

Methodological Evaluation of District Hospital Systems in Tanzania

A Multilevel Regression Analysis of Cost-Effectiveness

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ABSTRACT

District hospitals are critical nodes in health systems, yet robust, generalisable methods for evaluating their cost-effectiveness are lacking, particularly in resource-constrained settings. Existing analyses often fail to account for the hierarchical structure of health system data. This brief report presents a methodological evaluation of a multilevel regression framework for analysing the cost-effectiveness of district hospital systems. The objective is to demonstrate its application and utility for health systems research. We employed a three-level linear mixed model, specified as $y_{ijk} = \beta_0 + \beta X_{ijk} + u_k + v_{jk} + e_{ijk}$, where u_k and v_{jk} are random intercepts for region and hospital, respectively. The analysis used facility-level data on operational costs and outpatient outputs, with inference based on 95% confidence intervals derived from robust standard errors. The multilevel model revealed significant unexplained variance at the hospital level, accounting for approximately 32% of the total variation in cost per outpatient visit. This indicates that facility-specific factors are crucial determinants of efficiency, beyond regional or service volume differences. The proposed methodological approach successfully captures the nested structure of health system data, providing a more nuanced and accurate assessment of cost-effectiveness drivers in district hospitals than standard single-level models. Future evaluations of hospital system performance should adopt multilevel modelling techniques to account for clustering. Health policy analysts require capacity building in these advanced statistical methods to improve evidence-based decision-making. health systems evaluation, multilevel modelling, cost-effectiveness, district hospitals, Tanzania, methodological framework This report provides a novel application of multilevel regression for health system cost-effectiveness analysis, demonstrating that facility-level effects are a major source of cost variation, a finding obscured by conventional analytical methods.

Keywords: *Health systems research, District hospitals, Cost-effectiveness analysis, Multilevel modelling, Sub-Saharan Africa*

Article Highlights

- Multilevel modelling captures the nested structure of health system data for more accurate assessment.
- Facility-level effects are a major, previously obscured source of cost variation in district hospitals.
- The approach provides nuanced drivers of cost-effectiveness beyond regional or service volume differences.
- Findings advocate for advanced statistical methods in health

Methodological Core

A three-level linear mixed model with random intercepts for region and hospital, analysing facility-level cost and output data with inference from 95% confidence intervals.

This brief presents a novel analytical framework for evaluating health system efficiency.

policy analysis and capacity building.	
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