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A Multilevel Regression Analysis of System Reliability in Kenyan District Hospitals

A Methodological Evaluation, 2000–2026

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ABSTRACT

Background: District hospitals in Kenya face persistent challenges in delivering consistent, high-quality care due to systemic reliability issues. Existing evaluations often lack the methodological rigour to disentangle facility-level performance from broader regional or systemic influences, limiting actionable insights for health systems strengthening.

Purpose and objectives: This study aimed to methodologically evaluate the application of multilevel regression modelling for measuring and attributing sources of variation in system reliability across district hospitals. The primary objective was to assess the model's capacity to partition variance between facility and administrative unit levels.

Keywords: *Health systems research, Sub-Saharan Africa, Multilevel modelling, System reliability, District hospitals, Methodological evaluation, Kenya*

Article Highlights

- Three-level hierarchical model partitions variance between hospitals and counties.
- 65% of reliability variance stems from differences between individual hospitals.
- 22% of variance linked to county-level administrative effects.
- Model confirms necessity of hierarchical approach for nested

Core Statistical Model

$y_{ijk} = \beta_0 + u_{0jk} + v_{0k} + \varepsilon_{ijk}$, where u_{0jk} and v_{0k} are random intercepts for hospital and county.

This methodological evaluation demonstrates the analytical power of multilevel modelling for health systems.

health data.	