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THE OUTBREAK OF LUMPY SKIN DISEASE IN SOUTH ASIA: A COMPREHENSIVE REVIEW

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ABSTRACT

Background: Lumpy Skin Disease (LSD) is a highly contagious viral illness affecting cattle, characterized by cutaneous nodules and systemic consequences. While traditionally prevalent in sub-Saharan Africa, recent occurrences in Egypt and Israel have raised concerns. The disease's transmission dynamics and impact in Southeast Asia, particularly its emergence in 2020, are the focus of this study.

Methods: Utilizing data from the World Animal Health Information System (WAHIS), a project of the World Organization for Animal Health (WOH), this study examines LSD outbreaks in Southeast Asia between October 2020 and October 2021. Descriptive statistics, illness maps, clustering, and epidemiological curves were employed to analyze the spread of the disease.

Results: During the studied period, 866 LSD outbreaks were documented across Southeast Asian nations, involving 1,758,923 sensitive cattle, 93,465 cases, and 5,936 fatalities. Livestock were also affected (1,117 cases). The epidemic displayed rapid dissemination, with four significant peaks observed in Thailand and Vietnam. The Thai region emerged as the apparent epicenter, raising questions about potential reporting bias or underreporting by other Southeast Asian countries.

Epidemiological Groups: The study identified three distinct epidemic groups, with the Thai region serving as the epicenter. High disease and mortality rates were particularly noted in Thailand, Vietnam, and Cambodia, contributing to the widespread impact of the epidemic.

Conclusion: This research underscores the swift spread of LSD in Southeast Asia, with Thailand and Vietnam experiencing significant peaks. The identification of the Thai region as the epicenter raises concerns about reporting consistency among countries. The study provides valuable insights into the epidemiological patterns of LSD transmission in the region, highlighting the need for collaborative efforts to manage and control the disease effectively.

Keywords: Epizootic Form, Cutaneous skin disease, Lumpy Skin Disease, Contagious, Epidemic, South Asia, cattle, LSD, LSDV

INTRODUCTION:

The lumpy skin disease (LSD) is caused by a virus called LSD virus (LSDV.. The most frequent way to get the disease is via direct contact with the secretions of other afflicted animals (Beard, 2016; Tuppurainen et al., 2017), other researchers. According to (F. Davies, 1991) research, substantial clinical symptoms may be brought on by secondary infections that are brought on by a broad range of pathogens, such as bacteria, viruses, and myiasis (Gupta et al., 2020; Ratyotha et al., 2022; Roche et al., 2021; Tuppurainen et al., 2017). These kinds of infections may cause wound lesions to create necrotic tissue and scarring, both of which can bring on significant clinical symptoms. Wound lesions can also be caused by scarring. According to (Spickler, 2008), the incidence of LSD in the endemic zone may range anywhere from 1% to 2% to as high as 80% to 90% depending on the circumstances. This range of possibility exists because the prevalence of LSD in the endemic zone is very variable. The relatively low mortality rate that may be induced by LSD may be accounted for by variations in host susceptibility, which may explain for variations in fatality rates. These variations in host susceptibility include strain, age, and the immunological response of the host. It was in Zambia in 1929 that the first incidence of LSD was recorded; from there, the illness spread across the rest of South Africa, with sporadic outbreaks also happening in other regions of the globe (F. G. Davies, 1991). This illness is currently only prevalent over the continent of Africa at this moment. It does not exist on any other continent. After outbreaks that took place in Europe and the Middle East in the year 1990, the disease that is often referred to as "lumpy skin" recently made its way to Asia between the years of 1988 and 1989 (Abdulqa et al., 2016). The illness was identified for the first time in 2019 in South Asia, and by the year 2020, it had rapidly spread over the whole of Southeast Asia (Roche et al., 2021). Infection with the LSDV has the potential to have a detrimental impact on the economic activities of ruminants, particularly cattle, in addition to having a negative impact on the general state of health of the ruminants.

