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Brucellosis, Leptospirosis And Q Fever: Risks And Priority Strategies By The DISCONTOOLS Platform

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Abstract:
Background: *The study evaluated the eco-epidemiological impacts of three zoonotic reproductive diseases – Brucellosis, Leptospirosis, and Q Fever – using the Discontools platform, a tool that employs a structured scoring system to prioritize actions in public and veterinary health. The objective was to analyze these diseases from a One Health perspective, considering aspects such as animal health, public health, and environmental well-being*
Materials and Methods: *The methodology involved the analysis of six main categories: knowledge of the disease, impact on animal health and welfare, impact on public health, impact on society, impact on trade, and control tools. Experts assigned scores based on specific criteria for each category, using standardized scales ranging from 0 (no impact) to 4 (high impact), and for the control tools category, a scale ranging from -2 (effective tools) to +2 (inadequate or non-existent tools)*
Results: *The results identified Brucellosis as the most relevant disease, with the highest total score (376.89), reflecting its significant impact on public health, animal welfare, and the economy. Leptospirosis presented an intermediate score (247.39), with emphasis on its association with wildlife reservoirs and vectors, while Q Fever obtained the lowest score (210.73), highlighting challenges such as the persistence of the infectious agent in the environment and its high variability*
Conclusion: *The conclusion emphasizes the need to prioritize Brucellosis due to its broad impact while recommending specific actions for Leptospirosis and Q Fever, focusing on studies of reservoirs and control strategies. The study underscores the importance of a data-driven approach to mitigate zoonotic risks and strengthen public policies from a One Health perspective.*
Key Word: *One health; Zoonosis; Reproductive diseases; Prioritization; Veterinary care*

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I. Introduction

Several countries and international communities invest significant human and financial resources in veterinary public health and risk analysis tools. These investments include scoring models for risk mitigation, epidemiological characterization, socio-environmental priority setting, animal health, and animal welfare (AW), covering infectious and parasitic diseases.

According to data from the Discontools Disease Control Tools (DISCONTOOLS) [1], the public and private sectors across the 27 member countries of the European Union collectively invest around €1 billion each year in research focused on public health, animal welfare, and animal health. These initiatives assess risks of specific diseases, including reproductive diseases, based on criteria such as scale of impact and frequency (endemic, epidemic, and pandemic). Additionally, they prioritize epidemiological studies related to the importation of animals, products, and by-products, establishing international regulations [2]. The Discontools scoring model is widely used to characterize risks and define priorities in public and veterinary health.

Discontools is an open-access database designed to assist public and private funders in identifying research gaps, prevention measures, and planning future investigations in animal health. This database is supported by various international research funders, including founders of agricultural chains, private sector supporters, and the European Commission, which provides administrative support. The database information is prepared by groups of experts on specific diseases. These experts have produced detailed analyses of research gaps in comprehensive reviews of 57 diseases, including zoonotic, production, and epizootic diseases [1,3].

According to [3], animals should be primary targets of surveillance programs, which must be monitored and periodically reviewed in support of the One Health concept. This effort requires collaboration among multiple professionals in public and private partnerships. Biovigilance, control, mitigation, or prevention of diseases are crucial for efficient responses and for constructing new scenarios for local, national, or global risks related to emerging or re-emerging diseases.

Thus, this study aimed to evaluate the eco-epidemiological impacts of zoonotic reproductive diseases present in domestic animals, with emphasis on Brucellosis, Leptospirosis and Q fever.

II. Material And Methods

This retrospective comparative study utilized data from DISCONTOOLS and was conducted from November 2024 to January 2025. The database operates on a 5-year cycle; however, additional information can be added at any time [1,4]. The platform evaluated diseases across six main categories, each consisting of multiple items (Table 1)

Selection of Impact Categories

The disease prioritization model employed in this study is based on a closed scoring system available on the DISCONTOOLS platform. This system applies equal weights to six evaluation sections:

1. Disease Knowledge: Experts describe and score the relevance and risks of the disease across 10 evaluation criteria.
2. Impact on Animal Health and Welfare: This section assesses the duration of the disease, frequency, morbidity, and mortality using 3 criteria.
3. Impact on Public Health**:** This evaluates transmission routes, incidence, severity, food contamination, and healthcare burden across 6 criteria.
4. Impact on Society: This considers restrictions on human activities, damage to tourism, and threats to biodiversity using 3 criteria.
5. Impact on Trade: This weighs regulations related to the loss of domestic markets, export impacts, zoning, and loss of free areas across 4 criteria.
6. Effective Control Tools: This section evaluates diagnostics for specificity, sensitivity, and the ability to differentiate infected from vaccinated animals. For vaccines, it assesses availability, safety, and production capacity. For therapeutic products, it analyzes safety for animals, consumers, and the environment, focusing on their role in prevention and control using 3 evaluation criteria.

