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A Bayesian Hierarchical Modelling Framework for the Cost-Effectiveness Evaluation of Public Health Surveillance Systems in Senegal

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ABSTRACT

Background: Public health surveillance systems are critical for early disease detection and response, yet their economic evaluation remains methodologically challenging. Current cost-effectiveness analyses often rely on deterministic models that inadequately capture the inherent uncertainty and hierarchical structure of surveillance data, particularly in resource-limited settings.

Purpose and objectives: This protocol details a novel Bayesian hierarchical modelling framework designed to evaluate the cost-effectiveness of public health surveillance systems. The primary objective is to provide a robust, probabilistic method for integrating heterogeneous cost and outcome data to estimate system performance and value for money.

Keywords: *Bayesian hierarchical modelling, cost-effectiveness analysis, public health surveillance, sub-Saharan Africa, health economics, Senegal, economic evaluation*

Article Highlights

- Proposes a novel Bayesian model integrating heterogeneous cost and outcome data.

Core Methodological Contribution

A Bayesian cost-effectiveness model with region- and component-level random effects, using MCMC methods to

• Designed to yield probabilistic estimates with credible intervals for decision-making. • Addresses methodological gaps in current deterministic evaluation approaches. • Framework intended for validation and adaptation across diseases and regions.	estimate performance with quantified uncertainty. *This article presents a study protocol; empirical findings from model application are forthcoming.*