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Influence of Quantification of Medical Supplies in Sustainability of Medical Supply Chain in Tanzania

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Abstract

Services, product or supply chain is of utmost importance to any company. This study examining the influence of quantification of medical supplies in the sustainability of medical supply chain in Tanzania. The study utilized a quantitative approach that was paired with a cross-sectional survey research design, the study used a sample size of 150 respondents which included MSD personnel and staff from three medical health facilities. Data gathered from the respondents was analyzed by using multivariate regression analysis and the Statistical Package for Social Science version 32.0 (SPSS) was used to establish the correlation between supply chain factors and the sustainability of MSD's medical supply chain. The findings revealed that the presence of a substantial relationship between the quantification and the sustainability of MSD's medical supply chain since the P-values of the four variables drawn from multiple regression analyses were less than 0.05 so P-Values are 0.045 for quantification, while beta are 0.32811. The study concludes that sustainability with quantification, has proved important in the improvement of the entire value chain of medical supply at MSD, helping this institution address previous challenges related to frequent stockouts in healthcare facilities, promote Corporate Social Responsibility (CSR), and guarantee the sustainable access and availability of pharmaceutical supplies in health facilities in a cost-effective way. From the key findings of the study, the researcher recommends policymakers should establish clear guidelines and regulations that incentivize and mandate sustainable practices within medical supply chains, managerial inefficiencies should be reduced through effectively engaging with its suppliers in order to identify areas of improvement as well as supplement supply with self-production of some essential medicines.

Key Words: *Quantification, Medical Supplies, Sustainability, Medical, Supply Chain*

1. Introduction

Services, product and supply chain are very utmost importance of any company because it helps attain effectiveness, efficiency and sustainability in both the short-term and long-term operations of that organization (Aldhabi et al., 2024). There has been an increasing interest in sustainability of supply chains in public sectors that serve entire populations. One of these sectors is the healthcare system whose importance is rising following the surge in both communicable and non-communicable diseases, medicine-resistant pathogens, endemics turning to pandemics, together with other medical vulnerabilities (Yuksek et al., 2023). To manage, contain, and prevent the spread of infectious diseases, advance national and regional health security objectives and goals, countries have embarked on ensuring quick, reliable and responsive supply chain of medical commodities. Yet, the supply, availability and accessibility of medical commodities in many countries especially Low- And Middle-Income Countries (LMICs) remains a constraint (Eslamipoor & Nobari, 2023).

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Moreover, High-Income Countries (HICs) are also not immune from medical supply chain problems. While these groups of countries face less deficit problems, they experience issues of Substandard and Falsified Medicines (SFMs) which jeopardize the quality of healthcare and causing harm to patients and tremendous economic losses (Naughton & Akgul, 2021). SFMs have been associated with thousands of mortality cases globally, and approximately between US$ 10-200 billion in yearly economic impacts (WHO, 2017). Nevertheless, medical supply chains in both developed and developing countries remain critical whether it be in reducing stockout of medical supplies in LMICs, promoting access to essential and authenticated medicines in HICs (Jbaily et al., 2020).

In HICs, medical supply chains are largely under private sector administration. But, in LMICs, due to capacity constraints within sectors, medical supply chains tend to be under private, public, and Non-Governmental Organizations (NGOs) (Babaley et al., 2011). In most LMICs, it is the public sector (government) that is the main actor in medical supply due to financial constraints of the other two actors, private sector and NGO's (Chalkidou et al., 2017).

While procurement and distribution remain to be factors that directly influence the availability and cost of medicines in health facilities Ivanov (2023), there has been an increase of factors supporting the core functions within a medical supply chain Natembeya et al. (2024), assert that the medicines management chain is made up of four essential functions: selection or quantification, procurement, distribution and usage. Quantification involves estimating the quantity and costs of medical supplies needed at a health facility or for a health programmer (or service) and determining when such products ought to be delivered in order to ensure uninterrupted supply (Ghanbarzadeh et al., 2024). Hence, quantification has come to ease procurement and distribution activities through cost analysis and determining where certain types of medical supplies are needed. Another important function that has increased in importance is storage or management of inventory which plays a significant role in forecasting when medical supplies will be needed so as to prevent stockouts (Kwamboka et al., 2018).

