

Evaluating the Effect of Electronic Logistics Management Information System Facility Edition (eLMIS FE) on the Healthcare Supply Chain Management Performance in Ndola District Zambia: A Mixed Methods Study

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Abstract

In recognising the critical role of efficient healthcare supply chain management in ensuring patient access to vital medications, the electronic Logistics Management Information System (eLMIS) seeks to streamline this process. This study evaluated the effect of eLMIS on healthcare supply chain management (HSCM) performance in Ndola district. A pragmatic research philosophy was adopted and a mixed methods design was employed, combining quantitative data from a questionnaire with qualitative insights from semi-structured interviews with 115 healthcare workers across three facilities. Findings indicate that the eLMIS is integral to daily operations in healthcare facilities, with 13.9% of participants using it daily, 15.7% using it weekly and 60.9% using it monthly. The study identifies stock availability as the primary performance indicator monitored by 96.5% of respondents trailed by Timeliness of orders (59.1%) and data quality (44.3%). The R value of 0.649 indicates a moderate to strong positive correlation between the predictors and the supply chain performance outcomes. This suggests that the eLMIS utilisation practices, as a set of independent variables, have a substantial influence on the various aspects of supply chain performance measured in this study. The results show that the regression sum of squares (51.879) is significantly higher than the residual sum of squares (71.112), leading to a substantial F-value of 13.132 with an exceptionally low p-value of less than 0.001, providing strong evidence to reject the null hypothesis. This finding indicates that the model as a whole is highly statistically significant, meaning that the set of eLMIS utilisation practices included as predictors collectively have a meaningful and robust relationship with the various dimensions of supply chain performance. Recommendations include developing targeted training programs, implementing monthly or quarterly reporting cycles and data audits that could provide healthcare managers with up-to-date information, enabling them to identify trends and address issues before they escalate.

Keywords: eLMIS, Healthcare Supply Chain Management, Essential Health Commodities, Data Quality, Ndola, Zambia.

Introduction

Efficient healthcare supply chain management is fundamental to ensuring that patients have access to essential medicines and medical supplies (Vledder, Friedman, Sjöblom,

Brown, & Yadav, 2019). The Zambian Ministry of Health (MoH), with support from partners such as Centre for Disease Control and Prevention (CDC) and the United States Agency for International Development (USAID), transitioned from paper-based logistics systems to a web-based Open LMIS platform between 2012 and 2015 (AIDSFreeProject, 2018). The rollout of the eLMIS Central Edition (CE) in 2014 and the Facility Edition (FE) in 2016 aimed to automate reporting and ordering processes, strengthen real-time stock visibility, and enhance transparency in the management of essential medicines and health supplies (AIDSFreeProject, 2018; Mwencha, et al., 2017). Through electronic reporting and requisition mechanisms, eLMIS enables health facilities to submit logistics data to the central supply chain authority, Zambia Medicines and Medical Supplies Agency (ZAMMSA) thereby strengthening planning and distribution processes. (AIDSFreeProject, 2018). National reports indicate improvements in reporting rates and reductions in order processing times following implementation. Nonetheless, recent evidence from the *"ANTIMALARIALS AND ART/TPT QUANTIFICATION DATA CLEANING REPORT 2024"* highlights these issues as significant inconsistencies between facility stock control cards (SCC) and eLMIS records, largely due to poor data capturing by facility staff and incorrect data entry (Ministry of Health Zambia, 2024). For example, coartem tablet (6) had a variance of 211 as of January 2024. The SCC from all 16 facilities observed revealed a cumulative 1460 stock whereas eLMIS only captured 1249 stock. This undermines the reliability of consumption data used for quantification of commodities and decision-making raising concerns regarding the effectiveness of the system in supporting supply chain management. Contradictions exist between theoretical expectations that eLMIS improves data accuracy and the practical evidence of inconsistent and unreliable data observed in facility reporting (Mekonen, Cho, & Fenta, 2025). While the system was introduced to improve stock visibility, enhance forecasting and reduce stock-outs, persistent data quality challenges can limit its effectiveness in achieving these outcomes. If the information used for supply planning and procurement decisions is inaccurate, the anticipated performance improvements associated with the system may not be fully realised. This problem affects supply chain managers, pharmacists, laboratory technicians and patients who rely on uninterrupted access to essential medicines. The challenge is particularly evident in health facilities within Ndola district where discrepancies were observed.

