



# Bayesian Hierarchical Model for Evaluating Public Health Surveillance System Reliability in Rwanda: A Methodological Protocol

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## Abstract

Public health surveillance systems are crucial for monitoring diseases in real-time. In Rwanda, such systems aim to detect and respond quickly to outbreaks but require rigorous evaluation to ensure their reliability. The study will employ a Bayesian hierarchical model, which allows for the integration of multiple layers of data at different levels (e.g., individual cases vs. aggregated district reports). Uncertainty in estimates will be quantified using robust standard errors or credible intervals. We expect to identify specific themes and patterns in surveillance data that influence system performance, such as variations in reporting rates across different districts or time periods. The use of a Bayesian hierarchical model provides a nuanced understanding of public health surveillance systems' reliability by accounting for both systematic and random errors. These findings will inform policy decisions aimed at improving the efficiency and accuracy of Rwanda's public health surveillance system. Bayesian Hierarchical Model, Public Health Surveillance, System Reliability, Rwanda Treatment effect was estimated with  $\text{text}\{\text{logit}\}(\pi) = \beta_0 + \beta_1 X_i$ , and uncertainty reported using confidence-interval based inference.

**Keywords:** *Bayesian statistics, hierarchical modelling, epidemiology, surveillance systems, geographic information systems, spatial analysis, public health*

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