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A Multilevel Regression Analysis of System Reliability in Tanzanian Community Health Centres

A Methodological Evaluation, 2000–2026

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ABSTRACT

Background: The reliability of community health centre systems is a critical determinant of healthcare delivery and outcomes in resource-limited settings. Existing methodological approaches for evaluating system reliability often fail to account for the hierarchical, clustered nature of health system data, potentially leading to biased inferences.

Purpose and objectives: This study aimed to methodologically evaluate the application of multilevel regression for measuring system reliability in a network of community health centres, assessing its advantages over conventional single-level models for informing targeted interventions.

Keywords: *Sub-Saharan Africa, Health Systems Research, Multilevel Modelling, Primary Health Care, Methodological Evaluation, System Reliability, Community Health Centres*

Article Highlights

- Three-level model uncovers hidden district-level clustering in reliability data.
- Standard logistic regression produced artificially precise, potentially biased estimates.
- Demonstrates necessity of hierarchical methods for valid inference in health systems.
- Provides framework for targeting interventions at appropriate administrative levels.

Core Statistical Model

Three-level random intercept logistic regression: $\text{logit}(p_{ijk}) = \beta_0 + \beta X_{ijk} + u_k + v_{jk}$, where u_k and v_{jk} are district- and facility-level random effects.

This methodological evaluation demonstrates how analytical choice directly impacts intervention targeting.