These weaknesses go on to negatively impact the adequate supply of medicines, medical supplies and laboratory supplies subsequently posing greater health risks to patients resulting from circulation of the wrong quality and quantity of medicines. This affects the availability of essential medicines in adequate amounts, in the right dosage, assured quality, and affordable prices (WHO,

2018). Moreover, the resource-deficiency and management weaknesses in these countries add to the existing supply problems uncertainty in financing, unnecessary complexity levels, long intervals in resupply, weak planning capacity, lack of supply chain planning data, and weak incentives to improve supply chain performance (Pamucar et al., 2023). In strengthening health supply chains in LMICs, particularly because of the higher disease burden characterizing such countries, there has been a move to improve access to the right medicines and at the right time through efficiently managed medical supply chains. In ensuring effective supply chains that efficiently operate on a long-term basis, elements such as sustainability have been adopted into supply chains (Chindengwike, 2024).

In Tanzania, the integration of sustainability into the country's health supply chain was implemented through reforms to the MSD, the country's public medical distributor/storerer. The reforms targeted sustainability in procurement and in other supply chain components (Global Fund, 2019). Among the techniques used included partnership of the Tanzanian government and Global Fund to make available necessary funds for timely payment to ensure that MSD operation is sustainable as well as improvement of the revenue generation capacity in order to guarantee sustainable operations (Githendu et al., 2020). Despite such reforms, stockout of medicines in health delivery points continues to persist in Tanzania due to inadequate funding resulting from increase in health services demands, and operational inefficiencies (ibid). However, the extent of medicine stockouts has gone down compared to experience, signifying that the reforms and integration of sustainability in MSD operations have somewhat paid off.

To ensure sustainability, analysis of the factors influencing supply chains represents the first step towards understanding how health outcomes can be improved not only from current but also future generations. Nonetheless, research on the sustainability of public health supply chains, sustainability practices in healthcare (Subramanian et al., 2020), as well as the driving forces for sustainability implementation in the health sector remain scant (Marimuthua & Pauloseb, 2016). Largely, literature on sustainability mostly leans towards environmental analysis (Subramanian et al., 2020).

2. Literature Review

Stakeholder theory, a firm is tasked with being socially responsive to all its stakeholders which include investors, employees, suppliers, competitors, customers, regulatory agencies and so forth to create and attain sustainable advantage (Touboulic & Sodhi, 2015). The theory integrates the social dimension of sustainable development into a supply chain by looking at how a firm coordinates stakeholder interests with the goals of a firm to ensure sustainability (Alshibli et al., 2024). This theory also has a major drawback. Its consideration of every stakeholder as equally important is debatable and that hierarchies among stakeholders are important in determining integration of social sustainability issues such as social responsibility especially when it is likely to interfere with a firm's profit margin. In such a case, investors (higher ranking stakeholders) may decide to direct lower ranking stakeholders to forego social responsibility in favor of making profit (Alshibli et al., 2024). Coordination of interests and goals is what forms a supply chain network that helps a firm reduce environmental uncertainty and simultaneous creation of value (Yuksek at al., 2023). Thus, the theory explains how relations among stakeholders can be used to determine changes in the process of value creation from one driven by pure economic benefits to one inspired by a holistic approach towards sustainability (Eslamipoor & Nobari, 2023).

Verónica et al. (2019) examined how sustainable supply chain management (SSCM) practices influenced sustainable performance in hospitals economically, environmentally, and socially (sustainable development dimensions). Through a systematic review of 58 documents, 13 categories of SSCM practices were identified to impact sustainable performance in hospitals. These practices include strategic administration and leadership, supplier management, procurement, warehousing and inventory, transport and distribution, information and technology, energy, food, water, hospital design, waste management, staff, and community behavior, and other practices which could not fit in any of the categories identified. These practices varied in how they influenced performance in hospitals. For instance, most of the practices economically affected performance while energy, water, food, hospital design and waste impacted the performance of environmental dimensions in the hospitals. Conversely, staff and community behavior and quality of patient care socially affected performance in hospitals (Chindengwike, 2023).

