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Brief Report

# Beyond Outbreak Counts: A Novel Epidemiological Classification of Major Animal Diseases Using Loss-to-Case and Cases-per-Outbreak Ratios

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## ABSTRACT

The 2026 World Organisation for Animal Health (WOAH) 2nd edition of State of the World's Animal Health report provides critical insight into the global burden of infectious diseases affecting livestock, poultry, wildlife, and companion animals. While traditional epidemiological indicators such as the number of outbreaks, cases, and deaths remain essential for disease monitoring, they do not fully capture the severity and transmission dynamics associated with different diseases. This report introduces two additional epidemiological indicators: the loss/cases ratio and the cases/outbreaks ratio. The loss/cases ratio evaluates the relative severity and mortality burden of a disease by comparing total animal losses or culling events to confirmed cases, whereas the cases/outbreaks ratio estimates outbreak intensity and transmission scale by measuring the average number of cases per outbreak. Using these parameters, the ten major animal diseases were classified into high-, medium-, and low-impact categories. Sheep pox and goat pox together with Avian influenza in poultry emerged as high-loss diseases due to their exceptionally high mortality and culling burden. Avian influenza in poultry was identified as the only high-outbreak disease, reflecting the extreme transmission intensity associated with intensive poultry production systems. African swine fever, Foot and mouth disease, and Peste des petits ruminants demonstrated moderate outbreak intensity, while diseases such as Rabies and New World screwworm showed comparatively lower outbreak concentration despite wide geographic distribution. The findings demonstrate that integrating these new indicators into animal health surveillance systems can improve disease prioritisation, strengthen risk assessment, and support more targeted prevention and control strategies. This classification framework provides a more comprehensive understanding of disease behaviour and global animal health threats.

**Keywords:** Animal Diseases, Epidemiology, Outbreak Intensity, Mortality Ratio, Transboundary Diseases.

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## INTRODUCTION

The recent World Organisation for Animal Health (WOAH) second edition of the State of the World's Animal Health report provides a comprehensive overview of the major transboundary and zoonotic animal diseases currently affecting global livestock, poultry, wildlife, and companion animal populations.[1] Based on disease events reported between 1 January 2025 and 31 March 2026, the report highlights the continued global significance of ten major animal diseases and presents extensive epidemiological information, including the number of reporting countries, outbreak occurrence, confirmed cases, and deaths or animals killed. These indicators are essential for understanding the geographical spread and burden of disease, however, they often provide only a partial picture of the true epidemiological and economic impact associated with disease outbreaks.[2-4] Traditionally, disease assessments have relied heavily on absolute numbers such as total outbreaks or total reported cases to estimate disease importance. While these parameters are useful for surveillance and monitoring purposes, they may not adequately capture the severity of disease consequences or the intensity of transmission within affected populations. For example, a disease with a relatively small number of outbreaks may still cause devastating economic losses if each outbreak affects a very large number of animals or requires extensive preventive culling. Similarly, diseases with high outbreak frequency may differ considerably in their actual transmission dynamics and mortality impact. Therefore, there is a growing need for additional analytical indicators that can better interpret disease behaviour and support more effective risk-based prioritisation.

In response to this need, the present analysis proposes two additional epidemiological parameters derived from the reported

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WOAH data,[1] the loss/cases ratio and the cases/outbreaks ratio. These proposed indicators are intended to complement conventional epidemiological metrics and provide a more refined framework for evaluating disease impact, outbreak severity, and transmission characteristics across different animal diseases. The first proposed parameter, the Loss/Cases Ratio (LCR), measures the relationship between the total number of animal losses or animals killed and the number of confirmed disease cases. This parameter serves as an indicator of the overall destructive impact of a disease event. High LCR values reflect severe mortality rates, widespread disease-associated deaths, or extensive preventive depopulation strategies implemented to limit disease spread. In many transboundary animal diseases, particularly those affecting intensive livestock and poultry systems, the number of animals culled often exceeds the number of clinically infected animals because of emergency control measures. Consequently, the LCR provides important insight into both the biological severity of a disease and the economic consequences associated with disease control interventions. The second proposed parameter, the Cases/Outbreaks Ratio (COR), estimates the average number of infected animals associated with each reported outbreak. This indicator reflects outbreak magnitude and transmission intensity within susceptible animal populations. Diseases with high COR are associated with rapid spread, dense production systems, or highly efficient transmission dynamics that allow a single outbreak to involve very large numbers of animals. Conversely, diseases with low COR indicate more localised transmission patterns, sporadic infections, or outbreaks that remain relatively contained. This parameter is particularly valuable for understanding how disease behaviour differs between extensive and intensive production systems and for identifying diseases capable of generating large-scale epidemic events.

