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Emerging trends on epidemiology of infectious coryza disease in Mashonaland West Province of Zimbabwe

Medeline Bhebhe[1], Fungayi Primrose Chatiza[1] ,Calvin Gomo[1]

[1]Department of Animal Production and Technology ,School of Agricultural Sciences and Technology ,Chinhoyi University of Technology ,Chinhoyi ,Zimbabwe

Email mediebhebhe@gmail.com

Email fungayi.chatiza@gmail.com

Email drcalvingomo@yahoo.com

Abstract

Infectious coryza disease is an upper respiratory disease of avian species, commonly affecting chickens. It is caused by *Avibacterium paragallinarum*, a gram-negative bacterium. Infectious coryza poses a threat to the economy due to increased culling rates of infected chickens and a decrease in egg production of up to 40%. This study aimed to determine the spatial and temporal distribution of Infectious Coryza disease in Mashonaland West Province of Zimbabwe across seven districts from 2018- 2021, with a focus on disease prevalence and risk assessment. A retrospective method was used using a database obtained from the Central Veterinary Laboratory, which indicated infectious coryza disease cases in Mashonaland West Province of Zimbabwe. Data was examined using correlation analysis to determine the relationships between the total number of cases and deaths, and chi-square test to evaluate infectious coryza prevalence across districts .Prevalence of infectious coryza among districts was significant ($p<0.05$)for the period of 2018 -2021.Low disease incidence was reported in 2018 across all the seven districts ;2019 had a peak increase of infectious coryza disease prevalence across all the districts with Zvimba district having cases above 2500.A weak correlation between total cases and deaths (co - efficient 0.115), not statistically significant ($p> 0.05$), indicating other factors influencing the mortality rates. These findings highlight the need to improve management practices and vaccination programs in poultry production across Mashonaland West Province of Zimbabwe.

Keywords: Avibacterium *paragallinarum*, Infectious coryza, prevalence, Zimbabwe

Introduction

Infectious coryza (IC) is a respiratory disease that is common in chickens, mostly layers. The disease is caused by the bacterium *Avibacterium paragallinarum* previously called *Haemophilus paragallinarum.* The incubation period of the bacterium is 1-3 days(Nouri et al. 2021) . *Avibacterium paragallinarum* is widely distributed worldwide in areas with intensive poultry production (Babazadeh and Abd El-Ghany 2023), (Roy, 2009).Infectious coryza is characterized by nasal discharge, sneezing and facial swelling, swollen wattles, loss of condition, decreased egg production, and difficulty in breathing. Infectious coryza symptoms are more severe when it occurs with other infections (Mei et al. 2023). The disease occurs worldwide, and it has a negative impact on the economic side of the poultry industry due to increased culling rates(Mei et al. 2023). This study aims to determine the disease prevalence of infectious coryza in Mashonaland Province of Zimbabwe.

The first cause of infectious coryza was discovered in 1930 and the causative agent was isolated in 1931 ((Deshmukh 2015), (Mei et al. 2023).Chickens of all age groups are prone to the disease, but susceptibility increases with age, mostly after 4 weeks (Dereja and Hailemichael 2017) .Infectious coryza has been reported to affect broiler chickens in United States and layers in Pakistan .Serovar A and C were reported in Japan, Australia ,Indonesia and Malaysia(Roy 2009).Serovar A was reported in Korea in the 1980s (Han et al. 2016) .A study in South Africa reported the emergence of C-3 serovar of Kume ,the incidence of Kume C-3 serovar has increased from 30% to over 70% in the early 1990s(Blackall 1999).Infectious coryza is transmitted mainly through direct contact of birds, via contaminated drinking water or feed, airborne droplets through dust or respiratory droplets and carrier birds. The disease is reported to affect other avian species other than chickens (Nouri et al. 2021).

Infectious coryza poses a significant threat to the poultry industry, affecting turkeys, indigenous chickens and layer chickens (Marit, 2024). Infectious coryza has been reported to be the second important bacterial disease associated with mortalities in India after *Salmonellosis*. A study in Morocco highlighted that infectious outbreaks were associated with a drop in egg production ranging from 14 % to 54 % and mortality rates of 0,7 % (Blackall 1999) . Stress from respiratory distress reduces feed intake and feed conversion, thereby affecting the overall growth rate (Marit 2024). Infectious coryza occurs mainly on farms rearing birds of different ages, it is influenced

by environmental factors such as overcrowding and virulence of the bacteria (Author et al. 2007).A study on village chickens in Thailand reported that infectious coryza is the most cause of death in chickens younger than 2 months and those older than 6 months (Blackall 1999).

