



# 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) was introduced in Sierra Leone to improve drug supply management and provide accurate information that can be used for planning and resources allocation. The system managed drugs supplies, but this system is being influenced by factors to enhance effective drugs supply management.

**Methodology:** The study examined factors considered to influence LMIS effectiveness on drugs supplies management, using the conceptual framework model. Purposive and sequential exploratory means of data collection through self-administered questionnaires was employed.

**Results:** The study identified eleven factors and only four (forecasting, logistics, information quality and production) have significant influence on LMIS effectiveness on drugs supply management.

**Conclusion:** The study showed four factors having positive and statistically significant effect on LMIS effectiveness on drugs supply management. Therefore, strengthening these factors would significantly improve LMIS effectiveness on drugs supply management in Sierra Leone.

**Keywords:** Factors influencing logistics management information system effectiveness; Information system factors; Supply chain management factors

## ABBREVIATIONS

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.

## INTRODUCTION

The progression of Supply Chain Management (SCM) of pharmaceutical products and increased information requirements has facilitated the integration of Logistics Information Systems (LIS) and supply chain information systems to Logistics Management Information Systems (LMIS) [1]. LMIS provides quality information for better decision making, planning, and procurement of essential health commodities which are essential towards improving healthcare delivery in developing countries [2-

4].

Mostly, Sierra Leone SCM studies and interventions focus on pharmaceutical management of essential medicines, medical supplies and related systems strengthening, not on LMIS effectiveness. Supply Chain Management (SCM) challenges were identified during the Ebola outbreak leading to improvements [5]. No study identified factors that influence LMIS effectiveness. This study identified Information System (IS) and SCM factors that are most widely used, studied their influence on LMIS effectiveness, and suggested strategies to improve LMIS effectiveness [6-8].

## Background review of factors influencing LMIS effectiveness

Many studies have identified IS and SCM factors and developed models to determine LMIS effectiveness [9-11]. A textile industry's case study identified factors that were predicted to improve SCM effectiveness based on strengthening governance, capacity building on pharmaceutical management and services addressing information needed [12,13]. Another study identified IS factors

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found to be significant in operational information sharing effectiveness [14].

A web IS effectiveness study identified four factors which were found to significantly contribute to inter personal, professional skills, and performance level of the organization [15].

Similarly a project management study used a combined updated Delone and Mclean model of IS success to examine Project Management Information System (PMIS) effectiveness [16]. The findings indicated that information quality and service quality have significant relationship with system effectiveness. Relatively few studies attempted to use models and factors in assessing LMIS effectiveness. This type of study has not been attempted in Sierra Leone using factors to determine the level of effectiveness.

## METHODOLOGY

### Research design

**Research design, approach and sampling techniques:** This study used a mixed sequential exploratory design with a non-probability sampling technique involving quantitative data collection through a self-administered questionnaire. The qualitative data collection involved Focus Group Discussion (FGD).

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

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

### Data collection, analysis

The control of the content of the questionnaire used in the data collection was carried out before the start of the study through the consultation of well experienced academics in the field of LMIS operations.

Data collected were analyzed descriptively and inferentially using Statistical Package for Social Scientist (SPSS). The availability of data analyzed by category from the SPSS for influence of LMIS will be described below. The p-value approach was used to determine the statistical significance and a construct was rejected if the p-value was greater than  $\alpha$  (i.e.,  $p>0.05$ ) and accepted if the p-value is less than or equal to  $\alpha$  (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 in figure 1 below was used in the study as it was adopted from a derived literature reviews of IS and SCM factors based on similar findings from previous studies [18,19] (Figure 1).

**Hypothesis 1: System quality influences LMIS effectiveness:** System quality measures the performance needed to support system users. A hospital IS study determined IS effectiveness and found that system quality and information quality influenced computer end-user satisfaction [20].

**Hypothesis 2: Information quality influences LMIS effectiveness:** Information quality determined information output. A web-based study determined the web-based system effectiveness, which outlined a significant influence of Information quality to the web-based system.

