Supply Chain Management Practices and Hospital Operational Efficiency: The Nigerian Example

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DOI: 10.29322/IJSRP.9.07.2019.p9180
http://dx.doi.org/10.29322/IJSRP.9.07.2019.p9180

Abstract- This study explores public hospitals in Nigeria to investigate the relationship between supply chain management practices and operational efficiency- cost minimization, delivery quality and service availability. Survey design was adopted to delineate the study population, select participants, and design appropriate method of data collection and analysis. Out of 584 healthcare supply chain executives that constituted the study population, 293 were selected from 18 public hospitals in Southern geopolitical zone of Nigeria using the multistage sampling method. The structured questionnaire was employed to glean relevant primary data which was analyzed quantitatively. Findings shows that operational efficiency is significantly and positively influenced by three major practices: strategic supplier partnership, supplier selection decision, and integration of information communication technologies among supply chain partners. Relevant implications of the findings for managers were highlighted and discussed.

Index Terms- Supply chain management, hospital operational efficiency, collaborative inventory planning & forecasting

I. INTRODUCTION

Statistical estimates provided by the World Health Organization (WHO) revealed that about one third of people in the world do not have access to vital medicines[1]. In some African and Asian nations, the proportion increases to about 40 percent. In 2011, the United Nations Conference on Trade and Development (UNCTAD) provided evidence confirming that almost two billion of the world's population, many of whom live in less developed nations, lack access to life-saving medicines. A medicine is considered essential and life-saving if it is available, affordable, assured of quality and properly used by an individual or community[1].

Furthermore, in sub-Saharan Africa, there is statistical evidence that 30-50% of the population lack access to basic medical care, and many people are still suffering from preventable and treatable diseases because of inaccessibility to essential healthcare products. Specifically, the United Nations, in its 2013 survey of healthcare indicators, ranked Nigeria 187 out of 192 participating countries. This poor human development index (HDI) showcases the dismal performance of the country's healthcare outcome. A report by the WHO predicted that by 2015, Nigeria will still struggle to meet health requirements of the immediate past millennium development goals. Thus, access to healthcare remains one of the leading causes of poor health outcomes in most African countries, including Nigeria.

As gruesome as the above statistics may appear, poor access to essential medicine is further compounded by such factors as meager funding, insufficient research and development (R&D), inadequate human capacity, and the undeveloped network of healthcare supply and distribution chain in Nigeria. In a survey carried out by the Federal Ministry of Health in 2010, the medical supply system was described as poorly coordinated and fragmented, resulting in wastage of resources, and denying the populace of access to essential drugs and medications. The provision healthcare in Nigeria is deficient of a well harmonized supply chain platform, and poor quality of healthcare is often the excuse for patient switch to private clinics either within or outside the country.

Efficient supply chain management is essential to ensure healthcare products are available for users at service delivery points. A supply chain can be understood as an integrated system composing key players such as suppliers of materials and components, product manufacturers and distributors, retailers of goods as well as customers. In a supply chain system, materials flow downstream to customers, while information flows in both directions. Supply chain management (SCM) is therefore the planning, coordinating, and

controlling of series of interconnected activities involve in moving a firm's raw materials, equipment, component parts and finished products from suppliers to end-users or customers in order to increase service level and reduce system-wide costs[2,3]. At the minimum, efficient performance of healthcare supply chain is dependent on utilizing contemporary management practices to ensure members in the chain are effectively coordinated and add value to the medical supply chain network. Therefore, operational efficiency of healthcare supply chain must be strengthened to ensure its ability to deliver value to the end customer, the patient.

Operational efficiency explains the time, cost and flexibility needed to make quality delivery when an order is placed. Timeliness is concerned with speed and the consistency wherein the order is delivered. Apparently, customers anticipate their goods and service to be delivered on time, however, rapid delivery would make no sense if it is fraught with inconsistencies from one point to the order. In order to accomplish a secure supply and delivery operation, firms tend to put premium on service delivery consistency and afterward seeks to improve delivery speed[4,5] .

Costs of delivering a service and producing goods are other key features of operational efficiency that needs attention. A supplier should ensure that the cost of fulfilling an order is by no means greater than the aggregate gains expected from the order delivered. Consequently, the time value of rapid order delivery must be weigh against its correspondent cost of delivering an order. Variation in customer's demand and intermittent failure in service delivery process can also pose severe operational complications and disruption[6]. These can trigger customer dissatisfaction and switching issues if not properly handled.