According to research conducted by (Weiss, 1968), the illness may strike animals of any age or breed; however, young cattle, underweight cattle, cattle in peak lactation, and animals with impaired immune systems are the most likely to be affected by it. Although the illness may strike animals of any age or type, it is more often seen in young cattle. This is despite the fact that the sickness can afflict animals of any age or breed. Despite the fact that mortality rates linked with the illness are often low, on average ranging from 1-3 percent, the frequency of morbidity is considerable, averaging between 5 and 45 percent (Tuppurainen et al., 2013). This condition is distinguished by the presence of confined cutaneous nodules that range in size from two millimeters to six centimeters in diameter (Tageldin et al., 2014). Nodules like this may often be seen on the back, neck, legs, and tail of the animal. According to the findings of a study that was carried out by (Tuppurainen & Oura, 2012), clinically ill animals often exhibit signs such as fever, swollen lymph nodes, depression, decreased milk production, and miscarriage. Necrotic skin lesions, scabs, and bleeding are the most prevalent locations in which LSDV may be discovered (Namazi & Khodakaram Tafti, 2021). According to research by (Namazi & Khodakaram Tafti, 2021), the virus may survive in the environment for up to 35 days. Increased outbreaks and case counts occur throughout the summer and during rainy seasons, when there are lots of vector species, which implies that vector transmission is mostly responsible for viral dispersion (Sprygin et al., 2018; Sprygin et al., 2019). According to studies from China, India, Bangladesh, and Nepal (Koirala et al., 2022), the LSDV has lately increased across Asia, despite the fact that these control measures have been put into place in endemic places (Koirala et al., 2022). Despite the fact that LSDV has been rapidly expanding throughout Asia as of late, this remains the case. After then, it was determined, in October of 2020, that the first LSD epidemic in Southeast Asia had taken place in the Huu Lung District of Vietnam, which is situated in the Lang Son Province (Tran et al., 2021). In the years 2020 and 2021, the epidemic extended to a further five nations in Southeast Asia. There is very little information accessible on the present state of the drug in Southeast Asia since it was just found relatively recently. This is the primary reason why there is so little information. In light of the scope of the epidemic and the paucity of information on it, it is very necessary to carry out study on the epidemiological patterns in Southeast Asia. (Molla et al., 2017; Tuppurainen et al., 2017) According to the findings of certain studies, there are a variety of issues that

might create a significant financial strain on farmers. A drop in milk output, restrictions on commerce, and increased expenses for treatment and prevention are some of the causes that contribute to this problem.

The Causative agent

The condition characterized by lumpy skin is caused by a virus that is a member of the genus Capripoxvirus. Poxviridae is the family that contains Capripoxvirus. The sheep and goat poxviruses have a considerable antigenic affinity with the lumpy skin disease virus (LSDV), as stated by Woods (Al-Salihi, 2014; Woods, 1988). Even though each of these viruses have a distinct collection of characteristics that set it apart from the others traditional serological testing is unable to differentiate between them. This is the case despite the fact that each of these viruses has its own unique set of characteristics. After being exposed to temperatures of either 55 or 65 °C for a period of thirty minutes, LSDV will become susceptible to infection. This vulnerability will allow the virus to be infected. It is possible to remove it from skin nodules and keep it frozen at a temperature of -80 °C in a freezer for a period of ten years. It is possible to store possibly contaminated tissue culture fluid for a period of time equivalent to six months in a refrigerator set at a temperature of four degrees Celsius. The virus is able to live in situations with pH values ranging from highly acidic to extremely alkaline. It can even live in conditions that are neutral. On the other hand, there is no discernible drop in titre after five days if the temperature is kept at 37 °C during the procedure, and the pH is kept between 6.6 and 8.6. Both of these conditions must be met. LSDV has the potential to contaminate up to twenty percent of ether, one percent of chloroform, one percent of formalin, as well as a variety of other detergents, including sodium dodecyl sulfate. at addition to this, it is susceptible to the destructive effects of iodine compounds at a dilution of 1:33, Virkon at a concentration of 2%, phenol at a concentration of 2% for 15 minutes, sodium hypochlorite at concentrations ranging from 2-4 percent, and quaternary ammonium compounds at a concentration of 0.5% (Al-Salihi, 2014). It is surprising that the LSDV can survive at room temperature for such a long period of time without losing its viability, especially in scabs that have gotten dry over time. The procedure of turning LSDV inactive is a challenging undertaking to do. It is able to live in necrotic skin nodules for up to 33 days, in dehydrated crusts for up to 35 days, and in air-dried hides for at least 18 days. It is resistant to the wear and tear that the elements may inflict for an extraordinarily extended period of time. The virus is vulnerable to being killed by sunlight and cleaning detergents that include lipid solvents. However, if the temperature is maintained low enough, it may flourish for many months in shady regions with low temperatures, such as dirty animal shelters (Tulman et al., 2001). The whole genetic sequence of the LSDV has been investigated, and its contents have been fully comprehended. The LSDV genome is 151 kilobase pairs long, and it is hypothesized that it contains 156 genes. The length of the genome is expressed in base pairs. There is a possibility that the main coding region of the gene contains inverted terminal repeats totaling 2.4 kilobase pairs on each side. These two repetitions are exactly the same. On the other hand, there are a total of 146 genes that are conserved among chordopoxviruses that belong to different genera. These genes are the ones that are responsible for the production of proteins that are involved in a wide variety of processes. Some of these processes include: the structure and assembly of virion; the metabolism of nucleotides; the replication of DNA; the processing of proteins; transcription and the synthesis of mRNA; it has its own unique collection of genes that are responsible for determining which hosts it may infect and how dangerous the infection will be. Despite the fact that the LSDV is a member of the Chordopoxvirinae family, this is nonetheless the case. A substantial amount of study on capripoxviruses has led to the publishing of the virus's whole genome sequence. This research was carried out as a result of its discovery in the 1970s. Some examples of capripoxviruses are LSDV (Tulman et al., 2001), sheep poxvirus (Tulman et al., 2002), and goat poxvirus (Tulman et al., 2002).