Infectious coryza is most common during the brooding and laying phases of chickens, especially when stressed (Getaw Deresse 2022). Poor ventilation in poultry houses can cause infectious coryza (Veronica et al. 2022). Infectious coryza can be prevented by practicing good management practices, having a comprehensive biosecurity plan and vaccinating all birds. *Avibacterium paragallinarum* falls into nine serovars, making it a challenge to control the disease through inactivated vaccines due to limited cross protection among serovars(Roy 2009). In Zimbabwe, infectious coryza quickly spreads in communal areas where free-range birds move between households (homesteads) and fewer vaccinations are done in communal farms due to dosages of commercial vaccines per vial (1000 doses).

Materials and Method

Study site

The study focused on Mashonaland West Province of Zimbabwe which is situated in the northern region of Zimbabwe. It is in agro-ecological region 11 b. Mashonaland West Province has 6 administrative districts, namely Kariba, Sanyati, Zvimba, Chegutu, Makonde, Mhondoro - Ngezi and Hurungwe. Kariba falls under agro ecological region 5, which is located in the Zambezi valley where there is low farming activity. Hurungwe district falls under natural region 2b and is located in the northern part where game reserves is the main activity. Sanyati district is under natural farming region 2b and 3 of Zimbabwe where, crop production is the main farming activity done. Chegutu district is under agro- ecological region 3 where semi-intensive farming is carried out. Makonde district is under natural region 2a,3 and 4. Most areas are under agro ecological region 2a under intensive livestock farming. Mhondoro district falls under agro-ecological region 3 with semi–intensive farming activities.

Data collection

Data on IC cases reported from January 2018- December 2021 were extracted from the national disease surveillance database at Central Veterinary Laboratories for analysis. The database highlighted tentative diagnosis, final diagnosis, source of infection (vector, feed and water, or contact), total cases, deaths, age, and type of intervention (treatment), vaccination numbers, and month collected. Assistant veterinary officers compiled the database from the districts within the province. Data was collected based on clinical signs and owner's claim report and final diagnosis basis. Data on the outbreaks was compiled from communal farmers, commercial farmers, A1 and A2 farmers.

Statistical analysis

Data was examined using correlation analysis to determine the relationship between the total number of cases, one–way ANOVA ($p= 0.05$) to determine distribution and deaths, and chi-square tests to evaluate infectious coryza prevalence across districts. All the analysis were done using Python version 3.11.10 and R studio version 4.3.3.

Results

Coryza patterns across districts showed minimal variation among the districts ($F=0.454$). There was no statistically significant variation in infectious coryza prevalence between districts ($p > 0.05$).

