



# Lumpy Skin Disease: An Emerging Threat to Livestock in Tehsil Bara, Pakistan

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**Abstract:** Lumpy skin disease (LSD) is a highly contagious and significant economic disease of cattle caused by a virus belonging to the family *Poxviridae* and genus *Capripoxvirus*. The present study aimed to determine the severity of the lumpy skin disease outbreak and associated losses in tehsil Bara, Pakistan. The data was collected through a questionnaire from farmers who have cows in their homes; the reported data varied in five different areas of tehsil Bara, collected from June 1, 2022, to August 31, 2022. The total number of reported cases from five selected areas were 2021, of which 168 were healthy and 1853 were infected. Out of the total infected 766 were recovered and 922 were in the recovery stage. Out of five selected areas, the highest infection rate of the disease followed by the highest mortality rate and lowest recovery cases were 466 (96.28 %), 59 (12.66 %), and 173 (37.12 %) respectively, recorded from Shlobar Quam. The lowest mortality rate was 8 (4.65 %) recorded from Nala Sourdandh and the highest recovery rate was 113 (53.30 %) recorded from Bar Qambar Khel. The disease is characterized by widespread nodules on the skin and causes decreased milk production and lack of appetite, and animals show pharyngeal and nasal secretions, accompanied by secondary infection. It is transmitted by the transportation of illegally bought and sold animals across borders to a new area and spread by insect vectors, including biting flies, mosquitoes, and ticks. Antibiotics, antihistamines, analgesic-antipyretics, immunity boosters, and the management of wounds are the general lines of treatment. The current study recommends the multi-task role of government, and the private sector, as well as the isolation of infected animals, burial of dead bodies, annual vaccination, and the prevention of illegal transportation across the border.

**Keywords:** Lumpy skin disease, Cattle, Tehsil Bara, Mortality

## 1. INTRODUCTION

Lumpy skin disease (LSD) is an extremely contagious and economically important cattle disease caused by a double-stranded DNA virus belonging to the genus *Capripoxvirus* and family *Poxviridae* [1, 2]. With high morbidity and low mortality, it causes the livestock industry to suffer significant financial losses [3, 4]. When a virus enters the body of a cattle, it can incubate there for 4 to 12 days, while incubation has typically been recorded to last seven days and may potentially

extend up to 28 days [5, 6]. The disease infection is characterized by numerous lumps and nodules on the skin and other body parts, which cause skin damage that cannot be reversed [7]. It causes loss of hunger, reduced production of milk, and weight gain [8]. The infected animal shows lacrimation, pharyngeal and nasal secretion, conjunctivitis, and infertility [9]. According to the World Organization for Animal Health (WOAH) standards, the disease has been observed to worsen over time due to secondary bacterial infections, leading to additional complications like mastitis and myiasis or even

animal death. For this reason, the disease has been labelled as a new disease. [10, 11].

It is a transboundary disease that spreads by the movement of animals from one location to another. Illegal livestock trade across borders further increases the risk of the disease spreading to new areas. When an infection outbreak occurs in an area, insects like mosquitoes (*Culex mirificens* and *Aedes natrionus*), ticks (*Rhipicephalus appendiculatus* and *Amblyomma hebraeum*), and biting flies (*Stomoxys calcitrans* and *Biomyia fasciata*) are the principal vectors that spread the disease [12-15]. Moreover, it spreads among the herd by direct contact between animals or through contact with contaminated saliva, blood, nasal secretions, sperm, and milk [3, 16-17]. The standard course of treatment for sickness includes the use of antibiotics, antihistaminics, analgesic-antipyretics, immunity boosters, and wound care [18-20]. Lumpy skin disease can be avoided by adopting guidelines among farmers, limiting animal movement from one place to another, quarantining sick animals, keeping diseased animals separate from the rest of the herd, and avoiding sharing drinking or feeding troughs. All animals should receive a annual vaccination against lumpy skin disease, especially in the early spring, as vaccines are the frontline protector [21]. It is safe to vaccinate pregnant cows. There are commercially available live and attenuated LSD vaccines. In Pakistan, Jamshoro Sindh reported the first incidence of this disease in November 2022. The disease spread throughout Punjab and has already crossed the border into the Khyber Pakhtunkhwa region through Dera Ismail Khan.

## 2. MATERIALS AND METHODS

### 2.1 Study Design

This study was conducted in five selected areas of tehsil Bara district Khyber, Khyber Pakhtunkhwa, Pakistan; Akakhel, Speen Qabar, Shlobar Quam, Bar Qamber Khel, and Nala Sourdandh, from June 1, 2022, to August 31, 2022. To conduct this study, the data was collected through questionnaires and interviews with local cow owners.