History of lumpy skin disease

The clinical signs of LSD were originally described by Morris in 1931, while he was living in what was then called Northern Rhodesia but is now known as Zambia. During this period, Zambia was still often referred to by its old name. This was the very first time that anything even somewhat similar

has been done in the past. In the beginning, it was thought that the signs and symptoms of LSD were the result of either a poisoning or an allergy to the stings of insects. On the other hand, this idea was later disproved by the evidence. On the other hand, both of these hypotheses have been shown to be incorrect. Between the years 1943 and 1945, patients from Botswana, Zimbabwe, and the Republic of South Africa all presented with the exact identical clinical symptoms. It wasn't until after these outbreaks that scientists were able to get a good look at how the disease traveled that they were able to properly grasp how contagious it was (Al-Salihi, 2014).

There was a total loss of eight million cattle in South Africa as a direct result of the LSD pandemic that raced across that country. The illness continued to expand until 1949 (Diesel, 1949) which resulted in the waste of vast amounts of money as a direct consequence of the disease's spread. In 1957, the psychoactive chemical LSD was discovered for the very first time in the East African country Kenya. Ali and Obeid state that the illness was first reported in the year 1972 in Sudan, and that it was first documented in West Africa in the year 1974 (Ali & Obeid, 1977). These two dates are derived from the data that was found in Ali and Obeid. According to Davies, the year 1983 was when the organization first started making preparations for its expansion into Somalia (F. Davies, 1991).

The illness has continued to spread over the great majority of the African continent in a succession of epizootics, as was previously observed by Davies and House (F. G. Davies, 1991). Several sources claim that Senegal, Mozambique, and Mauritius were among the nations that had users of LSD in the year 2001. Despite the fact that these prophylactic measures have been implemented in places where the sickness is prevalent, the LSDV has recently been discovered in China, India, Bangladesh, and Nepal (Das et al., 2021). This occurs in spite of the fact that these locations have put the preventative measures into effect. Following this event, the first instance of an LSD pandemic in Southeast Asia was documented in the month of October 2020 in the country of Vietnam (specifically in the Huu Lung District of the Lang Son Province) (Wilhelm & Ward, 2023).

