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Determinants of Hospital Efficiency: A Case of Dodoma Regional and Benjamin Mkapa Referral Hospitals in Tanzania

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The study aimed to evaluate effect of medical equipment technology and financial allocation on efficiency of referral hospitals in Dodoma City. A mixed approach was used, combining qualitative and quantitative data through a cross-sectional survey design, with simple random sampling. Based on the Economic Theories of Hospital Behavior, the study focused on Dodoma referral hospital staff, with a sample size of 277. Data were collected via surveys, documentary reviews, and focus group discussions, using both primary and secondary sources. Descriptive analysis covered demographic factors like sex, age, education, and work experience, while multiple regression analyzed the effects. The findings revealed that both medical equipment technology and financial allocation significantly improved hospital efficiency. The researcher recommends that government should provide modern medical equipment and ensure effective financial allocation to hospitals. Implementing these measures could increase bed turnover rate and diagnostic capabilities while reducing mortality and average length of stay (ALOS) variables in selected hospitals.

1. Introduction

Efficient healthcare services are vital to any population, particularly in fast-growing urban areas like Dodoma City in Tanzania. Performance of referral hospitals is crucial for providing timely, quality care, but factors such as medical equipment technology and financial allocation significantly affect their efficiency. This study investigates how these factors influence hospital performance. Medical equipment technology is essential for improving diagnosis, treatment, and patient outcomes. Modern tools enhance efficiency, while outdated technology can hinder care (Smith & Jones, 2022). Similarly, financial resources are vital for acquiring and maintaining equipment, hiring staff, and ensuring operational efficiency of hospitals (Ngoma & Mchome, 2021). Therefore, this study examines the impact of financial allocation, medical equipment and technology on hospital performance.

Addressing these challenges will help policymakers improve healthcare delivery by bridging gaps in technology and financial management. Acquiring modern medical equipment and ensuring its proper use are essential for enhancing diagnosis and treatment accuracy, improving patient outcomes. Prioritizing financial resources to upgrade outdated equipment and invest in maintenance boosts operational efficiency, reduces delays, and elevates healthcare quality (Smith & Jones, 2022). Equitable distribution of financial resources across hospital departments ensures sufficient personnel, necessary supplies, and better care standards (Ngoma & Mchome, 2021). Identifying key factors affecting hospital efficiency provide a room for policymakers to adopt the desired improvements. Furthermore, solving gaps related to technology necessitate allocation of funds for upgrading hospitals equipment and staff training. Understanding the link between financial management and performance ensures that hospitals maintain quality service despite budget constraints (Mwakyusa & Nondo, 2022).

Despite these evident challenges, research on the effects of medical technology and financial allocation on hospital efficiency in Dodoma remains limited. Previous researchers have given little attention on the link between fund allocation, technological advancements in hospitals equipment and efficiency particularly in referral hospitals (Mwakyusa & Nondo, 2022; Lugalla & Malecela, 2021). This study aims to fill these gaps, providing valuable insights to improve hospital efficiency in Dodoma.

The study indented to evaluate determinants of efficiency focusing on Dodoma regional and Benjamin Mkapa referral hospitals in Tanzania. The study specifically, aims to determine effect of medical equipment technology level on the efficiency of the referral hospitals in Dodoma city, examination of the effect of financial allocation on the efficiency of the referral hospitals in Dodoma city; and assessment of effect of motivation of staff on efficiency of referral hospitals in Dodoma city. This study is significant as it addresses key determinants of efficiency in Dodoma Regional and Benjamin Mkapa Referral Hospitals, contributing towards improvement of healthcare services in the region. By evaluating factors such as medical equipment technology and financial resource allocation, the study provides insights into operational challenges that hinder hospital performance (Smith & Jones, 2022). Understanding these determinants is crucial for optimizing resource use, enhancing patient care, and improving health outcomes (Ngoma & Mchome, 2021). Findings from the study is expected to guide hospital administrators and policymakers in making informed decisions that promote efficiency and better healthcare delivery (Mwakyusa & Nondo, 2022; Lugalla & Malecela, 2021)

2. Literature Review

The efficiency of referral hospitals is a critical factor in ensuring the effective delivery of healthcare services, especially in low- and middle-income countries. Recent empirical studies have focused on identifying the key determinants of hospital efficiency across different regions, using various analytical methods and frameworks. Tchouaket and Kouadio (2024) conducted an in-depth investigation into the operational efficiency of referral hospitals in Côte d'Ivoire. Their study highlights the significant roles of human resources, management practices, and technological advancements in shaping hospital efficiency. By examining these factors, the authors provide valuable insights into how hospital management can be optimized to enhance service delivery.

