Bayesian Hierarchical Model for Measuring Efficiency Gains in Public Health Surveillance Systems in Tanzania: A Methodological Evaluation

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Abstract

Public health surveillance systems in Tanzania are critical for monitoring infectious diseases such as malaria and tuberculosis (TB). These systems often face challenges that affect their efficiency. A Bayesian hierarchical model was developed to estimate efficiency gains within public health surveillance systems. Data on surveillance activities were collected from multiple sources across different regions in Tanzania, allowing for intra- and inter-regional comparisons. The analysis revealed significant variability in efficiency levels between districts, with some achieving up to a 30% improvement over the baseline period. These findings underscore the importance of regional-specific interventions to enhance surveillance system performance. The Bayesian hierarchical model provided valuable insights into the efficiency dynamics within Tanzania's public health surveillance systems, highlighting areas for targeted intervention and policy development. Based on the findings, recommendations include prioritising regions with lower efficiency scores for support programmes and implementing standardised training protocols across all surveillance units to improve consistency in data collection and analysis. 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, methodological evaluation, public health surveillance, efficiency gains, spatial analysis, statistical methodology*

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