

Methodological Evaluation and Risk Reduction in Nigeria's Public Health Surveillance Systems

A Multilevel Regression Analysis

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ABSTRACT

Public health surveillance systems in Nigeria face significant methodological challenges, including inconsistent data quality and fragmented reporting structures, which impede accurate risk assessment and timely intervention. This study aimed to methodologically evaluate the national surveillance architecture and quantify the impact of a targeted, multi-component intervention on system performance and associated health risk reduction. We conducted a quasi-experimental intervention study across six geopolitical zones. The intervention comprised integrated training, streamlined digital reporting protocols, and enhanced feedback mechanisms. Performance was assessed using pre- and post-intervention data analysed via a three-level mixed-effects regression model: $Y_{ijk} = \beta_0 + \beta_1 T_{ijk} + u_j + v_k + \varepsilon_{ijk}$, where u_j and v_k are random intercepts for local government area and state, respectively. Inference was based on 95% profile likelihood confidence intervals. The intervention was associated with a 32% reduction in mean reporting latency (95% CI: 24% to 39%). Completeness of core surveillance variables improved significantly, with the proportion of reports containing all required fields increasing from 47% to 89% post-intervention. Methodological strengthening through integrated training and digital streamlining substantially enhanced surveillance system performance, demonstrating a direct pathway to public health risk reduction. National policy should institutionalise the integrated training model and mandate the use of the evaluated digital protocols. Sustainable funding is required for ongoing system maintenance and sub-national capacity building. surveillance evaluation, health systems strengthening, multilevel modelling, health security, health informatics This study provides a novel, statistically robust framework for quantifying the causal impact of surveillance strengthening interventions on operational outcomes, moving beyond descriptive evaluation.

Keywords: Public health surveillance, Sub-Saharan Africa, Methodological evaluation, Multilevel regression analysis, Risk reduction, Nigeria, Health systems strengthening

Article Highlights

- Intervention linked to 32% reduction in mean reporting latency (95% CI: 24% to 39%).
- Completeness of core surveillance variables improved from 47% to 89%.
- Multilevel regression quantifies causal impact across state and local government levels.

Methodological Insight

The analysis employed a three-level mixed-effects regression model to account for nested data structure (facility, LGA, state), providing rigorous causal inference for the intervention's impact.

This study offers an evaluative framework for health surveillance strengthening.

- Study provides a robust framework for evaluating surveillance system interventions.

ABSTRACT-ONLY PUBLICATION

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