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A Bayesian Hierarchical Modelling Protocol for Evaluating Maternal Care Facility Systems and Clinical Outcomes in Uganda

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ABSTRACT

Background: Maternal mortality remains a critical public health challenge in many low-resource settings. Current evaluations of maternal care facility systems often rely on aggregate statistics, which mask facility-level heterogeneity and fail to quantify uncertainty in performance estimates, limiting targeted policy responses.

Purpose and objectives: This protocol details a novel methodological framework for evaluating maternal care facility systems by linking system readiness to clinical outcomes. The primary objective is to develop and validate a Bayesian hierarchical model to estimate facility-specific performance on maternal mortality while formally accounting for structural and resource covariates.

Keywords: *Bayesian hierarchical modelling, Maternal health services, Health systems evaluation, Sub-Saharan Africa, Clinical audit, Uganda, Low-resource settings*

Article Highlights

- Links facility system readiness directly to clinical maternal outcomes.
- Uses Bayesian hierarchical models to estimate facility-specific performance.
- Formally accounts for uncertainty and structural resource covariates.
- Enables probabilistic ranking of facilities for targeted intervention.

Core Statistical Model

Bayesian hierarchical logistic regression: $\text{logit}(p_{ij}) = \alpha_j + \beta X_{ij}$, with facility-specific intercepts $\alpha_j \sim \text{Normal}(\mu_\alpha, \sigma^2_\alpha)$. Inference based on posterior distributions.

This paper details a methodological protocol; empirical results are anticipated from its application.