By integrating these two additional epidemiological indicators with traditional surveillance data, this report proposes a broader and more informative approach to evaluating global animal disease impact. Rather than relying solely on outbreak frequency or total case numbers, the proposed framework enables diseases to be assessed according to both their mortality burden and outbreak intensity. This multidimensional interpretation provides a clearer understanding of the comparative risks posed by different diseases and may support more targeted approaches to surveillance, preparedness, biosecurity, and disease control policy. The application of these parameters to the ten major diseases reported by WOAH[1] reveals substantial differences in disease behaviour, severity, and epidemiological patterns. Some diseases are characterised primarily by extremely high mortality and culling impact, whereas others are defined by their ability to generate large and widespread outbreaks. The proposed indicators therefore offer a practical and data-driven method for distinguishing between diseases that primarily threaten animal survival and those that primarily threaten production systems through rapid transmission and outbreak amplification. Ultimately, these new parameters may contribute to strengthening global animal health risk assessment and improving strategic prioritisation in transboundary disease management.[5,6]Using the LCR, the diseases can be divided into three categories. The high-loss category includes Sheep pox and goat pox and Avian influenza in poultry. These diseases demonstrated exceptionally high loss/cases ratios of 7.65 and 7.00 respectively, indicating devastating impacts on affected animal populations (Table 1). The medium-loss category includes African swine fever, Avian influenza in non-poultry including wild birds, and Rabies, with ratios ranging from 0.928 to 1.670 (Table 1). The remaining diseases, including Peste des petits ruminants, Lumpy skin disease, Foot and mouth disease, Rift Valley fever, and New World screwworm, fall into the low-loss category due to their comparatively lower mortality or culling impact relative to the number of cases (Table 1). When diseases are classified according to the COR, a different epidemiological pattern emerges. Avian influenza in poultry forms the only high-outbreak disease category, with an extraordinary ratio of 9429.51 cases per outbreak (Table 1). This reflects the highly concentrated nature of poultry production systems, where a single outbreak can rapidly affect thousands or even millions of birds. The medium-outbreak category includes Sheep pox and goat pox, African swine fever, Peste des petits ruminants, and Foot and mouth disease, with COR ranging between approximately 19 and 44 cases per outbreak (Table 1). The remaining diseases belong to the low-outbreak category, characterized by relatively smaller outbreak sizes and more limited transmission clusters.

Among the ten diseases analysed,[1] Avian influenza in poultry stands out as the most economically destructive and epidemiologically significant disease. Although only 2,121 outbreaks were reported across 64 countries, the disease caused approximately 20 million cases and 140 million animal losses.[1] The exceptionally high COR demonstrates the devastating impact of outbreaks within intensive poultry systems. Once introduced into commercial poultry farms, the virus can spread rapidly through dense animal populations, requiring large-scale depopulation measures to prevent wider dissemination.[7,8] The high LCR further reflects aggressive control strategies involving preventive culling of exposed flocks in addition to infected birds. Together, these indicators highlight the enormous economic and food security implications associated with avian influenza outbreaks in poultry.Sheep pox and goat pox also emerged as a highly important disease under the new classification framework. Although the disease affected fewer countries and generated fewer total cases compared to some other diseases, it recorded the highest LCR among all diseases evaluated. With 53,130 reported cases and more than 406,000 animal losses, the disease demonstrates a severe impact on small ruminant populations.[1,9,10] The medium-level COR of 19.63 indicates moderate outbreak expansion, but the very high mortality and culling burden elevate the disease into the high-loss category. This finding suggests that sheep and goat production systems remain highly vulnerable to major economic losses once outbreaks occur.African swine fever continues to represent one of the most serious threats to global pig production. The disease was reported by 64 countries and generated 15,759 outbreaks, making it one of the most geographically widespread diseases in the dataset.[1] Although its LCR of 1.67, places it within the medium-loss category, the disease caused more than 584,000 losses from nearly 350,000 cases. The COR of 22.20 indicates moderate outbreak intensity, with substantial numbers of infected pigs per outbreak. The persistence and expansion of African swine fever across multiple regions demonstrate the continuing challenges associated with biosecurity, wild boar reservoirs, and transboundary animal movement.[11,12]

