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*Full Length Research Paper*

# A three year follow-up study on the occurrence of bovine ehrlichiosis (cowdriosis) at Gondar University dairy farm

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**Bovine ehrlichiosis (cowdriosis) is an acute, fatal, non-contagious, infectious, tick-borne rickettsial disease of ruminants, caused by *Ehrlichia ruminantium* and transmitted by *Amblyomma* ticks. During the 3 years period, 37 cases were examined at the University of Gondar dairy farms with diagnosis based on clinical, post-mortem and squash smear preparations. The age of animals which showed clinical signs ranged from two months to 3.5 years, with an average of 1.27 years. Most cases were aged less than one year. Cases were recorded throughout the year; however, it was more prevalent in the rainy season than others. Of the 37 cases, 26 (70.27%) were female and 11 (29.73%) were male. Clinical signs observed include a body temperature of 37 to 41.5°C, reduced or no food consumption, depression, conjunctival congestion, grunting, shivering, head pressing, excessive chewing, salivation and self inflected trauma. The most commonly observed findings at post-mortem examination were hydro-pericardium, peticheal or generalized haemorrhages in the peritoneum and other organs. The economic loss to the farm, during the period of study was 7884.67 USD (142,924.20 Birr {Ethiopian Currency}). The disease should be included in the differential diagnosis of febrile conditions, so that the appropriate treatment and control measures can be implemented, as early as possible.**

**Key words:** Longitudinal study, cowdriosis, dairy farm, clinical observations, post-mortem, squash smear examination.

## INTRODUCTION

Bovine ehrlichiosis (also known as heartwater or cowdriosis) is an infectious and tick-borne disease of ruminants caused by the rickettsial organism, *Ehrlichia ruminantium* (formerly *Cowdria ruminantium*) and transmitted by ticks of the genus *Amblyomma*, particularly *Amblyomma variegatum* and *Amblyomma habraeum* which are widespread in Ethiopia (Mekonnen et al., 2001; Tessema and Gashaw, 2010), including Gondar (Miruts, 2010). The disease is endemic in sub-Saharan African countries (Deem et al., 1996a; McMillan and Meltzer, 1996; Radostits et al., 2007), and it has a serious negative impact on livestock productivity, with high morbidity and mortality rates (up to 90%) in susceptible ruminants. European breeds are generally more susceptible than

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more susceptible than indigenous African breeds (OIE, 2011).

Although bovine ehrlichiosis is recognized as one of the most devastating livestock diseases; the exact epidemiology is poorly understood in Ethiopia or other African countries. Many of the published studies on the disease are often for only short periods, without detailed follow up, which precludes any extensive evaluation of the risk factors, which might facilitate better understanding of the disease and its control. This study set out to evaluate the disease in the Gondar University dairy farm, including clinical observations, post-mortem and squash smear examination and resultant economic losses.

## MATERIALS AND METHODS

### Methodology

The study was conducted by included clinical examination, diagnosis based on squash smear preparations and post-mortem evaluation. Sick animals were thoroughly examined and clinical observations recorded on a standard template. Post-mortem examination was conducted and gross lesions were recorded for all animals which died. Brain squash smears were prepared for diagnostic confirmation.

### Study area

The study was conducted at University of Gondar, dairy farm, North-Western Ethiopia, from June, 2009 to May, 2012. The farm is located in the university compound, 740 km from Addis Ababa (the capital) at latitude, longitude and altitude of 12.3 to 13.8 North, 35.3 to35.7° East and 2200 m above sea level, respectively. The average annual rainfall may reach up to 1772 mmHg. The annual mean minimum and maximum temperature of the area varies between 12.3 to 17.7 and 22 to 30°C, respectively. The area has two seasons, the rainy season from June to September, and the dry season from October to May when there is low and erratic rainfall (MoA, 2003).

### Study population

The farm, which was established in May, 2009 comprises approximately 80 cross breed cows (Holestin Friesian × local Zebu), a dynamic population, where some cows were culled due to poor reproductive performance, infectious diseases and malness and calves were born during the study period. The herd is kept for milk production to generate income and for teaching purposes. Except one teaser bull, and those male calves born during the study period, all animals studied were female. The system of husbandry was semi-intensive, where animals were allowed access to grazing and supplied with brewery by-products and hay, typically late in the afternoon and evening, when they are housed in well constructed shade. All sick animals were examined clinically and treatment was given based on the diagnosis. Acaricides were applied when the majority of animals were infested with ticks.

