



# Bayesian Hierarchical Model for Evaluating Public Health Surveillance Systems in Rwanda: A Methodological Assessment

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## Abstract

Public health surveillance systems are crucial for monitoring infectious diseases in Rwanda. However, their effectiveness often depends on various factors that can vary across different regions and time periods. A Bayesian hierarchical model was employed to analyse data from multiple regions, accounting for spatial heterogeneity and temporal variations. Uncertainty quantification is provided through credible intervals. The analysis revealed significant variation in the effectiveness of surveillance systems across different districts, with some areas showing a reduction rate of up to 40% in disease incidence over one year. This study provides evidence on the impact of public health surveillance systems in Rwanda and highlights the need for targeted interventions to enhance their performance. Public health authorities should invest in training programmes tailored to specific regions, improve data collection methods, and monitor system performance regularly. Treatment effect was estimated with  $\text{logit}(\pi) = \beta_0 + \beta_1 X_i$ , and uncertainty reported using confidence-interval based inference.

**Keywords:** Rwanda, Public Health Surveillance, Bayesian Hierarchical Models, Methodological Evaluation, Geographic Variation, Risk Assessment, Spatial Analysis

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