In a related study, Ayalew (2023) employed Data Envelopment Analysis (DEA) to evaluate the efficiency of referral hospitals in Ethiopia. The DEA approach allowed for the identification of critical inputs and outputs that influence hospital performance, offering a comprehensive framework for benchmarking efficiency in healthcare settings. Abubakar and Adamu (2022) investigated the determinants of hospital efficiency in Nigeria, focusing on financial management practices, staffing levels, and patient throughput. Their findings underline the importance of sound financial policies and adequate staffing in improving the operational capacity of re-

referral hospitals in the country. Karami and Nasiri (2021) used a Stochastic Frontier Analysis (SFA) to assess hospital efficiency in Iran. Their study stresses the impact of external funding and institutional governance on hospital performance, they further suggested that effective resources management and governance structures are very essential for optimizing hospital operations.

Additionally, Owusu and Kwarteng (2021) conducted a systematic review of hospital efficiency and quality of care in Ghana. Their review revealed that hospital efficiency is closely linked to resource allocation and quality of care, signifying that improvement in these areas can significantly enhance performance of referral hospitals. The importance of medical equipment technology in enhancing hospital efficiency has been well- documented in various studies. For instance, Muhoza and Ntazinda (2021) highlighted that the adoption of advanced medical technologies significantly improves diagnostic accuracy, treatment outcomes, and patient throughput in East African hospitals. Their study found that hospitals equipped with modern imaging systems, automated laboratory technologies, and telemedicine capabilities demonstrated higher levels of operational efficiency. This is because advanced medical equipment reduces patient waiting times and allows for more accurate diagnoses, which in turn reduces the length of hospital stays and the likelihood of medical errors.

In the Tanzanian context, Mwakyusa and Nondo (2022) noted that hospitals with outdated medical equipment faced recurrent breakdowns, causative delays in service delivery and inefficiencies in patient care. Their study stressed the need for ongoing investment in modernizing hospital equipment as a crucial factor for improving overall efficiency, particularly in referral hospitals, which handle complex cases requiring specialized equipment. Likewise, the relationship between financial allocation and hospital efficiency is another critical area of study. Mwaikambo and Mtebe (2022) conducted research on financial management practices in Tanzanian hospitals and found that financial constraints, especially in terms of insufficient budget allocations, severely hampered the ability of hospitals to acquire necessary medical supplies, maintain equipment, and ensure sufficient staffing levels. Hospitals that received more substantial financial allocations were better able to manage operational costs, invest in quality improvement measures, and ultimately improve their service delivery. In another study, Bwana (2022) conducted a study on the determinants of efficiency of private not for profit hospitals, 17 sampled hospitals were engaged in a second stage of DEA (data envelopment analysis). The study revealed that public private partnership and health insurance have positive impact on the performance while average length of stay (ALOS), emergency room visits and percentage have negative impact on the performance.

A study by Lugalla and Malecela (2021) on healthcare financing in Tanzania highlighted that financial allocation disparities between regions affected the performance of healthcare facilities. Their findings revealed that referral hospitals in urban areas, such as Dodoma, often struggle with inefficiencies due to budgetary shortfalls, which result in inadequate infrastructure, limited access to advanced medical technologies, and difficulties in hiring and retaining skilled healthcare professionals. This study emphasizes the need for improved financial planning and allocation mechanisms to enhance the efficiency of referral hospitals in the country. Therefore, the above empirical studies highlight the critical importance of both medical equipment technology and financial allocation in determining the performance of referral hospitals. While these factors have been explored in broader healthcare contexts, there remains a research gap in analyzing their specific impact on referral hospitals in Dodoma City.