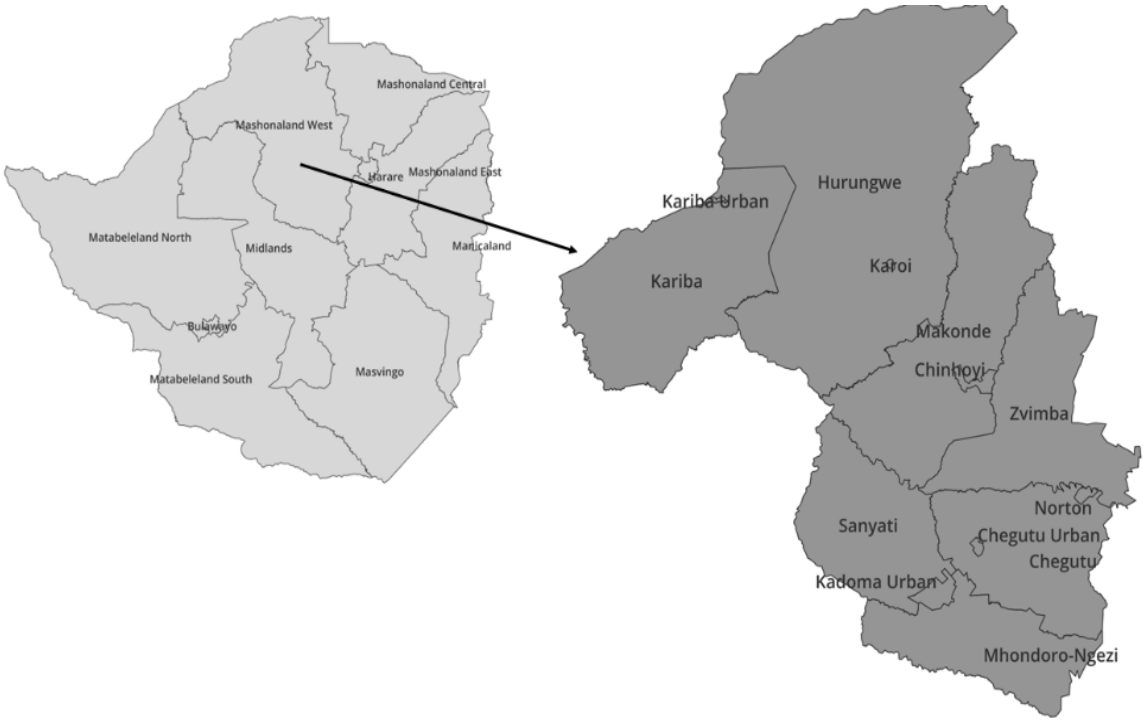

Figure 1: Map showing the districts in Mashonaland West Province

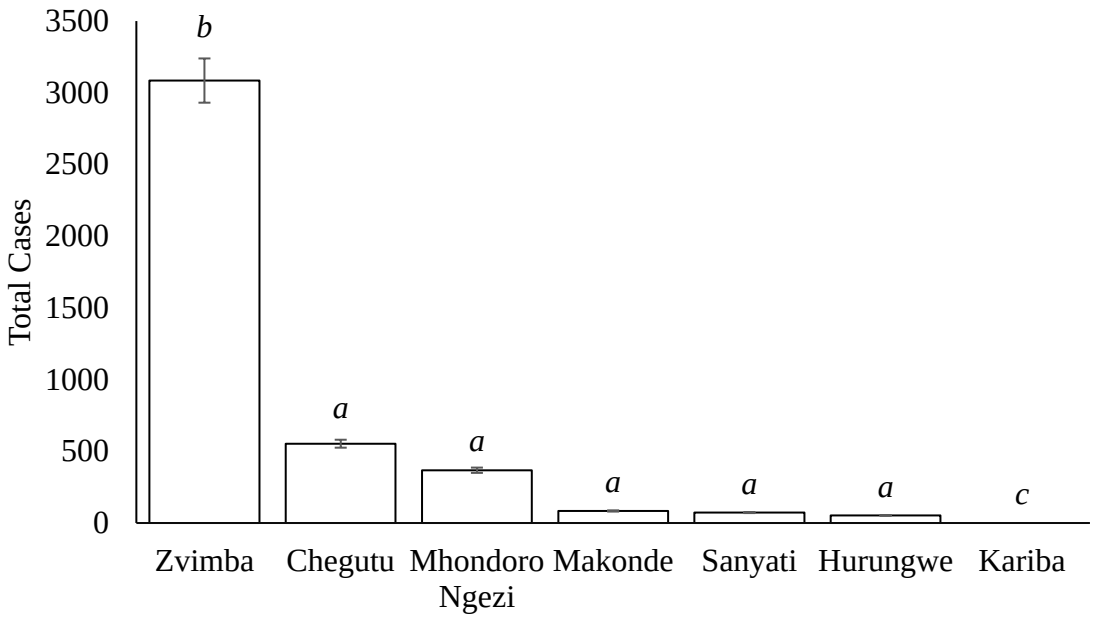

Figure 2. Total number of cases by district from 2018 – 2021 for infectious coryza in Mashonaland West Province

There is no significant difference in the total number of cases in Chegutu, Mhondoro-Ngezi, Makonde, and Hurungwe districts.

