Review Article

Lumpy Skin Disease: An unforeseen danger in India

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Abstract | In this manuscript, efforts have been made to gauge the unforeseen danger of Lumpy Skin Disease in India, which mainly affects cattle and buffaloes. India has the highest livestock population in the world, and this provides a significant economic contribution to small-scale farmers. The summer and monsoon months of 2022 witnessed a sudden spurge across 14 states and 1 union territory in India, with a spread spanning 251 districts and 43,759 epicenters. Around 2.4 million cattle were affected in India, and 0.11 million cattle succumbed to the disease. The 10 most affected states have been analyzed for mortality and morbidity. The mortality rate in different districts in India varied between 5% and 45%. The morbidity rate calculated is, however, lower and averages around 4.94% in the top ten most affected states of India. Rajasthan is the state with the highest morbidity, as this state has the highest cattle population in the world. The state of Punjab had the highest mortality rate of 10.15%. The affected states have run several vaccination drives, but 100% vaccination has not been achieved yet. The disease has subsided in the autumn and winter months, leading to callousness amongst farmers about getting their livestock vaccinated. Trends suggest that this disease could resurface in the summer of 2023 and could also spread across the nation, with the fear of becoming endemic. The virus can survive for months in dark enclosures. The main culprit behind the spread of the disease is indirect transmission via vector movement, which peaks during the summer and monsoon months. Direct transmission of the virus is found to be effectively low. Appropriate precautionary measures need to be implemented now to curb the re-emergence of the disease.

Keywords | Lumpy skin disease; Mortality rate; Morbidity rate; Vector transmission; Vaccination

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INTRODUCTION

Lumpy skin disease is a very contagious viral disease that is caused by the lumpy skin disease virus. This virus belongs to the *Capripoxvirus* genus (Hamdi et al., 2021) with the family *Poxviridae* and subfamily *Chordopoxvirniae*. The *Capripoxvirus* genus contains three species namely, the goatpox virus (GTPV) (Abutarbush, 2010), sheeppox virus (SPPV) (Bhanuprakash et al., 2006), and the lumpy skin disease virus infecting goat, sheep, and cattle respectively. The lumpy skin disease virus DNA is double-stranded and contains about 150-kilo base pairs of large sizes ranging between 230 to 260 nm (Stubbs et al., 2012) The disease is abbreviated as LSD. At times it is also named "*knopvelsiekte*", "*Neethling virus disease*", "*Pseudo-urticaria*", and "*exanthema nodularis bovis*" (Al-Salihi, 2014). LSD is a transboundary disease that is majorly vector-borne and a non-zoonotic disease (Namazi & Khodakaram Tafti, 2021) . It has a very limited host range and as per information, the disease is presently limited to domestic ruminants. Buffalo and cattle are the most susceptible hosts to LSD. The *Bos indicus* and *Bos taurus* cattle breeds and *Bubalus bulalis* buffalo breed are most prone to developing LSD. All the breeds and ages of cattle are affected, but calves and

lactating cattle are affected the most. Anthropod vectors are responsible for the spread of the disease (Lubinga et al., 2013). They include mosquitoes, ticks, and biting flies (Baldacchino et al., 2013). No natural infection of LSD is observed in sheep and goats, even when they are in close contact with infected buffaloes and cattle (Alemayehu et al., 2013). However, skin lesions (Namazi & Khodakaram Tafti, 2021) are observed in goats, sheep, impalas, giant gazelles, Arabian oryx, springbok, oryx, and giraffes upon experimental infection (Gupta et al., 2020).

This disease is indicated by the development of fever, swelling of lymph nodes, and skin nodules. The infected cattle are observed to have reduced milk production, abortions, and infertility (Abutarbush, 2010). This causes a lot of negative economic impact on livestock farmers as the economic value of the infected animal is affected. International trading of livestock is also severely affected.

