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A Randomised Field Trial of a Diagnostic Framework for Health Systems Optimisation in Nigerian District Hospitals

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ABSTRACT

District hospitals in Nigeria face systemic inefficiencies that impede health service delivery, yet evidence-based frameworks for diagnosing and optimising these complex systems are lacking. This study aimed to evaluate the efficacy of a novel diagnostic framework for health systems optimisation by measuring its impact on service yield in a randomised field trial. We conducted a cluster-randomised controlled trial across 40 district hospitals. Intervention hospitals implemented a structured diagnostic assessment of core operational subsystems (triage, laboratory, pharmacy, inpatient care), followed by targeted process redesign. The primary outcome was the composite service yield index. Analysis used a linear mixed-effects model: $Y\{ij\} = beta0 + beta1\,T\{ij\} + uj + \varepsilon\{ij\}$, where $Y\{ij\}$ is the yield for hospital j at time i, $T\{ij\}$ is the treatment indicator, uj is the hospital random effect, and $\varepsilon\{ij\}$ is the error term. Robust standard errors were estimated. Hospitals receiving the intervention demonstrated a significant increase in mean service yield (18.7 percentage points, 95% CI: 12.3 to 25.1) compared to control hospitals. The greatest improvement was observed in pharmacy subsystem efficiency, which increased by 32%. The diagnostic framework effectively identified and remediated systemic bottlenecks, leading to substantial and measurable gains in overall hospital service output. Health policymakers should integrate structured diagnostic assessments into routine hospital management cycles. Future implementation should prioritise pharmacy and laboratory subsystems for initial optimisation. health systems strengthening, operational research, randomised controlled trial, process optimisation, service delivery, district hospitals This paper provides the first experimental evidence for a structured diagnostic method to optimise district hospital systems in Nigeria, demonstrating a scalable model for improving service yield.

Keywords: *District hospitals, Nigeria, Health systems research, Randomised controlled trial, Diagnostic framework,*

Service delivery, Sub-Saharan Africa

Article Highlights

- Intervention hospitals showed an 18.7 percentage point increase in composite service yield.
- Pharmacy subsystem efficiency demonstrated the greatest improvement at 32%.
- The framework identifies bottlenecks in triage, lab, pharmacy, and inpatient care.
- Provides first experimental evidence for a scalable diagnostic model in Nigeria.

Methodological Note

Cluster-randomised controlled trial across 40 hospitals using a linear mixed-effects model to estimate the treatment effect on service yield.

This trial demonstrates a practical, evidence-based tool for health systems strengthening.