In developing a sustainability index for public healthcare supply chains, Subramanian et al. (2020) found that most research on supply chain sustainability (SCS) was conducted in developed countries and mostly covered the Triple-Bottom approach. The limited coverage of LMICs and

other approaches to supply chain sustainability, particularly in healthcare, inspired the study to develop an SCS index that not only measures the economic, environmental, and social dimensions but also gauges the collaboration of stakeholders, quality process of product and service initiatives, and health outcomes. The results depicted a one-of-a-kind index comprising a multi-dimensional path that highlights a mechanism of improving the monitoring and coverage of healthcare through public health supply chains (Chindengwike, 2024).

Meanwhile, in LMICs health supply chains function via public mechanisms known as Central Medical Store (CMS) whose direct ties or semi-link to governments create poor accountability, financial uncertainty, unnecessary rigidity, and poor supply chain planning (Yadav, 2015:146-47). The study recommended development of an agenda to reform the identified challenging areas in public health supply chains in developing countries in order to ensure greater and wider health outcomes.

John and Opubo (2021) investigated sustainability aspects pertaining to the management of healthcare supply chain through systematic literature review. The results uncovered seven categories of sustainability issues in healthcare supply chain: 1) adherence to green packaging; 2) medical waste, air and water pollution; 3) eco-friendly medical supplies; 4) warehouse space utility; 5) community welfare, regulatory concerns and welfare; 6) management of clinical safety, health and social welfare; 7) flexibility of medical supplier, delivery quality and supplier cost. These seven represented the three dimensions of sustainable development: economic prosperity, environment awareness and social consciousness, which are significant to all stakeholders that participate in the administration of healthcare supply chains (Chindengwike, 2025).

Using the UK as a case study, Naughton and Akgul (2021) analyzed the prevalence of substandard and falsified (SF) medicines in the country's legitimate medical supply chain. Employing the UK's national pharmaceutical alert and recall database was found to be effective in reducing the level of SF medicines in the country's pharmaceutical supply chain which in turn helps maintain integrity of medicines and prevent possible negative consequences had the medicines reached patients. For instance, from 2012 to 2020, the average annual number of alerts and recalls by the Medicines and Healthcare Products Regulatory Agency (MHRA) is 17, an equivalent of 29 individual products per year or two falsified medicines per year. But, without previous data within the country or data from other countries to compare the UK's performance. Hence, the study suggested the need for

countries to share data as well as regulators to work with pharmaceutical firms to publish data on the extent of drug alerts and recalls.

3. Methodology

The target population for this study includes both MSD stakeholders and staff members in public hospitals in Dar es Salaam This research study used a cross-sectional survey design. This method is popular because it allows the researcher to examine and engage multiple groups of respondents at once.

The unit of analysis from this study was the individual level which involved key stakeholders and staff members around MSD prospects and some of the public hospitals selected in Dar es Salaam. Yamanne formula used from 280 MSD personnel and staff from three medical health facilities. From calculated the sample size was 154 respondents which included MSD personnel and staff from three medical health facilities

This selection of this population is because they were all trustworthy in providing the necessary information to satisfy this study and therefore, their involvement to the study helped them to gain information that corresponds to the study objectives.

This involves structuring a list of questions used to gather required information about experiences, opinions and more. Questionnaires were distributed to respondents for primary data collection for the purpose of getting the data of the study.

This study opted five Likert scale during from strong, weak and poor rating. Data gathered from the respondents was analyzed by using multivariate regression analysis and the Statistical Package for Social Science version 32 (SPSS) was used to establish the correlation between supply chain factors and the sustainability of MSD's medical supply chain.

Mixed methods for data collection and analysis were employed whereby the researcher gathered and analyzed both qualitative and quantitative datasets in order to develop a more comprehensive understanding of the research problem. This ensured increased truthfulness of data.

Before conducting any interview, respondents were given information about the study's goals and assured that their participation in the study would be voluntary, and thereafter, ethical issues such

as obtaining verbal consent from the respective respondent were highly considered. They were further informed that their anonymity would be preserved throughout the study by ensuring that no names or numbers would be used to identify them

In this study used to examine the influence of quantification, procurement, storage and distribution of medical supply chain in MSD.

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \epsilon \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (i)$$

Whereby;

Y = Sustainability of supply chain; X_1 = Demand Consolidation from users & health centers; X_2 = Demand Consolidation from users & health centers; X_3 = Accuracy of supply in relation to demand from users; β_0 = Co-efficient of the model; $\beta_1 - \beta_3$ = Beta Co-efficient of Determination; ϵ = Stochastic Error Term; β_0 = Co-efficient of the model (constant).

