

APPLICATION OF MULTIPLE LINEAR REGRESSION MODEL IN THE MANAGEMENT OF PHARMACEUTICAL SUPPLIES

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ABSTRACT

The aim of this study was to demonstrate the applicability of the multiple regression models in the management of pharmaceutical supplies in public hospitals in Kenya. The study adopted the descriptive research design. This design was appropriate in establishing, comparing and describing the relationships and the influence among the variables of the study. A sample of 89 respondents (Staff) was employed for the study. The study utilized questionnaires for data collection at Nyeri Teaching and Referral Hospital. Mathematical Model evolved for response show that legal requirements, human resource factor and procurement processes contribute significantly towards proper management of pharmaceutical supplies. This suggests that adherence to legal requirements, involvement of competent employees and adherence to procurement processes would enhance management of pharmaceutical supplies in public hospitals in Kenya. The study exemplified that the development of statistical models for management of pharmaceutical supplies can be useful for predicting and understanding the effects of controlled factors.

KEYWORDS: Legal Factors; Human Resource Factors; Budgeting Factors; Procurement Factors; Management of Pharmaceutical Supplies; Regression Model

1.0 INTRODUCTION

Pharmaceutical drugs play a critical role in the management of health as whenever one is sick medicine are always prescribed by health practitioner. This makes their purchase to represent one of the largest shares of health expenditure in any country worldwide ranging from 5% to 12% in developed countries to as much as 40% in developing countries, [7]. The availability of drugs is thus crucial in the functioning of any hospital. For there to be continuity of flow of drugs, their procurement procedure and challenges

faced are essential and objectives should be considered in the procurement of drugs. Government hospitals in Kenya have for long time experienced frequent shortages of pharmaceutical products. Due to lack of constant supplies, most of the hospitals have been experiencing time-to-time shortages of pharmaceuticals therefore not being in a position to deliver better health care to patients. According to a study commissioned by Transparency International-Kenya, (2001) the shortage has created a trail of misery for patients across the country. In most hospitals, patients have been asked to buy pharmaceutical products from private chemists. In an effort to stabilize the supply of pharmaceutical products, Kenya Medical and Supplies Authority (KEMSA) was set-up by the government in the year 2000 to procure and supply drugs and pharmaceutical supplies to public, mission, and private hospitals in the country. Having formed KEMSA to be in charge of pharmaceutical products distribution in Kenya, the government has taken a move towards achieving consistency in supply to government hospitals,[8]. However, this has not been achieved since, inconsistency in supply of pharmaceutical products still engulf government hospitals in Kenya. The factors culminating to this state of affairs have not been well identified and this research therefore intends to uncover such factors. Chuka Teaching and Referral Hospital is the largest hospital in Tharaka Nithi County. Moreover, the hospital has in the past faced continuous stock outs of pharmaceutical supplies. This has led to an increase in the morbidity and mortality rates within the community. However, no research has been conducted on the issue in this particular hospital. Thus, this study examined the management of pharmaceutical supplies in public hospitals in Kenya with a focus on Chuka Referral and Teaching Hospital.

Theoretical Framework

According to [1], organizational performance is dictated by constraints. These are restrictions that prevent an organization from maximizing its performance and reaching its goals. He explained that constraints involve aspects such as people, supplies, information, equipment, or even policies, and can be internal or external to an organization. The theory postulates that a system can have only one constraint at a time and those other areas of weakness are non-constraints until they become the weakest link. In this study, the processes and systems are represented by management of pharmaceutical supplies while the constraints entail the factors that affect the management of pharmaceutical supplies. This study applies this theory to find out the constraints and non-constraints in effective management of pharmaceutical supplies.

2.0 MATERIAL AND METHODS

Research design

This study adopted the descriptive research design. This design was appropriate in establishing, comparing and describing the relationships and the influence among the variables of the study [3]. The descriptive research design allows the testing of hypotheses using regression and correlation to determine the effectiveness of the legal factor, human resource factor; procurement factor and budgeting factor have significant influence on management of pharmaceutical supplies.

Sample size

A sample of 89 respondents (Staff) was employed for the study. The study utilized questionnaires for data collection at Chuka Referral and Teaching Hospital.

Mathematical Model

The study adopted multiple linear regression models to establish the nature and magnitude of the relationship between the study variables as stated below;

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + e$$

Where

Y =Management of pharmaceutical supplies; $X_i(i=1,2,3,4)$ = i^{th} independent variable (1 =Budgeting factor; 2 =Legal factor; 3 =Human resource factor; 4 =Procurement factor); e = Error term which is normally distributed with a mean of zero and a variance of one. Data was analyzed by use of SPSS version 24.0.

3.0 RESULTS AND DISCUSSIONS

The corrected data was tested to confirm the major assumptions for parametric data analysis.

Table 1: Normality Test

Variable	Kolmogorov-Smirnov		
	Statistic	df	Sig.
X_1	0.374	37	0.058
X_2	0.207	41	0.057
X_3	0.264	10	0.094
X_4	0.058	10	0.050

Normality was tested using Kolmogorov-Smirnov (K-S) one-sample test, a non-parametric goodness of fit test. The test compares the cumulative distribution function for variables within a specified distribution,[2]. The goodness-of-fit test evaluated whether the observations could reasonably have come from the specified distribution. The results of the K-S tests for budgeting factor, legal factor, human resource factor and procurement factor revealed that the study data were normally distributed with a P-value of greater than 5% for all variables.

