals with other comorbidities because of an immature or deficient immune system (KRITSKI *et al*., 2018; CHAKAYA *et al*., 2021). The probability of the infection progressing to disease is higher in the first 12-24 months after contact (ORCAU; CAYLÀ & MARTÍNEZ, 2011). According to the World Health Organization, approximately 10 million tuberculosis cases are reported worldwide. In Brazil, in 2020, about 69,000 new cases and 4,500 deaths due to the disease were reported (CHAKAYA *et al*., 2021). Brazil remains among the 30 countries with high burden sums for tuberculosis and tuberculosis/AIDS co-infection and is therefore considered a priority for the control of the disease worldwide by the World Health Organization (ADEPOJU, 2020). Concerning bovine tuberculosis, the Brazilian Ministry of Agriculture, Livestock, and Supply (MAPA from Portuguese) established in 2001 the National Program for the Control and Eradication of Brucellosis and Animal Tuberculosis (NPCEBAT). The program aims to reduce the prevalence and incidence of these diseases in cattle and buffaloes, aiming at eradicating bovine tuberculosis through sanitary measures. The strategy of NPCEBAT 's action is based on the classification of Brazilian states regarding the degree of risk for brucellosis and tuberculosis, and the application of animal health defense procedures, according to the risk classification (BRASIL, 2006). Allergic tests of intradermal tuberculization are used for the diagnosis of tuberculosis. Routine tests are the simple cervical test, the caudal fold test, and the comparative cervical test, and the latter is also used as a confirmatory test. Tuberculinization should be performed in males and females aged six weeks or older (RUGGIERO *et al*., 2022). Abandoning treatment is one of the biggest challenges for the disease, which is long-term, at least six months, so the patient should take the medications regularly every day. Abandonment can result in the maintenance and transmission of the disease and antimicrobial resistance (CHAKAYA *et al*., 2021). Because of tuberculosis's importance, this study aims to describe the epidemiological aspects of human and bovine tuberculosis in Brazil and to foster discussion of the variables analyzed from a One Health perspective.

MATERIALS AND METHODS

This article results from a cross-sectional, descriptive, and quantitative epidemiological study. Its theme involves the notifications of human and bovine tuberculosis in Brazil from 2002 to 2021. Brazil is a South American country composed of 27 federative units that extend from the Amazon Basin in the North to the Iguassu Falls in the South. It is the fifth largest in the world in territorial area, with 8.510.345.540 km², equivalent to 47.3% of the South American territory, with an estimated population of 213.317.639 for 2021. In addition, the country had a gross domestic product (GDP) *per capita* of 35.161,70 in 2019 (BRASIL, 2022a). In the country, livestock has had a significant influence on the Brazilian economy, standing out since its beginning in the sixteenthcentury, exerting substantial interference in economic expansion due to its high export rate and supply of the domestic market (TEIXEIRA & HESPANHOL, 2014). Methodological strategies used: 1) analysis of the epidemiological bulletins made available by the Sistema de Informação de Agravos de Notificação (Sinan) (BRASIL, 2022c) to search for data on humans; and 2) analysis of the epidemiological bulletins made available by the Sistema Brasileiro de Vigilância e EmergênciasVeterinárias (e-SISBRAVET) (BRASIL, 2022d) for data related to bovine tuberculosis. Since the methodological strategy uses a database with epidemiological information, public domain, and free access, The National Health Council Resolution No. 510 of April 7, 2016, recommends the exemption from submission of this methodology to the Research Ethics Committee (BRASIL, 2016). Data were collected on October 28, 2022. The variables were analyzed using Excel® software and are presented as figures and tables. The elements studied are stratified according to information available on the notification forms. To calculate the annual incidence rate, we took as the numerator the number of notifications in each year; and, as the denominator, the Brazilian population in the respective year according to the projection of the Brazilian demographic census (BRASIL, 2022b), multiplied by one hundred thousand inhabitants. In the case of cattle, the denominator used was the number of heads of Brazilian cattle in each respective year according to the latest Brazilian agricultural census (BRASIL, 2017). Statistical analysis of the data was performed using GraphPad Prism 6 software. The Kolmogorov-Smirnov tests evaluated the normality of the dataand found a parametric distributionfor human tuberculosis and a non-parametric distribution for bovine tuberculosis. The human tuberculosis data were analyzed using one-way ANOVA and Tukey's multiple comparison test for comparison between groups. Bovine tuberculosis data were analyzed similarly, but the multiple comparison test was not performed. Values of $p < 0.05$ were considered significant. The authors carried out a brief integrative literature review to foster the discussion of the data. The bibliographical survey took place in the scientific article databases Scientific Electronic Library Online (Scielo), Medline (Pubmed), Google Scholar, Scopus, and Latin American and Caribbean Literature on Health Sciences (LILACS). We screened scientific papers on the role of the Veterinarian in the context of TB and public health, using the descriptors "bovine tuberculosis", "human tuberculosis", "public health", "public health systems research" and "Veterinary Medicine".