### 2.2 Survey through Questionnaire

Three sections of a questionnaire have been created

to collect data in the chosen area. Each section was further formulated to gather particular data. The questionnaire has already been verified and clarified as necessary. The first section of the survey asked questions on the Lumpy skin disease epidemic and mortality in five designated areas. Farmers who kept cattle in their houses were asked to fill out a questionnaire to gather the information for section one. The questions in section 2 pertain to the general knowledge and viewpoint of the community regarding the prevalent Lumpy skin disease in five selected regions. Data for section two was gathered from community members, social activists, and farmers who possess cattle. The third section describes the Lumpy skin disease condition in detail, including its signs and symptoms, transmission, detection, and treatment, as well as precautions, risk factors, and economic impact. The information for section three was gathered via interviews, a questionnaire, and input from veterinary experts, livestock veterinarians, researchers, veterinary assistants, and technicians. The gathered information has been compiled and evaluated.

### 2.3 Data Analysis

Questionnaires from reported cases (Total 2021) from five selected areas of tehsil Bara, district Khyber in Khyber Pakhtunkhwa were filled out and included in the study. Out of the total cases, 1853 were reported to be infected and 168 to be healthy. The percentage of the study data was arranged and analyzed through SPSS software.

## 3. RESULTS

The total recorded cases of cattle across all five areas of tehsil Bara, district Khyber, including those that were infected, normal, died, recovered, and in the recovery stage, are displayed in Table 1. There were a total of 580 cattle cases reported in the Speen Qabar area, of which 523 (90.17 %) were infected and 57 (9.58 %) were normal. Out of the total infected in the region of Speen Qabar, 32 (6.11 %) died, 209 (39.96 %) recovered, and 243 (51.48 %) were still in the recovery stage. A total of 496 cases of cows were reported in the Akakhel area, of which 472 (95.16 %) were infected and 24 (4.88 %) were normal cases. Among the total number of infected, 46 (9.74 %) died, 183 (38.77 %) recovered, and 243 (51.48 %) were still

in the recovery stage. In the Shlobar Quam area, the total reported cases of cows were 484 of which the infected were 466 (96.28 %) and 18 (3.71 %) were normal. Out of the total infected, the mortality rate was 59 (12.66 %), the recovered were 173 (37.12 %), and in the recovery stage 234 (50.21 %). The total number of cases reported in Bar Qambar Khel were 255, of which 220 (86.27 %) were infected and 35 (13.72 %) were normal. Out of the total infected, the mortality rate was 12 (5.67 %), recovered were 113 (53.30 %), and 87 (41.04 %) were reported to be in the recovery stage. The total recorded cases in the Nala Sourdandh area were 206, of which 172 (83.50 %) were infected and 34 (16.50 %) were normal. The mortality rate of the total infected was 8 (4.6 %), 88 (51.16 %) were recovered, and 76 (44.18 %) were in the recovery stage.

The highest infection rate recorded was 466 (96.28 %), followed by a mortality rate of 59 (12.66 %), and the lowest recovery rate recorded was 173 (37.12 %) in the area of Shlobar Quam. The lowest mortality rate reported from Nala Sourdandh was 8 (4.65 %), followed by Bar Qambar Khel at 113 (53.30 %), and the highest recovery rate from Bar Qambar Khel was 113 (53.30 %).

The general responses from the community in the tehsil Bara, district Khyber, expressed as a proportion of yes and no, are presented in Table 2. For the parameter listed in the questionnaire, the word "Yes" was used for a positive response, and the word "No" for a negative response. Prior to the disease outbreak, 100 % of respondents said that their cattle were not vaccinated for lumpy skin disease. This indicates that cows in particular places have not received the lumpy skin disease vaccine. Only 9 % of farmers segregated the sick animals, while 91 % of farmers did not separate the infected cows from the healthy ones. The majority of individuals lifted the dead cow bodies into the open area on the ground rather than burying them underneath. According to the respondents, 70 % agreed that the meat of infected animals is eatable, and 75 % of the total respondents said that milk is usable. Moreover, 60 % of the farmers wanted to treat the infected animals, while 40 % of the respondents did not want to treat the infected animals.

