



Off-grid Communities Systems in South Africa: A Panel-Data Analysis of Clinical Outcomes Measurement

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Abstract

Off-grid communities in South Africa are facing challenges in healthcare delivery due to geographical isolation. A mixed-method approach combining quantitative and qualitative data was employed. Panel data from 100 off-grid communities were analysed using generalized estimating equations (GEE) to estimate the impact of healthcare interventions on patient outcomes. The GEE model revealed a significant positive correlation between access to clean water and reduced incidence of diarrheal diseases in off-grid communities, with a coefficient of -0.57 (95% CI: -0.81 to -0.34). This study highlights the importance of integrated healthcare systems that include environmental improvements such as access to clean water. Policy-makers should prioritise infrastructure development and community engagement in off-grid areas to improve clinical outcomes. The empirical specification follows $Y = \beta_{0+\beta} p X + \text{varepsilon}$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *African Geography, Panel Data, Quantitative Methods, Qualitative Research, Healthcare Delivery, Geographic Isolation, Methodological Evaluation*

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