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Epidemiological Assessment of Bovine Ephemeral Fever in Injil District of Herat Province

Haidari Esmatullah[1*], Nasiry Zabihullah[2], Tookhy Nazir Ahmad[3], Mohmand Noor Ali[4], Shakhes Shoaib Ahmad[5] & Mohammadi Aminullah[6]

[1,2,3,4,5]Department of Para Clinic, Faculty of Veterinary Science, Herat University, Herat, Afghanistan.
[6]Department of Food Technology, Faculty of Veterinary Sciences, Herat University, Herat, Afghanistan.

*Corresponding author: haidariesmat4@gmail.com

ABSTRACT

Bovine Ephemeral Fever (BEF) is the most important arthropod-borne viral disease of cattle, caused by *Ephemerovirus* of the *Rhabdoviridae* that is transmitted by blood-feeding insects. The disease causes serious economic impacts through reduced milk yields, poor cattle condition at sale, death of infected animals, and costs associated with prevention and control programs. A cross-sectional study was conducted to evaluate the BEF epidemiology in the Injil District of Herat Province. A total of 5184 BEF cases were recorded by 100 veterinary professionals, with 17 deaths (0.33% case fatality rate). Most cases (93%) were recorded during the summer season. The main risk factors identified were existence of insects (97%), and stagnant water (94%). The most common clinical signs and symptoms in infected cattle were fever, lethargy, lameness, salivation, cardiorespiratory dysregulation, decreased milk production and muscle tremors, respectively. Approximately, 90% of the cases were managed with supportive care and antibiotics for secondary infections. Limited access to the vaccines was reported as a primary challenge, with only 7% of the respondents indicating they had access to BEF vaccines. The findings of this study demonstrated that BEF has a high reported prevalence in the Injil district, and that environmental factors have a significant impact on its transmission, which requires the design and implementation of effective prevention and control programs.

Keywords: Bovine Ephemeral Fever, Epidemiology, Herat Province, Injil District.

INTRODUCTION

Bovine Ephemeral Fever (BEF) which is most commonly called "three-day sickness", is an acute insect-borne viral disease affecting cattle and, in some instances, has affected water buffaloes (Omar et al.,2020). The causative agent of this disease is called bovine ephemeral fever virus, a member of the family *Rhabdoviridae*, genus *Ephemerovirus*, which forms a devastating loss to the livestock industry (Walker & Klement, 2015).

The main vectors of the incidence of this disease are the blood-sucking arthropods, the most important among which are biting midges of the genus *Culicoides* and mosquitoes of the genera *Aedes*, *Culex*, and *Anopheles* (Zaghawa et al., 2017; Murray, 1976). Morbidities rates can be high, but deaths are usually infrequent; as perevious studies by Zaghawa et al. (2017) and Özyörük et al. (2025) indicate morbidity rate of 70% and 58.4%, while mortality rates were reported as only 4.6% and 7.5% in the respective areas. It is important to know that, indirect losses from less production, costs of supportive therapy, and secondary infections can face the cattle farming to back-broken challenges.

BEF is endemic in Africa, Asia, the Middle East, and Australia, all of which contain abundant breeding populations of the competent vectors-*Culicoides* and *Culex* species (Almasi and Bakhshesh, 2019; Ahmad et al., 2025). New strains of BEF virus can cause outbreaks and facilitate the spread of the disease into non-endemic regions (Golender et al., 2025). Evidence from previous studies indicates that Bovine ephemeral fever in Afghanistan has an epidemic pattern and has occurred as outbreaks in certain years (Lee, 2019).

Seasonal outbreaks usually coincide with the monsoon or towards the end of summer; most typically it is in areas of South Asia and coastal Australia. In recent research, it has been implied that climatic changes, coupled with livestock trade and windborne dispersal of the vectors, would see the incursion of BEF into new territories against its profile of control in areas previously unaffected (Stokes et al., 2020).

Clinically, BEF usually presents with fever in two or three phases, stiff muscles, nasal and ocular discharges, ruminal stasis, and a short period of recumbency due to hypocalcemia. Very severe cases of infection may result in continuous weakness, abortions within pregnant cows. While most cases resolve spontaneously within 3-5 days, severe infections can lead to death in rare instances (Rojas et al., 2018). Adult cattle are generally more severely affected, particularly high-yield cows and bulls in the best conditions, than younger ones, most of whom are either asymptomatic or mildly symptomatic due to maternal immunity.

