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A Multilevel Regression Analysis of Clinical Outcomes in South African Community Health Centre Systems

A Methodological Evaluation

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ABSTRACT

Background: Community health centre (CHC) systems are critical for primary care delivery, yet robust methodological frameworks for evaluating their clinical performance are underdeveloped. Existing analyses often fail to account for the hierarchical structure of patient data nested within facilities, risking biased inference.

Purpose and objectives: This case study aims to methodologically evaluate the application of multilevel regression for measuring clinical outcomes within a CHC system. Its objective is to demonstrate the model's utility in partitioning variance and identifying facility-level predictors of patient outcomes.

Keywords: *Community health centres, South Africa, Multilevel modelling, Clinical outcomes, Primary healthcare, Methodological evaluation, Sub-Saharan Africa*

Article Highlights

- A two-level random intercepts model partitions variance between patient and facility levels.
- Facility-level staffing adequacy showed a clinically meaningful association with improved HbA1c.
- The method corrects for bias inherent in analysing nested, hierarchical health data.
- Provides a framework for targeting modifiable facility factors in resource allocation.

Core Analytical Model

Two-level random intercepts model: $y_{ij} = \beta_0 + \beta_1 X_{ij} + u_j + e_{ij}$, where u_j is the facility-specific random effect. Estimated using REML with robust standard errors.

This methodological evaluation demonstrates the utility of multilevel regression for health systems research.