Scoring System

The first five categories were scored on a scale from 0 (no impact) to 4 (high impact). The final category (control tools) was evaluated using scores ranging from -2 (effective tools) to +2 (ineffective or non-existent tools), focusing on disease control tools (effectiveness, quality, safety, and availability). This included the availability of validated diagnostic kits in countries (following protocols); laws regulating surveillance; techniques described by international organizations; permitted therapies; the status of surveillance; prevention strategies (use of anthelmintics and vaccinations); and regional control or zoning, such as free or non-free areas [3].

Evaluation Procedure

For each criterion, experts assigned a specific weight, generating a final score for each disease. The scores for each criterion were weighted and summed to obtain a total per category. The final score for each disease reflected its priority in terms of public health, animal welfare, and economic impact.

Methodology for Calculating the Weighting Coefficient (W)

The calculation of the weighting coefficient (W) involves assigning proportional weights to the criteria used in the analysis of zoonoses (brucellosis, leptospirosis, and Q fever). This coefficient standardizes the relevance of each criterion, ensuring that the assessments equitably reflect impacts across different categories. The formula used is:

$W = 100 / (X * I)$

Where:

W is the weighting coefficient.

X is the maximum score scale value for the criterion (in this case, 4).

I is the total number of items evaluated within the criterion.

Coefficient Calculation

For the category Knowledge about the Disease, with 10 items (I = 10) and a maximum score scale of 4 (X = 4), the coefficient was calculated as:

$W = 100 / (4 * 10) = 2.5$

III. Result

The results of the study on animal diseases, evaluated based on the criteria of the scoring system from the DISCONTOOLS platform, follow an epidemiological knowledge approach aligned with the One Health concept, integrating animal health, public health, and environmental health. These results are presented in Table 1 and Figure 1.

Table 1: Comparison of the eco-epidemiological impacts of Brucellosis, Leptospirosis, and Q Fever by category and scoring criteria on the DISCONTOOLS platform.

