

A Bayesian Hierarchical Model for Evaluating Surveillance System Efficacy and Attributable Risk Reduction in Senegal's Public Health Framework

Aminata Sow¹, Marième Diop^{2,3}, Abdoulaye Ndiaye⁴

Department of Epidemiology, African Institute for Mathematical Sciences (AIMS) Senegal | Department of Internal Medicine, Cheikh Anta Diop University (UCAD), Dakar | African Institute for Mathematical Sciences (AIMS) Senegal | Cheikh Anta Diop University (UCAD), Dakar

Correspondence: asow@gmail.com

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ABSTRACT

Background: Public health surveillance systems are critical for early detection and response to disease outbreaks, yet robust methodological frameworks for quantifying their efficacy and attributable risk reduction are lacking, particularly in resource-limited settings.

Purpose and objectives: This study aimed to develop and apply a novel Bayesian hierarchical model to evaluate the efficacy of a national surveillance framework and estimate the attributable reduction in disease risk conferred by its implementation.

Keywords: *Bayesian hierarchical model, public health surveillance, attributable risk, sub-Saharan Africa, Senegal, epidemiological methods, disease outbreak*

Article Highlights

- Bayesian model reveals strong negative association between surveillance intensity and reported disease risk.
- Estimates 14% attributable risk reduction per standard deviation increase in surveillance score.
- Spatial random effects identify significant heterogeneity in system performance across regions.
- Provides a robust, interpretable framework for evaluating public health infrastructure efficacy.

Methodological Insight

The core model quantifies the relationship between surveillance intensity and incidence via a log-linear regression with structured spatial and temporal random effects, estimated using MCMC sampling.

This study presents a novel analytical framework for quantifying the direct health impact of surveillance systems.

ABSTRACT-ONLY PUBLICATION

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