

Space-time clustering and climatic risk factors for lumpy skin disease of cattle in Uttar Pradesh, India, 2021-2022

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OBJECTIVE: Lumpy skin disease (LSD) is an economically significant emerging infectious disease of cattle causing high morbidity. Outbreaks of LSD have been reported in India since 2019, affecting over 15 states, including Uttar Pradesh. The main objective of this study is to assess the distribution and identify spatial, temporal, and space-time clusters of LSD. In addition, we evaluate the impact of climatic factors on the incidence of LSD.

METHODS: Outbreak data for the study was obtained from state veterinary officers, who collected the reported number of LSD cases in each district during outbreaks in 2021 and 2022 in Uttar Pradesh. Mapping and spatial and temporal cluster analysis were conducted using ArcGIS Pro and SatScan. District-level incidence rate choropleth maps were created for each month. Global and local clustering of LSD cases to identify areas with high and low rates was conducted for each month using Moran's I statistics. To identify areas and periods with higher than expected cases, retrospective discrete Poisson models were constructed to identify temporal, spatial, and space-time clusters using a circular scanning window that included 50% of the population at risk and/or study period. Statistically significant (p -value ≤ 0.05) clusters were estimated after 999 Monte Carlo simulations. A negative binomial regression model was built to investigate the impact of temperature and humidity on LSD incidence. The number of LSD cases in each district was included as the outcome, and the number of cattle in each district was included as exposure to account for the background population. Predicted LSD probabilities for variables from the negative regression model were calculated and illustrated in a figure.

RESULTS: In the 2021 outbreak, 5,784 LSD cases were reported across six districts, and in the 2022 outbreak, 112, 226 cases across 33 districts. No outbreaks were observed in 2022 in districts affected by LSD in 2021. In 2021, two significant high-rate spatial clusters were observed. In 2022 one temporal, sixteen spatial, and two space-time high-rate clusters were identified by the retrospective discrete Poisson scan statistics. The negative binomial regression model identified that the number of LSD cases significantly increased with the temperature rise (IRR=2.09, p -value<0.001) and humidity increase (IRR=1.37, p -value<0.001), suggesting a seasonality in LSD outbreaks.

CONCLUSIONS: Several spatial, temporal, and space-time LSD clusters were identified. The rise in temperature and humidity impacted the increase in LSD cases across districts in Uttar Pradesh. Our study provided information on LSD spatial epidemiology and identified climatic factors impacting LSD incidence that can aid animal health authorities in creating effective LSD prevention, surveillance, and control strategies in India.