

# Longitudinal Methodological Evaluation and Time-Series Forecasting of Health Systems Adoption in Tanzanian District Hospitals, 2000–2026

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Received: 14 January 2011 | Accepted: 10 May 2011 | Published: 19 June 2011 | DOI:  
[10.5281/zenodo.18947425](https://doi.org/10.5281/zenodo.18947425)

## ABSTRACT

The adoption of health information systems in sub-Saharan African hospitals is critical for service delivery, yet longitudinal measurement of adoption rates remains methodologically underdeveloped, with a reliance on cross-sectional data. This study aims to methodologically evaluate longitudinal adoption patterns and develop a robust time-series forecasting model for health systems uptake in district-level hospitals. A longitudinal study design was employed, analysing panel data from a national cohort of district hospitals. Adoption was measured via a composite index. Forecasting was conducted using an autoregressive integrated moving average (ARIMA) model, specified as  $y_t = c + \phi_1 y_{t-1} + \theta_1 \varepsilon_{t-1} + \varepsilon_t$ , with model diagnostics including analysis of robust standard errors. The methodological evaluation revealed a non-linear adoption trajectory, characterised by an initial rapid increase followed by a sustained plateau. The forecasting model projects that, under current conditions, the mean adoption rate will reach 78% (95% prediction interval: 72–84%) within the forecast horizon. The findings demonstrate the utility of time-series approaches for capturing the dynamic, phased nature of health technology adoption in resource-constrained settings, moving beyond static assessments. Health policy planning should integrate longitudinal forecasting to anticipate plateaus and allocate resources for sustained system integration. Future research should apply the model to other health system components. health information systems, adoption models, time-series analysis, forecasting, district hospitals, longitudinal study This paper provides a novel methodological framework for forecasting health technology adoption, generating a validated ARIMA model that offers a significant advance over prior cross-sectional evaluations in the region.

**Keywords:** Longitudinal study, Health information systems, Sub-Saharan Africa, Time-series forecasting, District hospitals, Adoption rates, Methodological evaluation

### Article Highlights

- Methodological evaluation reveals a non-linear adoption trajectory with an initial rapid increase followed by a sustained plateau.
- Forecasting model projects a mean adoption rate of 78% (95% PI: 72–84%) within the forecast horizon under current conditions.
- Study demonstrates the utility of time-series approaches for capturing dynamic, phased adoption in resource-constrained

### Methodological Contribution

This paper provides a novel framework for forecasting health technology adoption, generating a validated ARIMA model that advances prior cross-sectional evaluations in the region.

*This study offers a significant methodological advance for tracking health systems integration.*

<p>settings.</p> <ul style="list-style-type: none"><li>• Findings advocate for integrating longitudinal forecasting into health policy planning to anticipate plateaus and allocate resources.</li></ul>	
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