RESULTS

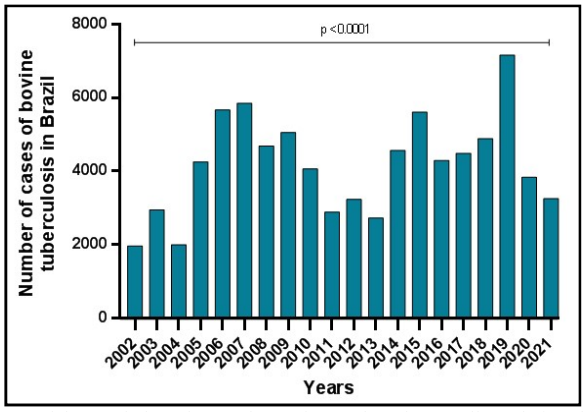
The prevalence of human tuberculosis in Brazil between 2002 and 2021 was 1.768.483 cases. Bovine tuberculosis had a majority of 83.483 points; 97.9% of the cases are related to bovine species and 2.1% to buffalo species. Figure 1 shows the numbers of annual human tuberculosis notifications and their respective statistical differences.



Source: Elaborated by the authors from the data collected in Sinan (BRASIL, 2022c).

Figure 1. Number of cases of human tuberculosis in Brazil (2002-2021)

Statistical analysis confirmed a significant difference between the number of reports from 2007 compared to 2018 and 2019; and between 2010, 2014, 2015, and 2016 compared to 2019. Figure 2 depicts the annual reports of bovine tuberculosis during the period studied. The statistical analysis found that the notifications showed significant differences between 2002 and 2021, with a $p < 0.0001$.



Source: Elaborated by the authors from the data collected in the e-SISBRAVET (BRASIL, 2022d).

Figure 2. Number of cases of bovine tuberculosis in Brazil (2002-2021)

Table 1 presents data on the annual incidence of tuberculosis for every 100.000/humans and 100.000/bovine heads during the period studied. Table 2 describes human tuberculosis notifications registered in each Brazilian region between 2002 and 2021.

Table 1. Annual incidence of tuberculosis in Brazil between 2002 and 2021

Year	The annual incidence in humans	The annual incidence in cattle
2002	49.64	1.06
2003	51.35	1.51
2004	50.50	0.98
2005	49.13	2.06
2006	46.39	2.75
2007	44.09	2.93
2008	45.02	2.32
2009	44.71	2.46
2010	43.64	1.94
2011	44.37	1.36
2012	44.41	1.53
2013	43.21	1.29
2014	41.92	2.15
2015	41.73	2.61
2016	41.65	1.97
2017	43.63	2.09
2018	44.92	2.29
2019	45.58	3.34
2020	40.64	1.76
2021	41.03	1.45

Source: Elaborated by the authors from the data collected in the Sinan (BRASIL, 2022c) and e-SISBRAVET (BRASIL, 2022d).

