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Bayesian Hierarchical Model for Evaluating Public Health Surveillance System Reliability in Tanzania

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Abstract

Public health surveillance systems in Tanzania are crucial for monitoring disease prevalence and guiding public health interventions. However, their reliability varies across different regions and can be influenced by multiple factors such as funding, personnel training, and infrastructure. A Bayesian hierarchical model is employed to analyse data from multiple surveillance sites, accounting for both within-site and site variations. Model parameters are estimated through Markov Chain Monte Carlo methods with robust standard errors provided. The analysis revealed significant heterogeneity in system performance across different regions of Tanzania, suggesting that local factors play a substantial role in determining the reliability of these systems. This study provides empirical evidence on the variability and determinants of public health surveillance systems in Tanzania using advanced statistical modelling techniques. The findings can inform policy decisions aimed at improving system reliability. Public health authorities should prioritise investing in training for personnel, enhancing infrastructure, and implementing targeted interventions to improve the performance of surveillance systems across all regions of Tanzania. Treatment effect was estimated with $text\{logit\}(\pi) = beta 0 + \vec{\beta} p X_i$, and uncertainty reported using confidence-interval based inference.

Keywords: *Bayesian statistics, hierarchical modelling, surveillance systems, public health, reliability analysis, Africa, geographic epidemiology*

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