

A systematic review and meta-analysis of machine learning-based early warning systems for Lassa fever outbreaks in West Africa

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Introduction

Lassa fever is still a big public health problem in West Africa, and outbreaks happen again and again in many countries in the region. This systematic review and meta-analysis looked at how well artificial intelligence and machine learning can help West African countries keep an eye on Lassa fever and predict outbreaks.

Methods

We searched the PubMed, Scopus, and African Journals Online databases (2015-2025) in a systematic way for studies that used machine learning algorithms to track Lassa fever. We used random-effects models to do a meta-analysis on 24 eligible studies to see how well different AI models could predict outcomes.

Results

The analysis looked at 24 studies from Nigeria (12), Sierra Leone (5), Liberia (4), and three other West African countries. For finding outbreaks, random forest algorithms had the best predictive accuracy (pooled AUC = 0.89, 95% CI: 0.85-0.93), followed by deep learning models (pooled AUC = 0.85, 95% CI: 0.81-0.89). Adding climate data, rodent surveillance, and human case reports to the model

made it work 27% better ($p < 0.001$). Compared to traditional surveillance methods, real-time data processing systems cut the time it took to find an outbreak by 8.3 days (95% CI: 6.2-10.4).

Conclusion

Surveillance systems that use machine learning are showing good results in finding and predicting Lassa fever outbreaks in West Africa. Combining data from different sources and using automated analysis makes it much easier to find outbreaks quickly. These results support the use of AI-powered surveillance systems to improve the ability of regions to prepare for and respond to Lassa fever outbreaks. Future studies should concentrate on making data collection methods more consistent and building stronger cross-border surveillance networks.