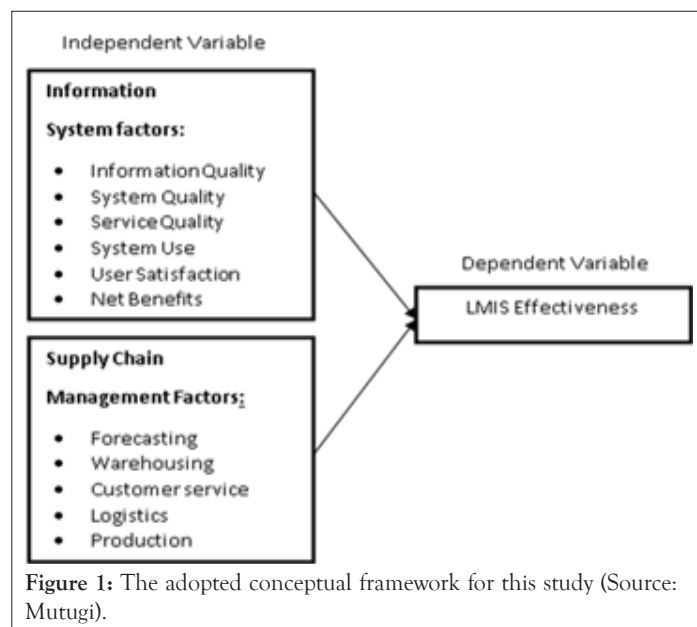


Figure 1: The adopted conceptual framework for this study (Source: Mutugi).

**Hypothesis 3: User satisfaction influence LMIS effectiveness:** User satisfaction measures service, knowledge, and participation. The web-based system effectiveness was determined based on information product. Findings influence of user satisfaction corresponding to information quality, system quality and service quality [21].

**Hypothesis 4: System use influence LMIS effectiveness:** System use appraised the amount, frequency, nature and purpose of use. An Electronic Medical Records (EMR) study indicated that information success can best be determined by system use.

**Hypothesis 5: Service quality influence LMIS effectiveness:** Service quality refers to the available user personnel supporting the system. A Hospital EMR study used IS factors to determine the EMR implementation success. Service quality was found to influence EMR effectiveness.

**Hypothesis 6: The net-benefit influences LMIS effectiveness:** Net-Benefit measures individual and organizational impact. An EMR study using net-benefit to determine EMR success found that user satisfaction perceived net-benefit.

**Hypothesis 7: Forecasting influences LMIS effectiveness:** Forecasting involves planning of SCM activities to improve SCM practices. According to this study that compared the relationship between Logistics and supply chain objectives, it was confirmed that forecasting was significantly related to supply chain performance.

**Hypothesis 8: Customer service influences LMIS effectiveness:** Customer service is a requirement from the supplier relationship. A study confirmed that customer service influences SCM responsiveness and improves its practices.

**Hypothesis 9: Warehousing influences LMIS effectiveness:** Warehousing aids cost reduction, increases customer service utility of products, and is considered to influence SCM practices.

**Hypothesis 10: Logistics influence LMIS effectiveness:** Logistics is an influential factor to LMIS effectiveness. A study confirmed that logistics practices influence SCM.

**Hypothesis 11: Production influences LMIS effectiveness:** Good products aid to increase customers' demand. A study observed that production leads to the receptiveness of fast delivery of final product to the customer [22].

## RESULTS

### Demographic data analysis

56.7% of respondents had a bachelor's degree, 26.7% had a master's degree, and 16.6% had diplomas and certificates. 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 the respondents were at middle, 25.3% were low and 20.0% were top management level staff.

### 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 result using cronbach's alpha coefficient for internal uniformity was 0.963. See Table 1 for 11 independent cronbach's alpha coefficient variables (Table 1).

**Table 1:** Regression analysis of factors influencing LMIS effectiveness.

Model	Standardized coefficients	t	Sig.
(Constant)	Beta	0.965	0.336
System quality_score	0.048	0.586	0.559
Information quality_score	0.453	2.766	0.006
User satisfaction_score	-0.131	-0.91	0.364
Usage_score	0.068	0.672	0.503
Service quality_score	-0.009	-0.071	0.943
Net benefit_score	-0.156	-1.157	0.249
SCM_forecasting score	0.316	3.211	0.002
SCM_warehousing score	0.093	0.717	0.475
SCM_customer score	0.05	0.382	0.703
SCM_logistics score	-0.364	-3.068	0.003
SCM_production score	0.318	2.558	0.012

### Regression data analysis

Regression analysis examined the cause-effect relationship of IS and SCM factors (independent variables) and LMIS effectiveness (dependent variable) as indicated in Figure 1. Table 2 shows the model summary of the data analyzed. The use of homoscedasticity, collinearity, linear relationship, normality, independence of residual techniques was tested to avoid violation of the assumption in the study (Table 2).