### Data analysis

Preliminary data was entered into Microsoft Excel. The average incidence was calculated by adding the number of cases in three years and divides it by three, or the number of cases divided by the total population in the specified period (Thrusfield, 2005). The economic loss induced by cowdriosis was based on the formula given by Singh and Prasad (2008). It included losses due to mortality, reduced milk yield, carcass meat (body weight) and the cost of acaricide and antibiotic treatment.

#### *Direct losses from mortality*

This was calculated as the product of the number of animals which died (D) due to the disease and probable average value (P) of the animal: $A = D \times P$.

#### *Losses in milk yield*

For the proportion of cows in milk in a year, the losses were expressed in terms of the reduction in milk yield, based on the market price of milk. When a cow died as a result of the disease, the loss was calculated based on the percentage of its lactation lost. Double counting or costing was avoided.

The overall cost of losses due to reduced milk production was calculated using the formula:

$$M_L = (S - D) \times P_l \times L \times Z \times P_M$$

Where $M_L$ is the milk losses in Birr (Ethiopian currency), S is the number of sick animals, D is the number of dead animals, $P_l$ is the proportion of animals in milk, L is the proportion of lactation lost, Z is the annual average milk yield per milk cows, PM is the price of milk (per kg)

### Estimation of losses in body weight

The body weight loss in non-milking animals was estimated by the formula:

$$B_L = (S - D)\ (1 - P_l) \times W_L \times W_A \times P_W$$

$B_L$ is the body weight losses in Birr, S is the number of sick animals, D is the number of dead animals, $P_l$ is the proportion of animals not in milk, $W_L$ is the proportion of body weight loss, $B_A$ is the average body weight, $P_M$ is the price of meat (per kg).

#### *Cost of treatment*

In order to estimate the cost of treatment, records of acardicide and antibiotics used were added up and multiplied by the average price of drugs.

## RESULTS

### Incidence

Thirty seven cattle, from a total of 80 animals observed for a period of three years, developed bovine ehrlichiosis, with an average incidence of 12.33 cases/annum (3.05 standard deviation (SD)) or 15% of the herd.

The number of cases was higher during the first year of the study and showed a decrease in the subsequent 2 years (Figure 1).

### Risk factors

Age, season and sex were considered as factors that

**Table 1.** Temperature response of case of bovine ehrlichiosis and survival rate.

| Body temperature (°C) | Number of cases | | Mortality | | Recovery | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % |
| >=39.5 | 21 | 56.76 | 3 | 14.29 | 18 | 80 |
| 38-39.5 | 7 | 18.92 | 2 | 28.57 | 5 | 60 |
| <38 | 9 | 24.32 | 4 | 44.44 | 5 | 33 |
| Total | 37 | - | 9 | 24.32 | 28 | 75.68 |

Total fatality rate (9/37) = 24.32 or 8.1%/annum.