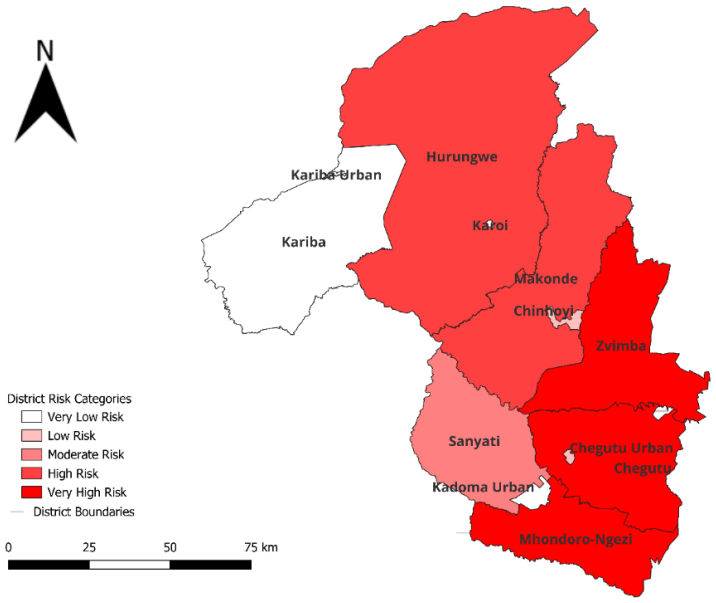

*Figure 3***.** Hotspot identification and risk assessment of the districts within Mashonaland West Province.

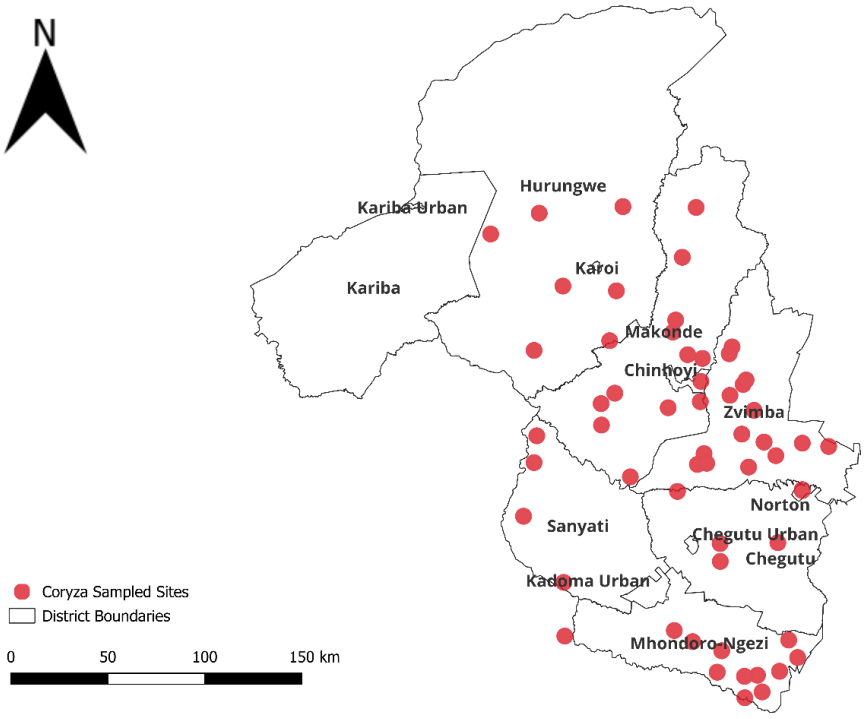

Figure 4. The distribution of Infectious Coryza in the various districts in Mashonaland West Province, Zimbabwe.

There was a substantial divergence in the prevalence of coryza across the districts in the province (figure 4), as indicated by the chi-square test analysis ($X^2 = 9978.002$, $p < 0.05$). This was seen in the study of the prevalence of infectious coryza throughout the districts. There was significant difference in prevalence between districts (p=0).