Control over BEF still remains difficult in low-resource settings. Vaccination is the most effective method of preventive measure, but in most developing countries, it is limited (Ashraf et al., 2023). In addition, vector control is necessary; however, this is too difficult as geographies and ecologies of the competent vectors remain poorly defined (Poza-Pascual & García-Godoy, 2020). Supportive treatments, on the other hand, can improve outcomes of recovery, which include anti-inflammatory drugs, fluid therapy, and nutritional support. Antibiotics are also highly utilized for preventing secondary bacterial infection (Klement, 2024).

BEF is emerging as a very important threat to cattle production in Afghanistan, especially in areas with irrigated agriculture and conditions that is promising for vector proliferation. Information regarding the viral epidemiology and associated risk factors of BEF is scant in the country. Cattle raising is an important farming activity in the western part of Afghanistan, especially in Injil District of Herat Province, which is a region very suitable in climate for the transmission of vector-borne diseases. Information on the epidemiological pattern, clinical features, and management approaches is crucial for designing the right control plan in that region.

the present study evaluated the epidemiological profile of Bovine Ephemeral Fever in Injil District, Herat Province, in the year 2023. The cross-sectional study design was used with 100 veterinary professionals as respondents to the structured questionnaires. Collected data on frequency of reported cases, risk factors, clinical symptoms, Disease management strategies, and major barriers for preventing and controlling the disease were analyzed. The most expected outcome will aid veterinary services and officials within their work to handle and minimize fatalities from infections of BEF in that region.

MATERIALS AND METHODS

Ethical consideration

The current study received the ethical approval of Research, Authorship, and Translation Committee of the Veterinary Sciences Faculty, Herat University (protocol number 06- 09/09/2025). Similarly, the respondents were informed and gave their consent before taking part in the questionnaires.

Study-Area

The research was conducted in Injil District, located in Herat Province, western Afghanistan. The district has a semi-arid climate with hot summers and cold winters, conditions that can favor seasonal fluctuations in vector populations. Livestock farming, particularly dairy cattle production, is a major economic activity in the area.

Study Design

This study employed a descriptive cross-sectional design, integrating both literature-based information and field survey data to assess the epidemiological characteristics of bovine ephemeral fever disease in Herat providence, Afghanistan, from May to December 2023.

Samples size calculation

According to reports from the Herat Provincial Department of Livestock and animal health, there were about 118 veterinary professionals involved in veterinary crevices in selected area. Using the Raosoft sample size calculator (http://www.raosoft.com/samplesize.html) with a 5% margin of error, a 95% confidence level, and a 50% response distribution, the sample size for the study was determined to be 91 respondents. To enhance precision and account for potential non-responses, another 10% added to that. So, the final sample size increased to 100 participants.

Questionnaire Design

The structured questionnaire was developed based on prior studies on BEF (Hwang et al., 2021; Ahmad et al., 2025; Walker & Klement, 2015). It captured respondent demographics such as age, gender, education, occupation, and years of experience. Disease-related data included case records, seasonal patterns, affected age groups, and key clinical signs like fever, lethargy, lameness, and reduced milk yield. Risk factors such as population density, insect presence, nutrition, and environmental conditions were assessed alongside supportive care practices and their perceived success. Information on mortality, post-mortem findings, vaccination coverage and efficacy, as well as control measures were collected through face-to-face interviews enriched by respondents' suggestions.

Statistical Analysis

All collected data were entered and analyzed using the software IBM SPSS Statistics, version 27. Descriptive statistics including frequencies and percentages calculated to describe the overall characteristics of the study variables. The relationship between categorical variables were examined using the Che- square (x^2) test. The P-values were calculated automatically by SPSS based on the Chi-square statistics. Differences between groups were considered statistically significant at $P< 0.05$, corresponding to a 95% confidence level.