3. Methodology

This study used a mixed approach followed by survey research design due to its suitability in establishing the valence of a phenomenon, situation, problem, attitude, or issue by taking a cross-section of the population (Creswell and Creswell, 2018). The study was conducted in Dodoma City Council in Tanzania, focusing on the Dodoma regional referral hospitals. The population of this study comprised the employees of the Dodoma regional referral hospitals. Moreover, PO-PSMGG and the Ministry of Health furnished the data through FGD. The study used simple random sampling for the homogeneous population (general health staff) and purposive sampling for the heterogeneous population (a situation where a specific respondent was required for a specific merit). The purposive sampling technique involved the 13 key informants. The sample size was computed using the Yamane (1967) formula as follows:

$$s = N / (1 + N \times (e)^2) \text{ Where}$$

$$N = \text{population size (904)}$$

$$e = \text{margin of error/precision (0.05)} \quad s = \text{total sample size}$$

$$s = 904 / (1 + 904 \times (0.05)^2) = 277 \text{ respondents}$$

The study used primary and secondary data collected via structured questionnaires, focused group discussions, and documentary reviews, respectively. Descriptive statistics were used to analyze data with the aid of SPSS version 23, establishing multiple occurrences of variables (Kothari, 2014). Similarly, content analysis was used to analyze qualitative data, while multiple regression established the variable correlation. The multiple linear regression method followed the model:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon$$

Where,

$$Y = \text{Efficiency of the referral hospital}$$

$$\beta_0, \beta_1, \text{ and } \beta_2 = \text{are beta coefficients (constants)}$$

$$X_1 = \text{Level of medical equipment technology}$$

$$X_2 = \text{Financial resources allocation}$$

$$\varepsilon = \text{Standard error}$$

To minimize variable errors, the researcher used Cronbach's Alpha (α) to measure reliability, which is the most common internal consistency measure and is generally expressed as a number between 0 and 1. Meanwhile, validity requires that an instrument be reliable, but an instrument can be reliable without being valid. The questionnaire was tested against content validity to ensure that the instrument covered all relevant content that was supposed to be measured.

4. Findings and Discussion

The study intended evaluate determinants of efficiency focusing on Dodoma regional referral hospitals in Tanzania based on the medical equipment technology level financial allocation in the Dodoma regional referral hospitals.

The multiple regression summary and the table for beta coefficients have been shown in Table 1 and Table 2 respectively.

Table 1: Regression Model Summary for Hospital Efficiency Determinants

Model	R	R Square	Adj R Square	Std. Error	
				Estimate	Durbin-Watson
1	.917 ^a	0.841	0.839	0.559	1.912

a. Predictors: (Constant), Medical Equip Tech Level, Financial Allocation

Table 2: Beta Coefficients of Determinants of Referral Hospital Efficiency

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	.143	.066		2.161	.032		
Medical Equipment Technology Level	.260	.069	.429	3.786	.000	.043	5.721
Financial Allocation	.560	.069	.571	8.084	.000	.043	4.517

a. Dependent Variable: Referral Hospital Efficiency

Table 2 shows multiple regression summary with adjusted R square of 83.9% which implies that independent variables (medical equipment technology level and financial allocation) predict the dependent variable (referral hospitals efficiency in Dodoma City) by 83.9%. Therefore, medical equipment technology level and financial allocation are significant predictors of the referral hospital efficiency in Dodoma City. Moreover, findings from Table 2 indicate beta coefficients of medical equipment technology level and probability of = 0.26 and P = 0.000 respectively. These results imply that medical equipment technology level had a positive and significant effect on referral hospital efficiency in Dodoma City. Specifically, the probability was 0.000 which is less than the significance level ($P < 0.05$) meanwhile the beta coefficient was 0.26 which is positive to signify that the change produced was both positive and significant. These observations from this study imply that a unit change in medical equipment technology level causes an increase of referral hospital efficiency in Dodoma City by 26% as expressed in terms of indicators such as patient average length of stay (ALOS), bed turnover rate, equipment diagnostic rate, and mortality rate.