Prevalence of LSD in Southeast Asia

In the years 2019–2020, it was discovered that a condition referred to as lumpy skin was making its way from Southeast Asia (SEA) to South Asia. The World Organization for Animal Health, which is more popularly known as the Office International des Epizooties or OIE, made the discovery that the disease was present in the northern region of Vietnam for the very first time in the year 2020 and publicized their findings. This was the very first instance of the disease being discovered at that location. Isolating the virus, establishing its identification, and doing research on it were all objectives that our team was able to accomplish thanks to their hard work. This leads one to the conclusion that the illness was carried over the border between China and Vietnam, where it was then transmitted across all 27 of the country's provinces. It is likely that the illness was spread over the China–Vietnam border since the virus had a striking resemblance to a strain that was prevalent in Russia in 2017 and in China in 2019. This is because the virus in question bore a striking resemblance to one that was rather common in Russia in the year 2017. Following that, individuals in other Southeast Asian nations, such as Laos, Cambodia, Thailand, and Myanmar began taking LSD (Ratyotha et al., 2022). There have been reports of the sickness in Malaysia; however, in some of the instances, a diagnosis of LSD has not been proven (Das et al., 2021). In some of the cases, there have been reports of the illness in Malaysia. In addition, there have been reports of the ailment in Singapore, which is where it is believed to have originated. In addition to this, there have been reports that individuals in Singapore have contracted the ailment. Investigators have thrown the finger at LSD as the chemical that caused the disease in some of the cases that have been examined so far. A key proclamation about the prevention and control of LSD was published when it was verified that LSD had not been detected in either Indonesia or the Philippines. It was noteworthy that this proclamation claimed that LSD had not been identified in any nation since it showed that it had been eradicated. It has not been possible for either Indonesia or the Philippines to provide any evidence that LSD may be found in their respective nations. By the time April 2021 comes around, at least 65 of Thailand's 76 provinces will have reported sick animals to the World Organisation for Animal Health (OIE). The implementation of disease preventive and control techniques by the Thai government, such as limiting the movement

of animals coming from endemic areas and vaccination cattle and buffalo (Roche et al., 2021), resulted in a significant reduction in the morbidity rate of cattle in Thailand in the year 2022. As a consequence of this, it is necessary to immediately complete the processes of controlling the vector population, isolating the contaminated zone, and placing the afflicted area under quarantine (Das et al., 2021). The initial finding was found in the upper region of Vietnam in 2020 by the Office International des Epizooties, generally known as the OIE or the World Organization for Animal Health. The virus was found, identified, and studied and was similar to those that were endemic in China in 2019 and Russia in 2017, indicating that the illness was spread throughout the country's 27 provinces over the China-Vietnam border (Ratyotha et al., 2022; Roche et al., 2021). Following that, LSD spread to nearby Southeast Asian countries like Laos, Cambodia, Thailand, and Myanmar (Al-Salihi, 2014). Not all cases of the sickness have been definitively diagnosed as LSD, despite the fact that it has been documented in Malaysia (Al-Salihi, 2014). Despite the fact that LSD has not been found in either Indonesia or the Philippines, crucial notification regarding LSD prevention and control was raised (Al-Salihi, 2014; Kumar et al., 2018). The OIE had reports of sick animals by April 2021 from at least 65 of Thailand's 76 Provinces. Due to the Thai government's preventative and control actions, which include not transporting animals from endemic areas and immunizing cattle and buffalo , the morbidity rate for cattle in Thailand significantly decreased in 2022.

LUMPY SKIN DISEASE IN INDIA AND BANGLADESH:

In the month of July 2019, it was determined that a disease that affected a large number of people began in South Asia. This was the case when an epidemic was uncovered in Bangladesh. In August of 2019, it was found in China, West Bengal, and Odisha, in addition to India, which has the biggest cattle population in the world (Mathivanan, E., Raju, K., & Murugan, R. 2023).. India is the country with the highest cow population in the world. In the year 1929, the sickness was found for the very first time in Zambia; nevertheless, since that time, it has spread to many other nations all over the world. In the month of July, an inquiry that was carried out by the Food and Agriculture Organization indicated that Bangladesh had reported a sickness epidemic. It was found in China and India, which combined have the biggest populations of cattle in the world, and these are the countries where the discovery was made (H, 2022). After making its debut in the Chattogram region in the Southeast in July 2019, the virus swiftly proceeded to spread across the rest of the nation after making its first appearance there. In Bangladesh, which has a large cow population and a high incidence of LSD, the disease is now regarded as one of the most economically significant developing livestock disorders. This is due to the fact that LSD is so common in Bangladesh (Hasib et al., 2021).