Table 2: Multicollinearity test

Variable	Collinearity Statistics	
	Tolerance	VIF
X_1	.482	2.075
X_2	.609	1.642
X_3	.544	1.839
X_4	.671	1.491

Multicollinearity in the current study was tested using Variance Inflation Factor (VIF) calculated using SPSS regression procedure as well as examination of correlation coefficient among variables. Multicollinearity refers to the linear correlation among variables. The VIF for independent and dependent variables were found to be less than 3 ($VIF \leq 3$) indicating that there is no problem of Multicollinearity. This implied that independent and dependent variables correlated highly as shown in the Table above.

Table 4: Correlation Analysis

		Y	X ₁	X ₂	X ₃	X ₄
Y	Pearson Correlation	1				
	Sig. (2-tailed)					
	N	89				
X ₁	Pearson Correlation	.046	1			
	Sig. (2-tailed)	.669				
	N	89	89			
X ₂	Pearson Correlation	.419**	.627**	1		
	Sig. (2-tailed)	.000	.000			
	N	89	89	89		
X ₃	Pearson Correlation	.328**	.590**	.771**	1	
	Sig. (2-tailed)	.002	.000	.000		
	N	89	89	89	89	
X ₄	Pearson Correlation	.470**	.473**	.817**	.827**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	89	89	89	89	89

In order to assess the relationships among the independent variables and dependent variable, a correlation analysis was conducted. The results of the Pearson's product moment correlation analysis show varied degrees of interrelationships. Legal factor is statistically significantly correlated with management of pharmaceutical supplies ($r=0.419$; Sig. 2 tailed (P-value) = $0.000 < 0.05$). Similarly, human resource factor is statistically significantly correlated with management of pharmaceutical supplies ($r=0.328$; and sig. 2 tailed (P-value) = $0.002 < 0.05$). However, there exists insignificant correlation between budgeting factor and management of pharmaceutical supplies in Chuka Referral and Teaching Hospital.

Table 5: The Goodness of fit of Model

R	R Square	Adjusted R Square	Std. Error of the Estimate
.860 ^a	.740	.727	.450

The results indicate that the predictors (legal, human resource, procurement) account for 72.7% of variation in the management of pharmaceutical supplies. This implies that predictors explained 72.7% of the variation in the management of pharmaceutical supplies at Chuka Referral and Teaching Hospital.

Table 6: The Overall Significance of Model

	Sum of Squares	df	Mean Square	F	Sig.
Regression	48.290	4	12.073	59.687	.000
Residual	16.990	84	.202		
Total	65.281	88			

F –test was used to assess the overall robustness and significance of the regression model. It was established that the regression equation was statistically significant at 5% significant level ($F=59.687$, P-value 0.000). This implies that the model was adequate for prediction purpose.

Table 7: The Individual Significance of Model

	Unstandardized Coefficients		Standardized Coefficients		t	Sig.
	B	Std. Error	Beta			
(Constant)	.793	.246			3.225	.002
X_1	-.040	.066	-.043		-.607	.546
X_2	.186	.074	-.201		-2.511	.014
X_3	.200	.074	.203		2.691	.009
X_4	.685	.053	.883		12.992	.000

The regression results revealed a statistically significant linear relationship between legal factor and management of pharmaceutical supplies at 5% significance level. The regression coefficient value of the computed scores of the legal factor was 0.186 with a t- test of -2.511 and a significant level of P-value =0.014 < 0.05. This implies that for one unit increase in legal factor, there is an improvement in the management of pharmaceutical supplies by a factor of 0.186. Similarly, the regression coefficient value of the computed scores of the procurement factor is 0.685 with a t- test of 12.992 and a P-value =0.000 < 0.05. This implies that for one unit increase in procurement factor, there is an improvement in the management of pharmaceutical supplies by a factor of 0.685. However, the result indicates that there exist no relationship between budget factor and management of pharmaceutical supplies. The regression equations to estimate improvement of management of pharmaceutical supplies at Chuka Referral and Teaching Hospital is stated as:

$$Y = 0.793 + 0.186X_2 + 0.200X_3 + 0.685X_4$$

Where:

Y = Management of pharmaceutical supplies; X_2 = Legal factor; X_3 = Human resource factor

X_4 = Procurement factor; 0.793 = Constant

In that regard, 0.793 is the estimate of the expected improvement in the management of pharmaceutical supplies when independent variables are zero.

CONCLUSION

The purpose of this study was to demonstrate the applicability of the multiple regression models in the management of pharmaceutical supplies in public hospitals in Kenya. Mathematical Model evolved for response show that legal requirements, human resource factor and procurement processes contribute significantly towards proper management of pharmaceutical supplies. This suggests that adhere to legal requirements, involvement of competent employees and adherence to procurement processes would enhance management of pharmaceutical supplies in Chuka Referral and Teaching Hospital. The study exemplified that the development of statistical models for management of pharmaceutical supplies can be useful for predicting and understanding the effects of controlled factors.

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