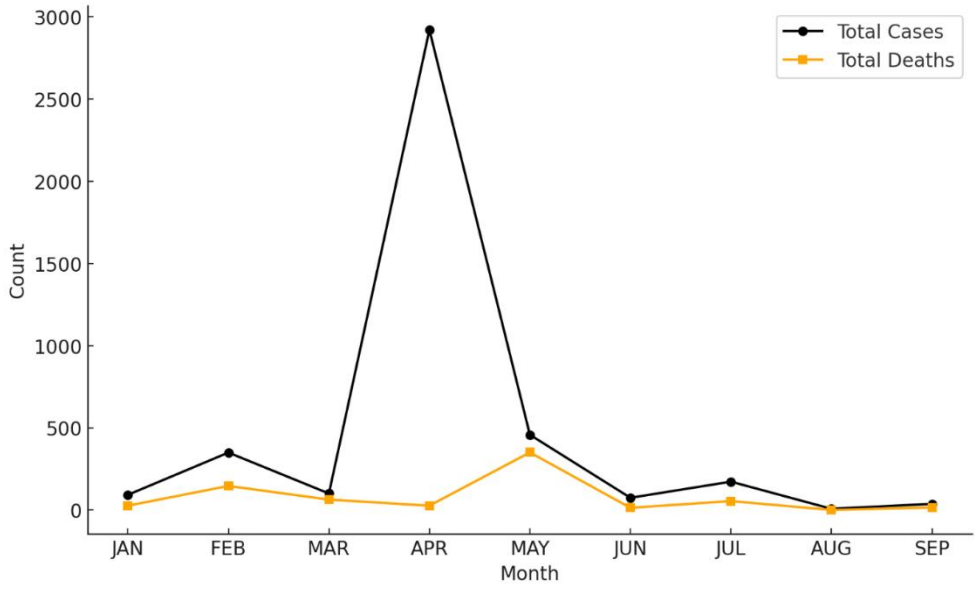

Figure 5. Spatial and temporal trends of infectious coryza disease by month from 2018 to 2021

The incidence of cases and fatalities for the period 2018 - 2021, was examined and indicated April has a notable increase in cases, totaling 2,920, but fatalities remained minimal, as shown in figure 5. February and May had a substantial number of cases and mortality figures, with 350 total cases and 147 deaths in February and 458 total cases and 351 deaths in May for the period of 2018-2021. From June to September, there was a decrease, with September recording the least number of total cases, with a mean of -12 from 2018 to 2021.