	Brucellosis			Leptospirosis			Q-Fever		
Category	Score	Co-eff	Total	Score	Co-eff	Total	Score	Co-eff	Total
DISEASE KNOWLEDGE - 10 criteria			62,5			72,5			77,5
Speed of spread	2,0	2,5	5,0	3,0	2,5	7,5	2,0	2,5	5,0
Number of livestock species involved	4,0	2,5	10,0	4,0	2,5	10,0	2,0	2,5	5,0
Persistence of the infectious agent in the environment	3,0	2,5	7,5	3,0	2,5	7,5	4,0	2,5	10,0
Risk of spread to susceptible populations	4,0	2,5	10,0	3,0	2,5	7,5	4,0	2,5	10,0
Potential for silent spread	3,0	2,5	7,5	3,0	2,5	7,5	4,0	2,5	10,0
Wildlife reservoir and potential spread	3,0	2,5	7,5	4,0	2,5	10,0	3,0	2,5	7,5
Vector reservoir and potential spread	0,0	2,5	0,0	4,0	2,5	10,0	3,0	2,5	7,5
Variability of the agent	2,0	2,5	5,0	3,0	2,5	7,5	3,0	2,5	7,5
Understanding of fundamental immunology	2,0	2,5	5,0	1,0	2,5	2,5	3,0	2,5	7,5
Host-Pathogen interaction	2,0	2,5	5,0	1,0	2,5	2,5	3,0	2,5	7,5
IMPACT ON ANIMAL HEALTH AND WELFARE - 3 criteria			74,97			66,64			58,31
Disease impact on production	3,0	8,33	24,99	3,0	8,33	24,99	2,0	8,33	16,66
Duration of animal welfare impact	4,0	8,33	33,32	4,0	8,33	33,32	2,0	8,33	16,66
Proportion of animal affected suffering pain/ injury/ distress as a result of the disease	2,0	8,33	16,66	1,0	8,33	8,33	3,0	8,33	24,99
IMPACT ON PUBLIC HEALTH - HUMAN HEALTH - 6 criteria			79,04			45,76			49,92
Impact of occurence on human health	4,0	4,16	16,64	3,0	4,16	12,48	3,0	4,16	12,48
Likelihood of occurence	4,0	4,16	16,64	3,0	4,16	12,48	2,0	4,16	8,32
Impact of occurrence on food safety	3,0	4,16	12,48	0,0	4,16	0,0	0,0	4,16	0,0
Transmissibility (spread from animal to human)	4,0	4,16	16,64	3,0	4,16	12,48	4,0	4,16	16,64
Spread in humans	1,0	4,16	4,16	1,0	4,16	4,16	1,0	4,16	4,16
Bioterrorism potential	3,0	4,16	12,48	1,0	4,16	4,16	2,0	4,16	8,32
IMPACT ON WIDER SOCIETY - 3 criteria			74,97			24,99			49,98
Economic direct impact (including cumulative costs (e,g, Enzoonotic vs Epizootic))	3,0	8,33	24,99	2,0	8,33	16,66	3,0	8,33	24,99
Economic indirect impact (social, market)	3,0	8,33	24,99	0,0	8,33	0,0	1,0	8,33	8,33
Agriterrorism potential	3,0	8,33	24,99	1,0	8,33	8,33	2,0	8,33	16,66
IMPACT ON TRADE - 4 criteria			68,75			37,5			25,0
Impact on international trade due to existing regulations	3,0	6,25	18,75	1,0	6,25	6,25	0,0	6,25	0,0
Impact on EC trade due to existing regulations	4,0	6,25	25,0	1,0	6,25	6,25	0,0	6,25	0,0
Potential for zoning	3,0	6,25	18,75	4,0	6,25	25,0	4,0	6,25	25,0
Impact on security of food supply	1,0	6,25	6,25	0,0	6,25	0,0	0,0	6,25	0,0
CONTROL TOOLS - 3 criteria			16,66			0,0			-49,98
Appropriate diagnostics	-1,0	16,66	-16,66	0,0	16,66	0,0	-1,0	16,66	-16,66
Appropriate vaccines	1,0	16,66	16,66	0,0	16,66	0,0	-1,0	16,66	-16,66
Appropriate pharmaceuticals	1,0	16,66	16,66	0,0	16,66	0,0	-1,0	16,66	-16,66
Total	376,89			247,39			210,73		

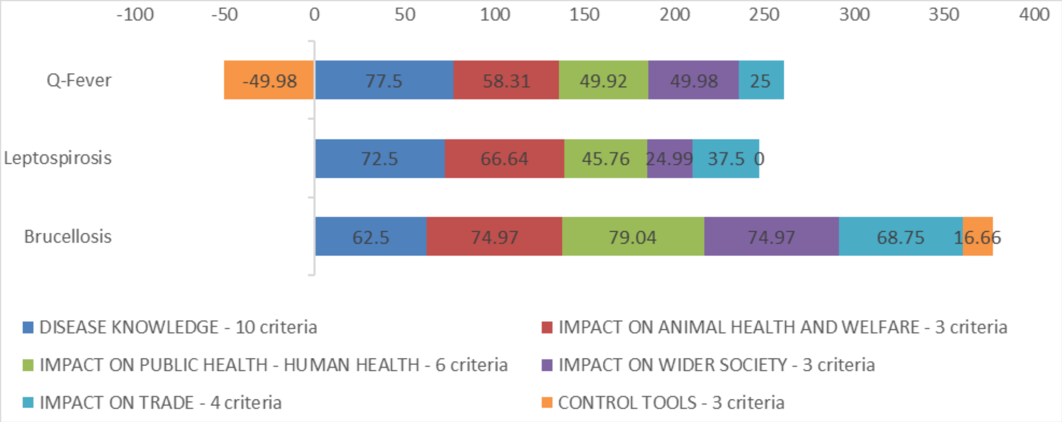

Figure 1: Diagram of total score distribution by category for zoonotic diseases in the DISCONTOOLS assessment. Brucellosis was identified as the most relevant zoonosis, highlighting the need for further investigation into its epidemiology, diagnosis, and immunoprophylaxis in cattle. Leptospirosis shows gaps in knowledge about transmission, risk factors, and the need for rapid diagnostics and health education. Q Fever, with a global distribution, has poorly understood aspects of epidemiology, transmission, and control, including the use of vaccines in livestock.