How agile an organization accommodates and addresses these irregularities constitutes another measure of operational efficiency. In supply chain function, process malfunction could be in terms of equipment, service failures, damaged goods, inaccurate documentation, and incorrect product assortment etc. When failure arises, the swiftness of recovery by the service operator is an important component or dimension of efficiency as well. Thus, operational efficiency explains how best an organization is able to coordinate every facets of its daily operational tasks with minimal resource utilization[7].

From the foregoing, this study argues that as healthcare organizations implement innovative supply chain management strategies, the likelihood of making significant operational gain in logistics, procurement and storage increases. This is likely to reduce incidence of out-of stock, ensure access to essential medicine, and increase order-fill rate. In consonant with the current view, a positive association was found amongst supplier trust, integration of information technologies, knowledge exchange, and hospital supply chain performance; measured by costs, speed and flexibility of operation[8]. In a related study, inventory location and ownership, inventory costs, and information sharing was reported as relevant strategies for success in managing healthcare supply chain[9]. In a study of the Malaysian consumer goods industry aimed at investigating the relationship between supply chain responsiveness and firm's competitive advantage, it was concluded that high level of competitive edge can be achieved by managers embracing SCM particularly by practicing information sharing[10]. With efficient supply chain, the performance of hospital inventory and dependability of its supplies could be heightened; resulting in costs reduction, reduced cycle time, and replenishment lead time[11,12, 13]. Thus, rather than seeing SCM as an arduous responsibility[14], public hospitals in Nigeria could gain significantly by incorporating the supply chain management into their organizational strategy.

Although public hospitals recognize the potentials in effective management of medical supply chain, there still exist insufficient knowledge concerning the parameters for SCM success. This is in terms of the conditions under which SCM is likely to yield operational efficiency gains for hospitals, and the elements that should be included in the planning process.

Similarly, there are concerns that contract negotiations in many public hospitals are adversarial due to lack of trust, incongruent goals, and incompatible information communication system. This has further reduced the efficiency of healthcare supplies leading to stock outages, longer replenishment lead time for essential drugs and vaccines, increased handling costs, limited access to essential healthcare and prolonged hospital stay. Specifically, there appear to be limited studies on the mechanism through which SCM could solve poor access to healthcare and variance in inventory demand and supply- two common occurrence in Nigerian hospitals.

This study is therefore aimed at examining the mechanisms in which supply chain management practices and hospital operational efficiency are related. The outcome will enable us have a clear insight into the nature of SCM activities commonly practiced amongst Nigerian pubic healthcare institutions, and how they impact operational efficiency. It is expected that findings could provide managers with appropriate models for designing efficient programs for managing hospital supply chain.

II. METHODOLOGY

The study was conducted using quantitative survey design. The survey design was chosen because it is economical, ensures swift collection of primary data and its ability to give a clear insight into the population characteristics by studying its sample. The study was based on primary data derived through pre-tested and structured questionnaire, and data so gathered was analysed with descriptive and inferential statistical techniques.

The accessible population consisted of all public tertiary hospitals operating in three south-south zones of Nigeria. Three kinds of healthcare institutions merited this description, namely: Federal Medical Centers, University Teaching Hospitals, and Specialist Hospitals. The target population and unit of analysis was therefore consisted of all supply chain executive officers from the three tertiary hospitals totaling 584. In addition, key vendors of medical consumables and medical/surgical suppliers also constituted the research population. A sample size of 234 supply chain officers (i.e 78 supply chain staff × 3 hospitals) constituted the respondents for the study.

The multistage sample method was adopted to choose participants. The first stage was to select accessible tertiary hospitals for the study. Hence, one hospital per state was purposively selected. The second stage in the sampling process involves selecting participants. Judgmental sampling approach was utilized to select the samples. Those recruited had to meet the inclusion criterion of being staff members of either procurement, central stores, or IT unit of the tertiary hospitals. This is because these departments were primarily associated with the problem this study sought to investigate. In addition, staff in the procurement, stores and IT section were assumed to have pertinent knowledge of medical supply chain management and would then be in the best position to offer valuable information for the study.