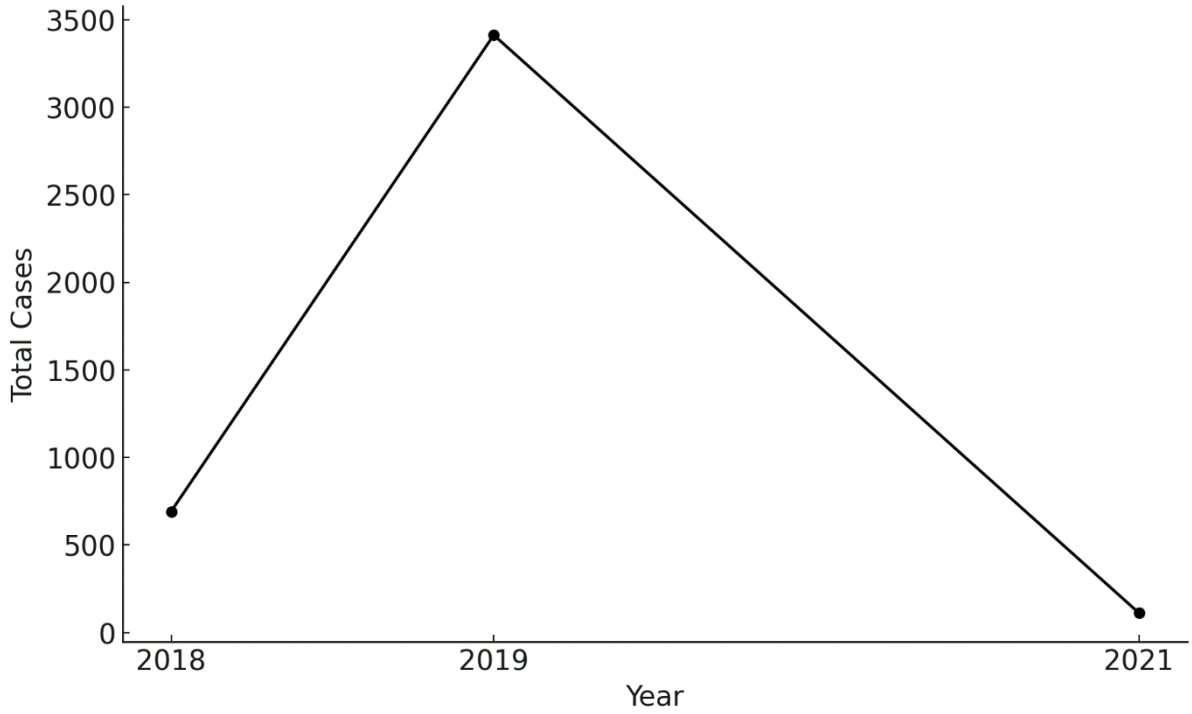

Figure 6. Temporal disease trends of infectious coryza total cases from 2018 to 2021

There was a considerable increase in the number of cases of infectious coryza in the Mashonaland West Province in 2019, with 3,412 cases, which indicates a serious epidemic (figure 6). However, in 2020, data on disease cases was missing due to the COVID-19 pandemic and lockdowns, which resulted in underreporting of cases to the relevant authorities. The number of cases in 2021 was much lower, this might be attributed to effective intervention efforts, decreased transmission, or underreporting.

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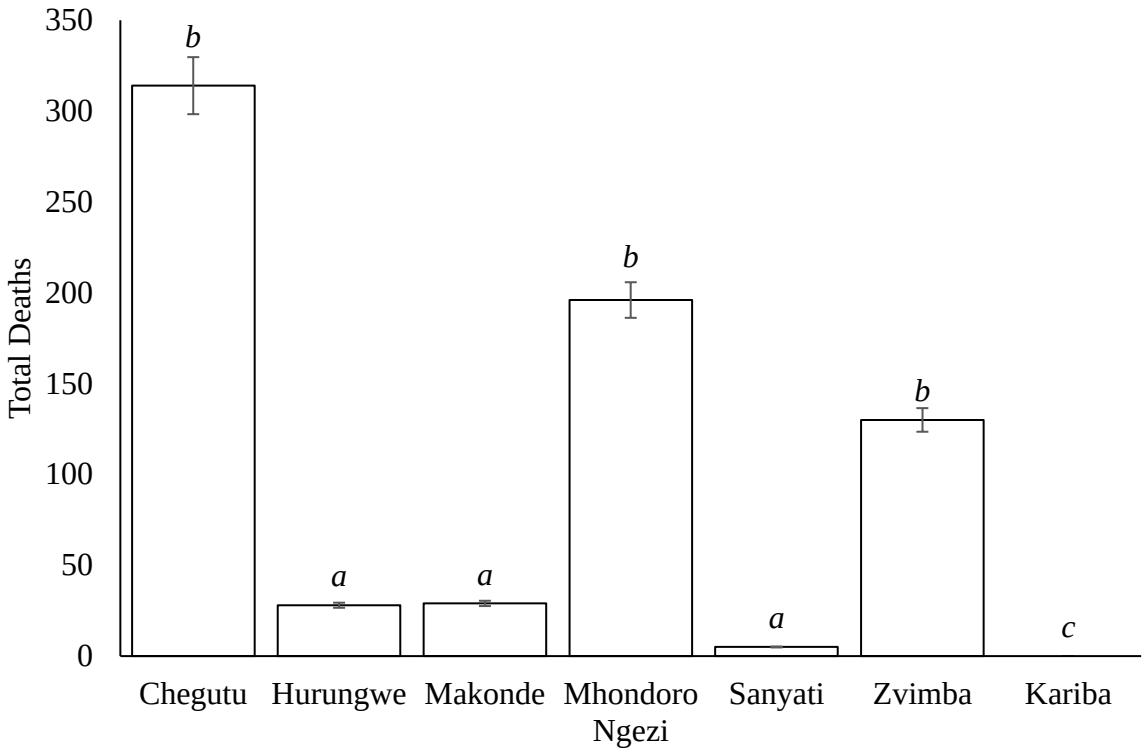

Figure 7. Total number of deaths by district from 2018 - 2021 for infectious coryza in Mashonaland West Province

Hurungwe, Makonde and Sanyati districts have no significant difference in number of deaths. Chegutu, Mhondoro – Ngezi and Zvimba are statistically significant with a higher number of deaths. Chegutu recorded the highest number of deaths, with 314 deaths in comparison to other districts. Mhondoro-Ngezi recorded the second highest incidence and mortality with 368 total cases and 196 fatalities. Other districts, including Makonde, Sanyati and Hurungwe, reported fewer cases and deaths.

