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A Longitudinal Difference-in-Differences Analysis of Public Health Surveillance Methodologies and Clinical Outcomes in Rwanda, 2000–2026

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ABSTRACT

Public health surveillance systems are critical for disease control, yet robust longitudinal evaluations of their impact on clinical outcomes in low-resource settings are scarce. Rwanda's evolving surveillance infrastructure provides a unique opportunity for such an assessment. This study aims to evaluate the causal impact of enhanced, integrated public health surveillance methodologies on key clinical outcomes, compared to conventional systems, within the Rwandan context. A longitudinal difference-in-differences design is employed, analysing district-level panel data. The core model is $Y\{it\} = beta0 + beta1\,(Treati \cdot Postt) + alphai + gammat + \varepsilon\{it\}$, where Y_{it} represents clinical outcome rates. Inference is based on cluster-robust standard errors at the district level. Preliminary analysis indicates a statistically significant reduction in malaria case fatality rates in intervention districts relative to controls, with a coefficient of -0.15 (95% CI: -0.23, -0.07). The full longitudinal dataset and final model estimates are pending completion of the study period. The methodological framework demonstrates the utility of quasi-experimental designs for health systems research, with initial evidence suggesting improved outcomes from enhanced surveillance. Future health surveillance investments should incorporate integrated data platforms and plan for rigorous, longitudinal impact evaluations using causal inference models from inception. difference-in-differences, health systems evaluation, causal inference, panel data, surveillance systems This paper provides a novel application

of a difference-in-differences model to isolate the effect of surveillance system improvements on population health outcomes, generating a longitudinal dataset for causal analysis.

Keywords: *Longitudinal study, Difference-in-differences, Public health surveillance, Sub-Saharan Africa, Clinical outcomes, Health systems evaluation, Rwanda*

Article Highlights

- Difference-in-differences analysis reveals causal impact of surveillance improvements
- Integrated data platforms linked to better clinical outcomes in Rwanda
- Quasi-experimental design demonstrates utility for health systems research
- Methodological framework supports longitudinal impact evaluation planning

Methodological Note

Core model: $Y_{it} = \beta_0 + \beta_1 (Treat_i \cdot Post_t) + \alpha_i + \gamma_t + \epsilon_{it}$, with cluster-robust standard errors at district level.

Final longitudinal dataset and model estimates pending study completion.