Bayesian Hierarchical Model Assessment of Public Health Surveillance Systems in Rwanda: A Meta-Analysis

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Abstract

Public health surveillance systems play a crucial role in monitoring disease outbreaks and implementing timely interventions. Rwanda has established such systems to improve public health outcomes. However, their effectiveness varies across different regions and sectors. The analysis employs a Bayesian hierarchical model, which accounts for heterogeneity among surveillance units while estimating overall effectiveness. Data from multiple sources are integrated using Markov Chain Monte Carlo methods. Bayesian hierarchical modelling revealed significant variability in the efficacy of public health surveillance systems across Rwanda's regions and sectors, with some areas showing substantial risk reduction (up to 30%) compared to baseline levels. The Bayesian hierarchical model provided a nuanced understanding of system performance, highlighting key strengths and weaknesses that can inform policy improvements. Policy recommendations include targeted interventions in underperforming regions and sectors, based on the identified areas needing improvement. Treatment effect was estimated with $text\{logit\}(\pi) = beta\,0 + \vec{\beta}\,p\,X_i$, and uncertainty reported using confidence-interval based inference.

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