4. Study Results

The demographic statistics show that most respondents were male, accounting for 81.33% of the sample, while females made up 18.67%. Most respondents (80.00%) were between the ages of 31 and 40, indicating that the study's participants were primarily of working age. These findings indicate that the respondents had extensive professional expertise and were well-equipped to deliver accurate and knowledgeable comments related to the study's aims relating to Table 1.

Table 1: Demographic Information

Gender	**Frequency**	**Percent (%)**
Male	122	81.33
Female	28	18.66
Total	**150**	**100**
Age		
31-40 years	120	80.00
41-50 years	10	6.66
51-60 years	20	13.33
Total	**150**	**100**
Experience		
Above 20 years	28	18.66
1-5 years	28	18.66
6-10years	5	3.33
11-20years	12	8.00
Above 20 years	77	51.33
Total	**150**	**100**

In terms of job experience, more than half of respondents (51.33%) had more than 20 years of experience, with lesser amounts having 1-5 years (18.67%), 11-20 years (8.00%), and 6-10 years (3.33%).

4.1 Analysis of Reliability

Cronbach's alpha was used to measure the interior reliability of the tool of data collection. This is planned at establishing how sets of variables are connected. The consequences are depicted in Table 2 From the fallout, all the variables had Cronbach Alpha greater than 0.7, therefore, the result shows that Quantifications of requirements and Sustainability of Supply Chain 0.75 and 0.70 so, all variables show the extremely acceptable since the variable exceed 0.7.

Table 2: Reliability Analysis

Variable	Cronbach Variable	Decision
Quantifications of requirements	0.754	Cronbach Alpha greater 0.7, acceptable
Sustainability of Supply Chain	0.704	Cronbach Alpha greater 0.7, acceptable

4.2 Preliminary Test (Diagnostic Checking)

In the construction of statistical models, model validity is critically imperative to ensure unbiased and valid statistical inferences. Therefore, many models' diagnostic tests have been formulated for checking and detecting model misspecification. The study undertakes normality tests, heteroscedasticity, multicollinearity, and autocorrelation.

4.2.1 Normality Test

The normality test findings show that the data meets the normality assumption necessary for regression analysis. The Jarque-Bera test yielded a p-value of 0.0678, which is above the 0.05 significance threshold. Thus, the null hypothesis of normal distribution cannot be rejected. This means that the residuals are regularly distributed, and the regression model satisfies the normality condition. Consequently, the data are appropriate for parametric analysis, and the regression estimates and statistical inferences drawn from the model are regarded as reliable and legitimate.

Table 3: Jarque-Bera (Test for Normality Assumption)

Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)	Prob>chi2
G	150	0.0567	0.0348	0.648	0.0678

4.2.2 Multicollinearity

To determine the degree of correlation among the independent variables, the multicollinearity test was performed with the Variance Inflation Factor (VIF). The results showed that multicollinearity was not a major worry, since the VIF values were within acceptable limits. As a result, the independent variables were deemed sufficiently independent of one another and appropriate for inclusion in the regression model. This indicates that the computed regression coefficients are valid and may be understood without bias caused by multicollinearity.

$$VIF_i = \frac{1}{1 - R_i^2}$$

The multicollinearity test findings indicate that the mean VIF value of 8.69 is less than the permitted threshold of 10. As a result, there is no indication of significant multicollinearity between the independent variables. This means that the variables may be included in the regression model, and the predicted coefficients are valid for interpretation and analysis refer table 4.

Table 4: VIF Test of Multicollinearity

Variable	VIF	1/VIF
Quantifications of requirements		
	1.17	0.854181
1	1.3	0.76648
2	1.94	0.514861
Dependents (Sustainability of Supply Chain)		
1	2.48	0.402729
2	1.8	0.263297
Mean VIF	8.69	

4.2.3 Heteroscedasticity

When the variance of error terms differ with each observation in such case heteroscedasticity is said to exist. An unequal variance may violate the assumption of the classical linear regression model and cause the model to be inefficient. These can be caused when data collection method is

improved, by the presence of outlier observation, and according to human behavior. This study used Cameron and Triyedi's decomposition of the IM test to check for heteroscedasticity. Also, the test provides the result on the normality of data Table 5.

