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Operational Efficiency and Healthcare Quality in First-Level Hospitals in Zambia: Evidence from Chilenje and Matero Facilities

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Abstract

Background: Health systems in low- and middle-income countries continue to face persistent resource constraints and service delivery inefficiencies that undermine healthcare quality. In Zambia, First Level Hospitals (FLHs) play a critical role in delivering essential healthcare services; however, they continue to experience operational challenges such as prolonged waiting times, shortages of essential resources, and workforce limitations. Despite global emphasis on improving operational efficiency to achieve Universal Health Coverage, there remains limited empirical evidence on the relationship between operational efficiency and healthcare quality within the Zambian context.

Methods: A facility-based quantitative cross-sectional study was conducted at Chilenje and Matero First Level Hospitals in Lusaka, Zambia. A total of 385 respondents, comprising patients, clinical staff, and hospital administrators, were selected using Cochran's formula. Data was collected using a structured Likert-scale questionnaire and analyzed using SPSS version 26. Descriptive statistics were used to summarize key variables, while Pearson correlation and multiple linear regression analyses were employed to examine the relationships between operational efficiency indicators and healthcare quality.

Results: The findings revealed substantial operational inefficiencies, including prolonged patient waiting times, despite the high perceived affordability of healthcare services. Significant shortages of medical and laboratory equipment, essential medicines, and healthcare personnel were widely reported. Correlation analysis demonstrated significant positive relationships among health system components ($r = 0.47–0.62$, $p < 0.01$), indicating strong interdependence within the healthcare system. Multiple regression analysis confirmed that all operational efficiency variables significantly predicted healthcare quality outcomes ($p < 0.05$), with staff availability ($\beta = 0.30$) and medicine supply ($\beta = 0.27$) exerting the strongest influence. Patient satisfaction was primarily associated with resource availability and reduced waiting times, whereas affordability was not found to be a significant predictor of healthcare quality.

Conclusion: Operational efficiency is a significant determinant of healthcare quality in Zambia's First Level Hospitals. Strengthening human resources and ensuring a consistent supply of essential medicines represent critical leverage points for improving service delivery. The findings underscore the need for integrated, system-level interventions aimed at enhancing operational efficiency, reducing service delays, and improving patient outcomes in resource-constrained healthcare settings. Future research employing longitudinal and multi-site study designs is recommended to evaluate the effectiveness of targeted operational interventions on healthcare outcomes over time.

Keywords: Operational efficiency; Healthcare quality; Patient satisfaction; Resource availability

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1. Introduction

Health systems globally are increasingly constrained by limited financial and human resources while simultaneously facing rising expectations for high-quality service delivery. Consequently, the efficient utilization of key inputs, including workforce, infrastructure, equipment, and financing, has become a central objective of health sector reforms [1]. However, persistent operational inefficiencies, manifested through prolonged waiting times, frequent stock-outs of essential medicines, underutilized infrastructure, and suboptimal patient experiences, continue to undermine the quality and effectiveness of healthcare delivery [2].

In this context, healthcare quality is commonly conceptualized using the Donabedian framework, which delineates three interrelated dimensions: structure, process, and outcomes [3]. Structural quality encompasses physical infrastructure, human resources, and equipment; process quality reflects adherence to clinical protocols, timeliness, and continuity of care; while outcome quality captures patient health status, mortality reduction, and patient satisfaction. Importantly, operational efficiency acts as a cross-cutting determinant influencing all three dimensions by shaping how effectively available resources are mobilized and translated into healthcare outputs [2]. At the global level, inefficiency represents a substantial loss of health system resources, with estimates indicating that approximately 20 - 40% of health expenditure is lost due to suboptimal resource use [1]. Accordingly, improving efficiency in low- and middle-income countries (LMICs) is pivotal for advancing Universal Health Coverage (UHC) and achieving Sustainable Development Goal 3 (SDG 3).

Within Zambia, First Level Hospitals (FLHs) constitute a critical component of the health system, serving as referral facilities for primary healthcare centres and delivering a wide range of services, including outpatient, inpatient, maternity, and emergency care. These facilities cater to large and often underserved populations, particularly in peri-urban and rural settings [4]. Despite ongoing health sector reforms, FLHs continue to face systemic challenges such as workforce shortages, inequitable resource distribution, and recurrent supply chain disruptions, which collectively constrain operational performance and service quality.