Avian influenza in non-poultry species, including wild birds, presents a different epidemiological profile compared to poultry outbreaks. Although 8,113 outbreaks were reported across 67 countries, the total number of cases and losses remained comparatively low.[1] The low COR of 3.07 suggests that outbreaks in wild bird populations are generally smaller and less concentrated than those observed in commercial poultry systems. Nevertheless, the disease remains epidemiologically important because wild birds play a critical role in virus maintenance and long-distance dissemination.[13,14] The medium LCR of 1.269 reflects moderate mortality levels within affected populations.

Rabies remains one of the most globally distributed zoonotic diseases, with reports from 99 countries.[1] Despite relatively modest numbers of outbreaks and cases compared with other diseases in the analysis, rabies remains a major public health concern because of its nearly 100 percent fatality rate in untreated humans and animals. The disease recorded a medium LCR of 0.928 but a very low COR of 1.71, indicating that outbreaks are typically small and involve isolated cases rather than large epidemic clusters. The widespread geographic distribution of rabies highlights the persistent challenges associated with wildlife reservoirs, stray animal populations, and uneven vaccination coverage.[15,16]

Peste des petits ruminants demonstrated a distinct epidemiological pattern characterised by relatively high outbreak intensity but lower mortality impact. The disease generated 61,053 cases across 1,402 outbreaks,[1] producing a COR of 43.55, one of the highest in the dataset after avian influenza in poultry. This indicates substantial transmission potential within susceptible sheep and goat populations. However, the comparatively low LCR of 0.403 suggests that mortality and culling impacts are lower than those observed in diseases such as sheep pox and goat pox or avian influenza in poultry. The disease nevertheless remains important due to its capacity to spread rapidly through vulnerable livestock populations.[17,18]Foot and mouth disease was associated with the highest number of outbreaks among all diseases analysed, totalling 19,034 outbreaks across 64 countries. The disease caused more than 412,000 cases and nearly 110,000 losses.[1] Despite the enormous number of outbreaks, the LCR remained relatively low at 0.266, placing the disease in the low-loss category. However, the COR of 21.65 places it within the medium-outbreak category, indicating substantial transmission within affected herds. These findings suggest that while mortality may be lower compared to other transboundary diseases, the disease remains economically important because of production losses, trade restrictions, and extensive outbreak occurrence.[19,20]Lumpy skin disease, Rift Valley fever, and New World screwworm all belong to the low-loss and low-outbreak categories under the proposed classification system. Lumpy skin disease showed moderate outbreak frequency but relatively limited mortality impact, with a LCR of 0.283. Rift Valley fever demonstrated comparatively small outbreak clusters and low mortality burden, although its zoonotic potential remains

**Table 1: List of disease identified in the World Organisation for Animal Health (WOAH) 2nd edition of State of the World's Animal Health report and assessing their impact based on Loss/Cases ratio and Cases/Outbreaks ratio parameters. Colour scale (high [red], Medium [yellow], Low [green]).**

| Disease | Reporting countries | Outbreaks | Cases | Losses | Loss / Cases ratio | Cases / Outbreaks ratio |
|---|---|---|---|---|---|---|
| Sheep pox and goat pox | 35 | 2706 | 53130 | 406561 | 7.652 | 19.63 |
| Avian influenza (poultry) | 64 | 2121 | 2E+07 | 1.4E+08 | 7.000 | 9429.51 |
| African swine fever | 64 | 15759 | 349927 | 584310 | 1.670 | 22.20 |
| Avian influenza (non-poultry & wild birds) | 67 | 8113 | 24907 | 31610 | 1.269 | 3.07 |
| Rabies | 99 | 6567 | 11205 | 10395 | 0.928 | 1.71 |
| Peste des petits ruminants | 43 | 1402 | 61053 | 24622 | 0.403 | 43.55 |
| Lumpy skin disease | 45 | 3184 | 26580 | 7522 | 0.283 | 8.35 |
| Foot and mouth disease | 64 | 19034 | 412110 | 109740 | 0.266 | 21.65 |
| Rift Valley fever | 11 | 319 | 1869 | 381 | 0.204 | 5.86 |
| New World screwworm | 18 | 37389 | 82388 | 166 | 0.002 | 2.20 |