Few studies reveal the eLMIS utilisation practices as well as key performance indicators that contribute to the efficiency of the healthcare supply chain. Therefore, this research addresses the critical gap in knowledge regarding the specific relationship between eLMIS utilisation, data quality and healthcare supply chain performance at health facilities in Zambia, considering the specific contextual factors and challenges highlighted in the report, including, Data Quality and System Accuracy, Impact of Infrastructure Limitations, Training and User Adoption, and Data Utilisation for Decision-Making (AIDSFreeProject, 2018; Peltola, 2019). Addressing the challenges that healthcare workers are facing with the system is the foundation to improving supply chain efficiency.

Research Objectives

- To establish what the eLMIS FE system is used for in health facilities in Ndola district.
- To identify the healthcare supply chain management performance indicators that are measured in the health care facilities.
- To assess the effect of the eLMIS system on the identified health supply chain management (HSCM) performance indicators.

Research Hypothesis

The following hypothesis will be tested to determine the relationship between eLMIS utilisation and supply chain performance:

- Ho There is No significant effect of eLMIS utilisation on supply chain performance.
- H1 There is a significant effect of eLMIS utilisation on supply chain performance.

Literature Review

The World Health Organization (WHO) recognises the crucial role of well-functioning logistics management information systems (LMIS) in strengthening health systems and improving access to essential medicines and supplies (Fritz, Herrick, & Gilbert, 2021). Electronic logistics management information systems (eLMIS) have emerged as a promising approach to addressing supply chain challenges in LMICs. This literature review examines the potential of eLMIS to transform healthcare supply chain management, analyses the key challenges to their successful implementation, and explores strategies for optimising their impact.

Functionality, Forms and System Engagement of eLMIS

Growth in the demand of health commodities requires organisations to improve their logistics management systems (Omary & Kalinga, 2017). A logistics Management Information System is key in realising the six rights set out by WHO. It is a system that Supply chain managers use to collect, store, analyse and organise logistics information. This logistics data is then used to make operational decisions. The whole system requires skilled people, processes and technology in order to survive. Paper- based logistics systems are being replaced with electronically operated logistics systems (JSI, 2020). eLMIS is a management system that allows facilities including district health offices to collect, organise and report commodity information on the Facility edition (FE). This information is then fed into higher levels of ELMIS on the Central Edition (CE). The information sent to the central edition is then used to make decisions that govern logistics and ensure that all six rights are fulfilled for each client. (Right Quantity, right quality, right time, right place, right cost). Data collected from ELMIS can be used to establish national level consumption, planning and quantification (JSI, 2020).

The literature describes that core eLMIS functions include stock management, which involves tracking stock levels, receiving, issuing and reporting on commodities; transaction verification, which ensures accurate accounting for commodities; order management, which facilitates the ordering of supplies based on real-time data; reporting, which generates timely and accurate reports; and data sharing, which provides visibility across various levels of the health system (Abdulkadir, Matellini, Jenkinson, Pyne, & Nguyen, 2024; Mwencha, et al., 2017; Vledder, Friedman, Sjöblom, Brown, & Yadav, 2019; Wasswa, et al., 2023). eLMIS commonly come in two primary editions: Central Edition (CE), which manages data centrally, and Facility Edition (FE), used by health facilities for reporting and transactions (Mwencha, et al., 2017). Low engagement with the logistics system can promote supply chain risks that can potentially disrupt the entire supply chain. As eLMIS provides data visibility across various levels, operational risks such as lead time can result from low system utilisation, (Mwanza & Telukdarie, 2022)