The first case of the virus was reported in Zambia in the year 1929 (Abutarbush et al., 2015). Then, the disease spread to many northern and southern African countries. Thereafter, the disease spread to Yemen, Kuwait, Oman, and Israel. The disease is declared endemic in many African countries. According to OIE, the disease has now spread to many European (Beard, 2016) and Asian countries as well. Subsequently, China and Bangladesh have also reported cases of LSD (Uddin et al., n.d.). In the year 2019, India reported its first case of LSD. The reason for the spread of the disease to India is not very clear but it is believed that livestock and vector movement across the long non- porous international border shared with China and Bangladesh caused the transmission of the disease. The infectious nature and the severity of the repercussions of the disease are a big cause of concern for India, which has the highest livestock population in the world. A sudden spurt in cases was observed in India, especially in the summer and monsoon months. This is the time when vector movement is at its peak and thereby this triggered the sudden spread of the disease. Massive vaccination drives are initiated in all the affected states. The onset of autumn led to a sharp decrease in cases in India. It has previously been observed that the virus always subsides with a decrease in temperature and humidity as vector movement reduces drastically and the disease resurfaces with a rise in temperatures (Datten et al., 2023). There is a high probability for the re-emergence of the disease in India in the summer of 2023 and the disease could attain endemic status in the country. Thereby, precautionary measures should be taken by government authorities to prevent any kind of disaster or situation of chaos. India has developed an indigenous vaccine called Lumpi-ProVacInd for this virus which is to be commercialized in 2023.

The Methodology used for the review

In the current manuscript, an extensive literature survey has been done from several sources. These sources date back to the days when the virus was first notified to the present state situation in several counties, with a major focus on India. Various cited papers have been used regarding the data about the spread and containment of the disease. The main review of the spread of lumpy skin disease in India is performed by analyzing data provided by the website of the Ministry of Animal Husbandry and Dairying. The objective of the review is to anticipate the unforeseen danger of the spread of the disease in the country. This anticipation has been done based on several reports of resurfacing of the disease in different locations across the globe during the month of summer when the vector movement peaks. These reports have been presented in the different cited papers. Based on the reports and trajectory of the spread of the virus in India, the regional hotspots of the virus were identified. The sustainability and transmission pattern of the virus was probed. The clinical signs and diagnosis methods have been identified. Vaccination status and been stated and the need for complete vaccination has been outlined.

Geographical spread of the virus

LSD virus (LSDV) was observed for the first time in Zambia in the year 1929. Thereafter, the disease extensively spread to most of the African nations and subsequently to South-eastern Europe, West and Central Asia, and most recently in the year 2019 to South Asia, and China (Anwar et al., 2022; Lu et al., 2021). After the spread in African countries, the disease was reported in Lebanon, Turkey, Iran, Israel, Iraq, Jordan, and Saudi Arabia (Sameea Yousefi et al., 2017). Since the year 2015, the disease spread further to Azerbaijan, Russia, Armenia, Albania, Greece, Bulgaria, Serbia, Montenegro, and Kosovo (Namazi & Khodakaram Tafti, 2021). There exists a huge risk of spread of the disease in the entire Asia and Europe. The disease has been declared endemic by FAO in various nations across Africa, the Syrian Arab Republic, Saudi Arabia, Iraq, and Turkey. In South Asia, Bangladesh was affected in July 2019 and subsequently LSDV reached India a month after in August. The initial cases in India were reported in the states of Odisha and West-Bengal. The FAO pointed out that there exist long porous borders between Bangladesh, India, and Nepal and this leads to significant amount of both informal and bilateral animal trade specially buffaloes and cattle. These factors along with vector transmission across long borders between India, Bangladesh and Nepal led to the spread of the virus. The situation turned out to be a full-blown crisis in many states of India which home to the largest cattle population the world.

Sustainability of the virus

The LSDV can sustain for long durations under ambient conditions. The virus can persevere in dried skin scabs for 35 days (Mulatu & Feyisa, 2018). It can also be present in necrotic lumps for 33 days and in air-dried body coverings for 18 days. Sunlight can kill the virus and so can some lipid detergents. However, the virus has the capacity to persist for several months in dark enclosures such as feed storage areas and animal sheds. The virus can be inactivated when kept at 55^0C for 2 hours. The virus is found to be susceptible to acidic and highly alkaline pH. LSDV is also susceptible to several compounds such as chloroform, phenol, ether, ammonium compounds, iodine compounds, and formalin. The virus can even be retrieved from the skin nodules after a period of 10 years when kept at -80^0C. The virus can persist in the semen for 42 days post infection (Annandale et al., 2010).

