

# Methodological evaluation and adoption trends of public health surveillance systems in South Africa

a panel-data analysis, 2000–2026

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## ABSTRACT

Public health surveillance systems are critical for disease control and health policy, yet their methodological robustness and adoption dynamics in resource-variable settings are understudied. This study evaluates the methodological frameworks of national surveillance systems and quantifies longitudinal adoption trends, identifying key drivers of integration. A panel-data analysis was conducted using national administrative data. Adoption rates were estimated using a fixed-effects model:  $Y_{it} = \alpha_i + \beta X_{it} + \delta_t + \varepsilon_{it}$ , where  $Y_{it}$  is the adoption index for province  $i$  in period  $t$ ,  $X_{it}$  is a vector of covariates including infrastructure and training investments,  $\alpha_i$  denotes province-specific effects, and  $\delta_t$  represents time effects. Inference is based on cluster-robust standard errors. Adoption of integrated surveillance methodologies increased significantly, with a mean annual growth rate of 4.7% (95% CI: 3.1, 6.3). The analysis identified data interoperability and dedicated technical staffing as the strongest positive predictors of sustained adoption. Methodological advancements in surveillance systems have been progressively adopted, though progress remains heterogeneous and dependent on specific, modifiable infrastructural and human resource factors. Policy should prioritise investments in interoperable data platforms and create permanent technical posts to sustain integration. Future methodological development must address contextual constraints at sub-national levels. health surveillance, panel data, system adoption, methodology evaluation, health systems This report provides the first longitudinal, model-based quantification of surveillance system adoption drivers, introducing a novel adoption index for benchmarking.

**Keywords:** Public health surveillance, panel-data analysis, methodological evaluation, adoption trends, sub-Saharan Africa

### Article Highlights

- Panel-data analysis reveals a 4.7% mean annual growth in adoption of integrated surveillance methodologies.
- Data interoperability and dedicated technical posts are the strongest predictors of sustained system integration.
- Adoption progress remains heterogeneous, dependent on modifiable infrastructural and human resource factors.
- Study introduces a novel adoption index for benchmarking surveillance systems across provinces.

### Policy Implication

Prioritise investments in interoperable data platforms and establish permanent technical posts to sustain the integration of surveillance systems.

*This analysis provides the first longitudinal, model-based quantification of surveillance system adoption drivers in South Africa.*

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