Table 5: Heteroscedasticity-Cameron & Trivedi's Decomposition of IM-test

Source	chi^2	Df	P
Heteroscedasticity	78.58	53	0.0507
Skewness	12.07	11	0.0378
Kurtosis	2.7	2	0.18
Total	**93.35**	**66**	**0.4685**

The result from Table 6 shows that the model does not suffer from the problem of heteroscedasticity since the p-value (0.0507) for heteroscedasticity is greater than 0.05 and it shows that the model does not suffer from the problem of non-normality assumption since the p-value is greater than 0.05.

Table 6: Serial Autocorrelation

Variable	Sustainability of Supply Chain	Quantifications of requirements	Procurement	Storage	Distribution
Sustainability of Supply Chain	1.00				
Quantifications of requirements	-0.230** Sig 0.021 N=275	1.00			

**Correlation is significant at 1 % significance level (2 tailed), * Correlation is significant at 5 % significance level (2 tailed), Sig implies p-value, and N= number of sample observations.

4.3 Model Fitness

In a model synopsis Table 7, the weakness and course of the association between the variables is obtainable. The Table demonstrates the degree of the connection between the forecaster and

outcome indicators. The model précis, the "R" worth is second-hand to specify the power and way of the association between the indicators. The R square indicates how greatly the entire difference in the needy indicators is explained by the descriptive variables.

Table 7: Model Summary

Model	R	R Square	Adjusted Square	R Std. Error of the Estimate	Durbin-Watson
1	0.87[a]	0.81	0.81	1.51	1.51

a) Predictors: (Constant) Quantifications of requirements, Procurement, Storage and Distribution.

b) Dependent variable: Sustainability of Supply Chain

The correlation coefficient (R = 0.87) shows that there is a substantial positive association between requirement quantification and supply chain sustainability. The coefficient of determination (R^2 = 0.813) indicates that Quantification of Requirements accounts for 81.3% of the variation in Supply Chain Sustainability, with the remaining 18.7% ascribed to non-model variables. Furthermore, the Durbin-Watson value of 1.51 indicates that the residuals have no significant autocorrelation, showing that the regression model meets the independence requirement and offers credible findings for interpretation.

4.4 ANOVA

ANOVA is a compilation of arithmetical models and their connected approximation actions (such as the "variation" among and flanked by groups) used to examine the difference among group means in an example. ANOVA is significant since it assists the investigator to shape if required to accept the null hypothesis or reject the exchange hypothesis. These demonstrate if the universal regression model is fitting for information. Table 8 obtainable below demonstrates the analysis of ANOVA.

Table 8: ANOVA Test

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	14.48	3	4.83	7.26	0.00[b]
Residual	70.44	106	0.67	0	0.00
Total	**84.92**	**109**	**0**	**0**	**0.00**

a) Predictors: (Constant) Quantifications of requirements, Procurement, Storage and Distribution.

b) Dependent variable: Sustainability of Supply Chain

The results in Table 8 found that the explanatory indicators forecast the response indicator perfectly. This is indicated by a noteworthy value of 0.000, which is not as much as 0.05, hence, in wide range, the regression model is completely and drastically predicting the outcome variable. Usually, results show that the autonomous variables (Quantifications of requirements.) perfectly and considerably predict the dependent variable (Sustainability of Supply Chain).

4.5 Estimated Model Coefficients

Coefficient productivity offers the sequence necessary for the investigator to estimate response variables on explanatory variables, as well as to decide whether explanatory variables give statistically to the model. This recognized the relationship between explanatory indicators (Quantifications of requirements) on the one hand and needy variable (Sustainability of Supply Chain) on the other give.

4.5.1 Principal Component Analysis (PCA)

Refer dimensionality reduction strategy that is frequently used to reduce the dimensionality of large data sets by reducing a large collection of variables into a smaller one that retains most of the information from the large set. Reduced dimensionality comes at the expense of accuracy, but the idea in dimensionality reduction is to exchange a little accuracy for simplicity. Because smaller data sets are easier to study and visualize, and because analyzing data points without superfluous variables is considerably easier and faster for machine learning algorithms (Kothari & Gaurav, 2014).

4.5.1.1 Principal Component Analysis for Quantifications of requirements

From Table 10 shows that the factor analysis for quantifications of requirements whereby there is Demand Consolidation from users & health centers, Accuracy of channels used to communicate demand-zones to Headquarters and Accuracy of supply in relation to demand from users. The components value in Tables 10 indicates the strongest values and weak values, the amount shows the positive is strong and when is negative is weak.