Transmission of the Virus

The principal track of the spread of LSDV is through mechanical transmission by the vectors (Sprygin et al., 2019). It has been observed that in countries such as Egypt, Ethiopia, and Africa where LSD has been classified under the endemic category, the disease spread increased significantly with the commencement of seasonal rainfall and the summer season (Fa et al., 2011). During this time there is activity of the vectors peak to the highest levels. However, the number of affected cattle drops down significantly during the onset of the winter season. Despite the restricted movement of animals from Egypt, the infection spread across to Israel situated 200 km away. This spread was a result of the air movement of biting insects. During winter conditions or dry conditions, the virus-transmitting insect density is low and thereby the spread of LSDV is also low. This inherently confirms the role of vectors in spreading the virus.

The LSDV is transmitted via arthropods and to be particular through blood-sucking insects (Chihota et al., 2001). *Aedes natrionus* and *Culex mirificens* mosquitoes are mechanical transmitters of the disease (Lubinga, 2013). Ticks such as *Rhipicephalus appendiculatus*, *Amblyomma hebraeum*, and *Amblyomma spp*. are reservoirs and mechanical vectors of the virus. Some mechanical flies such as *Biomyia fasciata* and *Stomoxy calictrans* are also responsible for the mechanical transmission of the virus.

The virus may also be transmitted via contaminated water and feed and at a later stage through semen, nasal secretions, milk, blood, lachrymal secretions, and saliva and they serve as indirect sources of virus transmission. It can also be transmitted via the intrauterine route (Rouby & Aboulsoud, 2016) and the infection can also spread from the infected mother to the calf through milk and skin abrasions. There is no correlation between the infection rate and cattle density. This points to the fact that direct transmission is low, especially during the early stages of the disease. Field observations have indicated that transmission of the virus by direct route is scarce. Indirect transmission has a high probability of spreading the disease (Carn & Kitching, 1995). One other possible route of the spread of the virus is through iatrogenic mode when the same needle is used for mass vaccination of cattle. The needle can acquire the infection skin crusts or scabs. Thus, quarantining the cattle may not be an efficient method for controlling the spread of the virus as vector movement can aggravate the spread.

Clinical signs and diagnosis of the Virus

The period of incubation of the LSDV in natural conditions is generally around 2 to 5 weeks. However, under experimental conditions, the duration is between 7 to 14 days. LSD can take an acute form, subacute form, and chronic form (Amin et al., 2021). The clinical signs of LSD include lacrimation, fever, hypersalivation, and distinctive skin nodular eruptions. Initially, the cattle suffer from biphasic fever followed by the development of a couple of nodules. This is followed by weakness, ocular discharge, and a reduction in milk production. Thereafter, the nodules spread over the entire body of the cattle including eyelids, ears, tail, nasal canals, vulva, respiratory tract, and even the mouth (Rouby & Aboulsoud, 2016). Under acute conditions, hundreds of nodules can be developed. These nodules are quite firm and are raised above the surrounding skin. The healing time of these nodules or lesions is very slow. These lesions are painful and after a span of 2 to 3 weeks, the lesions become necrotic and harder (Bedeković et al., 2018). This causes a lot of discomfort and animals find difficulty in movement. After shedding the lesion, the hole may be created which in turn attracts the invasion of bacteria and flies. Even swelling of lymph nodes is also observed in cattle. Abortion may also occur during the acute stage of the infection. The disease also leads to infertility for several months in both male and female cattle. Secondary infections and repercussions such as mastitis and pneumonia delay the recovery path. The animals become enervated in a period of six months. This automatically reduces milk production as mouth lesions reduce feed intake by the cattle. Affected pregnant cattle are found to suffer abortions. Milk production of lactating cattle is reduced significantly. Infertility is also observed in infected cattle.

Observational symptoms mentioned above lead to a principal diagnosis of the disease. However, an exact diagnosis is ascertained by using conventional PCR, real-time PCR, electron microscopy, virus isolation, virus neutralization, serological techniques, and histopathology (Ireland & Binepal, 1998). Real-time PCR differentiates LSDV from GTPV and SPPV (Lamien et al., 2011). It is found that

molecular processes are more reliable and faster in comparison to other methods and techniques. Virus neutralization test though slow and costly is considered to be a very precise and valid test for LSDV.

