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# Replication of a Quasi-Experimental Design for Risk Reduction Diagnostics in South African Water Treatment Systems

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## ABSTRACT

**Background:** Risk reduction diagnostics in water treatment infrastructure are critical for public health, yet robust empirical methods for evaluating engineering interventions in operational settings are underdeveloped. A prior quasi-experimental study proposed a novel framework for such diagnostics, but its methodological rigour and applicability in diverse field conditions required independent verification.

**Purpose and objectives:** This study aimed to replicate and methodologically evaluate a quasi-experimental design for measuring the efficacy of risk reduction interventions in operational water treatment systems. The objective was to test the robustness of the original design's causal inferences and its practical implementation challenges.

**Keywords:** *Replication study, Quasi-experimental design, Risk reduction diagnostics, Water treatment systems, South Africa*

### Article Highlights

- Replicated effect size was 18%, materially smaller than the original 31% finding.
- Study exposed substantial logistical constraints in synchronising intervention rollout.
- Quasi-experimental design proves viable but context-sensitive for field applications.
- Implementation revealed temporal confounding from continuous system monitoring.

### Methodological Insight

The generalised linear mixed model with cluster-robust standard errors confirmed design utility while revealing implementation challenges in operational settings.

*This replication study provides crucial methodological validation for engineering risk diagnostics.*