Key Performance Indicators in HSCM

Evaluating the effectiveness of eLMIS requires a comprehensive framework of key performance indicators (KPIs) that capture various dimensions of HSCM performance. These KPIs provide a basis for assessing improvements or deficiencies in supply chain operations (Abdulkadir, Matellini, Jenkinson, Pyne, & Nguyen, 2024; Mhazo, Miyango, Palani, & Maponga, 2024; Mwencha, et al., 2017; Vledder, Friedman, Sjöblom, Brown, & Yadav, 2019). The literature identifies several crucial performance indicators for HSCM which include, reporting rates, emphasising the timeliness, frequency, and accuracy of reports (Mwencha, et al., 2017); data quality, covering aspects such as completeness, reliability, relevance, accuracy, and timeliness (Abdulkadir, Matellini, Jenkinson, Pyne, & Nguyen, 2024; Vledder, Friedman, Sjöblom, Brown, & Yadav, 2019); and stock availability, focusing on the prevalence and duration of stockouts as well as overall commodity availability (Abdulkadir, Matellini, Jenkinson, Pyne, & Nguyen, 2024; Mhazo, Miyango, Palani, & Maponga, 2024; Vledder, Friedman, Sjöblom, Brown, & Yadav, 2019). Additionally, inventory management is measured through indicators like expiry rates, emergency order rates, and stock levels, while data accessibility and use highlight the ease of access and application of data in supply chain decision-making (Abdulkadir, Matellini, Jenkinson, Pyne, & Nguyen, 2024; Mhazo, Miyango, Palani, & Maponga, 2024; Wasswa, et al., 2023). However, the reliance on these KPIs must be balanced with an awareness of their limitations; for instance, high reporting rates do not necessarily correlate with effective inventory management. Therefore, a holistic approach that incorporates qualitative assessments and stakeholder feedback is essential for a comprehensive evaluation of eLMIS performance in HSCM.

Empirical Studies on the Electronic Logistics Management System and Supply Chain Performance

Electronic Logistics Management Information Systems (eLMIS) have emerged as a vital solution to the persistent challenge of stockouts in healthcare settings. Numerous studies indicate a strong positive correlation between eLMIS implementation and a significant reduction in stockouts, leading to improved medicine availability and patient access (Mwencha, et al., 2017; Niyomugaba, et al., 2026; Vledder, Friedman, Sjöblom, Brown, & Yadav, 2019). For instance, the introduction of eLMIS in Zambia resulted in a 17% reduction in stockouts at health facilities, while those using the eLMIS Facility Edition experienced 15.5% fewer stockouts compared to their paper-based counterparts (AIDSFreeZambia, 2019).

However, while these findings underscore the effectiveness of eLMIS, they also invite scrutiny regarding the broader implications of such technological interventions. A study in Tanzania revealed that the introduction of an integrated electronic immunization registry and logistics management system led to increased vaccine availability, yet it did not address vaccine wastage, which is critical for comprehensive supply chain assessment (Gilbert, et al., 2020). Furthermore, research in Uganda highlights that the benefits of eLMIS extend beyond improved data quality to include real-time reporting, data monitoring, and enhanced coordination among supply chain partners (Wasswa, et al., 2023). These findings suggest that while eLMIS can enhance operational efficiency, there are still gaps in addressing issues like wastage and the potential for data mismanagement. In Zambia, evaluations of eLMIS have shown improvements in stock availability, accessibility, and reporting accuracy (AIDSFreeProject, 2018). However, challenges persist, particularly concerning user training and data quality. (Kapyela & Chibomba, 2019) noted improvements in service delivery post-eLMIS integration, yet they emphasised the need for ongoing training to maximise system benefits. Similarly, (Tiye & Gudeta, 2018) reported enhanced reporting rates but also highlighted significant data quality issues that undermine the system's effectiveness. This duality suggests that while eLMIS offers substantial advantages, its successful implementation is contingent upon adequate training and support. Additionally, reports indicate that the administrative burden on healthcare workers remains a concern, as the increased complexity of digital systems can lead to resistance and errors in data entry (Akinola, et al., 2022). These challenges point to the need for a balanced approach that considers both the technological benefits and the human factors influencing system performance.

Theoretical and Conceptual Frameworks

This research draws on the Technology Acceptance Model (TAM), Contingency Theory and Systems thinking perspective (Atun et al. Framework) to guide the study on evaluating the effect of Electronic Logistics Management Information System (eLMIS) Facility Edition on the healthcare supply chain performance in Ndola District, Zambia.