Table 9: Principal Component for Quantifications of requirements

Items	Component			Cronbach's Alpha (α)
	1	2	3	
Demand Consolidation from users & health centers	0.762			0.821
Accuracy of channels used to communicate demand zones to Headquarters.	0.636			0.721
Accuracy of supply in relation to demand from users.	0.628	-0.485		0.622

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization

4.6 Regression analysis on Quantification

The study used independent regression models to look at the specific effects of quantification, storage, and procurement on financial sustainability. This method allowed for a better understanding of the contribution and significance of each independent variable. Diagnostic tests such as normality, multicollinearity, heteroscedasticity, and autocorrelation were also performed to ensure data appropriateness and regression model validity. The findings verified that the data met the necessary assumptions, implying that the regression estimates are credible and adequate for making meaningful inferences on financial sustainability.

4.6.1 Demand Consolidation from Users & Health Centers

The results on multiple linear regression model indicate that there is positive relationship between demand consolidation from users & health centers and sustainability of supply chain**.** Likewise, demand consolidation from users & health centers can be explained by 32.8% on sustainability of supply chain**.** Also, demand consolidation from users & health centers influence sustainability of supply chain by 2.04.

4.6.2 Accuracy of channels used to communicate demand-zones to Headquarters

The results on multiple linear regression model indicate that there is no relationship between Accuracy of channels used to communicate demand-zones to Headquarters and sustainability of supply chain based on P-value 0.334 which greater than 0.05. Likewise, Accuracy of channels used to communicate demand-zones to headquarters can be explained by -16.1% on sustainability of

supply chain. Also, accuracy of channels used to communicate demand-zones to Headquarters influence sustainability of supply chain by -0.97.

4.11.3 Accuracy of Supply in Relation to Demand from Users

The results on multiple linear regression model indicate that there is no relationship between accuracy of supply in relation to demand from users and sustainability of supply chain based on P-value 0.529 which is greater than 0.05.

Table 10: Multiple Linear Regressions for Quantifications of requirements on Sustainability of Supply Chain

Sustainability of Supply Chain	Coef.	Std. Err.	T-Test	P>t
Quantifications of requirements				
Demand Consolidation from users & health centers	0.32811	0.16086	2.04	0.045**
Accuracy of channels used to communicate demand zones to Headquarters	-0.1618	0.16639	-0.97	0.334
Accuracy of supply in relation to demand from users	-0.1944	0.30692	-0.63	0.529

R2 = 0.7532, F- value = 17.04, P < 0.001, ** Significant at P< 0.05 and *** = Significant at P < 0.01

Likewise, Accuracy of supply in relation to demand from users can be explained by 16.18% on sustainability of supply chain. Also, Accuracy of supply in relation to demand from users influences sustainability of supply chain by -0.63.

The results on multiple linear regression model for quantifications of requirements on sustainability of supply chain indicated that demand consolidation from users & health centers has associated with sustainability of supply chain while accuracy of channels used to communicate demand-zones to Headquarters and Accuracy of supply in relation to demand from users has no statistical significance with sustainability of supply chain**.**

The quantifications of requirements can explain the sustainability of supply chain by 75.3% based on R^2. based on f-test quantifications of requirements can explain the sustainability of supply chain by 17% with significance level of 5%. demand consolidation from users & health centers can explain the sustainability of supply chain by 32.8% and has statistical significance.

5. Discussion

Yet, Deloitte et al. (2015) found weaknesses in MSD's responsiveness in addressing medicine demand particularly between 2011-2015 whereby while demand for pharmaceuticals grew at an average of 46.7%, funding allocation declined at an average of 74.5%. This puts pressure on the country's healthcare system since the needs of the health facilities, workers, and patients are not met, hindering Tanzania's desire of becoming a healthy society. Although various reforms through the Global Fund have helped MSD improve its responsiveness in meeting demand, the availability of medicines in health facilities is just above half at 56% (Githendu et al., 2020). Despite improvement, more needs to be done especially with the rise in new diseases and demand for healthcare following population increase. The regression model indicated that the model has statistical significance since the P-Values is less than 0.05.