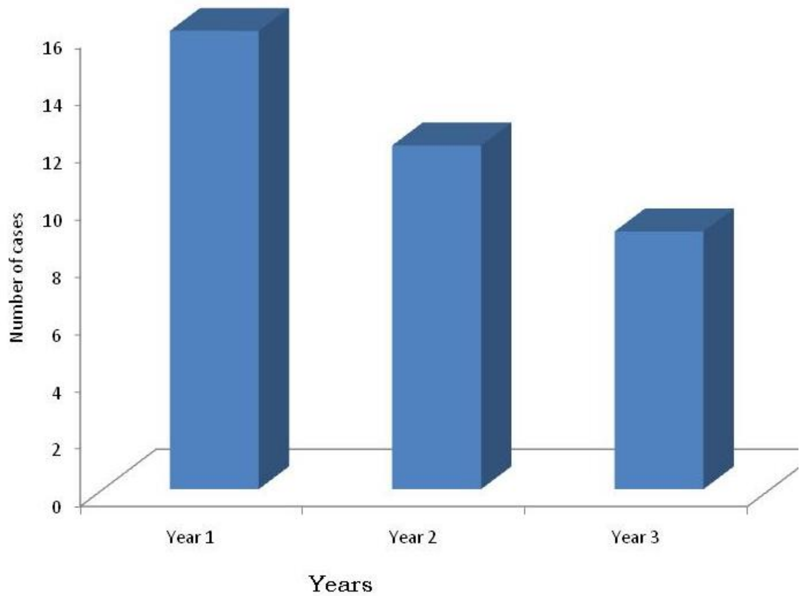


**Figure 1.** Number of cases in first, second and third year.

may contribute for the occurrence of the disease. The age of animals which showed clinical signs ranged from two months to 3.5 years, with an average of 1.27 years. Most cases were of age less than one year (Figure 2). Cases were recorded throughout the year; however, it was more prevalent in the rainy season than others (Figure 3). Of the 37 cases, 26 (70.27%) were female and 11 (29.73%) were male.

## Clinical signs

A variety of clinical signs were observed during the study period as explained thus.

### *Altered body temperature*

A change in body temperature was recorded, ranging from 37 to 41.5°C, with an average of 39.41°C, (median 38.20°C; mode 41°C). The recovery rate tended to be better if treatment commenced, while an animal was febrile (Table 1).

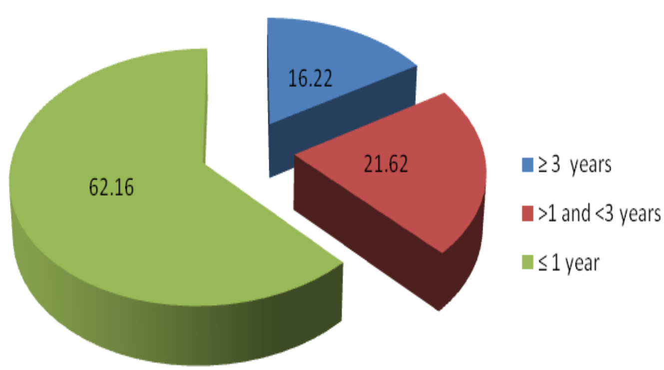


**Figure 2.** Age categories of cases of bovine ehrlichiosis.

### *In-appetence*

Reduced feed consumption or complete cessation of eating was observed in most cases, when most animals stopped eating grass, but would drink small amounts of milk.

### *Depression*

Affected animals became isolated from the herd, and distant from the feeding and watering area.

### *Conjunctiva congestion*

Conjuctival congestion was commonly observed in most of the cases of bovine ehrlichiosis (Figure 4).

### *Respiratory distress*

Respiratory distresses like, grunting was observed in most of the cases, particularly when the animals are in a recumbent position.

### *Head pressing*

Head pressing was observed in severe advanced cases, either against the wall or the ground (Figure 5).

### *Frequent chewing*

Frequent chewing movement and attempts to eat non edible materials such as soil or sand were also observed.

### *Salivation*

Excessive salivation was also observed in 12 (32.43%) cases (Figure 6).

### *Trauma*

Traumatic injuries as a result of frequent falling were observed in some cases (Figure 7).

### Post-mortem examination

Seven out of 9 animals which died were autopsied. A number of findings were recorded including hydropericardium (Figure 8), peticheal or generalized haemorrhages in the peritoneum and several organs (abomasum, heart and kidney). The gallbladder was also enlarged with excessive thick bile (Figure 9).

### Economic losses

The economic losses due to the disease are associated with deaths, the cost of acaricides and antibiotics and loss of milk yield (Table 2).

