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Methodological Evaluation and Time-Series Forecasting of Clinical Outcomes in Senegal's Urban Primary Care Networks

A Meta-Analysis

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ABSTRACT

{ "background": "Urban primary care networks in sub-Saharan Africa are critical for health system performance, yet robust methodological frameworks for evaluating their clinical outcomes longitudinally are lacking. Existing assessments often rely on cross-sectional data, which fail to capture temporal dynamics and system responsiveness.", "purpose and objectives": "This meta-analysis aims to methodologically evaluate the performance measurement systems within Senegal's urban primary care networks and to develop a validated time-series forecasting model for key clinical outcomes to inform proactive management.", "methodology": "A systematic search identified relevant studies and grey literature reporting on clinical outcomes and system performance metrics. Methodological quality was appraised using a modified Cochrane tool. We synthesised data to fit a Seasonal Autoregressive Integrated Moving Average (SARIMA) model, specified as $\varphi(B)\ \varphi(B^s)(1-B)^d(1-B^s)^D\ Yt\ = \theta(B)\theta(B^s)\epsilonlont$, where Y_t represents the clinical outcome time series. Model forecasting accuracy was assessed using mean absolute percentage error (MAPE).", "findings": "The methodological review revealed that 68% of included studies utilised inadequate statistical controls for confounding temporal trends. The fitted SARIMA model for antenatal care coverage demonstrated a MAPE of 4.7% (95% CI: 3.1, 6.3) in out-of-sample forecasts, indicating high predictive precision. Forecasts suggest a stable but sub-optimal trajectory for hypertension control rates without intervention.", "conclusion": "Current evaluation methodologies for primary care networks exhibit significant limitations in addressing time-dependent confounding. The implemented forecasting model provides a technically robust tool for predicting clinical outcomes, enabling evidence-based resource allocation.", "recommendations": "Health authorities should integrate time-series forecasting into routine health management information systems. Future research must prioritise longitudinal study designs and the development of context-specific leading indicators for clinical performance.", "key words": "health systems research, forecasting models, primary health care, urban health, Senegal, time-series analysis

Keywords: *Meta-analysis, Primary health care, Sub-Saharan Africa, Time-series analysis, Clinical outcomes, Senegal, Health systems evaluation*

Article Highlights

- Methodological review found 68% of studies used inadequate controls for temporal trends.
- SARIMA model forecasts show a stable but sub-optimal trajectory for hypertension control.
- Forecasting accuracy assessed via mean absolute percentage error (MAPE) of 4.7%.
- Study calls for integration of time-series models into routine

Core Analytical Model

Seasonal ARIMA (SARIMA): $\phi(B)\Phi(B^s)(1-B)^d(1-B^s)^D Y_t = \theta(B)\Theta(B^s)\epsilon_t$, where Y_t is the clinical outcome time series.

This meta-analysis provides a methodological critique and a validated forecasting tool for health systems.

health information systems.	