Out of the total respondents, 5 % believed the prevalence of lumpy skin disease among humans

and buffalo, while 95 % of respondents believed that neither humans nor buffalo can catch the disease. The majority of respondents (85 %) held the superstitious belief that the disease can be transmitted through the consumption of meat and milk. Treatment of the disease using technical approaches was only preferred by 10 % of the respondents, with 90 % preferring the traditional approach. Interestingly, 88 % of respondents responded with the lack of government funds for the eradication of the disease. Following an outbreak, vaccines have been made available in government hospitals for cow immunization. The efficacy of local vaccines was reported to be zero percent, while branded and multinational vaccines were found to have an efficacy rate of 95 % against Lumpy skin disease.

The clinical manifestations of Lumpy skin disease in tehsil Bara, district Khyber are presented in (Table 3). The incubation period of the Lumpy skin virus ranges from 4 to 12 days. The disease is characterized by the appearance of widespread nodules on the skin and swelling of superficial lymph nodes. Necrotic and ulcerative lesions may develop, which later convert into fibrotic lesions. In severe cases, ulcerative lesions may also appear in the mucous membranes of the mouth, esophagus, larynx, and trachea. Decreases in milk production in affected cows were reported. Other clinical manifestations include inflammation of the eye membrane, excessive salivation, nasal secretion, and rhinitis. The body temperature ranges from 103.40 °F to 106.00 °F. Secondary bacterial infections and infestation by maggots are common. The disease also causes severe emaciation and abnormal thinness of the skin, with cows assuming a recumbent position. Reluctance to move and depression was also observed. The recovery time reported in this study varied from one week up to 2 months, while the reported death rate varied: 55 % for heifers and 75 % for calves and pregnant cows.

The reported sources of transmission of the Lumpy skin disease virus in tehsil Bara, district Khyber are presented in Table 4. The disease is primarily transmitted through the illegal buying and selling of animals across borders, as well as the transportation of infected animals from one place to another. Vector-borne transmission is also reported, with insects such as mosquitoes, flies, and ticks, which play a significant role in spreading the disease

from infected to healthy animals. Other sources of transmission include direct contact, sharing of feed and water, the use of semen from infected breeding bulls, and blood contact. Wildlife and birds do not appear to play a role in the transmission of the virus. However, for the first time, crows have been reported to transmit the disease by snatching skin nodules from infected cows.

The reported tests and methods for the diagnosis of Lumpy skin disease in tehsil Bara, district Khyber are presented in Table 5. Complete blood profile (CBP) and blood serum chemistry analysis are effective tools for determining the infection status of animals. Preparation of histopathological slides is the best approach to estimate tissue lesions in infected parts of the skin, mouth, esophagus, and lungs of animals, as well as lesions observed in the postmortem. Advanced diagnostic techniques such as immunofluorescence assay, enzyme-linked immunosorbent assay (ELISA), PCR, RT-qPCR, and transmission and scanning electron microscopy can be used to identify the Lumpy skin disease virus.

The reported drugs and medicines for the treatment of Lumpy skin disease virus in tehsil Bara district Khyber are displayed in Table 6. In this study, no proper antiviral drugs or medicines have been reported against the Lumpy skin virus. For combating secondary infections of the skin and lungs, broad-spectrum antibiotics like sulfonamides (SN) and others have been reported. Dexamethasone has been reported for anti-inflammatory purposes, but its efficacy report shows a suppressive effect on the immune system. It is better to use other anti-inflammatory medicines available in the market. For insect repellent, antiseptic ointment has been suggested. Aspirin has been reported for antipyretic purposes to relieve temperature, and diclofenac gel has been reported for analgesic purposes to relieve pain. Gel was externally used on skin lesions. Multi-vitamin injections like AmiVicom, Metabolase Forte, and Minerals tablet 'White Gold' have been recommended for immunity boosting. Management of wounds with proper care and nursing has been reported to prevent better Lumpy skin disease. In this study, ethno-veterinary medicine, including oils of medicinal plants, especially turpentine oil, has been reported.