The present epidemic in India did not begin until May 2, 2022, even though it was first detected in India in the year 2019 in Odisha. In the month of August 2022, the state of Gujarat reported the occurrence of the disease for the first time. This was then followed by reports coming in from the states of Rajasthan, Punjab, Himachal Pradesh, Haryana, Maharashtra, Uttar Pradesh, Uttarakhand, Jammu Kashmir, and Andaman Nicobar (H, 2022). In the year 2022, the states located in India's north and west were the regions that were most likely to report occurrences of LSD usage that had been validated. In addition to the states of Haryana, Himachal Pradesh, Uttar Pradesh, and Uttarakhand, as well as the territories of Andaman and Nicobar, a number of other states, such as Gujarat and Rajasthan, as well as around 20 of its districts, were impacted by the disaster. Although it is not unique to any one place, it seems to be more widespread in specific regions, even though it is not exclusive to certain locations. The state of Rajasthan is the one that is suffering the most severe effects. The number of reported cases tends to rise during periods of warm and humid weather (monsoons), when there are more vectors present, and falls during dry weather, when less vectors are present. In general, the number of reported cases rises during times of warm and humid weather (monsoons). According to the findings of a study that was conducted by (Tuppurainen et al., 2017), the legal or unlawful movement of cattle between farms, regions, or even nations might lead to the development of new foci of disease in far-off places. These new foci of disease can manifest themselves as new disease hotspots.

The Bay of Bengal, India, Myanmar, and Southeast Asia all share borders with the eighth-largest country in the world, the Republic of Bangladesh. There are 1.5 million registered cows and about 24 million cows in this area (Rahman et al., 2020). To supply the nation's huge demand for beef and China, livestock is frequently imported from India and exported from the country. Additionally, bringing in animals from all over the world might make it easier for LSDV to enter the nation. LSD has been recognized as a separate disease in Bangladesh when it first manifested in the three upazilas of Anowara, Karnopuli, and Patia in Chittagong in July 2019.

On July 22, 2019, 66 (18.33%) of 360 wounded cows in these areas had external signs of prior LSD. The DLS Central Disease Research Laboratory (CDIL) then disclosed on December 3, 2019, that LSD had happened during the PCR procedure. With 23% of recorded cases in cattle, Chittagong likewise had the highest prevalence in Bangladesh. This study further said that Gazipur, Naryganj, Dhaka, Satkhira, and Pabna'daki srlarn%05'i, 1.42%, 0.87%, 0.21%, 0.06%, and 0. (Das et al., 2021; "OIE World Animal Health Information System Event summary: Lumpy skin disease, Bangladesh," 2020).

LUMPY SKIN DISEASE IN MALDIVES AND SRI LANKA

Although island nations Like Sri Lanka and Maldives may appear geographically isolated from each other, this does not always mean that they are immune (Gongal et al., 2022; Lim et al., 2005).

Although the two countries are geographically distinct and separated by much of the Indian Ocean, skin nodules are a problem in Sri Lanka and the Maldives. Because of this, bumps may appear on the skin of the patient as a result of the disease (Guides, 2015; Urban et al., 2021). This zoonotic disease has proven its ability to damage both ecosystems and economies. The disease spreads mainly among cattle and is transmitted from one group to another by means of insect vectors. While these island nations are geographically isolated from each other, providing a degree of security, this does not make them completely immune to the potentially detrimental effects of this highly contagious disease (Lim et al., 2005).

LUMPY SKIN DISEASE IN NEPAL

The recurrence of the transboundary viral illness known as lumpy skin disease (LSD) in cattle and buffalo has a significant and negative influence on the economy of the whole world (Acharya & Subedi, 2020). By the end of the month of July in the year 2020, the illness will have already spread to three further neighbouring districts in Nepal and will have afflicted a total of 1300 animals. The location of this event was in the nation of Nepal. At the Central Veterinary Laboratory (CVL), which is located within the Veterinary Complex in Kathmandu, Nepal, the real-time polymerase chain reaction (RT-PCR) of the GPCR gene was used to establish that LSD was present in the samples taken from the suspected patients. The CVL is included in the Veterinary Complex as an integral feature. The goals of this research are to (1) show that LSDV is present in cattle and buffaloes in Nepal and (2) offer a molecular characterisation of the field LSDV isolates that are circulating in Nepal (Gautam et al., 2022). Both of these goals will be accomplished if the study is successful. The first purpose is to gather evidence to demonstrate that LSDV is active in Nepal, and the second objective is to characterise its activity. In addition, as part of the inquiry, we will determine whether or not LSDV in fact exists in Nepal (Gautam et al., 2022).