IV. Discussion

The DISCONTOOLS assessment tool, developed by the European Community, addresses diseases of global importance and is based on the opinions of various experts from academia, government, and industry. This tool considers three categories of diseases: epizootic diseases (e.g., foot-and-mouth disease, bluetongue), production animal disease complexes (e.g., bovine viral diarrhea - BVD and mastitis caused by *Staphylococcus aureus*), and zoonotic diseases (e.g., brucellosis, leptospirosis, and Q fever). Its approach focuses on innovative control methods through biological products (vaccines), chemotherapeutics for veterinary treatments, and accurate diagnostics [3-6].

Various species of domestic terrestrial mammals in neotropical and humid environments are susceptible to the disease, with bovids being the majority of cases. However, these represent only a portion of a diverse group that includes rodents and deer [9]. Quantitative measures for evaluating the impacts and prioritization of disease risks include the calculation of epidemiological parameters such as incidence, prevalence, mortality and morbidity rates, and costs associated with prevention, treatment, or control of human diseases [15]. Studies on wildlife serve as important parameters for assessing animal health.

This study aimed to identify the main research or monitoring needs for reproductive diseases through comparisons. It also seeks to provide insights for targeted research and potential statistical modeling. The benefits of disease control tools for animal health and welfare (AHW), public health, and food security were considered, alongside social benefits, such as poverty alleviation. The guidelines suggest state or municipal regulations (harmonized by legislation), prevention strategies (e.g., internal and external biosecurity on farms), and strategic control (e.g., vaccination calendars), with enhanced surveillance in high-risk areas, particularly those near humid ecosystems.

In this context, brucellosis, caused by *Brucella abortus*, is a zoonosis of worldwide distribution with significant economic importance. The disease causes abortions, premature births, infertility, and decreased milk production in bovids [7]. Rural workers, practitioners, veterinarians, and slaughterhouse employees are among the groups at highest risk due to direct contact with infected animals. Consumers of milk or dairy products derived from these animals are also exposed to infection [8].

Brucellosis stands out as the disease with the greatest overall impact among the main evaluated categories, highlighting its relevance to public health, animal health, and the economy. The high scores indicate a solid understanding of its epidemiological and control aspects, as reflected in the Disease Knowledge category. The categories Impact on Animal Health and Welfare and Impact on Public Health emphasize the disease's severity in animals and humans. Additionally, its sociais and commercial impacts reinforce its position as a priority for control and eradication policies.

Leptospirosis, caused by pathogenic species of the genus *Leptospira*, affects domestic and wild animals as well as humans [10]. Its occurrence is associated with waterlogged soils and humid environments. Abortion is one of the main clinical signs of leptospirosis in production animals [7]. Despite its moderate scores, leptospirosis holds significant relevance to public health and animal welfare, with higher prevalence in tropical and subtropical regions. The high score in Disease Knowledge reflects advances in understanding its epidemiology, but the impacts on public health and animal welfare highlight the need for improvements in control and prevention tools. Its impact on society and commerce is relatively lower, reflecting a secondary priority compared to brucellosis.

When assessing scores for Wildlife Reservoir and Vector Reservoir and Potential Dissemination (Table 1), leptospirosis presented the worst scenario among the three evaluated diseases (score = 10). This result underscores the importance of studying the bacterium's circulation in wildlife populations and vectors to improve its control [16].

Q fever, caused by *Coxiella burnetii* and also known as milk fever, occurs in several countries, with transmission peaks during the rainy season. Incidence generally increases 1 to 3 months after environmental contamination [11]. *C. burnetii* is transmitted to humans and has also been reported in wild animals, such as sloths, bats, capybaras, and rodents, as well as in dogs, opossums, domestic ruminants, and birds [12-14]. The bacterium is found in high concentrations in the placenta, amniotic fluid, and other birth-related secretions of sheep, cattle, and goats.

The environmental persistence of Q fever's infectious agent is critical, increasing the risk of propagation, especially among susceptible populations. The potential for silent dissemination is high, as the infection often goes unnoticed for extended periods. Although its public health impact is significant, its effects on animal welfare, society, and commerce are more moderate. This positions Q fever as a relevant concern but with moderate urgency compared to other diseases, such as brucellosis. The focus should be on developing strategies to control the disease's transmission pathways, given its eco-epidemiological importance.

V. Conclusion

The assessment of reproductive diseases by the DISCONTOOLS platform identified brucellosis as the top priority for state veterinary attention due to its impact on public health, animal health, and the economy. Leptospirosis demonstrated significant relevance, particularly in tropical regions, while Q fever, despite its lower urgency, requires specific control strategies due to its potential for dissemination and environmental persistence.

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