Table 2. Distribution of human tuberculosis cases by Brazilian region during the period studied (2002-2021)

Year	Brazilian regions				
	North	*Northeast*	*Midwest*	*Southeast*	*South*
2002	7.713	24.851	3.745	42.451	10.340
2003	8.030	27.740	4.039	42.483	11.059
2004	8.376	27.398	3.932	42.138	11.079
2005	8.139	27.862	4.155	40.421	10.850
2006	7.813	25.170	3.810	40.396	10.121
2007	7.685	23.801	3.710	38.377	10.249
2008	8.015	24.337	3.747	39.694	10.651
2009	8.343	24.963	3.695	38.700	10.998
2010	8.358	23.799	3.719	38.498	11.029
2011	8.769	24.344	3.876	39.376	11.258
2012	8.556	23.638	4.288	38.490	11.161
2013	8.888	23.276	4.531	38.901	11.255
2014	8.752	22.497	4.348	38.230	11.190
2015	9.007	22.229	3.974	39.101	11.024
2016	9.369	22.464	4.137	39.229	10.693
2017	10.178	23.842	4.117	41.599	10.920
2018	10.427	25.068	4.539	42.675	11.394
2019	11.683	25.227	4.603	42.767	11.901
2020	10.478	22.228	4.182	39.003	10.500
2021	10.584	22.635	3.937	40.228	10.417

Source: Elaborated by the authors from the data collected in the Sinan (BRASIL, 2022c).

It was possible to identify that the Southeast region has the highest reports prevalence, followed by the Northeast and South regions. Figure 3 shows the spatial distribution of bovine tuberculosis cases registered in each Brazilian state between 2002 and 2021.

Source: e-SISBRAVET (BRASIL, 2022d). The red represents the most significant number of notifications, followed by yellow, green, and blue.

Figure 3. Spatial distribution of bovine tuberculosis cases in Brazil (2002 and 2021)

Table 3. Sociodemographic profile of humans with tuberculosis in Brazil between 2002 and 2021

Sex	N
Male	1.194.352
Female	573.889
Ignored/white	242
Race	N
White	517.826
Black	217.251
Brown	711.237
Yellow	15.179
Indigenous	17.361
Ignored/white	289.595
Schooling	N
Illiterate	103.285
1st to 4th incomplete grade of elementary school	227.483
4th entire grade of elementary school	72.120
5th to 8th incomplete elementary school	367.627
Complete elementary school	71.431
Incomplete high school	205.944
Complete high school	107.743
Incomplete higher education	33.552
Complete higher education	54.948
Ignored/white	524.350
Age group	N
0-14 years old	56.396
15-24 years old	304.436
25-34 years old	414.428
35-44 years old	357.507
45-54 years old	289.190
55-64 years old	188.048
65 years or older	157.352
Residence area	N
Rural	101.591
Urban	883.151
Periurban areas	8.299
Ignored/white	775.442
Groups with specific characteristics	N
Institutionalized individuals	62.977
Individuals deprived of liberty	80.450
Homeless population	26.711
Health professionals	9.140
Immigrant individuals	4.025

Legend: N represents the raw number of notifications for the characteristic described. Source: Elaborated by the authors from the data collected in the Sinan (BRASIL, 2022c).

The states with the highest number of reports of bovine tuberculosis were the southern states of Goiás, Minas Gerais, Pará, and Amapá. Table 3 shows the sociodemographic profile of Brazilian individuals who contracted tuberculosis between 2002 and 2021.

Table 4. Clinical information on tuberculosis and associated comorbidities in Brazilian individuals (2002 and 2021)

Type of input	N
New case	1.445.827
Relapse	120.371
Re-entry after abandonment	122.802
The notifier does not know how to inform	10.761
Transfer	62.959
Post-mortem	4.555
Ignored/white	1.208
Infection shape	N
Pulmonary	1.480.827
Extrapulmonary	228.896
Pulmonary + extrapulmonary	56.911
Ignored/white	1.849
Evolution	N
Healing	1.171.185
Abandonment	208.062
Death from tuberculosis	48.585
Death from other causes	83.187
Transfer of treatment to another state	117.270
Drug-resistant tuberculosis	12.327
Change of dosing scheme	4.742
Bankruptcy	561
Primary abandonment	5.193
Ignored/white	117.371
Associated diseases and comorbidities	N
Human Immunodeficiency Virus (HIV)	179.610
Acquired Immunodeficiency Syndrome (AIDS)	162.546
Mental illness	35.317
Diabetes *mellitus*	102.257
Alcoholism	251.356
Smoking	152.956
Illicit drug abuse (chemical dependence)	106.800

Legend: N represents the raw number of notifications for the characteristic described.Source: Elaborated by the authors from the data collected in the Sinan (BRASIL, 2022c).