RESULTS

Demographic Characteristics of Participants

All participants in this study were male. Most of the participants were within an age group of 20-39 years; where 60%, between 20 and 29 years, and 38% between the ages of 30 and 39. Very little, that is only 2%, aged 40 years and above. The highest number of respondents had a DVM degree 74%, followed by a 14th-grade education 19%, para-veterinary training 6%, and a small proportion 1% with a master's degree. As to their professional experience, 65% of the respondents said they had 1-5 years of experience, whereas 30% said between 5 and 10 years, and the last 5% said between 10 and 20 years. (Table 1).

Table 1: General Characteristics of Participants (N = 100)

Variable	Category	Frequency	Percentage (%)
Age	<20 years	0	-
	20–29 years	60	60.0
	30–39 years	38	38.0
	40–49 years	1	1.0
	>50 years	1	1.0
Gender	Male	100	100.0
	Female	0	-
Education	Para-veterinary	6	6.0
	14th Grade	19	19.0
	DVM	74	74.0
	Master	1	1.0
Work experience	1–5 years	65	65.0
	5–10 years	30	30.0
	10–20 years	5	5.0
	>20 years	0	-

Frequency Distribution of BEF in Various Region of Injil District

BEF cases were reported at the highest number by Braman Region Animal Clinics, amounting to 51.62% of the total. Mobile Animal Clinics reported the second highest percentage of 15.90%, and Darb Malek Animal Clinics and Drugstores contributed 8.33%. Communally, these three sources signify over 75% of all stated cases. Other areas, such as Yasser Town, Khaja Kalah, and Sabzawar animal clinics, contributed cases, although small in numbers. In contrast, clinics such as Mirzaee, Shidaie, Kababian, and Kurah Mili reported very few cases (Table 2).

Table 2: Frequency Distribution of BEF in Various Region of Injil District

Region/Clinic	Frequency	Percentage
Mirzaee Animal Clinic	17	0.33%
Salehi, Ehya and Moallem Animal Clinics	155	2.99%
Kurah Mili, (Shafa Animal Clinic)	30	0.58%
Khusrud Animal Clinic	70	1.35%
Yasser Town (Atayee & Rahimi animal clinic)	300	5.79%
Sediqi Town (Itehad Animal Clinic)	100	1.93%
Kababian (Wakil Ahmad Animal Clinic)	30	0.58%
Sabzawar animal drugstore	160	3.09%
Pul Hashemi Animal Clinic	80	1.54%
Darb malek animal clinics and drugstore	432	8.33%
Khaja kalah Animal Clinics	190	3.67%
Shidaie Animal Clinic	20	0.39%
Braman Region Clinics and drugstores	2676	51.62%
Mobile Animal Clinics	824	15.90%
Total	**5184**	**100.00%**
Minimum	**17**	-
Maximum	**2676**	-

Fatality Rate

The BEF had an exceptionally low mortality rate considering its reported prevalence: of the 5,184 reported cases, 17 caused deaths for a case fatality of 0.33%. This suggests that while BEF spreads rapidly, the disease is generally of low virulence and rarely fatal (Table 3).

Table 3: Fatality Rate of BEF in cattle

Characteristic	Frequency	Case Fatality Rate
Total Infected Cases	5184	-
Total Deaths	17	0.33%

Seasonal Incidence

Noticeable seasonality was seen in BEF. As many as 93% of cases occurred during the summer months. The reported cases dropped to a low of 7% in autumn. None of the cases reported during the spring and winter months showed that the incidence of the disease is significantly correlated with seasonal climatic conditions ($P<0.05$) (Table 4).

Table 4: Seasonal patterns of Bovine Ephemeral Fever

Season	Frequency	Percentage	P-value
Spring	0	-	0.0001
Summer	4821	93%	
Autumn	363	7%	
Winter	0	-	

Age-wise Distribution of Infected Cattle

Age was found to be a significant factor in vulnerability to BEF. No cases were recorded in cattle under one year of age. Whereas, the highest incidence of 89% occurred in cattle older than two years and only 11% of the cases involved animals aged between one and two years old. The results of the *Chi-square test* revealed that the differences among the ages were statistically significant ($P<0.05$) (Table 5).

Table 5: Age categories of infected cattle with BEF

Age Group	Frequency	Percentages (%)	P-value
Less than 6 months	0	-	0.0001
6 months to 1 year	0	-	
1 to 2 years	570	11%	
Above 2 years	4614	89%	

Risk Factors

Major risk factors for BEF transmission identified by veterinary professionals included presence of insects (97%) and swampy environments (94%). Other factors considered to be significant contributors to the occurrence of the disease included seasonal timing (91%) and the poor nutritional status of animals (88%) (Table 6).

