



A Quasi-Experimental Evaluation of District Hospital System Reliability in South Africa

A Methodological Framework

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ABSTRACT

{ "background": "District hospitals are critical nodes in sub-Saharan African health systems, yet robust methodological frameworks for evaluating their operational reliability are scarce. Existing assessments often lack rigorous causal designs to isolate system performance from confounding factors.", "purpose and objectives": "This study aimed to develop and apply a novel quasi-experimental framework to evaluate the reliability of district hospital systems, defined as the consistent delivery of intended clinical and administrative functions.", "methodology": "We employed a controlled interrupted time series design, analysing longitudinal administrative data from a sample of hospitals. System reliability was operationalised as a composite index of 12 process indicators. The impact of a systemic organisational intervention was estimated using a segmented regression model: $Y_t = \beta_0 + \beta_1 T_t + \beta_2 X_t + \beta_3 T_t X_t + \epsilon_t$, where Y_t is the reliability index at time t , T_t is time since start, and X_t is the intervention phase. Inference was based on Newey-West robust standard errors to account for autocorrelation.", "findings": "The methodological application revealed a statistically significant positive level change in the composite reliability index following the intervention ($\beta_2 = 0.18$, 95% CI: 0.07 to 0.29). The framework successfully quantified a 15% improvement in medication availability reliability, demonstrating its utility for isolating specific system effects.", "conclusion": "The proposed quasi-experimental framework provides a valid and feasible method for rigorously assessing district hospital system reliability, moving beyond descriptive metrics to causal inference.", "recommendations": "Health systems researchers and policymakers should adopt such causal designs for evaluating operational interventions. Future work should integrate this framework with cost-effectiveness analysis.", "key words": "health systems research, quasi-experimental design, hospital management, operational research, causal inference, South Africa", "contribution statement": "This paper

provides a novel methodological framework for causal assessment of health system reliability, demonstrating its application

Keywords: *district health systems, quasi-experimental design, health systems research, operational reliability, sub-Saharan Africa, South Africa, methodological framework*

Article Highlights

- Proposes a novel quasi-experimental framework for causal assessment of health system reliability.
- Applies a controlled interrupted time series design with a composite index of 12 process indicators.
- Reveals a statistically significant positive level change in system reliability post-intervention.
- Provides a valid method for moving beyond descriptive metrics to robust causal inference.

Core Methodological Contribution

A segmented regression model ($Y_t = \beta_0 + \beta_1 T_t + \beta_2 X_t + \beta_3 T_t X_t + \varepsilon_t$) with Newey-West robust standard errors isolates intervention effects from confounding trends.

This framework advances methodological rigor in health systems evaluation.

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