TAM theory posits that perceived usefulness and perceived ease of use are key determinants of user acceptance and subsequent usage of a technology (Akinola, et al., 2022; Okronipa, Aboagye-Darko, & Nyame, 2023). TAM was used as the backbone to examine the acceptance and usage of the eLMIS Facility Edition by healthcare workers in Ndola District. In the context of this study, TAM provides a framework for understanding how healthcare workers in Ndola District perceive the eLMIS Facility Edition. Through assessing perceived usefulness, the study can explore how healthcare workers believe that the system will enhance their job performance and improve healthcare supply chain management. This aspect is vital as it directly influences their willingness to utilise the eLMIS effectively (AIDSFreeProject, 2018). In contrast, Contingency Theory posits that the success of an intervention, such as the implementation of a new technology, depends on its alignment with the specific context in which it is applied (Akinola, et al., 2022). In this study, Contingency Theory informs the evaluation of the eLMIS Facility Edition by emphasising the importance of contextual factors that may influence its performance in Ndola District. These factors include infrastructure, human resources, data quality, and organisational support. By examining these contextual elements, the study can identify potential barriers and enablers to the effective implementation of eLMIS, providing a nuanced understanding of how local conditions impact technology adoption in the healthcare supply chain. Systems thinking, a concept emphasising the interconnectedness of components within a system, aligns well with the (Atun, Jongh, Secci, Ohiri, & Adeyi, 2010) framework for analysing health interventions. This framework acknowledges the complexity of integrating interventions into healthcare systems, recognizing them as "relational and complex" processes due to the interplay of diverse stakeholders, norms, and values (Akinola, et al., 2022; Atun, Jongh, Secci, Ohiri, & Adeyi, 2010). Based on works done by different researchers the conceptual framework was developed. The conceptual framework illustrates the hypothesised interrelationships between the eLMIS and supply chain performance indicators, as outlined in Figure 1

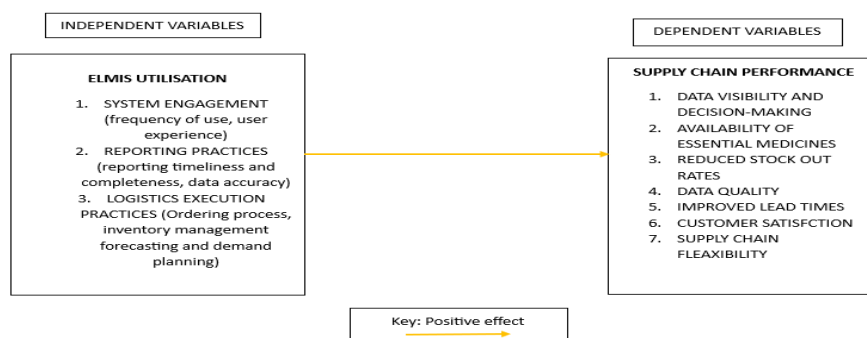


Figure 1: Conceptual Framework for Evaluating eLMIS Facility Edition in Ndola District, Zambia.

(Source: Author, 2024)

This study conceptualises that healthcare supply chain performance is influenced by the extent and quality of eLMIS utilisation practices at facility level. Effective utilisation characterised by frequent system use, accurate data entry, timely reporting and active use of data for decision-making enhances data quality, data visibility, quantification accuracy, lead times and overall stock management, which in turn improves stock availability, reduced stock-outs and strengthen overall supply chain responsiveness and efficiency.

Research Methodology

The study adopted a pragmatic research philosophy, emphasising the importance of combining both quantitative and qualitative data to obtain a holistic understanding of the real-world implications of eLMIS implementation. The study employed a convergent mixed methods approach. This design involved first collecting and analysing quantitative data, which included metrics such as inventory turnover rates, order fulfillment times, and healthcare product availability. Structured questionnaires were used to obtain quantitative data. Subsequent qualitative data, gathered through semi-structured interviews, provided richer insights into the experiences and perceptions of healthcare workers, administrators, and patients regarding the use of eLMIS. The convergent mixed methods approach was particularly well-suited for this study as it enabled researchers to explore multiple perspectives and data sources, offering a comprehensive evaluation of the complex interventions associated with eLMIS. Before conducting the main data collection procedure, a pilot study was carried out to assess the feasibility and refine the data collection instruments and procedures. The study population was healthcare workers stationed at Ndola Teaching Hospital, Arthur Davison Childrens Hospital and Ndola district Health Office. Stratified random sampling was employed due to the different facility types and staff categories within Ndola District. Each healthcare facility was identified as a stratum containing pharmacy and laboratory personnel. The sample size of 115 was calculated using the (Yamene, 1967) formula and was randomly selected from the two categories in each facility. Each healthcare facility was identified as a stratum containing two distinct sub-populations: pharmacy personnel and laboratory personnel. 100% response rate. Qualitative data were analysed using thematic analysis, which involved identifying, coding, and reporting patterns or themes within the data. The quantitative data were then analysed using descriptive and inferential statistical techniques.