Vaccination

It is extensively agreed that an effective method to cease the spread of LSDV is through vaccination (Douglass et al., 2021). Earlier, in disease-free nations and regions, the infected cattle were slaughtered. The restriction of the movement of cattle was also an effective plan in cases when the detection of the disease is done at a very early stage and control measures have been rightly adopted. However, if the disease gets unnoticed accidentally allowing vectors to get infected, it is impossible to eliminate the disease without undergoing vaccination. In nations with limited resources, the slaughter of infected and susceptible cattle is a waste of valuable resources. Also, it is effectively impossible to restrict cattle movement. *Capripoxvirus* genus exhibits cross-immunity among the members (Babiuk et al., 2008). Several companies have developed vaccines for LSD based on the different strains (Orlova et al., 2006). Vaccines based upon different strains such Neethling and SIS Neethling have been developed and are also being administered. Since *Capripoxvirus* genus comprises the GTPV, SPPV, and LSDV in the Poxviridae family, therefore cross-protection is provided by vaccines of SPPV and GTPV to LSDV (Ben-Gera et al., 2015). Since sheeppox and goatpox cases have not been reported in southern Africa, here simply attenuated LSD virus vaccines are used. In northern, and central Africa, and the Middle East, there exists an overlap between sheeppox, goatpox, and LSD. In these regions attenuated vaccines such as the Yugoslavian RM65 sheeppox strain, Romanian sheeppox strain, Gorgan sheeppox strain, and KSGP O-240 goatpox strain are used. As per the directions of OIE, various strains of the virus can be used as vaccine strains (Menasherow et al., 2014). The Gorgan sheeppox strain is widely used as LSD virus vaccination as it had negligible side effects. For the prevention and control of the disease, 100% vaccination should be mandatory. This is because the virus can survive in the environment for a very long time. New animals should be immunized before introducing them to the affected farm. Calves at the age of 3-4 months must be immunized. Their mothers should also be vaccinated. Breeding bulls and pregnant cows should be vaccinated annually.

India has developed a live attenuated vaccine named Lumpi-ProVacInd for LSD virus Lumpi-ProVacInd ICAR (*Agrinnovate India Limited (AgIn) Grants "Non-Exclusive Rights". for Commercial Production of "Lumpi-ProVacind" Jointly Developed by ICAR-NRC Equines and ICAR-IVRI to Biovet Pvt. Ltd* n.d.). It is made in collaboration with two organizations of the Indian Council of Agricultural Research. The two institutes are Indian Veterinary Research Institute, Bareilly, and National Equine Research Centre, Hisar. These two institutes started working on the vaccine in 2019 when the first case of LSD was detected in India. The vaccine was launched in August 2022 and will be commercialized in early 2023. 12,000 animals were administered this virus during the field trials. Prime Minister Narendra Modi and Agriculture Minister Narendra Singh Tomar launched the vaccine. Studies have pointed out that the vaccine has 100% efficacy and conforms with all the government standard protocols for vaccines and has no reported side effects. This vaccine is similar to the vaccines for rubella and tuberculosis. So far goatpox vaccine is administered to cattle in India. Some districts across different states in India have achieved 100% vaccination using the goatpox vaccination. Around 16 million cattle in India were vaccinated against the virus till September 2022.

Non- Zoonotic Infection

A large segment of scientists shares a common consensus that LSD does not have any apparent zoonotic link. This thereby rules out the transmission of this disease from animals to humans. The sudden spurt of this disease made people suspicious of the repercussions of LSD on human health due to direct or indirect contact. The vets prodded scientists to research to find any possible connection between LSD and human health. The cattle owners come under direct contact and the general population feeds on the milk provided by the cattle. The Indian Council for Medical Research (ICMR) carried out this study in India and found no proof about the LSD virus infected humans. Amongst the domestic animals, only cows, sheep, buffaloes, and goats are affected by the virus. Rumors about possible transmission of LSD in humans spread like wildfire on social platforms with people urging not to consume milk from infected cattle (Lumpy Skin Disease, n.d.). However, these rumors are baseless and should be strictly banned from spreading by government authorities.

Worst Hit States in India

According to the data from the Ministry of Fisheries, Animal Husbandry, and Dairying, the LSD has spread in 251 districts across 14 states and 1 Union Territory (UT). It has affected 24 lac animals till November 2. The top 10 worst-hit states are Rajasthan, Maharashtra, Punjab, Gujarat, Uttar Pradesh, Himachal Pradesh, Haryana, Jammu and Kashmir, Uttarakhand, and Madya Pradesh ("Lumpy Skin Disease," 2022). The disease has also spread across Goa, West Bengal, Andhra Pradesh, Delhi, and Bihar. Figure 1 depicts the affected states in India. Red-colored states are severely affected with cattle deaths above 5000 and 6 states fall in this category. Moderately affected states with cattle deaths less than 5000 and greater than 290 are depicted in yellow color and 4 states fall in this category.