In the final sampling stage, convenience sampling technique was used to select 78 supply chain executives from each hospital comprising procurement officers, central store officers, and IT support executives. The choice of convenience sampling was purposeful to select whoever was available and willing to participate in the study because not all members of staff in the selected units indicated their willingness to complete the research instrument. Five (5) vendors of medical consumable and hospital equipment from each hospital were also selected to form part of the target respondents. Based on the list of key vendors made available to the researcher, the first five vendors on the list were contacted by phone and were requested to participate in the survey**.**

The structured questionnaire was developed and used for data collection. The design of questionnaire items was done taking inputs from extensive review of supply chain management literature and pre-survey discussion with healthcare supply chain practitioners. Throughout the instruments, respondents were required to rate all constructs using the five point Likert scale. Two kinds of variables were measured by the questionnaire, namely: hospital operational efficiency being the dependent variable, and SCM practices as independent variable. Supply chain management practices was operationalised by five dimensional constructs namely: strategic supplier partnership, information/knowledge sharing, information technology integration, supplier selection attributes and collaborative inventory planning. On the other hand, operational efficiency (the dependent variable) was measured by thee widely used indicators: inventory costs efficiency, replenishment/delivery lead time, and revenue enhancement in terms of service level availability. These indicators were extracted from the Supply Chain Operations Reference (SCOR) model[15]. It is important to state that out of the 249 copies of questionnaire that were administered on participants, 105 copies were correctly filed and returned, and was therefore subjected to data analysis. In this light, a 42.2% response rate was achieved

III. RESULTS

3.1 Description of hospital supply chain management practices

To begin, we explore the data with a view to understand the nature of SCM currently practiced by surveyed hospitals. Thus, respondents were requested to state the degree to which certain practices were applied in their hospitals for managing supply chain. Though several supply chain management practices were identified, it was necessary to categorize them into five broad practices namely: strategic supplier partnership, information/knowledge sharing, supplier selection, information technology integration, and collaborative inventory planning, forecasting and replenishment practice.

Table 1 provides summary of results showing the extent to which Nigerian hospitals apply the array of practices in their supply chain management, the relative importance they attach to each SCM practice, and intercorrelation among the variables of study. The mean score of 3.00 was used as an index for decision making. This was derived by dividing the sum of the scale by 5. Accordingly, a variable with mean score less than 3.00 was considered low in terms of its application and relative importance to healthcare supply chain partners.

From Table 1, it can be seen that the mean responses of the distribution ranges between 2.73- 4.41, while the standard deviation lies between 0.69-1.22 suggesting that data are normally distributed. Data also exhibit relatively high mean score in all but one SCM practice, with information and knowledge sharing practice taking the highest mean score. That is, respondents appear be sensitive to practices that: a) promotes the sharing of vital demand and supply information/knowledge with supply chain partners (Mean= 4.41; SD=0.69); b) encourages strategic partnership in planning and executing supply chain initiative (Mean=3.79; SD=1.22); c) emphasizes multi-criteria supplier selection attributes (Mean= 3.73; SD=1.18); and d) integrate information technology infrastructure for easy and faster flow of distribution and logistics among supply chain partners (Mean=3.29; SD=1.09). Thus, one can infer from the results, that sample were rather confident that operational efficiency of their hospital supplies could be enhanced by according prominence to the above supply chain management practices.

However, respondents appear to attach less importance to initiative that advocates collaborative demand forecasting and replenishment of medical stock (Mean= 2.73, SD=1.14). This is understood to probably be due to the perceived lack of trust amongst supply chain partners, unpredictability of patient demand, relative dearth of quantitative forecasting skills, incongruent goals and priorities, and the tendency to be opportunistic with certain proprietary planning information such as patient demand data.

