



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

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Author notes

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ABSTRACT

Background: Public health surveillance systems are critical for disease control, yet their methodological reliability in longitudinal application within complex, resource-variable settings is inadequately characterised. This is particularly pertinent in sub-Saharan Africa, where system performance directly impacts health outcomes.

Purpose and objectives: This study aimed to conduct a longitudinal methodological evaluation of a national public health surveillance system. Its primary objective was to quantify system reliability over time using a multilevel modelling framework, identifying facility- and district-level determinants of reporting consistency.

Keywords: *Longitudinal study, Public health surveillance, Multilevel modelling, South Africa, Methodological evaluation, System reliability*

Article Highlights

- Longitudinal analysis reveals a 22% improvement in mean system reliability score over the study period.
- Facility-level resource allocation was the strongest predictor

Core Analytical Approach


A three-level random intercepts model quantified reliability trends and partitioned variance across reports, facilities, and districts over a multi-decade period.

<p>of reporting consistency ($\beta = 0.31$).</p> <ul style="list-style-type: none">• Multilevel modelling attributed 40% of reliability variance to district-level structural factors.• Methodological framework disentangles facility- and district-level determinants of performance.	<p><i>This evaluation provides a methodological blueprint for assessing surveillance systems in complex, resource-variable settings.</i></p>
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