Reliability Test

The reliability of the quantitative data collection instruments (i.e., the questionnaires) was assessed using Cronbach's alpha coefficient (Cronbach, 1951). This test measured the internal consistency and reliability of the items or questions within each construct or scale used in the questionnaires. The reliability of the scale was confirmed with a Cronbach's alpha of 0.82 (which is above 0.70) for the main utilisation construct, indicating good internal consistency.

Validity Test

The validity of the quantitative data collection instruments was evaluated to ensure that they measured what they were intended to measure. Content validity was established by consulting with subject matter experts and conducting a thorough literature review to ensure that the items or questions accurately represented the constructs being measured.

Results and Discussion

The utilisation of eLMIS system in health facilities in Ndola district

Figure 2 and Table 1 below show the responses of the participants regarding the use of eLMIS and the levels of agreement regarding the utilisation of the system. The levels are strongly agreed, Agree, Neutral, Disagree and Strongly disagree.

Frequency of Utilising the eLMIS System

The pie chart below represents the frequency of utilization of the eLMIS system at the facilities.

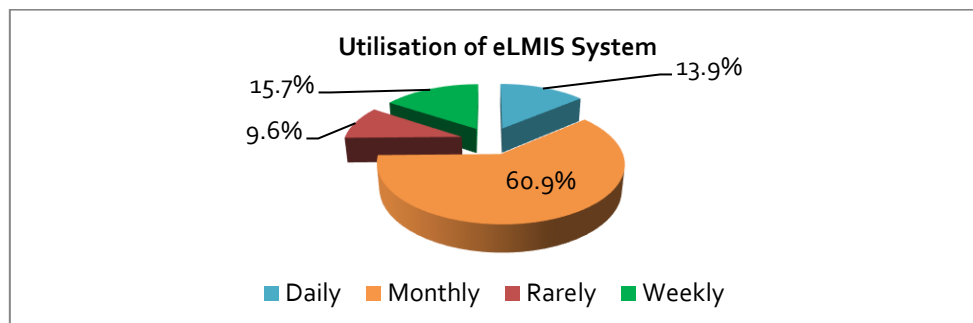


Figure 2: Frequency of utilising the eLMIS system

Source: Author (2025)

The pie chart on the utilisation of the eLMIS system (Figure 2) indicates that a significant 60.9% of participants engage with the system monthly, while 15.7% use it weekly, 13.9% daily, and 9.6% do so rarely. The high frequency of monthly eLMIS usage, reported by 60.9% of participants, aligns with the Technology Acceptance Model's (TAM) emphasis on perceived usefulness as a key determinant of technology adoption (Okronipa, Aboagye-Darko, & Nyame, 2023). Healthcare workers' consistent engagement with the system suggests that they recognise its value in facilitating continuous access to logistics information, enabling effective inventory management, and enhancing overall operational efficiency. This finding resonates with the Systems Thinking Perspective, which acknowledges the eLMIS as a critical subsystem within the broader healthcare supply chain (Atun, Jongh, Secci, Ohiri, & Adeyi, 2010). By integrating the eLMIS into their daily, weekly and monthly workflows, healthcare facilities are able to improve data visibility, responsiveness, and resilience across the supply chain (Yadav, 2024). Evidence from Sub-Saharan Africa also shows that fragmented information systems often lead to inefficiencies, while integrated digital platforms like eLMIS strengthen end-to-end supply

chain performance, providing benefits in reduced stockouts and medicine expires, monitoring of stock and data visibility. (Niyomugaba, et al., 2026)

However, the smaller percentages for weekly and rare usage may point to potential barriers that may be hindering persistent utilisation gaps. From a Contingency Theory standpoint, these barriers could be rooted in contextual factors, such as inadequate training, limited user support, or organisational resistance to change (Akinola, et al., 2022). Addressing these challenges through targeted capacity-building initiatives and user-centric design improvements can help ensure that all healthcare workers, regardless of their experience or technical proficiency, are empowered to leverage the eLMIS effectively. This minority may represent new staff members or those who have not received adequate training, highlighting a critical area for intervention.

