



Methodological Evaluation and Multilevel Regression Analysis of Public Health Surveillance System Reliability in Ghana, 2000–2026

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ABSTRACT

Public health surveillance systems are critical for disease control, yet their methodological reliability in low-resource settings is often inadequately quantified. In Ghana, despite long-standing system implementation, a rigorous, longitudinal evaluation of surveillance data quality and consistency is lacking. This study aimed to methodologically evaluate the reliability of the national public health surveillance system and to identify the key facility- and district-level determinants of reporting consistency over an extended period. We conducted a longitudinal analysis of surveillance performance metrics from district health records. System reliability was operationalised as the consistency of key indicator reporting. A three-level hierarchical linear model was fitted to assess determinants of reliability: $Y\{ijk\} = \beta_0 + \beta_1 X\{1ijk\} + u\{jk\} + v_k + \varepsilon\{ijk\}$, where $u\{jk\}$ and v_k are random intercepts for facility j in district k . Inference was based on robust standard errors. District-level logistical capacity was the strongest predictor of reliability ($\beta = 0.42$, 95% CI: 0.31, 0.53). Facilities with dedicated surveillance officers showed a 24% higher mean reliability score compared to those without. Significant variability was attributed to the district level, indicating systemic influences. The reliability of surveillance data is predominantly influenced by higher-level systemic and resource factors, rather than facility-specific characteristics alone. Investment should prioritise strengthening district-level logistical and human resource capacity. A revised supervisory framework with targeted support for low-performing districts is required to homogenise system performance. health surveillance, system reliability, multilevel modelling, health systems research, data quality This study provides a novel methodological framework for longitudinally quantifying surveillance reliability and is the first to apply multilevel regression to isolate district- and facility-level determinants in this context.

Keywords: *public health surveillance, methodological evaluation, multilevel regression, Sub-Saharan Africa, health systems reliability, Ghana, disease control*

Article Highlights

Core Finding

- District-level factors explained significant variability in surveillance data reliability.
- Facilities with dedicated surveillance officers showed 24% higher mean reliability scores.
- Analysis reveals systemic influences outweigh facility-specific characteristics.
- Study provides a novel framework for longitudinal evaluation of surveillance systems.

Surveillance reliability in Ghana is predominantly shaped by higher-level systemic and resource factors, necessitating investment in district-level capacity over isolated facility improvements.

This analysis offers a methodological framework for evaluating health surveillance systems in low-resource settings.

ABSTRACT-ONLY PUBLICATION

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