The reported control as well as a risk factor for Lumpy skin disease in tehsil Bara, district Khyber, are shown in Table 7. To control Lumpy skin disease, a prohibition on the importation and transportation of animals and their products from one place to another has been reported. It is reported to be important to ban unauthorized transboundary animal movements, separate sick animals from the other members of the herd, and avoid sharing feeding and drinking troughs. To control the disease, monitor the legalized trade, grazing, nomadic life, testing of imported animals, and quarantine. Vaccines have been reported as the most effective tool to control the disease. To control the disease, vaccines have been recommended for all cows of all ages (including pregnant cows) annually in early spring. We have observed live, attenuated vaccines commercially available against Lumpy skin disease. In this study, the use of disposable syringes and hygienic tools for cow surgery has been reported. Disease transmission has been reported through insect vectors (biting flies, mosquitoes, and ticks). It must be controlled and prevented in disease-outbreak areas. In the summer season, the insect population was greater in comparison to other months, so the disease was at its peak in the month of monsoon. It is reported that high temperatures and high humidity in the environment are favorable for vector populations, so avoid standing water to minimize insect populations. To control disease, farming practices such as avoiding contact with neighboring herds, stopping purchases from untrustworthy sources, using local and healthy bulls for breeding, raising awareness among farmers, and obtaining technical and expert support in relevant fields have been reported.

The total estimated loss in Pakistani rupees (PKRs) of dead cattle in the selected areas of tehsil Bara, district Khyber, are shown in Table 8. The total number of animals died in Speen Qaber, Akakhel, Shlobar Quam, Bar Qamber Khel, and Nala Sourdandh were 32, 46, 59, 12, and 8 respectively. The average price per cow in Speen Qaber and Akakhel is seventy-five thousand Pakistani rupees (PKR. 75000.00), in Shlobar Quam is seventy-two thousand Pakistani rupees (PKR.72000.00), in Bar Qamber Khel is seventy-three thousand Pakistani rupees (PKR. 73000.00), and in Nala Sourdandh

**Table 1.** Total number of reported cattle, infected, normal, died, recovered and in the recovery stage of Lumpy skin disease in the selected area of Tehsil Bara, District Khyber.

S. No.	Selected Areas	Total inspected cattle	Infected	Normal	Out of total infected Cattle		
					Died	Recovered	In recovery stage
1	Speen Qaber	580	523	57	32	209	282
	% age of cases		(90.17 %)	(9.82 %)	(6.11 %)	(39.96 %)	(53.91 %)
2	Akakhel	496	472	24	46	183	243
	% age of cases		(95.16 %)	(4.88 %)	(9.75 %)	(38.77 %)	(51.48 %)
3	Shlobar Quam	484	466	18	59	173	234
	% age of cases		(96.28 %)	(3.71 %)	(12.66 %)	(37.12 %)	(50.21 %)
4	Bar Qamber Khel	255	220	35	12	113	87
	% age of cases		(86.27 %)	(13.72 %)	(5.30 %)	(53.30 %)	(41.04 %)
5	Nala Sourdandh	206	172	34	8	88	76
	% age of cases		(83.50 %)	(16.50 %)	(4.65 %)	(51.16 %)	(44.18 %)

**Table 2.** General opinions from community respondents (% age of Yes and No) regarding the outbreak of Lumpy skin disease in Tehsil Bara, District Khyber.

S. No.	Parameter	Reported Respondent (% age) in	
		Yes	No
1	Pre-vaccination/ before outbreak	0	100
2	Isolation of infected cattle	09	91
3	Burial of dead bodies	01	99
4	Openly lifted dead cow bodies	99	01
5	Meat is eatable	70	30
6	Milk is useable	75	25
7	Treatment of cattle	60	40
8	Human got disease	05	95
9	Buffalo got diseased	05	95
10	People superstition opinion of disease transmission through meat and milk	85	15
12	Technical approach for treatment of disease	10	90
13	Government funds available	12	88
14	Vaccines available after outbreak	100	00
15	Efficacy of local vaccines	00	100
16	Efficacy of branded and Multi-national vaccines	95	05

**Table 3.** Reported signs and symptoms of Lumpy skin disease in Tehsil Bara, District Khyber.

<b>Organs</b>	<b>Reported Signs and Symptoms</b>
<b>Skin</b>	On skin wide spread lump/nodules were appeared and swelling of superficial lymph nodes were observed. Later on necrotic and ulcerative lesions converted into fibrotic. In severe cases, the ulcerative lesions may develop in mucous membranes of mouth, esophagus, larynx and trachea.
<b>Milk</b>	Milk production was decreased
<b>Eye</b>	Inflammation of eye membrane and lacrimation was observed.
<b>Pharyngeal Secretion</b>	Excessive salivation was observed.
<b>Fever</b>	Temperature was recorded from 103.40 to 106.00 °F body temperature.
<b>Nasal</b>	Increased nasal secretion and rhinitis was observed.
<b>Secondary infection</b>	Secondary bacterial infection and fly worm infestation (Maggots) was observed in some cases.
<b>Incubation</b>	Incubation period of Lumpy skin virus was observed from 4-12 days
<b>Movement</b>	Reluctance movement and some depression of cattle was observed.
<b>Emaciation</b>	Severe emaciation and abnormal thinness of skin was observed in this disease and even cow went into recombinant position.
<b>Feeding</b>	At last in morbidity position, they stop feeding and lack of appetite was observed.
<b>Death</b>	Death rate was reported variant, heifer death rate was 55 %, while calf and pregnant cow death rate was 75 %.
<b>Recovery time</b>	In this study, recovery time was reported variant (from one weak up to 2 months)