Although prior studies in Sub-Saharan Africa have predominantly evaluated hospital efficiency using approaches such as Data Envelopment Analysis (DEA) [1,6], limited empirical evidence exists on the direct relationship between operational efficiency and healthcare quality outcomes in the Zambian context. Furthermore, the tendency to examine efficiency and quality as separate constructs represents a critical gap, limiting the development of integrated, evidence-based performance improvement strategies.

Therefore, the present study investigated the influence of operational efficiency on healthcare quality in selected First Level Hospitals in Lusaka, Zambia, with a focus on Chilenje and Matero First Level Hospitals. By integrating efficiency and quality indicators, the study aimed to generate context-specific evidence to inform targeted operational interventions and policy decisions for strengthening health system performance and improving patient outcomes.

2. Methods

A facility-based quantitative cross-sectional study design was employed to examine the relationship between operational efficiency and healthcare quality in Zambia's FLHs. The study was conducted in two purposively selected public FLHs which were Chilenje and Matero FLHs in Lusaka District, selected based on patient volume, geographic representation (urban and peri-urban), and scope of services offered.

The sample size was determined using the Cochran formula below at a 95% confidence level and 5% margin of error, yielding a targeted sample size of 385 respondents comprising 168 patients, 189 clinical staff, and 28 hospital administrators.

$$n = \frac{Z^2 p(1-p)}{d^2}$$

Where;

- n = sample size of the unknown population
- z^2 = Selected critical value of desired confidence level
- p = Estimated proportion of an attribute that is present in the population
- d^2 = The desired level of precision

Data were collected using a structured, self-administered questionnaire developed from established literature on health systems performance, operational efficiency, and healthcare quality. The instrument was pretested on a subset of 15 respondents to ensure clarity, contextual relevance, and content validity, with subsequent refinements made accordingly. All items were measured on a 5-point Likert scale. Reliability analysis demonstrated high internal consistency (Cronbach's alpha = 0.89), while content and construct validity were confirmed through expert review and factor analysis.

Completed questionnaires were screened for completeness, and data were double entered into SPSS version 26 to minimize entry errors. Data cleaning procedures included checks for missing values, outliers, and inconsistencies, with minimal missing data handled using listwise deletion. Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to summarize respondent characteristics and key study variables which included waiting time, service affordability, resource availability, and patient satisfaction.

Inferential analysis involved Pearson correlation to assess the strength and direction of bivariate relationships between operational efficiency indicators and healthcare quality. Multiple linear regression analysis was subsequently conducted to identify significant predictors of healthcare quality and quantify the relative contribution of operational variables, with standardized beta coefficients (β) and the coefficient of determination (R^2) used to evaluate model performance and explanatory power.

3. Results

3.1. Socio-demographic Characteristics of the Study Participants

As shown in Figure 1, a total of 385 respondents were included, with a near-equal distribution between Matero (52%) and Chilenje (48%) FLHs. The study participants were predominantly aged between 21-40 years (60-65%), with a slight female predominance (55- 60%), while older age groups (≥50 years) were minimally represented.

Non-management staff constituted the largest proportion (49.1%), followed by patients (43.6%), with limited representation from management (7.3%). Educational attainment was mainly at undergraduate level (50%), with fewer diploma (20 - 25%), certificate (10 - 15%), and postgraduate qualifications (<5%).

Most respondents had ≤3 years of work experience (45-50%), followed by 3-6 years (25-30%), while >10 years was less common (10-15%). Nurses formed the largest professional group (40-45%), and the majority of respondents were outpatient clients (60 - 65%). Overall, the sample reflects a predominantly young, early-career workforce with mid-level qualifications (Figure 1).

