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

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Abstract

Public health surveillance systems play a crucial role in monitoring infectious diseases such as influenza and tuberculosis (TB). Rwanda has implemented such systems to enhance early detection and response mechanisms. A Bayesian hierarchical model was developed to estimate the costs and benefits associated with public health surveillance. This approach accounts for both fixed and random effects, allowing for more nuanced cost-effectiveness analysis. The model revealed that TB surveillance in Rwanda had a positive net benefit, indicating that the investment in these systems provided greater value than its cost. The Bayesian hierarchical model demonstrated effectiveness in quantifying the cost-effectiveness of public health surveillance systems in Rwanda. This method can be applied to other healthcare interventions. Further research should explore how different surveillance strategies might affect the cost-effectiveness outcomes, potentially leading to optimised resource allocation. Treatment effect was estimated with $text\{logit\}(\pi) = beta0 + \beta^{\rightarrow} p X_i$, and uncertainty reported using confidence-interval based inference.

Keywords: *Bayesian statistics, cost-effectiveness analysis, hierarchical modelling, infectious diseases, Rwanda, surveillance systems, uncertainty quantification*

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