

## **Integrating spatiotemporal and compartmental modelling to understand Lassa fever transmission in Nigeria**

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### **Introduction**

Lassa fever which is endemic as a zoonotic haemorrhagic fever in West Africa presents escalating public health risks to Nigeria due to its expanding geographical presence as well as inadequate reporting practices. Despite its significant burden (300,000–500,000 annual cases), gaps persist in understanding transmission dynamics and optimal interventions.

### **Methods**

We integrated spatiotemporal and compartmental modelling using 2018–2024 NCDC prevalence data. A deterministic SEIR-SEI model with 16 parameters (7 literature-derived, 4 estimated, 5 fitted using nonlinear least squares) was used to assess transmission dynamics of the disease. Spatial analyses included Moran's I clustering and hotspot detection (Local Moran's I), while temporal patterns were evaluated through ARIMA modelling and classical decomposition. Scenario analyses compared intervention efficacies.

### **Results**

The Next-Generation Matrix showed higher transmission potential (basic reproduction number = 1.66) than empirical estimates ( $\approx 1$ ), highlighting the role of zoonotic/environmental factors.

Sensitivity analysis revealed human transmission rate (1.0) and recovery rate (-0.73) as dominant drivers. Rodent control reduced infections three times more than healthcare improvement (61.67% vs. 16.07% reduction at 25% implementation). Spatial analysis confirmed strong clustering (Global Moran's  $I=0.138$ ,  $p=0.027$ ) with persistent hotspots in Edo and Delta states ( $p < 0.01$ ), while spatial autocorrelation declined from 2018 ( $I=0.144$ ,  $p=0.014$ ) to 2024 ( $I=0.097$ ,  $p=0.086$ ). Temporal analysis confirmed seasonal peaks (ARIMA model fit:  $p=0.381$ ) and forecasted 2025–2026 outbreaks with a peak of approximately 350 cases

### **Conclusion**

The study revealed that controlling Lassa fever requires integrated One Health strategies that should emphasize rodent management alongside healthcare development. Research data on spatial and temporal patterns and intervention efficiency gives public health professionals actionable insights to improve their public health response strategies.