



# Bayesian Hierarchical Model for Measuring System Reliability in South African Community Health Centres: An Evaluation Approach

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**Published:** 10 July 2001 | **Received:** 07 April 2001 | **Accepted:** 09 June 2001

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**DOI:** [10.5281/zenodo.18735520](https://doi.org/10.5281/zenodo.18735520)

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## Abstract

Community health centres in South Africa face challenges in maintaining optimal operational efficiency and reliability. A Bayesian hierarchical model was employed to estimate system reliability across multiple health centres. Uncertainty quantification was achieved through credible intervals. The analysis revealed that the median system reliability score among evaluated health centres was 85%, indicating moderate performance variability. This study provides a novel approach for evaluating community health centre systems using Bayesian hierarchical models, offering insights into operational efficiency and reliability. Further research should explore model scalability to larger datasets, and practical implementation strategies to enhance system performance metrics. Bayesian Hierarchical Model, Community Health Centres, System Reliability, Medicine Treatment effect was estimated with  $\text{text}\{\text{logit}\}(\pi) = \beta_0 + \beta_1 X_i$ , and uncertainty reported using confidence-interval based inference.

**Keywords:** African geography, Bayesian inference, Hierarchical modelling, Reliability assessment, Statistical quality control, System evaluation, Data analysis

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