Mildly affected states having cattle deaths of less than 290 are depicted in green color.

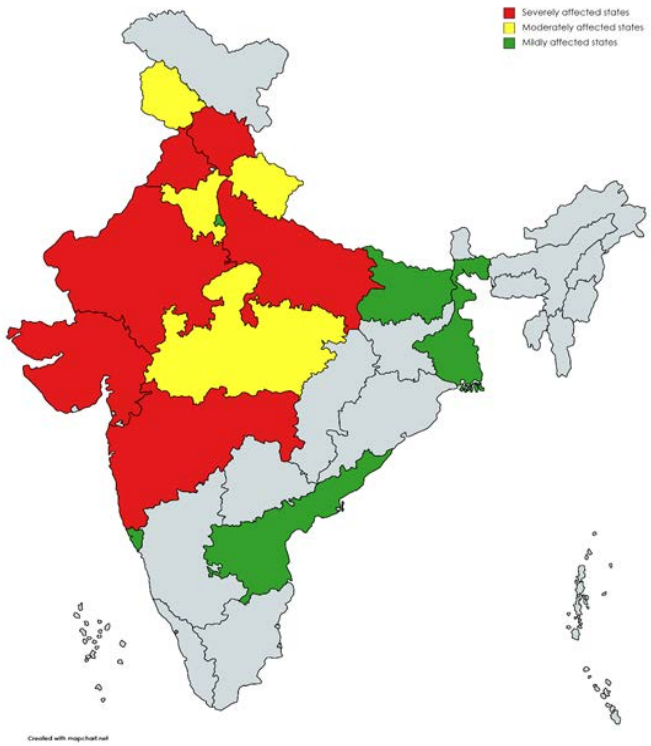

Figure 1: State-wise geographic domain of LSD virus deaths in India. Red states are severely affected with cattle deaths greater than 5000. Yellow states are moderately affected with cattle deaths less than 5000 and greater than 290. Green states have cases less than 290.

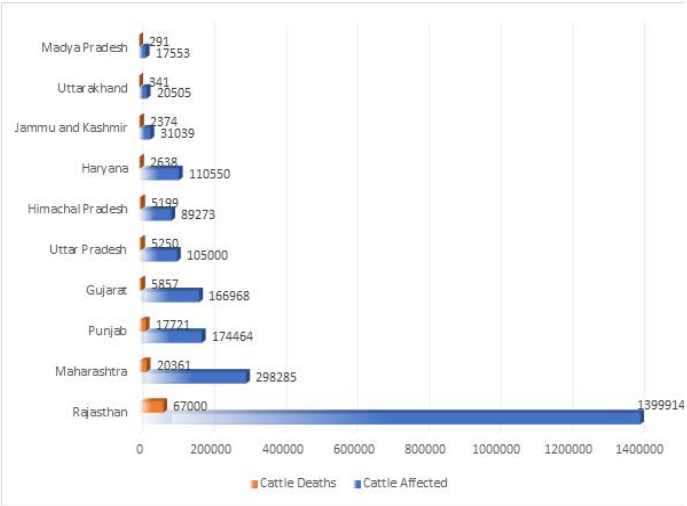

Figure 2: Chart depicting cattle affecting and cattle deaths in the top 10 most affected states in India

There were around 43,759 epicenters across these states and UT. 36 million cattle were susceptible to LSDV in these states. Approximately half of the cattle affected by LSD have recovered. The number of cattle affected in Rajasthan due to LSD is around 1.39 million and cattle death was around 67,000. Maharashtra reported around 0.298 million cases and around 20,300 cattle deaths were reported. Punjab witnessed around 0.174 million cases with cattle deaths of around 18000. This was followed by Gujarat reporting around 0.166 million cases and around 6000 cattle deaths. Around 0.05 million cases were reported from Uttar Pradesh with 5250 cattle deaths. The details of affected cattle and cattle deaths in the top 10 most affected states are presented in Figure 2.