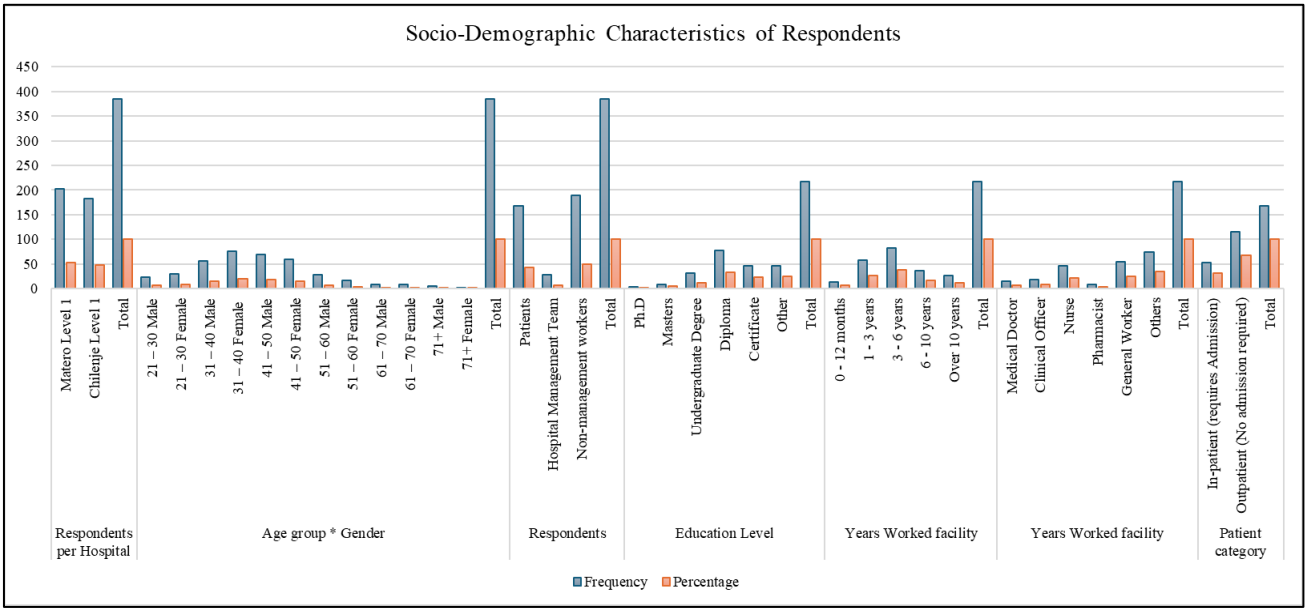

Figure 1 Socio-demographic Characteristics of the Study Participants

3.2. Patient Wait Times and Length of Stay

The findings indicate notable operational inefficiencies, characterized by prolonged patient waiting times despite generally short hospital stays and high perceived affordability of services (Table 1). Most respondents reported waiting for about 1 - 2 hours for doctor consultation (39.3%), followed by 30 minutes - 1 hour (27.4%) and over 2 hours (25.0%), with only 8.3% being attended within 30 minutes.

In contrast, the length of hospital stay was predominantly short, with the majority of patients spending between 1-4 hours from the hospital (38.7%). Other durations of hospital stay included 0 - 1 hour and 4 - 8 hours (14.9% each), while extended stays beyond 24 hours were relatively uncommon, including 1 - 4 days (11.9%), 5 days - 1 week (4.8%), and over one week (1.8%) respectively.

Perceived affordability of services was high, with 92.26% of respondents indicating that services were affordable, compared to 7.74% who reported otherwise. Overall, the results suggest that while financial access to care is largely adequate, delays in service delivery remain a critical operational challenge.

Table 1 Wait time for doctor consultation, Length of hospital stay and affordability

Category	Description	Frequency	Percentage	Std. Deviation
Patient Wait Time for Doctor Consultation	0 mins - 30 Mins	14	8.3	0.909
	30 mins - 1 Hour	46	27.4	
	1 hour - 2 Hours	66	39.3	
	Over 2 Hours	42	25.0	
	Total	168	100.0	
Length of Hospital Stay	0 mins - 1 Hour	25	14.9	1.519
	1 hour - 4 Hours	65	38.7	
	4 hours - 8 Hours	25	14.9	
	8 hours - 24 hours	22	13.1	
	1 day - 4 Days	20	11.9	
	4 days - 1 Week	8	4.8	
	Over 1 Week	3	1.8	
	Total	168	100.0	
Affordability of services	Yes	155	92.26	0.163
	No	13	7.74	
	Total	168	100.0	

3.3. Availability of Hospital Equipment, Supplies, and Workforce

The findings in Table 2 demonstrate pronounced deficits in critical health system inputs, indicating constrained operational capacity across the assessed facilities. For instance, among hospital management respondents, a substantial proportion reported inadequate availability of essential resources such medical equipment (82.1%; Mean = 1.82, SD = 0.390), medicines (67.9%; Mean = 1.68, SD = 0.476), medical supplies (75.0%; Mean = 1.75, SD = 0.441), laboratory equipment and reagents (64.3%; Mean = 1.64, SD = 0.488), and hospital staff (78.6%; Mean = 1.79, SD = 0.418).

Consistent with these findings, non-management respondents also reported significant workforce constraints, with 62.4% indicating inadequate staff availability compared to 37.6% reporting adequacy (Mean = 1.62; SD = 0.486). The low mean scores across indicators (approaching the “No” response category) further substantiate the widespread perception of insufficient resource availability.

