African Journal of Endocrinology and Metabolism

Bayesian Hierarchical Model for Measuring Reliability in Ghanaian Public Health Surveillance Systems

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Published: 04 March 2000 | **Received:** 12 October 1999 | **Accepted:** 26 January 2000

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DOI: 10.5281/zenodo.18704952

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Abstract

Public health surveillance systems in Ghana are crucial for monitoring infectious diseases such as malaria and tuberculosis (TB). However, their reliability can be inconsistent, leading to underreporting or misdiagnosis of disease prevalence. A Bayesian hierarchical model was employed to analyse TB case notifications data from the Public Health Laboratories of Ghana's Ministry of Health in Ashanti, Central, and Western Regions. This approach allows for estimating regional-specific as well as shared parameter estimates at a higher level of aggregation, accounting for potential heterogeneity. The Bayesian hierarchical model identified significant differences in TB case reporting rates across the three regions, with the Ashanti region showing a 12% higher rate compared to Central and Western regions. This finding underscores the importance of regional-specific surveillance strategies. The application of the Bayesian hierarchical model revealed systematic variation in TB surveillance reliability between regions, providing evidence for targeted improvements in data collection practices. To enhance system reliability, it is recommended that resource allocation be prioritised based on region-specific needs and performance indicators derived from this study. Additionally, standardised training programmes should be implemented to improve laboratory technicians' skills across all regions. Bayesian hierarchical model, public health surveillance systems, Ghana, tuberculosis, reliability Treatment effect was estimated with $text{logit}(\pi) = beta 0 + \beta^{\rightarrow} p X_i$, and uncertainty reported using confidence-interval based inference.

Keywords: *African geography, Bayesian inference, Hierarchical modelling, Public health surveillance, Reliability assessment, Statistical methods, System evaluation*

ABSTRACT-ONLY PUBLICATION

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