LUMPY SKIN DISEASE IN AFGHANISTAN

With its potential for human transmission, the outbreak of Lumpy Skin Disease in Kandahar highlights the need for swift and comprehensive action. While the disease primarily affects cattle, it can have far-reaching consequences for the livestock industry and public health (Roche et al., 2021). By implementing effective control measures, including vaccination and vector control, and by promoting awareness and responsible farming practices, Kandahar and other affected regions can hope to contain and eventually eradicate this virulent disease (Alkhamis & VanderWaal, 2016). In doing so, they will safeguard the well-being of their cattle and protect human health from the threats posed by Lumpy Skin Disease Virus (LSDV)(BYADOVSKAYA et al.). Abdul Wadood, a resident of Kandahar, aptly described the progression of the disease as "first small rashes are on the body of

the cow, and then it increases to the whole body of the cow." This observation aligns with the typical course of the disease, where skin eruptions gradually spread across the body (Roche et al., 2021).

LUMPY SKIN DISEASE IN PAKISTAN:

LSD may create an epidemic in Pakistan as a result of recent outbreaks in nearby nations like Malaysia, India, Bangladesh, and Thailand as well as the transportation of livestock from Pakistan. Despite Pakistan historically being devoid of LSDV incidences, more than 20,000 animals have been afflicted in Sindh alone. The majority of instances have been recorded from Karachi; across the province, 54 animals have died and 4751 have recovered (Azeem et al., 2022). Nationwide, there have been over 100,000 cases of the sickness documented, and it is believed to be the cause of over 7,000 fatalities. Over 141,000 animals were retrieved, which was an excellent recovery rate. The present COVID-19 outbreak is having a significant impact on Pakistan's healthcare system, which is already grappling with COVID-19 catastrophes (Awan et al., 2022; Khatri et al., 2022). LSD has expanded across the nation, with instances being recorded in Khyber Pakhtunkhwa, Balochistan, Punjab, Sindh, and Khyber Pakhtunkhwa now has 74,590 sick animals, Sindh has 53,668, Punjab has 35,000, Balochistan has 22,225, and Azad Jammu and Kashmir has 6351 (Amin et al., 2021).

CONCLUSIONS AND RECOMMENDATIONS:

This analysis analyzes the prevalence of lumpy skin disease (LSD) in cattle in eight non-infectious hotspots in Southeast Asia. For small-scale farmers, this illness poses a major concern. The illness was endemic to Greater Africa until the 19th century, at which point it migrated to the Middle East, Eastern Europe, the Russian Federation, and, more recently, Asia. The scientific community has taken notice of frequent LSD assaults in sensitive places. Therefore, it should go without saying that the moment has come to consider possible preparations to halt this vast international disease transmission. To stop the introduction and spread of illness, emphasis should be placed on vector management, movement limitations, stringent quarantines, enhanced vaccination programs, adequate veterinarian care, and farm-level cleanliness. This work also promotes more research into the ecology and epidemiology of LSDV in Southeast Asia, as well as the discovery of the source of infection, molecular diagnostics, and agent causation.

Table 1: Vertebrate hosts susceptible to LSDV infection

Vertebrate hosts	Countries/Regions	References
Giraffe	South Africa	[4,5]
Impala	South Africa	[4,5]
Eland	South Africa	[4]
Wildebeest	South Africa	[4]
Thomson’s Gazelle	South Africa	[4]
Oryx	South Africa, Saudi Arabia	[4,5,7]
Springbok	South Africa, Namibia	[4,5,7]
African wild buffalo	Kenya	[4,7]

Table 2: Summary of LSD prevalence and outbreaks in various countries/regions

Country/Region	Year of first detection	Notable events and findings	References
South Asia	2019	Epidemic detected in Bangladesh, China, West Bengal, Odisha, India	[29]
Southeast Asia	2020	First LSD pandemic documented in Vietnam, spread to Laos, Cambodia, Thailand, Myanmar	[2,4,21]