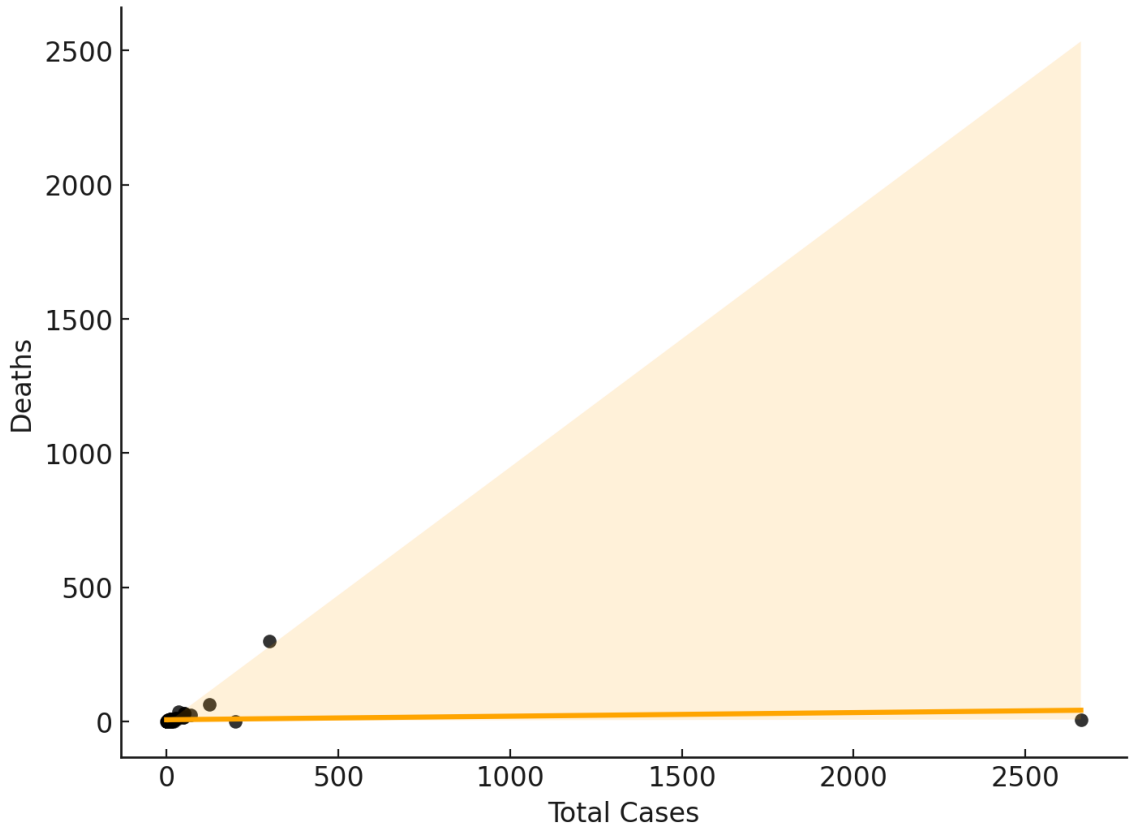

Figure 8. Correlation between total cases and deaths from infectious coryza disease from 2018-2021

There is a weak positive correlation (p=0.115) between total cases and deaths. However, the relationship is not statistically significant (p-value > 0.05). Infectious coryza has high morbidity rates but low mortality rates (Figure 8).

