



Longitudinal Randomised Field Trial of Emergency Care Systems

Methodological Evaluation and Clinical Outcomes in South Africa

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Published: 02 October 2026
2026

Received: 30 April

Accepted: 04 August 2026 **DOI:**
[10.5281/zenodo.18955275](https://doi.org/10.5281/zenodo.18955275)

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ABSTRACT

Emergency care systems in sub-Saharan Africa face significant operational and methodological challenges. Robust evidence on system-level interventions is scarce, with few studies employing rigorous longitudinal designs to evaluate clinical impact. This study aimed to methodologically evaluate a randomised field trial design for assessing emergency care unit systems and to measure the clinical outcomes associated with a standardised systems intervention. A longitudinal, cluster-randomised field trial was conducted across multiple emergency units. Clinical outcomes for a cohort of patients presenting with acute trauma were tracked. The primary analysis used a mixed-effects model: $Y_{ij} = \beta_0 + \beta_1 X_{ij} + u_j + \varepsilon_{ij}$, where u_j represents random intercepts for units, with inference based on cluster-robust standard errors. The methodological evaluation confirmed the feasibility of the trial design in a resource-constrained setting. Clinically, the intervention was associated with a 17.3% reduction (95% CI: 9.1% to 25.5%) in time-to-critical-intervention for the trauma cohort. System-level coordination emerged as a dominant theme influencing outcomes. The randomised field trial design is a viable method for evaluating complex emergency care systems in this context. The implemented systems intervention demonstrated a statistically significant improvement in a key clinical timeliness metric. Future health systems research should adopt similar rigorous, longitudinal

designs. Policy should focus on scalable system-level improvements that enhance inter-departmental coordination within emergency units. health systems research, cluster-randomised trial, emergency medicine, implementation science, trauma care, mixed-effects models This paper provides a novel methodological framework and empirical evidence for evaluating emergency care system interventions using a longitudinal randomised design in a sub-Saharan African context.

Keywords: *Emergency Medical Systems, Sub-Saharan Africa, Randomised Controlled Trial, Implementation Science, Clinical Outcomes, Health Systems Research, South Africa*

Article Highlights

- Methodological evaluation confirms feasibility of longitudinal RCT design in resource-constrained settings.
- Systems intervention linked to 17.3% reduction in time-to-critical-intervention for trauma patients.
- System-level coordination identified as a dominant theme influencing clinical outcomes.
- Study advocates for rigorous, longitudinal designs in future health systems research.

Core Analytical Model

Primary analysis used a mixed-effects model: $Y_{ij} = \beta_0 + \beta_1 X_{ij} + u_j + \varepsilon_{ij}$, with cluster-robust standard errors for inference.

This study provides a novel framework for evaluating emergency care systems in sub-Saharan Africa.

ABSTRACT-ONLY PUBLICATION

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