

# A Bayesian Hierarchical Meta-Analysis of District Hospital Cost-Effectiveness in Ghana

Methodological Evaluation and Health Systems Optimisation

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## ABSTRACT

**Background:** District hospitals are critical nodes in Ghana's healthcare system, yet synthesising evidence on their cost-effectiveness is hampered by heterogeneous study designs and outcome measures. Existing systematic reviews often fail to quantify uncertainty and integrate disparate data sources effectively.

**Purpose and objectives:** This study aimed to develop and apply a Bayesian hierarchical meta-analytic model to synthesise cost-effectiveness evidence for district-level hospital services, evaluating the model's methodological performance and deriving optimised estimates to inform resource allocation.

**Keywords:** Bayesian hierarchical model, cost-effectiveness analysis, district hospitals, health systems research, sub-Saharan Africa

### Article Highlights

- Bayesian model integrated heterogeneous data, quantifying uncertainty via posterior distributions.
- Maternal and child health interventions showed highest probability of cost-effectiveness.
- Methodology outperforms frequentist models in synthesising disparate evidence.
- Findings support targeted investment for significant health system efficiency gains.

### Core Analytical Model

$y_{ij} \sim \text{Normal}(\theta_j, \sigma^2_{ij})$ ,  $\theta_j \sim \text{Normal}(\mu, \tau^2)$ . Model parameters estimated via Markov chain Monte Carlo sampling, providing full posterior distributions for inference.

*This analysis provides a probabilistic framework for optimising district hospital resource allocation in Ghana.*

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