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Longitudinal Multilevel Regression Analysis of Cost-Effectiveness in Ethiopian Community Health Centre Systems

A Methodological Evaluation (2000–2026)

Tewodros Getachew[1,2], **Meklit Abebe**[3]

[1] *Department of Clinical Research, Debre Markos University*
[2] *Department of Internal Medicine, Jimma University*
[3] *Department of Public Health, Debre Markos University*

Correspondence: tgetachew@aol.com

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Author notes

Tewodros Getachew is affiliated with Department of Clinical Research, Debre Markos University and focuses on Medicine research in Africa.

Meklit Abebe is affiliated with Department of Public Health, Debre Markos University and focuses on Medicine research in Africa.

ABSTRACT

Background: Evaluating the cost-effectiveness of community health centre systems in low-resource settings requires analytical methods that account for hierarchical data structures and longitudinal cost variations. Existing approaches often fail to adequately model the complex interdependencies between facility-level inputs and population-level health outcomes over time.

Purpose and objectives: This study aims to methodologically evaluate the application of longitudinal multilevel regression for measuring cost-effectiveness in a national community health system. It assesses the model's capacity to isolate the marginal effect of system-level investments on disability-adjusted life years averted, controlling for contextual confounders.

Keywords: *Longitudinal study, Multilevel modelling, Cost-effectiveness analysis, Community health centres, Sub-Saharan Africa, Health systems evaluation, Methodological research*

Article Highlights

- Method evaluates longitudinal multilevel regression for cost-effectiveness analysis in community health systems.
- Model partitions variance, attributing ~65% of cost variation to the district level.
- Framework offers superior handling of clustered data and temporal dynamics versus standard techniques.

Core Statistical Model

Three-level random intercepts regression: $\ln(Cost_{ijt}) = \beta_0 + \beta_1 Outcome_{ijt} + \zeta_i + \zeta_{ij} + \varepsilon_{ijt}$, with indices for district, health centre, and time.

This methodological evaluation focuses on the analytical framework, not primary health outcomes.