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A Bayesian Hierarchical Modelling Framework for the Methodological Evaluation and Optimisation of Public Health Surveillance Systems in Uganda (2000–2026)

Nakato Muwanga[1]
[1] *Kampala International University (KIU)*
Correspondence: nmuwanga@hotmail.com

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Author notes
Nakato Muwanga is affiliated with Kampala International University (KIU) and focuses on Medicine research in Africa.

ABSTRACT

Background: Public health surveillance systems in Uganda face persistent methodological challenges, including fragmented data streams, inconsistent case definitions, and variable reporting completeness. These issues compromise the timeliness and accuracy of outbreak detection and resource allocation. A robust, quantitative framework for the systematic evaluation and optimisation of these systems is critically needed.

Purpose and objectives: This protocol details the development and application of a novel Bayesian hierarchical modelling framework to methodologically evaluate and optimise the efficiency of public health surveillance systems. The primary objective is to quantify efficiency gains from hypothetical system improvements, such as integrating laboratory and community-based reporting.

Keywords: *Bayesian hierarchical modelling, public health surveillance, methodological evaluation, Sub-Saharan Africa, health systems strengthening, data integration, Uganda*

Article Highlights

- A novel Bayesian hierarchical model for evaluating surveillance system efficiency.
- Quantifies expected gains from interventions like data stream integration.
- Designed for application in fragmented, resource-constrained settings.
- Aims to shift surveillance assessment from qualitative to evidence-based.

Core Methodological Contribution

The protocol details a Bayesian hierarchical model with structured spatial and temporal random effects, using Hamiltonian Monte Carlo for estimation and posterior predictive checks for validation.

This article presents a study protocol; empirical findings are forthcoming.