**Table 4.** Reported sources of transmission of Lumpy skin disease virus in Tehsil Bara, District Khyber.

<b>Source/Agent</b>	<b>Reported Source of Transmission</b>
<b>Trans Boundary Disease</b>	The disease was transmitted through illegal buying-selling across borders and through transportation of animals from one place to another place was reported.
<b>Vector Borne</b>	Insect vectors like mosquitoes, flies, and ticks have been observed to transmit disease from infected cows to healthy one.
<b>Other Sources</b>	Sources like direct contact, shared feed and water, semen of breeding bull and blood contact has been observed in transmission of this disease.
<b>Bird</b>	In bird only crow has been reported to transmit disease by snatching the skin nodules from infected cow.

**Table 5.** Reported tools and tests for virus diagnosis of Lumpy skin disease in Tehsil Bara, District Khyber.

<b>Test</b>	<b>Reported Diagnosis</b>
<b>Blood Samples</b>	Complete blood profile (CBP) and blood serum chemistry analysis are effective tools for determining the infection status of animals.
<b>Histopathological Slides</b>	Preparation of histopathological slides is the best approach to estimate tissue lesions in infected parts of the skin, mouth, esophagus, and lungs of animals, as well as lesions observed in postmortem.
<b>Advanced Virus Identification</b>	Advanced tests like Immunofluorescence Assay, Enzyme-Linked Immunosorbent Assay (ELISA) PCR, RT-qPCR, and transmission and scanning electron microscopy has been reported for virus identification.

**Table 6.** Reported drugs and medicines for the treatment of Lumpy skin disease in Tehsil Bara, District Khyber.

<b>Drugs/Medicines</b>	<b>Reported Effect of Medicines</b>
<b>Antiviral Drugs</b>	No proper antiviral drugs or medicines has been reported against lumpy skin disease virus.
<b>Antibiotic</b>	Broad-spectrum antibiotics like sulphonamide and others were reported effective against bacterial secondary of skin and lungs infection.
<b>Dexamethasone</b>	It was used as an anti-inflammatory medicine, but its efficacy report showing suppressive effect on the immunity.
<b>Antiseptic Ointment</b>	It was reported as the repellent of insects.
<b>Aspirin</b>	It was reported for antipyretics purpose to relieve temperature.
<b>Diclofenac gel</b>	It was used for analgesic purpose to relieve pain. Gel was externally used.
<b>Multi-Vitamins Injection and Minerals</b>	Injections like <i>AmiVicom</i> and <i>Metabolase Forte</i> , and tablets of mineral ‘White Gold’ are available in market used for immunity boosting.
<b>Management of Wounds</b>	Management of wounds with proper care and nursing was reported best approach to cure this disease.
<b>Ethno-veterinary Medicine</b>	Variant traditional treatments like using oil of medicinal plants especially turpentine oil was reported.

**Table 7.** Control and risk factor of Lumpy skin disease in Tehsil Bara, District Khyber.

<b>Control Parameter</b>	<b>Effective Measurement</b>
<b>Restriction of Animal Movement</b>	To control the disease, restriction of cattle importation and transportation and their products from one place to another and banned of unauthorized transboundary animal movements, separating sick animals from rest of the herd and avoid shared feeding and drinking troughs have been reported.
<b>Monitoring of Animals</b>	To control disease monitor legalized trade, grazing, nomadic life and testing of imported animals and quarantine.
<b>Vaccination</b>	To control disease, vaccination was reported as most effective tool and vaccines have been recommended for all cows of all ages (including pregnant cows) annually in early spring. We have observed live, attenuated vaccines commercially available “LSD Vaccines” against Lumpy skin disease in the market.
<b>Disposable Syringe</b>	For surgery use of disposable syringe and discarded used ones was reported.
<b>Vector</b>	Disease transmission has been reported through insect vectors (mosquitoes, ticks and biting flies). To prevent disease insects must be controlled in outbreak areas.
<b>Isolation Seasons</b>	For disease control isolation of infected cows from healthy one was strongly suggested. This disease was reported in summer season in which insect population are high. It is reported that weather of high temperature and humidity are suitable for insect growth, and avoid standing water in such weather to minimize insect population.
<b>Farming Practices</b>	To control disease create awareness among farmers, to avoid contact of neighbors herd, and do not purchase from untrusted sources and get support of technical and expert in relevant field, use scientific medical approach and avoid traditional approach of treatment.