**Table 2:** Regression analysis cause-effect relationship model.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
	0.615	0.378	0.328	0.195

The linear regression analysis conducted, all factors used in determining the model's success and level of influence on LMIS effectiveness were entered once. Table 1 describes the research model summary with adjusted  $R^2 = 0.328$  which indicates that 32.8% of these factors had influence on LMIS effectiveness and 67.2% have no influence. Table 1 shows standardized beta ( $\beta$ ) values and prediction of influence on LMIS effectiveness.

### Hypothesis testing of the effectiveness of LMIS

The p value of a factor determining the significant influence of

LMIS effectiveness should either be less than or equal to 0.05 as in Table 1. From the Hypotheses H1 to H11 tested only four were significant (information quality, forecasting, logistics and production) with p values: 0.006, 0.002, 0.003 and 0.012. Therefore, these four factors should be accepted and included to be part of the revised model.

**Hypothesis 12: Information quality influenced LMIS effectiveness:** Information quality has a beta value of 0.453 with p-value of 0.006 which is within the study accepted range of p ( $\alpha < 0.05$ ). This shows that Information quality has an influence on LMIS effectiveness.

**Hypothesis 13: Forecasting influenced 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 ( $\alpha < 0.05$ ). This means Forecasting has a statistical influence on LMIS effectiveness.

**Hypothesis 14: Logistics influenced LMIS effectiveness:** The beta value of Logistics is -0.364 and p value of 0.003 which is within the accepted range of p ( $\alpha < 0.05$ ) this means that Logistics p-value is within the study. This means Logistics hypothesis has an influence on LMIS effectiveness.

**Hypothesis 15: Production influenced LMIS effectiveness:** Production with beta value of 0.318 and p value of 0.012 is within the accepted significance range of p ( $\alpha < 0.05$ ). This means production has an influence on LMIS effectiveness.

## DISCUSSION

The study was conducted to determine IS and SCM factors that influenced LMIS effectiveness.

The influence of IS and SCM factors on LMIS effectiveness were described below:

The result in H2 gives a clear significant influence of information quality to LMIS effectiveness. This means that improving efforts towards quality of information management will improve SCM. The hypotheses is in line with previous study conducted by improving users attitude towards producing or collecting quality information, LMIS effectiveness will be higher [23].

The FGD affirmed information quality a central core on LMIS effectiveness as it is in the management of drugs supplies in Sierra Leone.

Hypothesis (H7), forecasting showed a significant influence on LMIS effectiveness with the p-value of 0.002. The result is in line with a study indicating forecasting to strongly influence SCM practices. The FGD affirmed that efficient and effective forecasting will minimize stock-out, over stocking, improve quantification and procurement activities [24,25].

The result of hypothesis (H10) has a significant influence on LMIS effectiveness with a p-value of 0.003. Similar study assessed the effect of SCM performance in private hospitals and it was confirmed that better logistics management improves the performance of SCM and other supplies systems [26]. The FGD highlighted that Logistics is the pivot pillar of SCM with timely delivery of products to the intended customer.

Production (H11) has a significant influence on LMIS effectiveness, with a p-value of 0.012. This was supported by a study which proves that production influenced the performance of SCM. The FGD indicated that with quality information sharing will improve production [27].

In summary, Forecasting with  $\beta=0.316$ , ( $p=0.002$ ), Information Quality with  $\beta=0.453$ , ( $p=0.006$ ), are factors 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 [28].

## CONCLUSION

The study assessed eleven independent variables of IS and SCM factors that were proposed to influence LMIS effectiveness on drug SCM in Sierra Leone and the influence of these factors in improving the LMIS effectiveness was evaluated.

Based on linear regressions analysis results, forecasting, information quality, logistics and production statistically and significantly influenced LMIS effectiveness and are part of the final theoretical framework model of the study.

## 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. Similar study confirmed information integration and logistics performance to have improved information sharing, production, delivery performance.

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

## DECLARATIONS

### Contributions

LK carried out the entire research process from concept note and proposal development to conduct 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.

## 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 (DRT), Ministry of Health and Sanitation (MHS). 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

None declared.

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Not applicable.

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