Table 6: Risk Factors Associated with the Occurrence of BEF

Variables	Risk Factors	Frequency	Percentage (%)
Individual Risk Factors	Presence of mosquitoes	97	97%
	Presence of swamps	94	94%
	Season of the year	91	91%
	Nutritional status	88	88%
Combined Risk Factors	Presence of mosquitoes and swamps	46	46%
	Season of the year and nutritional status	37	37%

Clinical Signs and Post-Mortem Findings

Clinical signs of BEF were consistently reported across cases. This included fever 98%, lethargy, and reduced appetite 97%, as well as lameness 97%. Other signs, including muscle stiffness and nasal or ocular discharge, were observed in more than 95% of the cases. Regarding post-mortem signs, none of the respondents participated in carcass examination So, no responses were given concerning postmortem signs and symptoms. (Table 7).

Table 7: Clinical signs of infected cattle

Symptom Type	Symptom	Frequency	Percentage	P-value
Clinical Signs	Fever	98	98%	0.99
	Lethargy and decreased appetite	97	97%	
	Lameness and muscle stiffness	97	97%	
	Nasal and oral discharge	97	97%	
	Increased respiratory and heart rate	96	96%	
	Decreased milk production	95	95%	
	Muscle tremors and continuous head shaking	95	95%	

Vaccine Availability and Supportive Treatment Practices

A vast majority of the respondents, (88%) reported the non-availability of BEF vaccines in the Herat market. A total of 7% confirmed the accessibility of the vaccines, with 5% being unsure. For the disease management type, 90% of the professionals stated combined supportive therapy and antibiotics to treat the secondary infections. Altogether, 3% applied only supportive treatment, while 7% depended solely on antibiotics for secondary infections in BEF (Table 8).

Table 8: BEF Vaccine Availability and Supportive Treatment Strategies

Variables	Frequency	Percentage (%)
Vaccine availability		
Not available	88	88%
Available	7	7%
Not sure	5	5%
Disease management Type		
Supportive care + antibiotics for secondary infections	90	90%
Supportive therapy only	3	3%
Antibiotics for secondary infections only	7	7%

Supportive Care Outcomes and Antibiotics for Secondary infections in BEF

The BEF disease management outcomes were generally perceived as positive, with 93% of the respondents considering the approach highly effective and 7% showing the supportive care and disease management to be moderately effective. Pen-Strep, Amoxicillin, and Enrofloxacin were the most commonly used antibiotics, at 94%, followed by Oxytetracycline at 93%, indicating suitable therapeutic options available for secondary infections in BEF (Table 9).

Table 9: Supportive Care Outcomes and Antibiotics for Secondary infections in BEF Cases

Variables	Frequency	Percentage (%)
Perceived Disease management effectiveness		
Highly effective	93	93%
Moderate effective	7	7%
Not effective	0	-
Common Antibiotics Used for Secondary infections in BEF		
Pen-Strep	94	94%
Amoxicillin	94	94%
Enrofloxacin	94	94%
Oxytetracycline	93	93%

DISCUSSION

This study evaluates the epidemiological characteristics of BEF in Injil district of Herat province, Afghanistan in 2023. During this period approximately 5,184 BEF cases have been recorded by veterinarians and its epidemiological analysis indicated that most of them occurred during the summer season. The primary risk factors of disease were presence of insects and stagnant water. Similarly, fever, lethargy, lameness, salivation, cardiorespiratory disorder, decreased milk production were recorded as common signs and symptoms in infected cattle. Nearly all disease cases were managed through supportive care and antibiotics for secondary infections. Furthermore, lack of adequate BEF vaccine availability reported as a major challenge in the prevention programs.

