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A Systematic Review of Panel Data Methodologies for Evaluating Technical Efficiency in South African District Health Systems, 2000–2026

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ABSTRACT

Background: District health systems are critical for delivering primary and secondary care in South Africa, yet persistent inefficiencies constrain service delivery. Technical efficiency analysis using panel data offers a robust framework for identifying performance drivers over time, but the methodological approaches and their applications within this context have not been systematically catalogued.

Purpose and objectives: This systematic review aims to identify, evaluate, and synthesise the panel data methodologies employed to estimate technical efficiency within the district health system, assessing their comparative strengths, limitations, and contextual appropriateness.

Keywords: *Technical efficiency, Panel data analysis, District health systems, South Africa, Healthcare evaluation, Data envelopment analysis, Stochastic frontier analysis*

Article Highlights

- True fixed-effects models outperform conventional estimators by controlling for unobserved heterogeneity.
- Methodological choice directly alters efficiency estimates and subsequent policy inferences.
- Routine data collection must be strengthened to support robust longitudinal analysis.
- Advanced panel estimators best separate persistent heterogeneity from time-varying inefficiency.

Core Analytical Model

The review assessed models of the form $\ln y_{it} = \beta_0 + \beta \ln x_{it} + v_{it} - u_{it}$, where u_{it} represents time-varying inefficiency.

This review synthesises 27 studies to map the methodological landscape for efficiency analysis.