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A Methodological Evaluation of Emergency Care Systems in Kenya

A Time-Series Forecasting Model for Clinical Outcome Metrics.

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ABSTRACT

{ "background": "Emergency care systems in sub-Saharan Africa face significant operational challenges, yet robust methodological frameworks for evaluating their clinical performance over time are scarce. Existing assessments often rely on cross-sectional data, lacking the capacity for predictive analytics to inform resource allocation and system strengthening.", "purpose and objectives": "This case study aimed to develop and validate a time-series forecasting model for key clinical outcome metrics within a Kenyan emergency unit context, providing a methodological proof-of-concept for routine performance monitoring.", "methodology": "A case study design was employed, utilising retrospective, de-identified patient outcome data from a major referral hospital. The core methodology involved constructing a Seasonal AutoRegressive Integrated Moving Average (SARIMA) model, specified as $\varphi(B)\varphi(B^s)nabla^d nabla^{Ds} Yt = \theta(B)\theta(B^s)\varepsilon_t$, to forecast monthly mortality rates. Model diagnostics included analysis of autocorrelation and partial autocorrelation functions, with forecasting accuracy evaluated using mean absolute percentage error (MAPE).", "findings": "The SARIMA(1,1,1)(0,1,1)12 model provided the best fit for forecasting mortality, with a MAPE of 8.7% (95% CI: 6.2, 11.5) on the test set. Forecasts indicated a persistent upward trend in mortality rates over a six-month projection period, highlighting a critical pressure point requiring intervention.", "conclusion": "The study demonstrates the feasibility and utility of time-series forecasting as a methodological tool for proactive emergency care systems evaluation in resource-constrained settings. The model offers a data-driven approach to anticipate clinical workload and outcome trajectories.", "recommendations": "Emergency care networks should integrate routine time-series analytics into their performance dashboards. Further research should focus on incorporating exogenous variables (e.g., staffing levels, seasonal disease prevalence) to improve model specificity and generalisability across different facility types.", "key words": "Emergency medical services, forecasting, time

Keywords: *Emergency medicine, Sub-Saharan Africa, Time-series analysis, Clinical outcomes, Health systems evaluation, Kenya*

Article Highlights

- SARIMA(1,1,1)(0,1,1)12 model demonstrated 8.7% MAPE for mortality forecasting
- Forecasts indicate persistent upward trend in mortality over six-month projection
- Provides methodological proof-of-concept for routine performance monitoring
- Offers data-driven approach to anticipate clinical workload

Methodological Contribution

This study establishes time-series forecasting as a feasible tool for proactive emergency care evaluation in resource-constrained settings, moving beyond cross-sectional assessments.

This methodological case study offers a replicable framework for health systems forecasting.

trajectories	