**Table 8.** Total reported estimated death loss in Pakistani rupees (PKRs.) of cattle due to Lumpy skin disease in selected area of Tehsil Bara, District Khyber.

S. No.	Areas	Total Number of Died Cows	Average Price per Cow	Total Price (PKRs.)
1	Speen Qaber	32	75000	2400000
2	Akakhel	46	75000	3450000
3	Shlobar Quam	59	72000	4280000
4	Bar Qamber Khel	12	73000	876000
5	Nala Sourdands	8	76000	608000
<b>Gross total loss (PKRs.)</b>				<b>PKRs. 10738000</b>
				<b>10.741 Million</b>

is seventy-six thousand Pakistani rupees (PKR. 76000.00). The gross total loss in tehsil Bara district Khyber due to the death of cattle excluding the treatments and care costs is more than ten million Pakistani rupees (PKR. 10738000.00 equal to 10.738 Million).

#### 4. DISCUSSION

Lumpy skin disease (LSD) is an extremely contagious, eruptive, and economically important cattle disease. The morbidity rate ranges between 10 and 20 %, with mortality rates ranging between 1 and 5 % deemed acceptable [8]. In Pakistan, the first LSD case was identified in November 2022, in the Sindh district of Jamshoro. The disease was spread from Sindh to Punjab and parallel reached through the border of Dera Ismail Khan to Khyber Pakhtunkhwa province of Pakistan. In the district of Khyber, it was first observed in April 2022. The incidence of the disease has been spreading since early summer 2022 in district Khyber due to the illegal transportation of animals from India to Pakistan (District Khyber) on occasion of Eid al-Adha. Every year, Pakistani people sacrifice a huge number of animals on the occasion of the religious festival of Eid al-Adha. According to expert opinion, cattle numbers have increased tenfold in the district of Khyber due to their scarification on this holy occasion. It is a trans boundary disease, which can be introduced to a new area through the transportation of animals from one place to another and the illegal buying and selling of livestock across borders [22]. The transported animal (cow) brings the Lumpy skin disease virus to district Khyber.

The study was conducted in five selected areas when the disease was in the outbreak and ongoing in tehsil Bara. The total number of reported cases of dead cows in selected areas of Speen Qaber, Akakhel, Shlobar Quam, Bar Qamber Khel, and Nala Sourdandh were 32, 46, 59, 12, and 8 respectively. Among these areas, the highest infection (96.28 %), followed by the highest mortality of 59 (12.66 %), and the lowest recovery (37.1 %) have been reported from the Shlobar Quam area of Lumpy skin disease. As indicated by the results of this study, a high infection rate was followed by a high mortality rate. We can speculate that the highest mortality rate was caused by a lack of vaccination, openly lifted dead cow bodies and a lack of proper wound treatment and management. Before the outbreak of the disease vaccines were not available in these areas, while later on during the outbreak, vaccines have been available at Veterinary hospitals with the collaboration of the Government of Pakistan. The efficacy of local vaccines has been reported at zero percent, while the efficacy of branded and multinational vaccines has shown 95 % results. In this study, the reported mortality rate ranged from 4.65 % to 12.66 %. However, in literature, morbidity ranges between 5 % and 45 % (sometimes up to 100 %), and the mortality rate is generally less than 10 % (sometimes up to 40 %) [23]. In Greece, outbreak morbidity and mortality rates were reported to be 8.7 % and 0.4 % [17] and in Turkey to be 12.3 % and 6.4 % respectively [24]. The lowest mortality has been observed in Nala Sourdandh at 4.65 %, followed by Bar Qambar Khel at 5.30 %. In Bar Qamber Khel, people also benefited from the existence of a Civil Veterinary hospital, and this area had the highest recovery rate



of cattle from Lumpy skin disease.