Table 2 Availability of hospital Equipment, Supplies and Workers

Variable	Respondent	Yes N (%)	No N (%)	Mean	Std. Deviation
Medical equipment for treatment/procedures	Hospital management	5 (17.9)	23 (82.1)	1.82	0.39
Medicines for any illness	Hospital management	9 (32.1)	19 (67.9)	1.68	0.476
Medical supplies always available	Hospital management	7 (25.0)	21 (75.0)	1.75	0.441
Laboratory equipment for all tests	Hospital management	10 (35.7)	18 (64.3)	1.64	0.488
Hospital staff availability	Hospital management	6 (21.4)	22 (78.6)	1.79	0.418
Hospital staff availability	Non-management	71 (37.6)	118 (62.4)	1.62	0.486

3.4. Interrelationships Among Health System Components

As shown in Table 3, all variables, medical/laboratory equipment, medicines supply, and staff availability, were positively and significantly correlated ($p < 0.01$), indicating strong interrelationships among health system components in the assessed first-level hospitals (FLHs). Medical/laboratory equipment exhibited a strong correlation with medicines supply ($r = 0.62$, $p < 0.01$) and a moderate correlation with staff availability ($r = 0.49$, $p < 0.01$). Similarly, medicines supply was moderately associated with staff availability ($r = 0.52$, $p < 0.01$). Overall, these findings suggest that improvements in one component of the health system are likely to be associated with improvements in others, reflecting the integrated nature of healthcare service delivery systems.

Table 3 Interrelationships Among Health System Components

Variable	1	2	3	4
Medical Equipment	1			
Medicines Supply	0.62**	1		
Laboratory Equipment	0.55**	0.60**	1	
Staff Availability	0.49**	0.52**	0.47**	1

3.5. Predictors of Health System Performance

Table 4 presents the multiple linear regression results examining the influence of medical equipment, medicines supply, and staff availability on the dependent variable. The regression model shows that all four independent variables are statistically significant predictors of the outcome variable (quality of the healthcare service provided by the FLH) ($p < 0.05$). Among the predictors, staff availability had the strongest standardized effect ($\beta = 0.30$, $p = 0.001$), suggesting it is the most influential determinant of the outcome. This was followed by availability of essential medicines ($\beta = 0.27$, $p = 0.001$), laboratory equipment ($\beta = 0.21$, $p = 0.003$), and medical equipment ($\beta = 0.20$, $p = 0.005$). The findings indicate that all health system components contribute positively and significantly to the outcome, with human resource capacity (staff availability) and pharmaceutical supply systems (medicines supply) exerting relatively greater influence.

Table 4 Predictors of Health System Performance

Variable	B	Std. Error	Beta (β)	t	Sig.
Constant	0.72	0.28	-	2.57	.011
Medical Equipment	0.17	0.06	0.2	2.83	.005
Medicines Supply	0.23	0.07	0.27	3.29	.001
Laboratory Equipment	0.18	0.06	0.21	3	.003
Staff Availability	0.26	0.08	0.3	3.25	.001

4. Discussion

The findings of the current study affirm that operational efficiency plays a critical role in shaping healthcare quality in First Level Hospitals in Zambia. The observed prolonged waiting times, variability in service delivery, and resource constraints highlight systemic operational challenges that influence patient experiences and service outcomes. These results underscore the need for operational reforms and resource optimization as essential strategies for improving healthcare quality in resource-constrained settings.

Prolonged patient waiting times before consultation were common, with the majority of respondents reporting waits of one to two hours and a notable proportion waiting longer. Extended delays in service delivery are widely recognized as a barrier to healthcare utilization and a determinant of patient dissatisfaction. Studies by other scholars indicate that waiting time is a strong predictor of perceived service quality, with delays often interpreted as indicators of inefficiency [7,8]. In low-resource health systems, high patient volumes and limited staffing further exacerbate service bottlenecks, reducing operational efficiency and quality outcomes [9]. The moderate variability in waiting times observed in this study suggests inconsistencies in operational processes across facilities, likely reflecting differences in patient flow management and triage systems. Studies have shown that structured triage protocols and optimized scheduling can reduce delays and enhance service efficiency [10], highlighting the potential for operational improvements in FLHs.

