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Assessing Factors Influencing the Effectiveness of Logistics Management Information Systems on Drugs Supply Chain Management in Sierra Leone

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ABSTRACT

Background: Logistics Management Information System (LMIS) is a system introduced in Sierra Leone to improve drugs supply management and healthcare quality that yield accurate information for planning and resources allocation. This system proposed to be influenced by factors believed to enhance effective management system.

Methodology: The study used purposive and sequential exploratory means of data collection through self-administered questionnaires. The factors were examined using conceptual framework model in determining LMIS effectiveness on drugs supplies management.

Results: The study proved Forecasting, Logistics, Information Quality and Production factors to significantly influenced LMIS effectiveness on drugs supply management.

Conclusion: The study provides valuable insights into the Information System and Supply Chain Management factors associated to influence LMIS effectiveness on drugs SCM in Sierra Leone. The findings suggest that health workers and decision-makers should prioritize the utilization of information quality, forecasting, logistics and production factors to improve LMIS effectiveness. Therefore, it is essential to tailor Ministry of Health finances towards strategy on improving factors that influence LMIS effectiveness in Sierra Leone.

Keywords: Factors Influencing Logistics Management Information System effectiveness, Information System factors, Supply Chain Management factors

INTRODUCTION

The progression of pharmaceutical products within the Supply Chain Management (SCM) have increased information requirements. This facilitated the integration of Logistics Information Systems (LIS) and supply chain management system into Logistics Management Information Systems (LMIS) [1]. LMIS is presumed to provide quality information for planning and decision-making which are essential towards improving healthcare service delivery in developing countries[2];[3];[4].

However, the SCM studies and interventions conducted in Sierra Leone focused mainly on pharmaceutical management of essential medicines, medical supplies and related systems strengthening with less emphasis on LMIS effectiveness[5]. The studies identified SCM challenges that lead to interventions for improvements during Ebola outbreak [5]. But none of these studies or interventions identified factors that influence LMIS effectiveness. This study identified Information System and SCM factors that were hypothesized to influence LMIS effectiveness [6];[7]; [8].

BACKGROUND REVIEW OF FACTORS INFLUENCING LMIS EFFECTIVENESS

Following a background check, similar studies used IS and SCM factors through framework models to determine LMIS effectiveness [9]; [10] ; [11] .

For instance, a textile industries case study identified factors predicted to improve SCM effectiveness [12] and all addressed information needed[13].

Another study [14] identified IS factors that were significant in operational information sharing effectiveness.

A web based IS study [15] identified four factors that significantly contributed to inter-personal, professional skills, and organization level performance.

Also, a project management information system (PMIS) study[16] used Delone and Mclean model of IS Success to examine PMIS effectiveness. The information quality and service quality factors significantly influenced system effectiveness.

Relatively few studies attempted to use models and factors in assessing LMIS effectiveness. This

study made the attempt in Sierra Leone using factors to determine the level of effectiveness.

METHODOLOGY

Research Design, Approach and Sampling Techniques

This study used mixed sequential exploratory design with non-probability sampling technique involving quantitative data collection through self-administered questionnaire. The qualitative data collection involved Focus Group Discussion (FGD).

Sample size was determined based on number of LMIS users in MoH delivery services. Using Yamane's simplified formula for finite study populations with an assumption of 95% confidence level (P=0.5). (Yamane, 1967). Questionnaires administered to one hundred and sixty-five (165) respondents

The identified factors were proposed to influence LMIS effectiveness on improving drug supply chain[17] .

Data Collection, Analysis

Data collected were analyzed descriptively and inferentially using Statistical Package for Social Scientist (SPSS). The p-value approach was used to determine the statistical significance, and a construct was rejected if the p-value was greater than α (i.e., $p > 0.05$) and accepted if the p-value is less than or equal to α (i.e., $p <= 0.05$). The content analysis done on qualitative data collected through FGD to identify parallel trends in the responses.

DEVELOPMENT OF A RESEARCH MODEL

The conceptual framework (Figure 1) used was adopted from literature reviews of IS and SCM factors[10];[9] based on similar findings from previous studies [18];[19]. Hence, these factors were hypothesized to predict level of influence on LMIS effectiveness

Hypothesis 1: System quality influences LMIS effectiveness

System quality measures performance needed to support system users. This was illustrated by IS effectiveness study[20] which found that system quality and information quality influenced computer end-user satisfaction.

Hypothesis2: Information quality influences LMIS effectiveness.

Information quality was used to determine information output through a web-based study[21] which confirmed the significant influenced of Information quality to the web-based system performance.

Hypothesis3: User satisfaction influence LMIS effectiveness.

User satisfaction measures service, knowledge, and participation. The web-based system used information product [21] to confirm the influence of user satisfaction by IS factors.

Hypothesis 4: *System use influence LMIS effectiveness*

System use appraised the amount, frequency, nature, and purpose of use. An EMR study[1] confirmed that information success can best be determined by system use.