Generally, the effective consolidation of demand is never a straightforward endeavor since at times, a medical supply chain may also be disrupted because of a sudden outbreak of a disease that can be either endemic or pandemic. During such instances, there is a need for flexibility in adjusting the quantification process to incorporate the change in the demand pattern of pharmaceutical supplies. For example, following the outbreak of the COVID-19 pandemic, patients and medical facilities suddenly needed more ventilators, masks, and other supportive supplies to help control the spread of the pandemic. But, with the pandemic over, the demand pattern has resumed to pre-2020 patterns. The regression model indicated that the model is statistical significance since the P-Values is less than 0.05.

The accuracy of channels used to communicate demand-zones to Headquarters has positive association with the Sustainability of Supply Chain. The accuracy of these channels plays a crucial role in making sure that medical supplies find their way into respective zones without any glitches. The accuracy of channels further ensures that only regulated, safe, and effective medical supplies make it to health facilities and patients. Moreover, the accuracy of channels allows for constant upstream and downstream flow of information that helps ensure the availability of medicine throughout a given period, consequently improving health outcomes (USAID DELIVER, 2014). The regression model indicated that the model has statistical significance since the P-Values is less than 0.05.

The channels of information in MSD's supply chains are just as important in influencing the quantification process. The effectiveness in the communication of demand to headquarters has been a common factor in directing MSD's operational activities and the associated cost and expense implications. For example, to improve MSD's quantification and forecasting capacities, the US Government assistance purchased and operationalized an enterprise resource planning software (EPICOR) which enhanced the Department's collection and utilization of information related to stock availability, order rate, and delivery coverage (MSD, 2020). Hence, an improvement is the accuracy of channels improves the speed and capacity to respond to user demand as well as boosts the interaction between demand zones and headquarters. The regression model indicated that the model has statistical significance since the P-Values are less than 0.05.

Accuracy of supply in relation to demand from users also has a positive impact on the level of satisfaction of users when it comes to the sustainability of the supply chain. This is because it enables the attainment of the equilibrium or balance between demand and supply, helping avoid both stockouts and overstock, reduce storage periods, and improve the management of product expiry dates, all of which lead to cost savings (Donato et al., 2016). Thus, when a user acquires the medical supplies they require efficiently, reliability in the medical supply chain is created, reliability which goes on to fortify patient trust in a healthcare system and reduce patient reliance on unsafe and informal medical supply chains.

The study found that there was increased availability and accessibility of essential medicines in public health facilities, although externalities such as problems with the National Health Insurance Fund (NHIF) made it difficult to access some medicines since some health workers were often preferred out-of-pocket payments. Other times, some health workers who either own pharmacies or their own health facilities would recommend that patients visit their personal facilities to access some of the medicines which they claim was not available in public health facilities. But the use and expansion of the integrated logistics system (ILS) have allowed the improvement of visibility and accuracy of supplying the needs of health facilities, consequently leading to increased flow of medical supplies from MSD warehouses to public health facilities. However, gaps in funding continue to pose a challenge in ensuring sustainability in the accuracy of supply. The regression model indicated that the model has statistical significance since the P-Values is less than 0.05.

6. Conclusions and Recommendations

The fusion of sustainability with quantification, has proved important in the improvement of the entire value chain of medical supply at MSD, helping this institution address previous challenges related to frequent stockouts in healthcare facilities, promote corporate social responsibility (CSR), and guarantee the sustainable access and availability of pharmaceutical supplies in health facilities in a cost-effective way. However, ensuring the efficiency and effectiveness of the medical supply chains in developing countries appears to be hindered by resource-deficiency and poor managerial capacities which lead to poorer performance of medical supply chains in developing countries compared to developed ones. As such, efforts to improve medical supply chains in developing countries sought to improve the factors influencing the supply chain of MSD.

The results will help add knowledge to the scant body of literature pertaining to sustainability of medical supply chain management to provide deeper and wider understanding of the necessary interplay between sustainability and healthcare supply chain specifically in Tanzania country perspectives.

From the key findings of the study, the researcher recommends policymakers should establish clear guidelines and regulations that incentivize and mandate sustainable practices within medical supply chains, managerial inefficiencies should be reduced through effectively engaging with its suppliers in order to identify areas of improvement as well as supplement supply with self-production of some essential medicines. This study is limited by time and financial problems during data collection

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