Variability in length of hospital stay further reflects operational bottlenecks in diagnostic and treatment processes. Extended stays often result from delays in diagnostic testing, treatment initiation, and discharge procedures, increasing resource utilization and operational costs. Research in East Africa has demonstrated that diagnostic delays significantly prolong hospital stays and reduce system efficiency [11]. When diagnostic infrastructure is limited, patients may remain in facilities longer than necessary, awaiting results or clinical decisions. This not only increases operational costs but also exposes patients to additional risks such as hospital-acquired infections. Operational strategies such as point-of-care testing and streamlined diagnostic workflows have been shown to reduce length of stay and improve service throughput [12]. These interventions are particularly relevant for FLHs, which serve as primary entry points to the health system and frequently experience high service demand.

Resource allocation emerged as a critical determinant of operational efficiency and healthcare quality. Inadequacies in medical equipment, medicines, and staffing levels reflect systemic constraints that undermine service delivery. Resource shortages disrupt clinical workflows and contribute to treatment delays, reducing service capacity and patient satisfaction. Evidence from sub-Saharan Africa demonstrates that medicine stockouts and equipment shortages negatively affect service quality and clinical outcomes [13,14]. When essential resources are unavailable, clinicians may delay care or refer patients to higher-level facilities, increasing system burden and reducing efficiency. These findings emphasize the importance of strengthening supply chain systems and ensuring consistent availability of medical resources as core components of operational reform.

Human resource constraints further exacerbate operational inefficiencies by increasing workloads and reducing time available for patient interactions. Staffing shortages often lead to extended waiting times and diminished service quality, as overburdened staff struggle to meet patient demand. Studies have shown that facilities with adequate staffing levels achieve shorter waiting times and higher patient satisfaction [15]. Task-sharing and optimized staff deployment strategies offer feasible solutions in resource-limited settings, enabling health systems to maximize existing human resources while maintaining service quality [16]. These approaches are particularly relevant for first level hospitals, where workforce constraints frequently limit operational capacity.

The correlation analysis demonstrated that core health system inputs; medical/laboratory equipment, medicines supply, and staff availability, are positively and significantly interrelated, confirming strong interdependence among service delivery components in FLHs. Furthermore, the regression results established that all components significantly influence healthcare quality, with staff availability and medicines supply exerting the greatest effect. This indicates that operational efficiency, as a determinant of healthcare quality, is primarily driven by the combined effectiveness of human resources and essential supply systems.

These findings are consistent with the WHO health systems framework, which posits that healthcare quality outcomes depend on the coordinated performance of multiple system inputs [1,18]. Empirical studies across sub-Saharan Africa similarly highlight that adequate staffing and reliable medicine supply chains are critical determinants of service quality and patient outcomes. For example, studies in Kenya and Tanzania have shown that facilities with sufficient health personnel and consistent drug availability achieve better clinical outcomes and higher patient satisfaction [9,18]. Comparable evidence from Zambia also indicates that shortages in human resources and essential medicines significantly undermine healthcare delivery at primary care level [13,20,21,22].

From an analytical standpoint, the present findings reinforce that operational efficiency is a multi-dimensional, system-level construct, arising from the interaction of interdependent inputs. The relatively stronger influence of staff availability and medicines supply suggests that these components function as critical leverage points within the healthcare system. This aligns with prior research demonstrating that even where infrastructure and equipment are available, inefficiencies in staffing and pharmaceutical supply chains can substantially compromise service quality [19,18,21,23].

Overall, the findings both support and extend existing literature by showing that in Chilenje and Matero first-level hospitals, improving healthcare quality requires integrated strengthening of human resources and supply systems, rather than isolated investments in individual components.

5. Conclusion

Our present study demonstrates that operational efficiency is a key determinant of healthcare quality in First Level Hospitals in Zambia. While services are generally affordable, prolonged waiting times and shortages in staff and essential medicines significantly undermine service delivery and patient satisfaction.

The findings demonstrate that healthcare quality is influenced by the combined functioning of health system components, with staff availability and medicines supply emerging as the most influential factors. Patient satisfaction is more strongly influenced by timeliness and resource availability than by cost.

Improving healthcare quality in FLHs therefore requires integrated system-level interventions, particularly strengthening human resources, ensuring consistent medicine supply, and optimizing patient flow processes.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

The authors declare no conflicts of interest.

Statement of ethical approval

Ethical approval was obtained from the University of Lusaka Research Ethics Committee and the National Health Research Authority (NHRA). All procedures complied with local and international ethical standards for research involving human participants.

Statement of informed consent

Informed consent was obtained from all participants, who were assured of confidentiality and the right to withdraw.

Transparency Statement

The corresponding author, Bubala Namakobo, affirms that this manuscript presents an honest, accurate, and transparent account of the study, and that no important aspects of the study have been omitted.

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