Hypothesis 5: *Service quality influence LMIS effectiveness*

Service quality measures available user personnel supporting the system. An EMR study[1] confirmed that Service quality influenced EMR effectiveness.

Hypothesis 6: *The net-benefit influence LMIS effectiveness*

Net-Benefit measures individual and organizational impact. An EMR study using net-benefit[1] to determine EMR success confirmed user satisfaction to perceive net-benefit.

Hypothesis 7: Forecasting influences LMIS effectiveness

Forecasting incudes planning, aiming to improve SCM practices. The conducted study [22] confirmed that forecasting significantly related to supply chain performance.

Hypothesis 8: Customer service influences LMIS effectiveness

Customer service directly linked with supplier relationship. The study[22] confirmed that customer service influenced SCM responsiveness and improved its practices.

Hypothesis 9: Warehousing influences LMIS effectiveness

Warehousing aids cost reduction, increases customer service utility of products[22], and is considered to influence SCM practices.

Hypothesis10: Logistics has influence on LMIS effectiveness

Logistics is a leading factor to LMIS effectiveness. A study confirmed [22], that logistics practices influence SCM.

Hypothesis11: Production influences LMIS effectiveness

Good products aid to increase customers' demand. A study [22] observed that production leads to the receptiveness of fast delivery of final product to the customer.

RESULTS

Demographic (Data) Analysis

The descriptive analysis of respondents' educational level and years of experienced acquired were that 56.7% of respondents had bachelor's degree, 26.7% with master's degree, and 16.6% had Diplomas and Certificates. While 37.3% of respondents had work

experience of 6 - 10 years, 24.7% above 16 years, 24.0% between 11 – 15 years and 14% between 1 – 5 years' experience. 54.7% of them found at middle, 25.3% at low and 20.0% at top management level.

Reliability and Validity Test

Sampling adequacy using Kaiser-Meyer-Olkin (KMO) method was 0.56, higher than the minimal value of 0.5. Reliability test using Cronbach's alpha coefficient for internal uniformity was 0.963. See table 1 for 11 identified independent variables and result of Cronbach's alpha coefficient of the study.

Regression Analysis

Regression analysis examined the cause-effect relationship of IS and SCM factors (independent variables) and LMIS effectiveness (dependent variable). Table 2 shows the model summary.

The eleven factors were entered once in determining the model's success and level of influence. Table 2 described the research model summary with adjusted R^2 = 0.328 which indicates that 32.8% of these factors influenced LMIS effectiveness while 67.2% have no influence.

Table 3 shows standardized beta (β) values and prediction of influence on LMIS effectiveness.

Hypotheses Testing of the Effectiveness of LMIS

The p value of factors determining significant influence of LMIS effectiveness should either be less than or equal to 0.05. See Table 3. From the Hypotheses (H1 to H11) tested only four were significant (Information Quality, Forecasting, Logistics and Production) with ρ values: 0.006, 0.002, 0.003 and 0.012.

H2: Information quality has an influence on LMIS effectiveness

Information quality has a beta value of 0.453 with p-value of .006 which is within the study accepted range of p ($\alpha < 0.05$).

H7: *Forecasting has an influence on LMIS effectiveness*

The beta value of Forecasting is 0.316 with p value of 0.002 which is within the study accepted range of p ($\alpha < .05$). This means Forecasting has a statistical influence on LMIS effectiveness.

H10: *Logistics has an influence on LMIS effectiveness*

The beta value of Logistics is -0.364 and p value of 0.003 which is within the accepted range of p ($\alpha < .05$) this means that Logistics p-value is within the study. This means Logistics hypothesis has an influence on LMIS effectiveness.

H11: *Production has an influence on LMIS effectiveness*

Production with beta value of 0.318 and p value of 0.012 is within the accepted significance range of p ($\alpha < .05$). This means production has an influence on LMIS effectiveness.

DISCUSSION

The study was conducted to determine IS and SCM factors that influenced LMIS effectiveness on drugs supplies in Sierra Leone.

The influence of IS and SCM factors on LMIS effectiveness were tested using regression hypotheses:

The results of H2 signifies influence on LMIS effectiveness. The hypothesis was demonstrated by the study [1] which looked at improving users attitude towards processing quality information increases LMIS effectiveness [23].

The H7(forecasting) findings illustrated a significant influence on LMIS effectiveness with p-value of 0.002. The H7 findings was proven by a study[24] which indicated that forecasting influenced SCM practices [25].

The H10 signifies influencing LMIS effectiveness with p-value of 0.003. Similar study confirmed that better logistics management improves the performance of SCM [26].

The H11 signifies influencing LMIS effectiveness with p-value of 0.012. This was exemplified by a study [27] which ratify that production influenced the performance of SCM.

The focus group discussion held with respondents of LMIS management, after the quantitative analysis, affirmed that quality information influenced appropriate logistics management of drugs supplies in Sierra Leone. The discussion continued to affirm that with accurate information shared during forecasting stock-out, over stocking will be minimized, quantification, procurement and production of drugs will improve.