Level of Agreement Regarding the use of the eLMIS System

The level of agreement about the use of the eLMIS system was show through a five-point Likert scale. The table below shows the level of agreement regarding the use of the system.

Table 1: Level of agreement regarding the use of the eLMIS system

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean	Standard Deviation
I find the eLMIS system easy to navigate.	20	55	26	11	3	3.67	1.17
The eLMIS system improves my efficiency in managing inventory.	26	72	13	2	2	4.30	0.73
I receive adequate training to use the eLMIS system effectively.	9	31	12	37	26	2.18	1.14

Source: Author Constructed

The findings regarding the level of agreement about the eLMIS system reveal varied perceptions among users as shown in Table 1. The mixed perceptions regarding the system's ease of navigation, with a mean score of 3.67, suggest that while many users find the interface manageable, there is still room for improvement. This aligns with the TAM's emphasis on perceived ease of use as a key factor influencing technology adoption (Okronipa, Aboagye-Darko, & Nyame, 2023). By enhancing the system's user-friendliness and addressing usability concerns, healthcare facilities can foster a more inclusive and empowering environment for eLMIS utilisation, ultimately contributing to a more resilient

and responsive healthcare supply chain. The strong consensus on the eLMIS system's contribution to inventory management efficiency, with a mean score of 4.30, underscores the system's value in aligning with the Supply Chain Management (SCM) Theory (Mohsen, 2023; Ralston, Schwieterman, Bell, & Ellram, 2022). By streamlining inventory processes and enhancing data visibility, the eLMIS enables healthcare facilities to better plan, monitor, and respond to supply chain demands, improving the availability of essential medicines and commodities (USAID, 2023). This finding highlights the system's potential to strengthen the overall healthcare supply chain performance in Ndola District. However, the concerning mean score of 2.18 regarding adequate training indicates that many users feel unprepared to utilise the eLMIS effectively. This discrepancy between the perceived usefulness and the lack of training support points to the need for more comprehensive capacity-building initiatives, as emphasised by the Contingency Theory (Akinola, et al., 2022). By ensuring that all healthcare workers receive comprehensive training and ongoing support, facilities can empower their staff to fully leverage the eLMIS system's capabilities, fostering a culture of continuous learning and adaptability.

Thematic Analysis

Three major themes emerged from the qualitative data: (1) Integration of eLMIS into daily operations, (2) Data quality and training challenges, and (3) Perceived effects on supply chain responsiveness.

Integration of eLMIS into Daily Operations: Participants described eLMIS as “*integral*” to tasks such as inventory tracking, ordering, and reporting. This supports the quantitative finding that most staff use eLMIS at least monthly. “*Every month, I use eLMIS to reconcile stock and submit reports. It’s part of my workflow.*” (Participant, Pharmacy).

Data Quality and Training Challenges: Many users reported inconsistent data entry and insufficient training, echoing the low mean score for training adequacy in the survey. “*I still struggle with some eLMIS features, and training was too short.*” (Participant, Lab Technician).

Perceived Effects on Responsiveness: Several staff noted improvements in order processing and inventory management, aligning with high quantitative scores for perceived efficiency. “*Since using eLMIS, we know faster when something is out of stock and can act quickly.*” (Participant, Facility Manager)

These qualitative insights reinforced the statistical association between eLMIS utilisation and improved supply chain management performance. The quantitative improvements in supply chain performance are a direct outcome of the systems functionalities identified in the qualitative codes. Codes like drug ordering, stock tracking and reporting explain the reduction in stock outs as they reflect improved coordination and real-time stock visibility. Data reliability and accurate AMC support the high inventory accuracy confirming that the system produces dependable data for decision making.