Note: The raw data shown in this table is from the World Organisation for Animal Health, The State of the World's Animal Health 2026 report.[1]

significant in endemic regions. New World screwworm presented a particularly unique profile, with the highest number of outbreaks in the dataset, totalling 37,389 outbreaks, but an extremely low LCR of 0.002. This indicates that despite widespread occurrence, the disease rarely results in direct mortality when detection and treatment are implemented effectively.[21,22]The introduction of the LCR and COR parameters provides a valuable framework for improving disease prioritisation and risk assessment in animal health management. Traditional epidemiological indicators such as total outbreaks and total cases remain important, but they do not fully capture disease severity or outbreak concentration.[23,24] The LCR offers insight into the destructive consequences of disease outbreaks, while the COR highlights transmission intensity and outbreak scale. Together, these indicators provide a more comprehensive understanding of disease behaviours and control challenges. The analysis demonstrates that diseases differ substantially in their epidemiological profiles. Some diseases, such as Avian influenza in poultry, combine extremely high mortality impact with massive outbreak intensity, making them especially dangerous for global food systems and trade.[8,13] Others, such as Foot and mouth disease and African swine fever, exhibit widespread geographic dissemination and persistent transmission across multiple regions.[11,12,19] Diseases like Rabies remain globally important because of their zoonotic implications, even when outbreak sizes are relatively small.[1,16] Meanwhile, diseases such as New World screwworm illustrate how high outbreak frequency does not necessarily correspond to high mortality impact.[1,23]

## CONCLUSION

In conclusion, the proposed classification framework based on the Loss/Cases Ratio (LCR) and Cases/Outbreaks Ratio (COR) provides a more comprehensive and nuanced interpretation of global animal disease data than conventional epidemiological indicators alone. By integrating measures of mortality impact and outbreak intensity, these parameters allow for a deeper understanding of disease behaviour, transmission dynamics, and the broader economic consequences associated with transboundary and zoonotic animal diseases. The findings highlight the importance of adopting disease-specific surveillance, prevention, and control strategies tailored to the epidemiological characteristics of individual diseases. High-loss diseases require rapid containment measures, strict movement control, and strengthened biosecurity systems to reduce mortality and minimise large-scale economic losses, whereas high-outbreak diseases demand enhanced surveillance capacity, early warning systems, and rapid response mechanisms capable of preventing widespread transmission events within intensive production systems. As global livestock production continues to intensify and international trade and animal movement expand, the risks associated with emerging and re-emerging animal diseases are likely to increase further. In this context, the incorporation of additional analytical indicators such as LCR and COR may significantly strengthen global animal health monitoring and risk assessment frameworks. These parameters not only improve comparative disease evaluation but also support evidence-based prioritisation for resource allocation, preparedness planning, and policy development at both national and international levels. Further, the World Organisation for Animal Health (WOAH) may consider incorporating these proposed epidemiological indicators into future editions of the State of the World's Animal Health report and related global surveillance assessments. Expanding the application of LCR and COR to a broader range of notifiable and emerging animal diseases could provide a more standardised and informative method for assessing disease impact worldwide. Such an approach would enhance the interpretation of surveillance data, improve international comparability between diseases and regions, and contribute to the development of more targeted and effective global animal health strategies.

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## ABBREVIATIONS

**WOAH:** World Organisation for Animal Health; **LCR:** Loss/Cases Ratio; **COR:** Cases/Outbreaks Ratio; **PPR:** Peste des petits ruminants; **LSD:** Lumpy Skin Diseasel; **DVM:** Doctor of Veterinary Medicine; **PhD:** Doctor of Philosophy; **PMAT:** PPR Monitoring and Assessment Tool.

## CONFLICT OF INTEREST

The author declares that there is no conflict of interest.

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