Males, brown, aged between 25 and 34 years, living in the urban area, and with low schooling are the most affected by the infection. In addition, it was possible to identify a high infection rate in institutionalized individuals (asylum, orphanages, and psychiatric hospitals, among other places). Regarding TB diagnosis during pregnancy, 4,955 cases were reported in different gestational periods. There were 1.558 cases during the first quarter, 2.097 during the second quarter, and 1.300 during the third quarter. In addition, in 2.445 notifications, the practitioner ignored the gestational age.Table 4 describes the clinical information of the disease and the associated comorbidities that patients had, extracted from Brazilian notifications between the years studied.Most of the reports were of new cases, of the pulmonary type, with defined laboratory diagnoses that evolved to cure. The most affected individuals are alcohol dependence (alcoholism).

DISCUSSION

Veterinary Medicine is one of the areas of knowledge responsible for One Health's approachto maintaining a balance between human, environmental, and animal health. Thus, these professionals play a fundamental role in controlling and preventing zoonosis since 75% of the reemerging or emerging diseases of the last century are zoonoses (ANJOS *et al*., 2021). The epidemiological panorama of tuberculosis is characterized by a global spread of infection, causing significant economic and health losses to local, national, and international livestock (MURAKAMI *et al*., 2009). In 2013, 9 million new cases were registered worldwide, with 1.5 million dying, mostly in men. However, there were significant deaths in women (510.000) and children (80.000) affected by the infection. These data refer to Asia (56%) and the African region (29%), while America had 3% of the cases. On the continents mentioned above, countries such as India, China, Nigeria, Pakistan, Indonesia, and South Africa stand out (WHO, 2014). The Americas are considered the regions with the lowest TB rates on average since most countries have levels below 50 per 100.000 inhabitants per year, especially Brazil (WHO, 2014). In addition, in 2021, 213.200 new cases of infection were recorded in the American continent, with an incidence of 21 points per 100.000 inhabitants, with a mortality rate of 23.000 (WHO, 2022). This evidence corroborates the present study's findings that an annual incidence in Brazil in 2021 of 51.35 per 100.000/inhabitants. In addition, there was a 31% change in the total number of deaths from tuberculosis between 2015 and 2021 (WHO, 2022). Brazil has epidemiological aspects consistent with the spread of the infection in other American countries. The data in this study indicated a significant percentage of the disease in male individuals, in age groups over 15 years, with the form of pulmonary infection and who evolved to cure, corroborating international descriptions for TB in the Americas (WHO, 2022). In addition, it was possible to compare the detection rates of drug-resistant tuberculosis in Brazil with other continents, being 4% in the American continent, 26% in Europe, 2.8% in Africa, 2.9% in South-East Asia, 3.3% in Western Pacific, 2.9% in South-East Asia, and 5.3% in Eastern Mediterranean (WHO, 2022). According to the Pan American Health Organization (PAHO), Peru, Haiti and Bolivia have the highest prevalence rates in Latin America, and Haiti has recorded seven times more cases than other Latin countries (BARRETO *et al*., 2012). Colombia, on the other hand, had a variable incidence of 63.8 to 100 cases per 100.000 inhabitants, according to the region analyzed (OCHOA *et al*., 2017).Regarding the distribution of bovine tuberculosis in South America, Garcia *et al*. (2021) highlight the prevalence of this disease in Argentina and Chile, respectively, with 257.766 and 28.864 cases that were positive and reported for the disease from 2012 to 2018.