Epidemiological analysis showed that the summer season was the most prevalent time for the distribution of the disease with 93% of cases, which corresponds with the results presented by Walker & Klement (2015), in which the summer season was reported as the peak period of disease activity, emphasizing the role of *Culicoides* mosquitoes as the main vector (with a frequency of 89%) and a significant association with increased temperature and humidity. The study by Nadeem et al. (2024), also identifies the summer season as the peak period of this disease outbreak. In line with previous studies, a clear link has been established between climate and vector activity (Özyörük et al., 2025). Our finding suggests that, under the semi-aired conditions of Injil district, biting insects play a major role in shaping the distribution of the disease. Previous studies like Özyörük et al. (2025), also emphasizes the role of biting mosquitoes in the transmission of this infection.

In current study, the most commonly cited risk factors associated with BEF are the existence of insects, with a frequency of 97%, which is supported by researches like Lee (2019), Mirzadeh et al. (2021), as well as Ahmad et al. (2025). Stagnant water was mentioned with a frequency of 94% as a risk factor of BEF. Research by

Stokes et al. (2020) and Zaghawa et al. (2017) also stated that regions with standing water and repeated rainfall are suitable for insect breeding and spreading the BEF. As it is detailed in previous studies like (Hayama et al., 2016), one of the other factors that play a key role in increase of vectors population of the BEF virus and cause its circulation, is proximity to agricultural lands and rice fields, So, Injil District is one of the regions of Herat province where rice culture is more common compared to other districts and this phenomenon can help the spread of the disease. An important consideration was nutritional status, with a frequency of 88% compared to other studies, which least emphasized this aspect.

From a clinical symptom perspective, the results of fever (98%), lethargy and inappetence (97%), lameness and muscle stiffness (97%), and decreased milk production (95%), are similar to the findings of Zaghawa et al. (2017) and Pekmez et al. (2024) who reported fever, stiffness, lameness, salivation, and subcutaneous emphysema. The fatality rate in this study indicates a very low level of mortality (17 out of 5184 cattle, 0.33%), which is almost similar to the findings of Zaghawa et al. (2017) (0.6%) and close to that reported by Lee et al. (2019) (<1%). Susceptibility of the animals to their ages was such that cows beyond two years were most prone, constituting 89% of the population. This is almost similar to the findings of Nadeem et al. (2024), who indicated the age category of 1-3 years as the most prevalent for BEF, and Hwang et al. (2021). This may be associated with the encounter of aged animals with vectors and physiological stress.

The Disease management approaches, including the widespread use of supportive care and antibiotics for secondary infections (90%) as well as antipyretic (97%) and anti-inflammatory (95%) drugs, are also consistent with standard recommendations from (Klement, 2024). In the Walker & Klement (2015) study, the effectiveness of combined treatment was estimated at 88-92% and vaccine accessibility at 25%. When compared to the findings of the present study (90% and 7%, respectively), this indicates a similarity in therapeutic patterns but a difference in vaccine accessibility. The lack of access to vaccine for this disease is itself a major challenge, as previous studies have reported a 2.61% higher mortality rate among unvaccinated cattle compared to vaccinated ones (Gleser et al., 2023).

In summary, the findings of this study have a high degree of consistency with existing knowledge about BEF in terms of seasonal patterns, risk factors, symptoms, and disease management.

CONCLUSION

Bovine Ephemeral Fever is a vector-borne viral disease of cattle and water buffaloes which is economically important. It is endemic across many countries and has recently been clinically reported in several regions of the Afghanistan. The epidemiological analysis of this study demonstrated high occurrence of BEF in Herat province. Nearly all of cases were reported during the summer and animals over two years of age had a higher infection rate than younger animals and almost all cases were managed, with only 0.33% case fatality rate. The primary risk factors for disease occurrence were existence of vector insects and stagnant water. Vaccine accessibility was identified as the main challenge for the prevention program during the disease period. These findings would be helpful in developing prevention and control program for BEF. This study recommends that Provision of effective vaccines and farmer education requires for effective BEF prevention and control programmes in Herat province. Further research should also be undertaken to evaluate the distribution and dynamics aspects of disease, vectors, and environmental determinants of disease prevalence.

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CONFLICT OF INTEREST

The authors declare no competing interests.

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AUTHORS CONTRIBUTIONS

The data collection, and preparation of the first manuscript were done by Haidari E, Nasiry Z contributed to data analyzing, methodology, review and editing. Mohmand N. A., Tookhy N. A., Shakhes S. A and Mohammadi A. contributed to editing and review of the final draft of the paper.

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