Bayesian Hierarchical Model for Evaluating Cost-Effectiveness of Public Health Surveillance Systems in Tanzania

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Abstract

Public health surveillance systems are crucial for monitoring diseases and managing outbreaks effectively. In Tanzania, these systems face challenges in cost-effectiveness due to varying resource allocation across regions. A Bayesian hierarchical model was employed, incorporating data from multiple regions with varying levels of healthcare infrastructure. Model parameters were estimated using Markov Chain Monte Carlo methods, accounting for uncertainty through robust standard errors. The model revealed significant regional variations in the efficiency and cost-effectiveness of surveillance systems, with some rural areas underperforming compared to urban settings by a margin of at least 20% in terms of detection rates. This study provides evidence that supports targeted investments in infrastructure and training for underserved regions to improve overall system performance. Policy makers should prioritise investment in surveillance systems in rural areas, where the cost-effectiveness gap is most pronounced. Additionally, continuous monitoring and adaptive management strategies are recommended. Bayesian hierarchical model, public health surveillance, cost-effectiveness, 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: *Tanzania, Bayesian Hierarchical Model, Cost-Effectiveness Analysis, Public Health Surveillance, Geographic Information Systems, Epidemiology Modelling, Resource Allocation Optimization*

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