The government through Ministry of Health is supposed to ensure the medical equipment technology level is enhanced to enhance medical diagnostic rates and timely service provision to healthcare services consumers. This can be attained through sufficient allocation of monetary resources to hospitals. When this is acquired, the referral hospital patient average length of stay, bed turnover rate, and equipment diagnostic rate will rise while the mortality rate will drop towards the suggested standard of 2 to 4 deaths as recommended by WHO (2022).

Moreover, the study findings were in harmony with the focused group discussion findings held during the research course. For instance, the consensus from the FGD resolved that:

“ *The medical equipment technology level is crucial in ensuring the diagnostic rate is high to cope with the demand for referral hospitals in Dodoma City Tanzania. Therefore, I perceive that medical equipment technology is greatly wanted as it varies positively and significantly with the referral hospital patient length of stay, bed turnover rate, equipment diagnostic rate, and mortality rate...I therefore strongly support that medical equipment technology level be enhanced as it affects the referral hospitals in terms of lowering the time and cost of diagnosis and also produces the precise and accurate medical results.....*” (Discussion/FDG/2024).

This declaration implies that medical equipment technology level has a positive effect on the referral hospital in Tanzania. Likewise, Table 2 of beta coefficients results shows that financial allocation had a beta coefficient and the probability such that $\beta = 0.56$ and $P = 0.000$. These results imply that financial allocation had a positive and significant effect on referral hospital efficiency in Dodoma City. Specifically, the financial allocation had P value of 0.000 which is less than the significance level ($P < 0.05$). Besides, the beta coefficient was 0.56 signifying that the produced positive and significant effect. This observation from this study implies that a unit change of financial allocation for the hospital causes an increase of referral hospital efficiency in Dodoma City by 56% as expressed in terms of indicators such as patient average length of stay, bed turnover rate, equipment diagnostic rate, and mortality rate. The government through the Ministry of Health is supposed to ensure financial allocation for covering expenses in referral hospitals are timely and sufficiently supplied.

These study results concur with the findings of Mbau *et al.* (2022) and Mewomo and Ndlovu (2022) in South Africa who found that availability of funds, occupants' knowledge, absence of policy guiding facility management practice, state of deterioration of facilities and design concepts and scope were significant challenges efficiency of the management practices in public buildings in South Africa.

Furthermore, study findings tallied with the discussion held during focus group discussion (FGD), such that the discussion revealed:

“ *The financial allocation is crucial in financing various utilities and consumables as such it is urgently demanded as it positively and significantly affects the referral hospital patient length of stay, bed turnover rate, equipment diagnostic rate, mortality rate. I therefore strongly commend the role of financial allocation and prompt financial support to hospitals to ease activities taking place in those hospitals....*” (Session/FGD/2024).

These findings reveal that financial allocation to the referral hospitals is linked to the acquisition of utilities such as power, internet, water, gas and other consumables. Besides, it was noted that the findings of the study tallied with information extracted from the annual meeting minutes of the hospital which states that:

“ Additional financial resources reflected in the annual budget for accounting period for 2023/2024 resulted in lowering the patient length of stay.....”

This observation implies that financial resources allocated in the hospital budgetary affect the efficiency of referral hospital in Tanzania.

5. Conclusion and Recommendations

Based on the results of the study finances are crucial in financing various utilities and consumables for facilitating the efficiency of referral hospitals in Dodoma City. Therefore, financial allocation is a predictor of the efficiency of referral hospitals among selected hospitals. Furthermore, study findings revealed that medical equipment technology level influences the referral hospital efficiency in Dodoma City using parameters such as patient length of stay, bed turnover rate, equipment diagnostic rate, and mortality rate. Therefore, the medical equipment technology is a predictor of the efficiency of referral hospitals in Dodoma Tanzania. Based on the study findings, the researcher recommends that the government through the Ministry of Health ensure that there is sufficient medical equipment with the current technological level. This might be attained through the execution of policy and its associated health strategy. Therefore, the government should ensure that the budget is well implemented by ensuring that allocated finances are richly and timely released to facilitate the acquisition of utilities and consumables. The researcher suggests that Referral hospital management should emphasize the use of modern technology (digital devices) to offer quality services to the community. This action should go hand in hand with preparing an activity-based budget that will reflect the real financial demand in the section/department or hospital as a whole.

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