Okafor *et al*. (2011) mapped tuberculosis-positive cattle herds in the state of Michigan in the United States of America. Between 1995 and 2010, more than 35.000 tuberculinization tests were performed in Michigan herds, evidencing 49 infected cattle herds in the state, which, in turn, approached 150 cattle positives in the study time interval (OKAFOR *et al*., 2011). In Europe, Schiller *et al*. (2011) report that the continent's programs for eradicating and controlling bovine tuberculosis have faced several challenges. Furthermore, the authors point out that these challenges may be linked to the growing national and international trade in cattle herds on the European continent (SCHILLER *et al*., 2011).There is no vaccine or specific treatment for bovine tuberculosis, so disease prevention is the key to control programs (BRASIL, 2006). In Brazil, the BCG vaccine (Bacillus of Calmette &Guérin) arrived in 1925 and became mandatory 45 years ago, being applied in a single dose in newborns. The vaccine in question does not confer total immunity to prevent human tuberculosis. Still, when used in bulk, it contains severe forms of the disease, such as tuberculous meningitis and miliary tuberculosis (disseminated form) (BRASIL, 2011). According to WHO data, in the last 20 years, there has been a 30% reduction in deaths caused by tuberculosis worldwide due to the effectiveness of vaccination programs (WHO, 2022).The treatment of tuberculosis in humans aims to cure and rapidly reduce transmission so that the drugs used can reduce the bacillary population, prevent the selection of naturally resistant strains, and sterilize the lesion, in addition to implementing public health measures, such as isolation and cough labeling. The antituberculosis regimen has an efficacy of up to 95%; however, the effectiveness varies according to the location, leading the national average to about 70% efficacy. The decrease in the efficacy rate is associated with the lack of adherence of the affected population, either through the abandonment of treatment, misuse of drugs, or irregular use of medication (RABAHI *et al*., 2017; SOTGIU *et al*., 2016).Currently, the basic regimen for the treatment of adults (>10 years), without detection of resistance and for all forms of the disease in Brazil is composed of the intensive phase of 2 months with the combination of Rifampicin (R), Isoniazid (H), Pyrazinamide (Z) and Ethambutol (E) (RHZE) in Combined Fixed Dose (HRD). Then by the maintenance phase of 4 months with the hr. scheme in HR in DFC. In each tablet there are 150 mg of rifampicin, 75 mg of

isoniazid, 400 mg of pyrazinamide and 275 mg of ethambutol. There is an exception in the case of tuberculosis meningitis that changes from 4 months to 7 months in the maintenance phase, and an oral or intravenous corticosteroid is associated (RABAHI *et al*., 2017). In addition, there is the possibility of indicating other therapeutic alternatives related to the resistance of the etiological agent and the association of infection with other diseases. This study identified the association of TB with other diseases and comorbidities. These data are consistent with international notifications since there are, in the Americas, 34.000 cases of alcoholics contracting the infection, 12.000 cases associated with diabetic patients, 22.000 cases of co-infection between HIV and TB, 18.000 cases of TB in smokers, 46.000 cases of malnourished patients contracting the disease (WHO, 2022).The threat to public health by this disease caused the World Organization of Animal Health (OIE) to demand the eradication of this zoonosis, through the rigorous inspection of meat and pasteurization or boiling of milk, in addition to the promotion of research, especially in diagnostic tests (KANEENE *et al*., 2014). In the context of bovine tuberculosis, the Official Veterinary Service is responsible for animal health defense actions in Brazil, including the receipt of notifications of confirmed cases of tuberculosis on the country's properties, provided for by law by Normative Instructions No. 50 of 2013 and No. 10 of 2017 (BRASIL, 2017).

