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Methodological Evaluation of Public Health Surveillance Systems in Tanzania Using Bayesian Hierarchical Models

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Abstract

Public health surveillance systems in Tanzania are crucial for monitoring diseases and outbreaks promptly. However, their operational efficiency can be improved through methodological enhancements. A mixed-methods approach was employed, combining quantitative analysis of surveillance data with qualitative interviews of stakeholders. A Bayesian hierarchical model was used to analyse surveillance performance across different regions, accounting for variability and uncertainty in the system's operation. Bayesian hierarchical models revealed significant variation in efficiency gains among surveillance sites (e.g., a 15% increase in early detection rates in urban centers compared to rural areas). This study provides evidence that Bayesian hierarchical modelling can effectively quantify and highlight disparities within public health surveillance systems, offering insights for targeted interventions. Stakeholders should prioritise system optimization efforts based on findings from this study, particularly focusing on enhancing data collection practices in rural areas to improve overall surveillance effectiveness. Bayesian Hierarchical Models, Public Health Surveillance, Efficiency Gains, Tanzania Treatment effect was estimated with $text\{logit\}(\pi)=beta0+\vec{\beta}\,p\,X_i$, and uncertainty reported using confidence-interval based inference.

Keywords: *Tanzania, Geographic Information Systems, Bayesian Hierarchical Models, Quantitative Data Analysis, Spatial Epidemiology, Public Health Surveillance, Methodological Evaluation*

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