Frequent use strengthens the positive relationship observed in the regression model, while inconsistent use can explain why the correlation is moderate rather than strong, this indicates that the full benefits of eLMIS depend on consistent and widespread utilisation.

Performance Indicators Regularly Tracked in the Facility

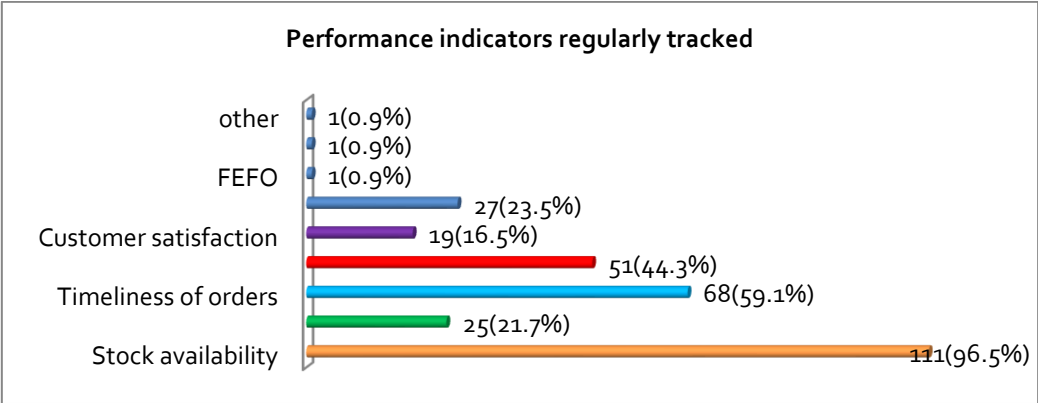


Figure 3: Performance indicators regularly tracked in the facility

Source: Author (2025)

The emphasis on stock availability as the primary performance indicator, reported by 96.5% of respondents, reflects the healthcare facilities' commitment to ensuring the consistent availability of essential medicines and commodities. By prioritising stock availability in medical supply chain management, healthcare facilities are demonstrating their understanding of the system-wide implications of stockouts, which can lead to delays in treatment, increased patient morbidity, and overall dissatisfaction with healthcare services (Topher & Ocen, 2026). This strategic approach underscores the facilities' efforts to strengthen the resilience and responsiveness of the supply chain, ultimately enhancing the quality of care and patient outcomes. The tracking of additional indicators, such as timeliness of orders (59.1%) and data quality (44.3%), suggests a more comprehensive approach to assessing supply chain performance. From a Supply Chain Management (SCM) Theory perspective, these indicators are crucial in ensuring the efficient flow of materials and information throughout the healthcare system. (Mohsen, 2023; Ralston, Schwieterman, Bell, & Ellram, 2022) Timely order fulfilment enables healthcare facilities to maintain uninterrupted service delivery, while high-quality data supports informed decision-making and the development of effective procurement strategies. By monitoring these multifaceted performance metrics, healthcare facilities can gain a more holistic understanding of their supply chain's strengths and weaknesses, informing targeted interventions to improve overall system performance. The varied attention to performance indicators, with lower tracking rates for customer satisfaction (16.5%) and reporting accuracy (21.7%), points to areas where improvements could strengthen the healthcare supply chain.

Frequency of Reporting the Indicators

The pie chart below represents the frequency of reporting the supply chain indicators.

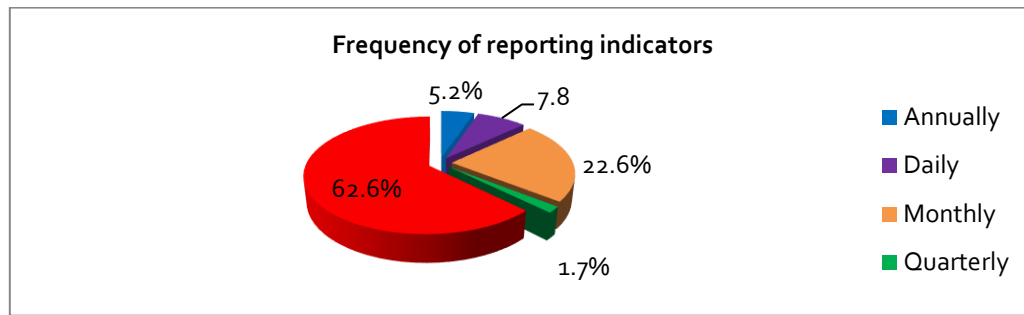


Figure 4: Frequency of reporting the indicators

Source: Author (2025)