Morbidity and mortality rates

It has been observed that the mortality rate of LSDV is far less as compared to the morbidity rates (Abutarbush et al., 2015). This is indicative of the fact that disease is cured in due period and the death rate is comparatively low. The severity of this disease is dependent on several entities such as the production period, immunity, breed, and age. The morbidity rate varies from region to region, and it varies between 5% to 45% and at times even to 100%. The mortality rate is often under 10%, however, cases have been reported when it can even go up to 40%. Turkey reported 12.3% morbidity and 6.4% mortality rate (Şevik & Doğan, 2017) . Greece reported 8.7% and 0.4% morbidity and mortality rates respectively (Tasioudi et al., 2016). The morbidity rate in India varied between 2 to 45% in different districts and the mortality reached 15% in some western districts of the country with Rajasthan being the most affected state. The mortality rates in the 10 most affected states are mentioned in Table 1 and their average stands at 4.94%. The total mortality rate in India is 4.58%. The morbidity rate is highest in Punjab (10.15%) and lowest in Madhya Pradesh (1.6%).

Table 1: Mortality rate of 10 most affected states in India

S. No	State	Mortality Rate
1.	Madhya Pradesh	1.6%
2.	Uttarakhand	1.66%
3.	Jammu and Kashmir	7.65%
4.	Haryana	2.39%
5.	Himachal Pradesh	5.82%
6.	Uttar Pradesh	5%
7.	Gujarat	3.5%
8.	Punjab	10.15%
9.	Maharashtra	6.82%
10.	Rajasthan	4.78%
	Average	4.94%

Economic Impact of Lumpy Skin Disease in India

Lumpy skin disease virus has infected around 2.4 million animals in India and has also caused 0.11 million causalities amongst cattle. LSD has roughly led to a direct loss of Rs 500 crore. India has the largest cattle population

in the world, leading it to be the largest milk producer in the world. Farming livestock is the primary source of income for most of India's poor farmers, specifically in arid and semi-arid geographical domains. This sector contributes to about 4.35 % of the total agricultural income of India. Marginal and small farmers have a greater share of livestock in comparison to middle-class and rich farmers. Livestock farming is a kind of insurance as it is more reliable than crops. The livelihood of a large population of farmers is inherently dependent upon cattle. The spread of the virus has in turn severely jolted the economies of these farmers (Tuppurainen et al., n.d.). Several rumors made rounds across social media urging people not to consume milk for a few days because of the spread of the lumpy skin disease virus (Lumpy Skin Disease: Viral Cattle Disease Sends Rumours Flying in India - BBC News, n.d.). As a result, dairy farmers had to bear losses. Cases were reported where people threw away milk causing further economic stress to the farmers. The dairy farmers were already under strain because of the loss of cattle and low production of milk and these rumors aggravated the situation furthermore. Google search trends regarding the safety of milk from LSD-affected cattle increased by 5000%.

The farmers in the state of Rajasthan were affected the most as this state has the highest cattle population in the country amounting to 56 million. For indigenous cattle, the loss in milk production amounted to between 26-42%, and exotic breeds such as Holstein- Friesian reported a milk production loss of around 50%. The sale value of the affected cattle and the value of their leather also reduced drastically. Furthermore, indirect losses from trading restrictions caused further economic impact. Trading restrictions prohibited the export of dairy products, hides, live animals, and meat products. The estimated indirect loss due to LSD is estimated to be around Rs 2000 crore. This loss amount is accounted for by several factors such as loss in milk production by the recovered cattle, reduction of body mass, infertility, abortions, conception reduction, and trading losses.

Prevention and Control of LSD

LSD has spread at an unprecedented rate to several countries. The possible reason for this expansion is because of poverty in the farming sectors. There is a lot of illegal and legal trading of cattle apart from vector movement. The most effective tool to curb the spread is vaccination. Both heterologous and homologous live attenuated vaccines can be used against LSD (Şevik et al., 2016). Restriction of movement of cattle, quarantining, and culling the infected cattle can control the spread, but to a very limited extent. The treatment of this virus is targeted toward preventing other secondary bacterial infections by using various combinations of anti-inflammatory, antimicrobials, and anti-septic solutions. Risk factors should be taken into consideration while planning out the control action points. The cattle owners and veterinarians should be educated so that they can perform timely diagnoses of the cases and thus control the spread of the disease. Disinfection and cleaning of the premises should be done regularly to control the spread of the disease. During the eruption of LSD, the carcasses should be disposed of properly along with undertaking insect control measures. Stringent restrictions on the import of cattle, hides, semen (Irons et al., 2005), and carcasses from endemic regions must be implemented in regions that are free of the disease.