3. 2: Linking supply chain management practices with hospital operational efficiency

Correlation coefficient was calculated to observe the nature of association amongst supply chain management practices and operational efficiency as shown in Table 1. The analysis in Table 1 indicates positive correlation between supply chain operational efficiency and strategic supplier partnership (r = 0.565, $p < 0.01$), information/knowledge sharing (r = 0.612, $p < 0.01$), and supplier selection (r = 0.362, $p < 0.01$), while the other two variables correlated negatively. In brief, these results suggest that hospitals that strategically partner with key suppliers, share quality demand information and knowledge with suppliers, and adopt multi-criteria supplier selection strategy tend to score high and perform efficiently in their supply chain operation. This is in terms of inventory costs efficiency, replenishment/delivery lead time, access to essential healthcare through service level availability, and delivery process flexibility. On the contrary, integration of information technology between hospital and key suppliers, and the use of collaborative planning and forecasting of inventory demand appear not to be significantly related to hospital operational efficiency in the context of the study.

Table 1: Mean, standard deviation (SD), Reliability Analysis, and Correlations Matrix (N=105)

Dimension		*Reliability coefficient (α)*	*Mean*	*SD*	*SSP*	*IFS*	*SSD*	*CIP*	*ITT*	*OE*
Strategic supplier partnership	(SSP)	0.65	3.79	1.22	1.00					
Information/knowledge sharing	(IFS)	0.72	4.41	0.69	.557**	1.00				
Supplier selection decision	(SSD)	0.82	3.73	1.18	-.193	.681**	1.00			
Collaborative inventory planning & forecasting	(CIP)	0.77	2.73	1.14	.740**	-.271	.726**	1.00		
Information technology integration	(ITT)	0.68	3.29	1.09	.646**	.510**	- .178	.372**	1.00	
Operational efficiency	(OE)	0.57	4.04	0.92	.565**	.612**	.362**	-.165	-.211	1.00

***. Correlation is significant at the 0.01 level (2-tailed) i.e p < 0.01*
Reliability score in parenthesis

3.3 Effects of SCM practices on hospital operational efficiency

In order to evaluate the effect of supply chain practices on measures of hospital operational efficiency, multiple regression analysis was performed. We employed the least square regression technique. This was used to study and explain the extent to which each of the dimensional construct of operational efficiency are affected or can be predicted by series of SCM practices identified by respondents. In summary, results in Table 2 depicts hierarchical multiple regression analysis.

Table 2: Multiple regression analysis

	Dependent variable				
SCM practices	Costs efficiency	Delivery efficiency	Service level efficiency	Overall operational efficiency	Remark
Strategic supplier partnership	0.452** (3.771) [0.063]	0.302** (2.492) [0.062]	0.213** (5.317) [0.045]	0.203** (4.217) [0.024]	H1 Supported
Information/knowledge sharing	0.456** (6.100) [0.056]	-0.181** (-2.681) [0.046]	0.410** (6.918) [0.040]	0.315** (6.715) [0.038]	H2 Supported
Supplier selection decision	0.539** (7.907) [0.045]	0.930** (11.958) [0.052]	0.466** (5.002) [0.056]	0.241** (4.138) [0.041]	H3 Supported
Collaborative inventory planning and forecasting	0.107 (1.679) [0.016]	0.209 (1.008) [0.011]	0.380** (3.064) [0.014]	-0.106 (0.008) [0.024]	H4 Rejected
Information technology integration	0.410** (6.918) [0.040]	0.102 (1.492) [0.062]	0.156** (1.100) [0.056]	-0.122 (0.041) [0.033]	H5 Rejected
F-value	84.948**	74.681**	82.747**	180.22**	
R^2	0.743	0.790	0.839	0.828	
Adjusted R^2	0.735	0.783	0.833	0.823	
N	105	105	105	105	

*Note: ** p < 0.01, numbers in the first parenthesis are t-scores; standard errors are in the second parenthesis.*

The standardised beta estimates (β) and t-scores are used in order to compare and determine the impact of SCM approaches on the three measures of hospital supply operational efficiency**.** Results on Table 2 indicate the coefficient of determination (adjusted R^2) for model IV as 0.823. This implies that the fitted model explains about 82.3% of variance in overall operational efficiency. The balance of 17.7% could be attributed to chance error or exogenous variables not considered by the study. As indicated, the overall fit of the regression model is good with a significant ANOVA (F-value) of 180.22.