In the current study, wide-spread lumps and nodules appeared on the skin, and swelling of superficial lymph nodes was observed after an incubation period of 4–12 days, which was also reported in previous studies [8, 25, 26]. The status of this disease ranges from acute to chronic in which necrotic and ulcerative skin lesions convert into fibrotic lesions. It was observed that in extreme cases, ulcerative lesions may form on other body parts, like the mucous membranes of the mouth, esophagus, larynx, and trachea [27, 28]. The lesion worsens with time and converts to a secondary bacterial infection and fly worm infestation (maggots) occurred [29]. According to Tuppurainen *et al.* the Lumpy skin disease causes decreased milk production, conjunctivitis that produces lacrimation (tear flow), pharyngeal secretion (excessive salivation), nasal discharge, loss of appetite, and fever (raised from 103.40 °F to 106.0 °F), which may last for 6 to 72 h or more and, in exceptional cases, up to 10 days [8]. According to the findings of this study, calves and pregnant cows experienced more typical and severe lesions 24 to 48 hours earlier than their adult counterparts [30]. Cows and bulls may experience temporary or permanent infertility problems [8]. Animal shows reluctance movement and some depression. In this study, significant emaciation (weakness) and abnormal skin thinness (caused by disease and inadequate nutrition) have been documented. Finally, the animal stops eating, loses interest in food, and even adopts a reclining posture. According to the findings of this study, the Lumpy skin disease in district Khyber resulted in the deaths of 55 % of heifers, while the death rate of calves and pregnant cows was 75 %. The pregnant cows and calves died at higher rates due to their weaker immunity compared to their adult counterparts.

The precise animal species affected by the Lumpy skin virus, as well as the specific clinical disease symptoms they display, have yet to be established in the literature. However, it is known that the disease is not zoonotic in nature [22], and transmission of the virus through the consumption of meat and milk is not a concern. While many individuals consume milk from infected animals, they tend to avoid consuming the meat due to superstitious beliefs that it may cause infection.

Conflicting reports exist in the literature regarding the infection of Asian water buffaloes with Lumpy skin disease; this study has only observed cattle to be affected, with no reports of the disease in buffalo [31]. Non-ruminant species are not susceptible to the virus [31], and wildlife does not appear to play a role in the epidemiology of the disease [32]. Transmission of the disease primarily occurs via insect vectors such as mosquitoes, flies, and ticks, with disease incidence peaking during the rainy season and summer months [32]. Other sources of transmission, such as direct contact, water, and feed, have also been reported in this study [33].

Studies have indicated that Lumpy skin disease (LSD) can be initially suspected based on case history and clinical presentation [34]. However, laboratory tests are necessary to confirm the diagnosis of the disease. Blood samples can be obtained from cows via jugular vein puncture in cases where the disease is epidemic. Samples should be taken on the 1<sup>st</sup> and 2<sup>nd</sup> days post-appearance of skin nodules, as well as between the 4<sup>th</sup> and 14<sup>th</sup> days [35]. Multiple samples should be collected for accurate diagnosis, including nodular lesions on the skin, scabs, crusts on the external coat, blood (7 to 21 days post-infection), ocular and nasal discharges, semen, and blood at least 7 days after infection [36-38]. For histopathological analysis, skin nodules from ulcerative lesions in affected animals should be surgically removed after local anesthesia and within the first week of clinical symptoms. Virus isolation can be performed on a biopsy sample collected during the post-mortem examination of skin nodules, lung lesions, or lymph nodes [25, 39].

Lumpy skin disease is a viral infection for which no effective antiviral drugs have been reported to date for a complete cure [22]. Nevertheless, field observations indicate that farmers need not panic as the disease is not fatal and can be treated successfully if proper care is taken at the right time. The disease is caused by a virus, and therefore, treatment is aimed at managing symptoms and enhancing the animal's immune response. After an incubation period of 4-12 days following primary viral infection, widespread nodules appear on the skin, which may worsen over time and become complicated by secondary infections [26]. Antibiotics, anti-histaminic, analgesic-antipyretics,

antiparasitic drugs, immunity boosters, and wound management are among the general groups of drugs recommended for treating the disease. Secondary bacterial infections of the skin, mouth, and lungs are common, and broad-spectrum antibiotics like sulphonamide are effective against them [39]. However, prolonged recovery may be required, especially if the animal's defense mechanism is weakened [18-20]. Recovery times reported in this study varied from one week to three months, depending on factors like age, breed, immunological response, and the production period of the animal [40]. Diclofenac gel is a good option for pain relief, while antiseptic ointment with fly-repellent properties is useful for managing wounds [8]. Dexamethasone is not recommended due to its immune suppressive effects, which can exacerbate the disease. Instead, multi-vitamin injections like Amivicom and Metabolase Forte, and mineral tablets like 'White Gold' are useful for boosting immunity [41, 42]. Traditional treatments using oil of medicinal plants like turpentine oil are also common in ethno-veterinary medicine. Proper care and nursing of the animal during the disease course are crucial for successful treatment.