Most of the accessible commercial vaccines for LSDV are live attenuated vaccines. The vaccinated livestock have reported developing cutaneous nodules upon exposure to the virus, but a greater number of cases was observed for the unvaccinated flock. Most of these live attenuated vaccines are cheap and provide satisfactory protection via the annual programs for vaccination. The live attenuated vaccines provide sturdy and long-term immunity and are efficient in controlling the spread of the disease. There are however some side effects such as skin lesions and local inflammation (Brenner et al., 2009). In comparison, the inactivated LSD vaccines are costly and do not provide long-term immunity. However, they are safe and therefore these vaccines can be combined with antigens to form polyvalent vaccines which can be used in countries that are free from the disease (Carn et al., 1994). The naturally infected cattle become worse when upon vaccination by the live vaccine. Also, there is a risk of co-infection if the live strain virus is combined with the wild strain virus (Rao et al., 2022). These live vaccines are not recommended in countries free from the disease.

India needs to boost the vaccination program as the possibility of the re-occurrence of the disease in India in the summer of 2023 is very high. The commercialization of indigenous vaccines in India can help in achieving 100% vaccination in the country and that too at low costs.

CONCLUSIONS

In the end, it can be concluded that there is a looming fear of the spread of LSD in the summer of 2023 in India unless timely appropriate remedial measures are taken by livestock farmers and government authorities. LSD spread pattern has indicated that the virus subsides during the winter months and resurfaces back in the summer. LSD caused an approximate Rs 500 crore loss in India in the year 2022 and poor farmers were affected the most. Livestock farming contributes around 4.35% of the total agricultural income. Milk production was reduced significantly due to the disease, and it also led to abortions and infertility. This,

thus led to a decrease in the market value of the cattle.

14 states and 1 Union Territory in India were affected at different scales. Around 2.4 million cattle were affected in India and casualties mounted to 0.11 million. Rajasthan, Maharashtra, Punjab, Gujarat, Uttar Pradesh, and Himachal Pradesh were the most affected states with cattle deaths exceeding 5000 in each state. The disease-free states are very susceptible to getting affected in the future. Indirect transmission via vector movement is a major cause of transmission and even direct transmission during later stages can occur because of cattle movement and trading. Precautionary measures should be taken at present, else the disease could turn into endemic as India has the largest livestock in the world. The morbidity percentage varies between 5% to 45% in different districts of the country and at times even reaches 100%. The mortality rates in the top 10 affected states have been calculated. It is highest in the state of Punjab and stands at 10.5%. The average mortality rate of these states is 4.94% and the national mortality rate is slightly lower at 4.58%.

Vaccination seems to be the most effective tool to curb the spread of this disease. This includes immunization of new animals before introducing them to the affected farm. Calves and mothers should also be immunized timely. Pregnant cows and breeding bulls should be vaccinated annually. The virus is non-zoonotic and thus cannot be transmitted to humans. Live attenuated vaccines based upon different strains and even inactivated LSD are available in the market. Live vaccines are sturdy and provide long-term immunity, but they have some side effects as well. Inactivated vaccines are safe, but they do not provide long-term immunity. In the year 2022 goatpox vaccine was used for immunization as it provided cross-protection against LSD. Its efficacy is close to 70%. However, India has developed its indigenous vaccine named Lumpi-ProVacInd, which will be commercialized in 2023. This vaccine is reported to have 100% efficacy and meets all government standards.

STATEMENTS OF DECLARATIONS

The author declares that there exist no known competing financial and personal relationships that could have appeared to influence the work reported in this paper.
The author declares that there is no potential conflict of interest to disclose.
This article does not contain any studies involving animals performed by the author.
This article does not contain any studies involving human participants performed by the author.
The author did not receive support from any organization for the submitted work.

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CONFLICT OF INTEREST

The author declares that there is no potential conflict of interest to declare.

NOVELTY STATEMENT

The manuscript presents a novel assessment of the possible large scale spread of LSD virus in India in the near future.

AUTHOR CONTRIBUTION

The author is the sole contributor to the entire manuscript and has done all the work.

DATA AVAILABILITY

There is no data to share for this manuscript.

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