Table 2 also provides summary of data for the three regression model. Note that three of the five SCM constructs (strategic supplier partnership, information/knowledge sharing, and supplier selection decision) contribute in a significant positive manner toward predicting individual and overall measures of operational efficiency for surveyed sample. For instance, information /knowledge sharing (Beta= 0.315; t=6.715; p< 0.01) had the highest significant influence on operational efficiency. This is followed by supplier selection decision (Beta=0.241; t=4.138; p<0.01), and strategic supplier partnership (Beta=0.203; t=4.217; p<0.01). What this results attempt to explain is that varying any of the SCM practices in the model is likely to stimulate a proportional variation in operational efficiency. For instance, by increasing the

accuracy and timeliness wherein customer orders are fulfilled, inventory level is maintained, and market information are shared amongst supply partners say by one percent, the organizations under survey could derive 31.5% improvement in hospital supply efficiency. By implication, hospital supply chain managers could reach and possibly exceed desired level of operational proficiency by executing SCM policies along three important dimensions, namely: information/knowledge sharing, supplier selection, and strategic supplier partnership.

IV. Discussion of Findings

This study focused on supply chain functions in Nigerian public hospitals with the view to improving its efficiency through a gamut of SCM practices. The study reveals the following findings:

First, respondents were sensitive to most SCM practices under investigation, and were equally confident that a range of SCM practices can significantly lead to efficient hospital supply. Operation. This finding appear consistent with the views that in an effort towards sustaining effective and efficient treatment of patient, managers of public hospitals are beginning to embrace the essentials of effective supply chain management[16].

Second, efficiency of hospital supply operations was found to correlate positively with three SCM practices, namely: a) The need to share proprietary information/knowledge, b) engage in strategic partnership with vendors, and c) adopt multi-dimensional attributes for suppliers' selection. The findings, again appear to corroborate empirical evidences which espouse the need for sharing undistorted information along all supply chain echelons as a means of achieving competitive edge [17,18,19,20]. In like manner, exchange of SC information fosters team spirit and cohesion amongst supply chain partners. It assists in producing better appreciation of the needs of the end customer, and lead to quick responds to market changes[20].

Third, three SCM practices including information/knowledge sharing, supplier selection, and strategic supplier partnership had positive influence on hospital operational efficiency. This finding also substantiate previous research result which highlighted the existence of significant relationship between knowledge exchange, hospital-supplier integration and supply chain performance in US hospitals[20].

Finally, the study however found no significant effect of information technology integration, and collaborative inventory planning and forecasting on supply chain efficiency. What managers are saying here is that the IT infrastructural requirements and capacity to facilitate supply chain integration in Nigerian hospitals are still under developed for an uncoordinated and fragmented health sector to operate. Three kinds of information technologies are required for successful SCM integration namely: electronic data interchange (EDI), enterprise resource planning system (ERP), an uninterrupted internet, intranet, and extranet facilities[21, 22]. However, these capabilities are still at embryonic developmental stage in most Nigerian public hospitals.

V. Conclusion

Seeking to gain operational efficiency through SCM has been recognized as strategic path that should be taken by all firms. Healthcare supply chain must be efficient and integrated to remain competitive and live up to its social obligation. An important means of achieving access and dependable healthcare delivery is supply chain management. This study has provided evidence necessary to ensure that Nigerian hospitals achieve supply efficiency and therefore improve on access to essential healthcare delivery.

From the findings, it is meaningful to conclude that exchange of accurate and timely inventory and demand data along the supply chain network is capable of enhancing efficient supply operations. It is also concluded that the sharing of relevant information would be facilitated by robust integration of information technologies, entering into strategic (long term) partnership arrangement with suppliers (like public private partnership, outsourcing etc), and ensuring the use of the right criteria for selecting vendors.

Given the conclusion, it is suggested that public hospitals in Nigeria embrace the practices of supply chain management, particularly by increasing it information sharing capabilities. Equally, important is the need for hospitals to look beyond quotation price and financial capabilities in selecting medical material vendors. Prominence should be given to attributes such as quality of delivery, delivery lead time, flexibility of product delivery, order fill rate etc. Moreover, supply chain efficiencies could bse gain for hospital that

improve its capacity to forecast demand, generate purchase orders, and manage inventory through automation such as electronic data interchange, automatic replenishment tools etc. Hospital should encourage long term collaboration on public private partnership involving supplier and manufacturers of medical and surgical materials.

As hospital embraces supply chain management and implement the practices highlighted in this study, access to healthcare delivery in Nigeria is likely to substantially improve.

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