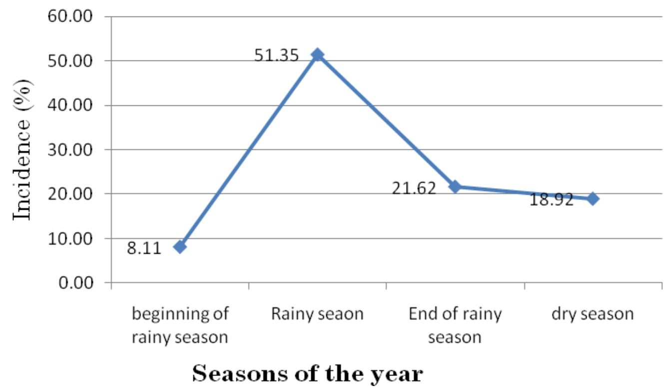


**Figure 3.** Bovine ehrlichiosis cases in different seasons of the year.

**Figure 4.** Animals showing congestion of the conjunctiva.

**Figure 5.** Head pressing; Sign of a case of bovine ehrlichiosis.

**Table 2.** Summary of the economic losses due to bovine ehrlichiosis in the three years study period.

| Parameter | Estimated cost lost (Birr) | Estimated cost lost (USD) | Remark |
|---|---|---|---|
| Mortality | 36,000.00 | 2000.00 | - |
| Acaricide cost | 1029.60 | 57.20 | - |
| Cost of treatment | 980.00 | 54.44 | - |
| Cost due to loss of milk | 15,256.22 | 847.57 | - |
| Costs related with meat loss | 87,178.38 | 4843.24 | - |
| Management cost | 1480.00 | 82.22 | - |
| Total | 141,924.20 | 7884.67 | - |

