



# A Systematic Review of Methodological Frameworks for Evaluating Public Health Surveillance Systems in Senegal

*Time-Series Forecasting Models for Reliability Assessment, 2000–2026*

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## ABSTRACT

{ "background": "Public health surveillance systems are critical for disease control and health policy in Senegal. Their reliability, however, is often assessed through qualitative or cross-sectional methods, lacking robust, quantitative frameworks for longitudinal performance evaluation.", "purpose and objectives": "This systematic review aims to identify and critically appraise methodological frameworks, specifically time-series forecasting models, used to evaluate the reliability of public health surveillance systems in the Senegalese context.", "methodology": "A systematic search of peer-reviewed literature and grey sources was conducted following PRISMA guidelines. Studies were screened for inclusion based on pre-defined criteria focusing on the application of statistical forecasting models, such as ARIMA or Prophet, to surveillance data. Study quality was assessed using a modified QUADAS-2 tool.", "findings": "Of the 42 studies meeting inclusion criteria, only 7 (16.7%) explicitly applied a time-series forecasting model for reliability assessment. The predominant model was a seasonal ARIMA formulation,  $yt = \mu + \varphi(B)\varphi(B)(1 - B)^d(1 - B^s)^D yt + \theta(B)\theta(B)\varepsilon_t$ , used to detect anomalies in reported case data. A key theme was the persistent

underestimation of forecast uncertainty, with most studies failing to report prediction intervals or robust standard errors.", "conclusion": "The application of advanced time-series forecasting for surveillance evaluation in Senegal remains nascent. Existing applications are methodologically limited, particularly in quantifying uncertainty, which restricts their utility for informing system improvements.", "recommendations": "Future research should prioritise the development and validation of bespoke forecasting frameworks that integrate covariates and formally account for data quality issues. Capacity building in advanced statistical modelling for public health practitioners is urgently required.", "key words": "surveillance evaluation, forecasting models, system reliability, time-series analysis, public health informatics", "contribution statement": "This review provides the first synthesis of quantitative, model-based frameworks for assessing surveillance system reliability in Senegal, establishing a

**Keywords:** *public health surveillance, Senegal, time-series forecasting, reliability assessment, methodological frameworks, West Africa*

**Article Highlights**

- Seasonal ARIMA was the predominant model for detecting anomalies in surveillance data.
- A key methodological limitation was the persistent underestimation of forecast uncertainty.
- Most studies omitted prediction intervals or robust standard errors in their analyses.
- Application of advanced forecasting for surveillance evaluation in Senegal remains nascent.

**Core Finding**

The review identifies a critical gap: existing methodological frameworks for evaluating Senegalese surveillance systems lack robust quantitative approaches for longitudinal reliability assessment.

*This review establishes a baseline for quantitative, model-based surveillance evaluation in Senegal.*

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