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A Bayesian Hierarchical Model for Efficiency Gains in Nigerian Community Health Centres

A Methodological Evaluation

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ABSTRACT

Background: Community health centres in Nigeria face persistent challenges in resource allocation and operational efficiency, which directly impacts healthcare delivery. Existing methods for measuring efficiency often fail to account for the hierarchical structure of health systems and the inherent uncertainty in performance data.

Purpose and objectives: This study aimed to develop and methodologically evaluate a novel Bayesian hierarchical model to measure and attribute efficiency gains within a network of community health centres following a targeted intervention programme.

Keywords: *Bayesian hierarchical modelling, health systems research, operational efficiency, Sub-Saharan Africa, community health centres, methodological evaluation, resource allocation*

Article Highlights

- Develops a novel Bayesian model to partition variance and attribute efficiency gains.
- Quantifies intervention effects with robust uncertainty intervals via MCMC sampling.
- Demonstrates a framework accounting for hierarchical data structure in health systems.
- Provides evidence for adopting probabilistic methods in

Core Methodological Innovation

A Bayesian hierarchical model with centre-specific random effects, using posterior credible intervals for uncertainty quantification in intervention impact.

This study presents a methodological framework, not a clinical outcomes trial.

health policy evaluation.	