**Figure 6.** Animals showing salivation.

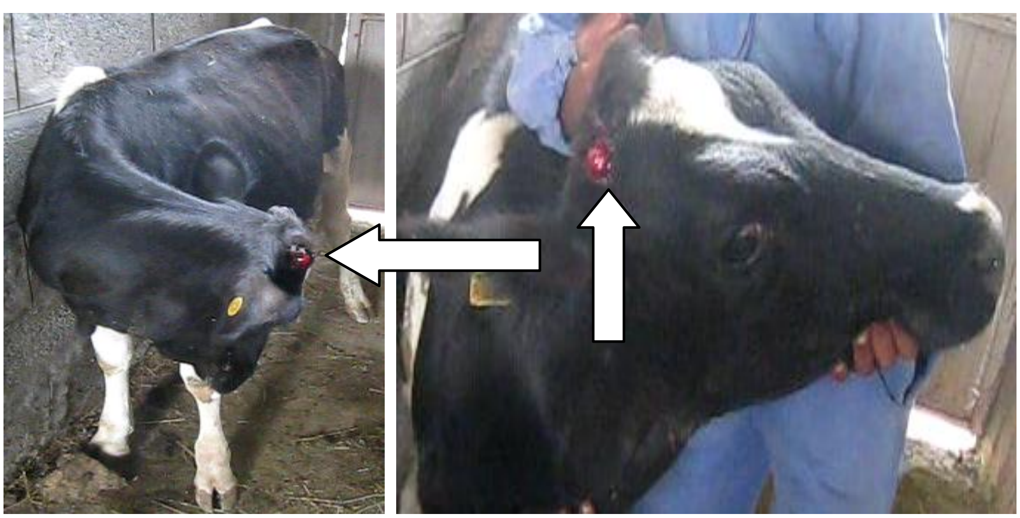

**Figure 7.** Traumatic lesion induced on the poll.

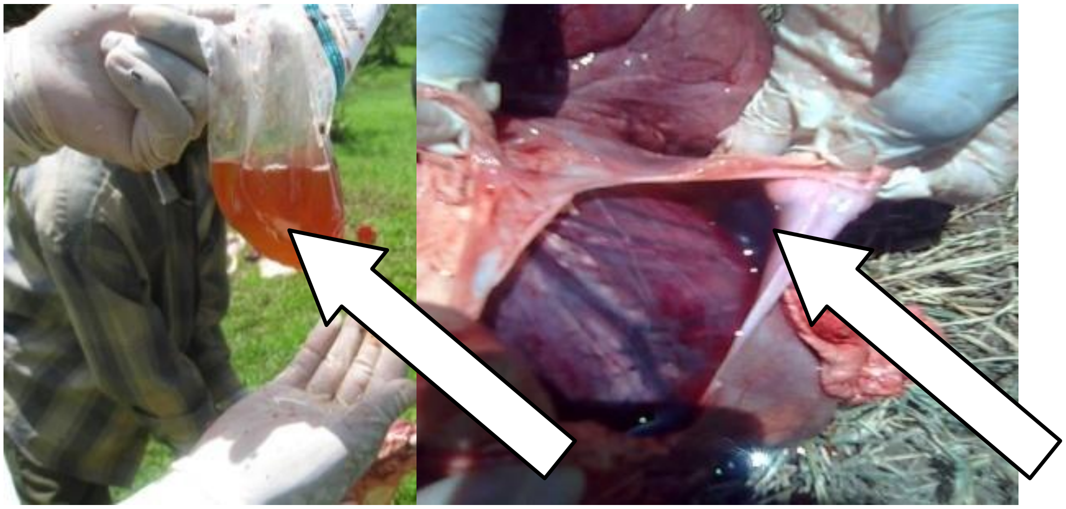

**Figure 8.** Fluid collected from pericardium and fluid around the heart (Hydropericardium).

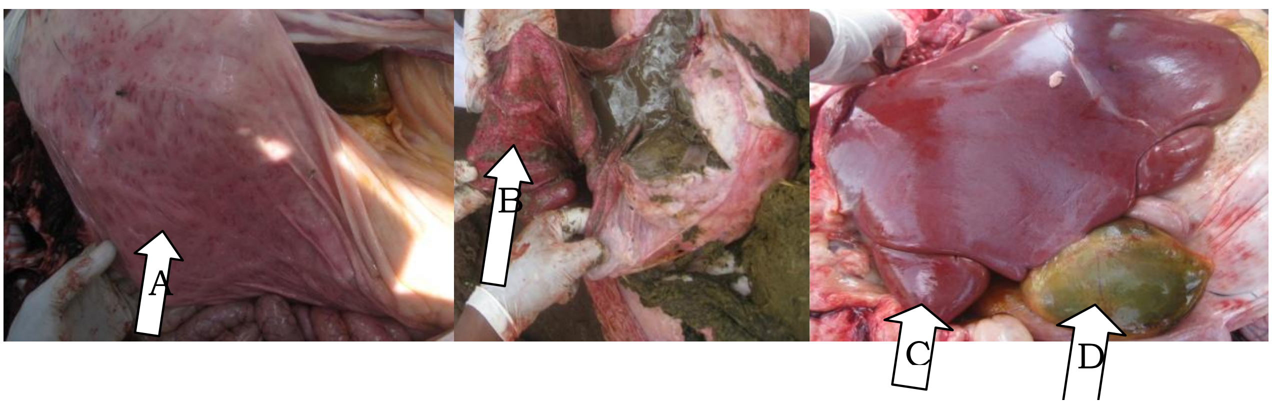


**Figure 9.** Haemorrhage on the peritoneum (A), and abomasum (B), enlarged liver (C) and gall bladder (D).

***Mortality***

There were 9 deaths 9 × 4,000 Birr (animal's value) 36,000 Birr (2000.00 United States Dollar (USD)) was lost due to mortality.

***Tick control and cost of acaricides***

The acaricides were applied using a hand knap sac sprayer. The animals were sprayed on average once every two weeks. The frequency was high during the rainy season when the tick challenge increased. Three full (20 ml) knap sac sprayers were enough for one round of spraying, totalling 60 ml to spray the herd. In the study period, 780 rounds of spraying took place, totalling 4680 ml of acaricide. The average price of the acaricides was 0.22 Birr/ml. The approximate cost of acaricide utilisation was 1029.6 Birr (57.2 USD).

***Treatment costs***

For the treatment of these cases of cowdriosis, a number of different drugs were used, most commonly oxytetracycline10%. Twenty eight vials were used, at 25 Birr/vial, a total cost of 700.00 Birr (38.88 USD).

Oxytetracycline 20% was used for more susceptible animals as prophylaxis during peak outbreaks. For this purpose, 7 vials were used, a total cost of 280 Birr (15.56 USD).

***Milk losses***

The milk loss was calculated using the formula: $M_L = (S - D) \times P_I \times L \times Z \times P_M$

where $M_L$ is the milk losses in Birr, S is the number of sick animals = 37, D is the number of dead animals = 9, $P_l$ is the proportion of animals in milk = 5/37, L is the proportion of lactation lost = 15%, Z is the annual average milk yield per milk cows = 6 L×360 days, $P_M$ is the price of milk (per kg) = 8.00

Hence, the total loss due to reduced milk yield was 15,256.22 Birr (847.47 USD).

