



Bayesian Hierarchical Model for Evaluating System Reliability in Uganda's Community Health Centres

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Abstract

Community health centers in Uganda are crucial for providing essential healthcare services to underserved populations. However, evaluating their reliability and identifying areas for improvement is challenging due to varying operational conditions across different centers. A Bayesian hierarchical model was employed to analyse data from multiple community health centers. The model accounts for both fixed and random effects, allowing for intra-centre variability and inter-centre comparisons. The analysis revealed significant differences in reliability scores across different regions, with some centers scoring above the national average by a margin of up to 20% (direction: higher than expected). This study demonstrates the effectiveness of Bayesian hierarchical modelling in evaluating community health centre systems and highlights areas that require targeted interventions. Based on the findings, we recommend focused training programmes for staff in regions scoring below average and investment in infrastructure to improve service delivery. Treatment effect was estimated with $\text{logit}(\pi) = \beta_0 + \beta_1 X_i$, and uncertainty reported using confidence-interval based inference.

Keywords: *African geography, Bayesian statistics, Hierarchical modelling, System reliability, Community health centers, Quantitative methods, Spatial analysis*

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