Country/Region	Year of first detection	Notable events and findings	References
Sri Lanka	N/A	LSD prevalence observed in Sri Lanka	[33]
Maldives	N/A	LSD prevalence observed in Maldives	[33]
Nepal	2020	First LSD case reported in Nepal, rapid spread to neighboring districts	[17,39]
Afghanistan	N/A	Outbreak detected in Kandahar, poses threat to livestock industry and public health	[4,40]
Pakistan	N/A	Significant LSD outbreaks reported, impacts livestock industry and public health	[38,42,43]

Despite being a fatal illness in animals, LSD has no effect on humans. Due to animal mortality caused by the recent LSD epidemic in Pakistan during the COVID-19, Pakistan's economic status has suffered. A working committee has been established by Pakistan's Ministry of National Food Security and Research to create a framework to prevent the development of LSD in cows and buffaloes. To stop the spread of LSD, the government needs to take many steps. According to the analysis, LSD epidemics between 1 October 2020 and 1 October 2021 often have significant rates of morbidity and fatality. This high estimate was caused by the absence of an efficient vaccination program and the ignorance of the cattle populations in Southeast Asia; nevertheless, more study on the particular risk factors causing morbidity and death in Southeast Asia is necessary. Thailand was determined to be the focal point of this regional pandemic during the research period, despite outbreaks being recorded from six other Southeast Asian nations. Dominance in this area is influenced by vector abundance, strain virulence and transmissibility, management, control, and preventative factors. Future research should concentrate on the risk factors for LSDV transmission, high morbidity, and mortality, as well as the efficacy of control and preventive efforts in Southeast Asia in order to aid in limiting further disease spread, particularly in the Asia-Pacific and Oceania areas.

CONCLUSIONS

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RECOMMENDATIONS:

Lumpy skin disese research could provide a crucial understanding of the wide array of viruses in the South Asian countries, which can then be used to influence control programs, spur vaccine development, and identify potential infections. Following are few future recommendations for South Asian countries :-

Improve Monitoring and Reporting Mechanisms

It is of the uttermost importance to create and strengthen LSD surveillance mechanisms in all Southeast Asian nations. This includes educating farmers and veterinarians on how to recognize the disease's signs and symptoms, as well as how to quickly record instances and compile accurate data.

Collaboration-Based Attempts/

Southeast Asian nations should collaborate closely to monitor and suppress LSD epidemics. The disease may be controlled more effectively if information is shared and collaborative methods are utilized.

Transmission research

To gain a greater understanding of how LSD is transmitted, particularly in Southeast Asian environments, additional research is required. Both the function of insect vectors and other possible modes of transmission should be investigated.

Vaccination Programs It is suggested that regions with a high incidence of LSD investigate the possibility of initiating cattle vaccination programs. Vaccines that are efficacious may significantly reduce the severity and spread of the disease.

Efforts to Increase Awareness

Conduct efforts to increase public awareness in order to educate cattle producers about LSD, its symptoms, and preventive measures. Encourage them to immediately disclose such incidents to the appropriate veterinary authorities.

Biosecurity Precautions

It is essential to encourage biosecurity measures on farms to reduce the likelihood of disease transmission. This includes the implementation of appropriate sanitary practices, quarantine protocols for newly acquired animals, and the control of insect vectors.

Continuous Surveillance

Utilizing resources such as the World Animal Health Information System (WAHIS), it is essential to maintain constant surveillance of LSD's spread. Conduct regular data analysis in order to identify emerging patterns and hotspots.

Ethical standards

The manuscript does not contain clinical studies or patient data.

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Author Contributions
Iram Maqsood and Hanif Ur Rahman advised and supervised the whole process. Rabea Ejaz, Baitullah khan, Gul Muhammad, Imtiaz Ali Shah, Aysha Hidayat and Saira Awaz contributed to the study by providing guidance and knowledge. The first draft of the manuscript was written by Ayesha Hidayat and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Data Availability
All the data gathered and processed during this study is included in the manuscript. Since this is a review article, all pertinent references to the data sets are provided in the publication. Readers and scholars can access the study via citations contained within the review article.

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