### *Costs related to meat loss (body weight)*

The body weight loss in non-milking animals was estimated using the formula:

$B_L = (S - D)(1 - P_l) \times W_L \times W_A \times P_W$

where $B_L$ is the body weight losses in Birr, S is the number of sick animals = 37, D is the number of dead animals = 9, $P_l$ is the proportion of animals in milk = 5/37, $W_L$ is the proportion of body weight loss = 10%, $W_A$ is the average body weight = 300 kg, $P_M$ is the price of meat (per kg) 80 Birr.

Hence, the total loss due to reduced body weight was 87,178.38 Birr (4,843.24 USD). The cost of increased management and professional advice was approximately 40 Birr/sick animal. 37×40=1480.00 (82.22 USD).

## DISCUSSION

This study has demonstrated an annual incidence of 12.33 animals/annum (15% of the herd) succumbing to cowdriosis in one susceptible dairy herd, where there was clinical monitoring and treatment, with implementation of vector control measures. The numbers of cases were higher during the first year of the study period and show slight decrement in the following years. This may be related to the restocking process which took place during the beginning of the study period, as restocking of animals into endemic areas is known to increase the incidence of bovine ehrlichiosis with mortality (Hanks and Lopes Pereira, 1998), particularly where the restocked animals are from more susceptible breeds. The annual fatality rate in this study was 8.1% of affected animals. In a similar study conducted in Arsi, Ethiopia the mortality rate was 15.71% (Obsa and Zerihun, 1993). Heartwater accounted for 51% of all mortalities on farms in Zimbabwe (Meltzer et al., 1996). Such differences may be related to breed, the severity of the tick challenge, the vector control programme and the timing of treatment. The increased incidence in females reflects the relatively low number of male animals on the farm.

The youngest animals affected were 2 months old. An age-dependent resistance has long been recognized and young animals which are believed to have innate resistance (Radostits et al*.,* 2007). Colostrum-derived antibodies to *Cowdria* have been detected in sera from calves up to four weeks old (ILRAD, 1991). The reduced susceptibility of young calves may also reflect reduced exposure to ticks of indoor calves.

In addition to tick borne disease, vertical transmission of *C. ruminantium* from cows to their calves (Deem et al*.,* 1996b) has been demonstrated, suggesting that at an early age calves may have two sources of infection, either from the dam or tick infestation. It has also been observed that in calves, seroprevalence rose steadily with age up to a maximum of 73% in endemic areas (Koney et al*.,* 2004).

In this study, no animal was re-infected or exhibited clinical signs after recovery, which concurs with the observation that cattle recovering from the disease are immune for 6 months to 4 years (Radostits et al*.,* 2007). A long period of antibody persistence has been detected in animals after clinical disease, which may prevent reoccurrence of the disease (ILRAD, 1991).

In this study, cases were recorded throughout the year, but more frequently in the rainy season. This may be related to the seasonal occurrence of *Amblyomma* vectors, reported by a number of different authors (Gebre et al., 2001; Tesema and Gashaw, 2010; Koney et al*.,* 2004; Kivaria et al*.,* 2012; Bekker et al*.*, 2001).The characteristic clinical signs of heartwater, cowdriosis (Radostits et al., 2007) were recorded in this study. The temperature elevation declines as the disease progresses which results in a more unfavourable prognosis.

Bovine ehrlichiosis can induce significant economic losses. In this study, approximately 141,924.20 Birr (7884.67 USD) was lost during the three year period. This is an approximate estimation as the price of animals has since increased. Mukhebi et al. (1999), estimated total annual losses of Z$ 61.3 million (US$ 5.6 million) in Zimbabwe, the most significant portion attributed to the costs of acaricides (76%), followed by milk loss (18%) and the cost of antibiotics (5%).

In conclusion, bovine ehrlichiosis is prevalent in the Gondar University dairy farm and can be detected throughout the year, but more often in the rainy season. The typical clinical signs and post-mortem lesions were observed and the economic loss was significant. The disease should be suspected if any unrecognised febrile condition occurs, particularly in young stock. Various tick control strategies need to be implemented. Any evidence of clinical disease needs to be reported without delay, so that intravenous treatment can be commenced immediately, at high doses. Two or three vials of short acting (10%) Oxytetracycline needs to be made available on the farm for a quick response. To determine the prevalence of the disease, other diagnostic techniques, including serology should be implemented, and care should be taken when introducing new stock, especially if it is from susceptible breeds.

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