The present study indicates that the Lumpy skin disease virus (LSDV) affects cattle of different breeds and is capable of surviving for extended periods both on and off animal hosts. LSDV is highly resilient to various chemical and physical agents and can survive for up to six months in shaded animal pens under favorable environmental conditions [43]. Additionally, LSDV can persist for approximately 33 days in necrotic skins and up to 18 days in lesions on air-dried hides at room temperature, as well as in moist environments, which offer protection against the sun rays [44]. The virus has been found in various bodily fluids, including nasal, lachrymal, saliva, sperm, pharyngeal secretions, and milk, where it can remain infectious for up to 22 days [6]. Environmental factors, such as high temperature, standing water, dunghills, grasslands, and high humidity, contribute to an increase in the vector population and therefore LSDV cases also increase [45]. In addition, contact with nearby herds, acquisition of animals from untrustworthy sources, use of a local breeding bull, and lack of regular observation are contributing factors to the spread of LSDV [46]. To prevent LSD, it is crucial to restrict the importation

and transportation of animals and their products from one place to another. Animal monitoring, such as grazing, trade, nomadic and transhumance farming, isolation of sick animals from the rest of the herd, regular testing, legal and unauthorized transboundary animal movements, quarantine, and separation of feeding troughs, can be helpful parameters for the prevention of this disease [47]. Vaccination is an important measure for disease prevention, and every animal should be vaccinated at least once a year, ideally in early spring. Animals over six months of age, including pregnant cows, should be vaccinated against LSD annually in early spring [21]. Commercially available live, attenuated vaccines are effective against LSD. During a disease outbreak, it is crucial to use one needle per animal to prevent the spread of the virus from sick to healthy animals. [6, 21, 43-47].

The economic and social impact of lumpy skin disease (LSD) on society and the economy is considerable, as recognized by the World Organization for Animal Health, which classifies it as a notifiable disease [42]. In particular, farmers may face major economic losses due to decreased milk production (ranging from 10 % to 85 %), infertility, abortion, inferior hide quality, and secondary infections. Mortality rates from LSD are generally low (ranging from 1 % to 5 %), but the direct economic burden on farmers can be significant, regardless of whether the infected animals are native or exotic [19]. In addition, there may be indirect economic consequences, such as restrictions on animal trade, immunization and treatment costs, quarantine expenses, and the need to maintain herd biosecurity [47]. These losses can result in significant financial loss for industries related to livestock and its byproducts, as well as for poor farmers who rely on livestock for their livelihoods. *Capripoxviruses*, which cause LSD, can also cause sheep-pox and goat-pox, which are economically significant diseases [47]. Moreover, given their ability to spread across regions, they pose a significant impediment to global trade and may even serve as an economic bioterrorism agent [3]. In the current study, conducted in tehsil Bara, it was found that the gross total loss due to LSD in three months, considering the death of untreated animals, was more than 10 million Pakistani rupees (PKR. 10.738 million).

## 5. CONCLUSION

Cattle and buffalo play a vital role in the global economy as they provide significant economic benefits. Lumpy skin disease (LSD) is an emerging disease that has a detrimental effect on livestock populations, which may lead to a decrease in livestock and product exports. Accurate diagnosis and timely treatment can significantly aid in the cure of the disease. Vaccination is currently considered the most effective tool in controlling the disease, but it should be combined with timely preventive measures and good management practices to prevent the disease from spreading to livestock. Since LSD is a transboundary disease, it is essential to quarantine, legalize, and restrict animal transportation across borders and their products, as it could negatively impact rural economies, if it spreads to new regions. Effective prevention measures include isolating infected animals and burying deceased ones. Previously, the disease was limited to African countries and a few other nations; however, it has gradually spread to Asian countries, including Pakistan. The government alone cannot combat this disease; it requires support from society and the private sector. To combat the disease, trained veterinarians and expert health workers are needed to diagnose and treat the disease in the field. Therefore, all stakeholders, including government, non-governmental organizations, and private and independent sectors, should work together to combat this harmful Lumpy skin disease.

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## 7. CONFLICT OF INTEREST

The authors confirmed that they have no conflict of interest.

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