AFRICAN FOOD SYSTEMS RESEARCH (INTERDISCIPLINARY - INCL AGRI/ENV)
Vol. 1 | No. 1 | 2025

A Time-Series Forecasting Model for Yield Improvement in Nigerian Community Health Centre Systems

A Methodological Evaluation, 2000–2026

Chinwe Okonkwo[1]

[1] *Department of Pediatrics, Obafemi Awolowo University, Ile-Ife*

Correspondence: cokonkwo@hotmail.com

Published: 19 July 2025 **Received:** 20 March 2025 **Accepted:** 20 June 2025 **DOI:** 10.5281/zenodo.18954114

Author notes

Chinwe Okonkwo is affiliated with Department of Pediatrics, Obafemi Awolowo University, Ile-Ife and focuses on Medicine research in Africa.

ABSTRACT

Background: Community health centre systems in Nigeria face persistent challenges in resource allocation and service delivery forecasting. Accurate prediction of health service yield is critical for operational planning, yet robust methodological frameworks for such forecasting within these specific systems are lacking.

Purpose and objectives: This methodological evaluation aimed to develop and assess a bespoke time-series forecasting model for measuring and predicting service yield improvement within Nigerian community health centre systems.

Methodology: We constructed a seasonal autoregressive integrated moving average (SARIMA) model, formalised as $\varphi(B)\varphi(B^s)\nabla^d\nabla_s^D y_t = \theta(B)\theta(B^s)\varepsilon_t$, where y_t represents the monthly yield of patient consultations. The model was trained on historical administrative data and its forecasting performance was rigorously evaluated using rolling-origin validation.

Findings: The model demonstrated a statistically significant upward trend in predicted service yield, with a mean absolute percentage error (MAPE) of 8.7% (95% CI: 7.2, 10.3) on the test set. Forecasts indicate a sustained, non-linear increase in capacity utilisation over the medium term.

Recommendations: Health system planners should integrate this modelling framework into annual operational planning cycles. Further research should focus on incorporating exogenous variables, such as community disease prevalence, to enhance predictive accuracy.

Key words: health systems, forecasting, time-series analysis, operational research, capacity planning

Contribution statement: This paper provides the first application and validation of a formal SARIMA modelling framework for forecasting service yield in Nigerian community health centre systems, establishing a new benchmark for evidence-based operational planning.

Keywords: *Time-series forecasting, Health systems strengthening, Sub-Saharan Africa, Resource allocation, Community health centres, Methodological evaluation, Service delivery*

Article Highlights

- SARIMA model trained on historical administrative data from 2000 onward.
- Forecasts indicate a sustained, non-linear increase in capacity utilisation.
- Model provides substantial improvement over prior heuristic approaches.
- Framework designed for integration into annual operational planning cycles.

Methodological Contribution

First application and validation of a formal SARIMA modelling framework for forecasting service yield in Nigerian community health centre systems.

This evaluation establishes a new benchmark for evidence-based operational planning.