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A Bayesian Hierarchical Model for Cost-Effectiveness Analysis of Community Health Centres in Ethiopia

A Methodological Case Study

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ABSTRACT

Background: Evaluating the cost-effectiveness of community health centres is critical for resource allocation in low-resource settings, yet standard frequentist methods often struggle with sparse, hierarchical data and do not fully quantify uncertainty.

Purpose and objectives: This case study presents a novel Bayesian hierarchical model for cost-effectiveness analysis and demonstrates its application to assess the efficiency of a national network of primary care facilities.

Keywords: *Bayesian hierarchical modelling, cost-effectiveness analysis, community health centres, Sub-Saharan Africa, health systems evaluation, resource-limited settings, health economics*

Article Highlights

- Model accounts for clustering at regional and district levels in sparse data.
- Quantifies probabilistic inferences with posterior distributions via MCMC sampling.
- Reveals high variability in cost-effectiveness between districts.
- Provides wide credible intervals reflecting substantial system

Core Model Specification

$\log(\text{Cost}_{ij}) = \alpha + \beta\,\text{Effectiveness}_{ij} + u_i + v_{ij} + \varepsilon_{ij}$, with $u_i \sim N(0, \sigma^2_{\text{region}})$ and $v_{ij} \sim N(0, \sigma^2_{\text{district}})$.

Presents a novel modelling framework for economic evaluation in resource-limited settings.

heterogeneity.	

ABSTRACT-ONLY PUBLICATION

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