In summary, forecasting with β=0.316 and Information Quality with β=0.453 are found to influence LMIS effectiveness by contributing 31.6% and 45.3% of the research model.

Logistics and Production are found to influence LMIS effectiveness by contributing 36.4% and 31.8% of the research model.

CONCLUSION

The study provides valuable insights into the IS and SCM factors associated to influence LMIS effectiveness on drugs SCM in Sierra Leone.

The findings suggest that health workers and decision-makers should prioritize the generation and utilization of quality information, forecasting, Logistics, and production factors to improve LMIS effectiveness. There is need for MoHS targeted interventions to improve on LMIS effectiveness in Sierra Leone.

Therefore, it is essential to tailor MoHS finances towards strategy on improving factors that influence LMIS effectiveness in Sierra Leone.

RESEARCH CONTRIBUTIONS

The study has provided a theoretical framework of factors that could be of help to determine LMIS effectiveness and serve as foundation for future research work.

The study has contributed to the body of knowledge for decision-makers.

The study provided a new aspect of assessing LMIS effectiveness in healthcare delivery service.

The study contributed towards research work as very limited work available on IS and SCM factors to determine LMIS effectiveness.

LIMITATIONS

The small sample size and the limited funding might have affected the results. In future the researcher hopes to increase sample size to minimize errors.

RECOMMENDATIONS

It is recommended that Forecasting, Logistics, Information Quality and Production factors are integrated and strengthened to improve the LMIS effectiveness in Sierra Leone. The pharmaceutical management project provided accountability materials for information management that helped information collection [5]. Similar study confirmed information integration and logistics performance to have improved information sharing, production, delivery performance [9];[28].

Future studies are recommended to confirm the model and its tools through surveys using larger sample size from various organizations in different Countries.

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DECLARATION

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Contributions

LK carried out the entire research process from concept note and proposal development to conduct of the research and dissertation writing as a partial fulfillment for his Masters' Degree. LK developed the manuscript for publication. ECK supervised LK during the development of the concept note, proposal, implementation of research and dissertation writing. She also guided the development of the manuscript for publication. All authors read and approved the final manuscript.

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Ethics approval and consent to participate

Data collection of the study commenced after obtaining ethical approval on 2 April 2019 from Sierra Leone Ethics and Scientific Review Committee (SLESRC) of the Directorate of Research and Training, Ministry of Health. All study procedures were under the ethical standards of the Helsinki Declaration. Informed consent was obtained from all respondents.

Consent for publication

Not required.

Data availability

The data that support the findings of this study are available from the corresponding author, [author LK], upon reasonable request.

Competing interests

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None declared.

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CoICT	College of Information Communication and Technology
DDMS	Directorate of Drugs and Medical Supplies
EMR	Electronic Medical Records
IS	Information Systems
KMO	Kaiser-Meyer-Olkin
LIS	Logistics Information Systems
LMIS	Logistics Management Information Systems
MoHS	Ministry of Health and Sanitation
SCM	Supply Chain Management
SPSS	Special Package for Social Scientists

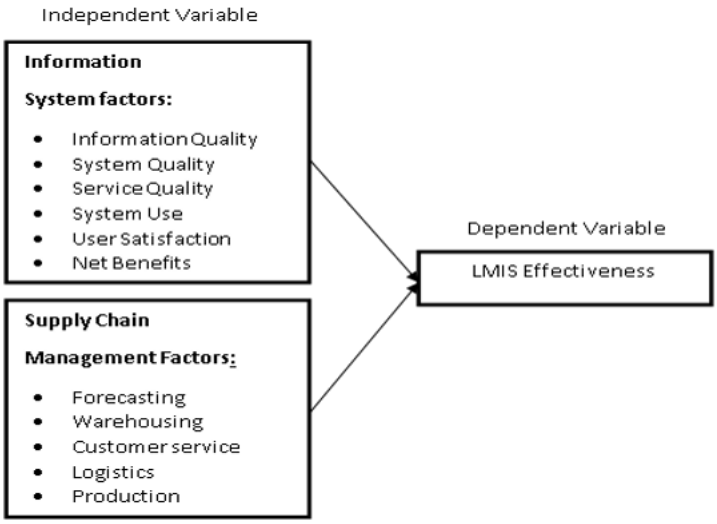

Figure 1: The Adopted Conceptual Framework for This Study (source: Mutugi BM; 2014)

Table1: The Reliability Measures of the Factors Used to Determine LMIS Effectiveness

Factor	Item #	Cronbach's alpha (α)
System Quality	**9**	0.771
Information Quality	**12**	0.934
User Satisfaction	**4**	0.891
System Usage	**5**	0.827
Service Quality	**5**	0.849
Net-Benefit	**6**	0.888
Forecasting	**2**	0.530
Warehousing	**3**	0.690
Customer Service	**5**	0.834
Logistics	**2**	0.573
Production	**2**	0.477

Table 2: Regression Analysis Cause-Effect Relationship Model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
	.615[a]	.378	.328	.195