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A Bayesian Hierarchical Model for Evaluating the Adoption of Public Health Surveillance Systems in Nigeria, 2000–2026

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ABSTRACT

Background: Public health surveillance systems are critical for disease control, yet their adoption across diverse administrative regions in Nigeria remains uneven and poorly quantified. Existing evaluations often lack a formal statistical framework to integrate multi-level data and account for spatial and temporal heterogeneity.

Purpose and objectives: This study aimed to develop and apply a novel Bayesian hierarchical model to evaluate the adoption rates of integrated disease surveillance and response (IDSR) systems across Nigerian states, and to project future trajectories under current policy conditions.

Keywords: *Bayesian hierarchical modelling, public health surveillance, sub-Saharan Africa, health systems evaluation, adoption rates, Nigeria*

Article Highlights

- Bayesian hierarchical model projects a median national adoption rate of 67% by 2026.
- Substantial inter-state variation reveals persistent geographical inequities in system adoption.
- The framework formally incorporates uncertainty and spatio-temporal heterogeneity in evaluation.
- Findings advocate for data-driven, targeted policy support in low-adoption regions.

Methodological Contribution

Introduces a novel Bayesian hierarchical logistic model for the spatio-temporal analysis of public health system adoption, providing a robust probabilistic framework that integrates multi-level data.

This study provides a formal statistical framework for evaluating and projecting health surveillance system adoption across diverse regions.