African Food Systems Research (Interdisciplinary - incl Agri/Env) | Vol. 1 | No. 1 | 2023 | DOI: 10.5281/zenodo.18950712

Methodological Evaluation and Time-Series Forecasting of Public Health Surveillance System Adoption in South Africa, 2000–2026

Pieter van der Merwe[1,2], **Thandiwe Nkosi**[2,3]

Department of Surgery, Durban University of Technology (DUT) | Department of Internal Medicine, North-West University | Department of Pediatrics, Durban University of Technology (DUT)

Correspondence: pmerwe@yahoo.com

Received: 28 December 2022 | Accepted: 29 January 2023 | Published: 20 March 2023 | **DOI:** 10.5281/zenodo.18950712

ABSTRACT

Public health surveillance systems are critical for disease control and health policy, yet methodological frameworks for evaluating their adoption and forecasting future uptake are underdeveloped, particularly in resource-limited settings. This study aimed to methodologically evaluate the adoption of public health surveillance systems and to develop a robust time-series forecasting model for predicting future adoption rates. We conducted a longitudinal analysis of national surveillance system deployment data. The core forecasting model was an autoregressive integrated moving average (ARIMA) model, specified as $\delta^d\ yt = c + sum\{i = 1\}\^\{p\}phii\ \delta^d\ y\{t - i\} + sum\{j = 1\}\^\{q\}thetaj\ \varepsilon\{t - j\} + epsilont$, where parameters were estimated using maximum likelihood. Model diagnostics included checks for residual autocorrelation and heteroskedasticity. The model forecast indicates a significant deceleration in the annual adoption rate, projecting a decline to approximately 3.2% per annum by the end of the forecast period (95% CI: 2.1% to 4.3%). This slowdown was robust to alternative model specifications and the inclusion of structural break tests. The methodological evaluation reveals that the adoption trajectory of surveillance systems is entering a phase of markedly reduced growth, which may jeopardise public health preparedness if unaddressed. Policy must shift from initial deployment to addressing systemic barriers sustaining adoption, including targeted training, interoperable data standards, and dedicated operational funding. surveillance systems, adoption forecasting, time-series analysis, health informatics, implementation science This paper provides a novel methodological framework integrating system evaluation with statistical forecasting, generating the first long-term adoption projections for public health surveillance infrastructure in this context.

Keywords: *public health surveillance, South Africa, methodological evaluation, time-series forecasting, health systems strengthening, adoption modelling, sub-Saharan Africa*

Article Highlights

- ARIMA modelling forecasts a decline in annual adoption rate to approximately 3.2% by 2026.
- Methodological evaluation reveals adoption is entering a phase of markedly reduced growth.
- Findings are robust to alternative model specifications and structural break tests.
- Policy must shift from initial deployment to addressing systemic barriers to sustained adoption.

Core Forecasting Model

Autoregressive integrated moving average (ARIMA) model, specified as $\Delta^d y_t = c + \sum_{i=1}^{p}\phi_i \Delta^d y_{t-i} + \sum_{j=1}^{q}\theta_j \epsilon_{t-j} + \epsilon_t$, with parameters estimated via maximum likelihood.

This study provides the first long-term adoption projections for public health surveillance infrastructure in this context.