Discussion

The study focused on infectious coryza disease prevalence and factors influencing distribution in Mashonaland West Province of Zimbabwe. Chegutu has a high disease incidence among other districts in the Mashonaland West Province. This might be due to the scale of poultry production carried out in the district, most farmers are urban farmers and rely on backyard farming practices (Zimunya and Dube 2021). Vaccinations and proper biosecurity programs are difficult to implement due to the limited space of land used for poultry production. Kariba district has no or low infectious coryza cases due to the absence of intensive poultry farming. As shown in figure 3, Kariba district has low risk of infectious coryza incidence. This might be due to environmental conditions in Kariba, it is characterized by high temperatures during most times of the year, hindering the proliferation of *Avibacterium paragallinarum*. The main farming activities are fish farming and crocodile farming.

The least number of infectious coryza cases was recorded in 2021 as illustrated in figure 6, this might be attributed to effective intervention efforts, decreased transmission, underreporting of the cases or implementation of the vaccination program across the province. This points to the possibility of a connection between the reporting of diseases and their spread. Vaccination as an intervention method has proved to be effective on individual farms (Edgardo Soriamo-Vargas 2024) Vaccinations on farms are carried out between 10 and 20 weeks of age, and layers are protected by administering 2 injections.

Infectious coryza cases are commonly reported from intensive poultry production farms in developing countries due to poor management and the presence of other infections (Babazadeh and Abd El-Ghany 2023). In most developing countries occurrence of the disease is high due to the rearing of all age groups at the same place in free-range farming (Author et al. 2007) .Reports from a study conducted in Egypt from 2013 to 2015 indicated the presence of *Avibacterium paragallinarum*. A molecular characterization method was used on field isolates, revealing four isolates of serovar A, three of serovar C, and two of serovar B. (El-Naenaeey, Abd El-Aziz, and Asaad 2021).Difference in prevalence and distribution worldwide might be due to differences in climate conditions. The tropical climate is favorable for the proliferation of microorganisms (Dereja and Hailemichael 2017).

IC has been reported to be the second most significant bacterial disease associated with mortalities in Pakistan (Muhammand Hamza, 2024).Infectious coryza cases are commonly reported from intensive poultry production farms in developing countries due to poor management and the presence of other infections (Babazadeh and Abd El-Ghany 2023).

The seasonal patterns as indicated in figure 5 show that, the peak season for epidemics is late summer and low prevalence in winter months, June having 160 cases and July having 130 cases .*Avibacterium paragallinarum* pathogenicity is influenced by humid and warmer environment, which favors bacterial survival and transmission (Deshmukh 2015) The highest incidence of disease was in April with 2 920 cases as shown in figure 5, in Zimbabwe during this month, the temperatures are high and humid environments are common, *Avibacterium paragallinarum* proliferation is robust in these conditions. These findings differ from those of Dereja and Hailemichael (2017) who reported high disease incidence in January to April in Ethiopia, these are the windy months of the year so bacterial transmission is more rapid.

Observations from the correlation analysis state that there is a weak correlation between total number of cases and deaths $p > 0.05$ ($p = 0.283$). This suggests that other factors beyond the number of cases may influence the number of deaths observed. Flocks in Argentina, both broilers and layers have been reported to have *Salmonella spp* and infectious bronchitis virus. The disease is more common in adult birds because of the weak immune system in older birds. This makes the spread of microbes much easier. A study conducted in Jimma (Ethiopia) highlighted that younger chickens are more resistant compared to adult birds. this is in agreement with the work conducted in Thailand, where prevalence was high in chickens above six months (Dereja and Hailemichael, 2017).

Double-dose vaccination done with a 3-week time interval has been reported to offer long-term immune protection of 30-40 weeks after vaccination. Inactivated vaccines are the most common type of vaccines being used worldwide (El-Naenaeey et al. 2021)

Conclusion

This study highlights the emerging trends on epidemiological patterns of infectious coryza disease in Mashonaland West Province of Zimbabwe. It is difficult to control infectious coryza disease due to the presence of different serovars of *Avibacterium paragallinarum* around the world. Key risk factors, includes poor biosecurity measures, poor vaccination programs and interaction between commercial and backyard poultry systems, contributes to the persistence and spread of the disease .The increasing disease incidence worldwide highlights the need to improve biosecurity measures and vaccination programs in poultry production farms.Re-emergence of infectious coryza highlights the need for better disease surveillance and improved diagnostic services , use of laboratory diagnostic facilities enhances early detection of the bacterium and enhances controlled movement of birds .

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