In addition, the National Program for the Control and Eradication of Brucellosis and Animal Tuberculosis (NPCEBAT) establishes that all veterinarians and accredited laboratories must notify the occurrence of positive diagnoses within one working day. Once the notification has been properly carried out, it may direct these animalsto sanitary slaughter or euthanasia (BRASIL, 2006). Concerning the disposal of meat from animals positive for tuberculosis in slaughterhouses, the Regulation of the Industrial and Sanitary Inspection of Products of Animal Origin - RIISPOA, published through Decree No. 9.013 of 2017, is the legislation that guides the decision-making of veterinarians' tax auditors in such cases. Art. 171 of RIISPOA deliberates on the specifications of carcasses of animals with tuberculosis, considering *antemortem* examination as one of the determining stages for their design since, in cases of febrile appearance and cachexia, animals must be promptly condemned (BRASIL, 2017). Furthermore, in identifying tuberculosis lesions in the musculoskeletal system or the lymph nodes; caseous lesions in the thorax or abdomen; miliary lesions in parenchyma or serosa, or reactive lymph nodes in more than one site of choice, these carcasses should be condemned for human consumption. Finally, the carcass will also be considered unfit for human consumption whenever there is evidence of bacillus (*M. tuberculosis*) in the bloodstream (BRASIL, 2017). There is also the possibility of conditional use for the meat of positive animals that do not fit the above descriptions. For these cases, RIISPOA provides heat sterilization as a viable alternative only after removing the affected areas and when lesions in organs or lymph nodes are discrete, localized, encapsulated, and limited to the same cavity. It is noteworthy that the legislation warns of the condemnation of parts of the carcass that may be contaminated with tuberculous material, by accidental contact, for example. Finally, the release is allowed when there is a single discrete and calcified tuberculosis lesion in the carcass (BRASIL, 2017).

Several forms of transmission affect cattle and transform them into reservoirs, such as by the airway, being the main route, occurring by inhalation of cough droplets or infected nasal secretions. Other ways of TB transmission are milk intake by calves, in cows with tuberculosis, the vertical form that occurs the passage via umbilical blood vessels, and the transmission that can affect cattle in cases of injuries, rarer, in the penis or preputial mucosa of males or lesions present in the vulva or vaginal mucosa of females (FARIA, 2019).According to Faria(2019), the forms of transmission to the man from *M. bovis* occur mainly through consuming milk and its derivatives without proper manipulation, such as pasteurization and boiling. Processes that are mandatory for the realization of milk trade even for small producers who do not want to lose the habit of consuming the raw product known as "pure, fat and strong milk"*(*ABRAHÃO; WALNUT&MALUCELLI, 2005). There is also aerosol transmission to employees in farms or slaughterhouses who directly interact with animals (FARIA, 2019). Swine contamination by *M. bovis* occurs from transmission from ingestion of by-products of bovine origin, such as contaminated bovine milk whey, and contamination by *Mycobacterium tuberculosis* occurs accidentally. On the other hand, infection of pigs by tuberculosis occurs mainly in subsistence creation, transmitted mainly orally, in contaminated environments, and in food. Transmission to humans from the pig happens through contact with unclean animals in farms and slaughterhouses. However, there are also reports of contamination in clandestine slaughters (CARDOSO, 2009). The Veterinarian has tremendous importance in disease epidemiology since he is the professional responsible for detecting and preventing changes in the factors that determine and influence animal health. Moreover, he acts as the professional accountable for promoting prevention and disease control to eliminate, reduce or eradicate health risks (BRASIL, 2021). In line with the NPCEBAT, the Ministry of Agriculture, Livestock, and Supply from Brazil and the Departments of Agriculture of the Brazilian states act by enabling Veterinarians of the private network through courses and training on methods of diagnosis and control of tuberculosis to contribute to public health. Thus, these strategies seek to control and reduce the spread of the disease to the population through good animal health management practices (BRASIL, 2021). The One Health approach is essential to effectively prevent, detect, and respond to health challenges from contact between humans, animals, and the environment (ARAUJO; LEAL & SILVA, 2020). Faced with a global anthroponotic infection like tuberculosis, this approach becomes categorical to manage and safeguard the health of man, animal, and the environment through transdisciplinary and multi-professional teams (MILLER & OLEA-POLPEKA, 2013). Ecological, climatic, socioeconomic, human, and animal health, and distribution of the clonal complexes of tuberculosis are essential for the transmission and permanence of the disease. Therefore, the integrality between human and animal medicine with ecology, sociology, and economics is fundamental from the epidemiological point of view. Moreover, transdisciplinary and multidisciplinary approaches, added to other knowledge, are essential for tuberculosis control (KANEENE, 2014).

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