The pie chart illustrating the frequency of reporting (Figure 4) indicators indicates that a dominant 62.6% of respondents report indicators weekly, while 22.6% report monthly, 7.8% daily, 1.7% quarterly, and 5.2% annually. This suggests that while weekly reporting is the norm, there is still a significant opportunity for more frequent assessments to enhance responsiveness to supply chain challenges. The reliance on annual reports may hinder timely decision-making, potentially impacting overall healthcare service delivery. Encouraging a shift toward more frequent reporting, as recommended by the literature (Aityassine F., et al. 2022), could facilitate agile responses to emerging issues, ultimately improving the healthcare supply chain's effectiveness.

Effect of eLMIS on Supply Chain Performance

Inferential Statistics

Inferential statistics were employed to analyse the influence that predictors such as User experience, ordering process, reporting practices, Supply chain forecasting and demand, Inventory management practices, System engagement and the healthcare supply chain performance.

Multiple Regression Analysis

The table below shows the Model Summary based off of the multiple regression analysis conducted at 95% confidence interval

Table 2: Model Summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.649 ^a	.422	.390	.811
a. Predictors: (Constant), User experience, ordering process, reporting practices, Supply chain forecasting and demand, Inventory management practices, System engagement				

Source: Author (2025)

The Model Summary table 2 indicates important insights about the relationship between the eLMIS utilisation practices and healthcare supply chain performance in Ndola District. The R value of 0.649 indicates a moderate to strong positive correlation between the predictors and the supply chain performance outcomes. This suggests that the eLMIS utilisation practices, as a set of independent variables, have a substantial influence on the various aspects of supply chain performance measured in this study. The R Square value of 0.422 further indicates that approximately 42.2% of the variability in supply chain performance can be accounted for by the eLMIS utilisation practices included in the model. This is a noteworthy finding, as it highlights the significant role that the effective use of the eLMIS Facility Edition plays in driving improvements across the healthcare supply chain. The Adjusted R Square of 0.390 provides a more conservative estimate, taking into account the number of predictors in the model, and still demonstrates a strong explanatory power. A lower standard error of estimate (0.811) indicates that the model's predictions are generally close to the actual performance values, enhancing the reliability of the findings.

Analysis of Variance

The table below shows the analysis of variance.

Table 3: ANOVA

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	51.879	6	8.646	13.132	.000 ^b
	Residual	71.112	108	.658		
	Total	122.991	114			
a. Dependent Variable: Supply chain performance						
b. Predictors: (Constant), User experience, ordering process, reporting practices, Supply chain forecasting and demand, Inventory management practices, System engagement						

Source: Author (2025)

The ANOVA table 3 provides a critical evaluation of the overall statistical significance of the regression model in explaining the variations in healthcare supply chain performance in Ndola District. The results show that the regression sum of squares (51.879) is significantly higher than the residual sum of squares (71.112), leading to a substantial F-value of 13.132 with an exceptionally low p-value of less than 0.001. This finding indicates that the model as a whole is highly statistically significant, meaning that the set of eLMIS utilisation practices included as predictors collectively have a meaningful and robust relationship with the various dimensions of supply chain performance. The very low p-value ($p < 0.001$) provides strong evidence to reject the null hypothesis, which would suggest no significant relationship between the independent variables and the dependent variable. This result underscores the importance of the eLMIS Facility Edition and its effective utilisation by

healthcare workers in driving improvements across the healthcare supply chain in Ndola District. The statistical significance of the overall model is a crucial finding, as it validates the conceptual framework and the underlying theoretical assumptions guiding this research. It suggests that by focusing on enhancing the eLMIS utilisation practices, such as improving forecasting and demand management, strengthening user experience, and optimising inventory management, healthcare facilities and policymakers can expect to see tangible improvements in supply chain performance indicators, including data visibility, stockout rates, availability of essential medicines, and overall supply chain efficiency.

Table 4 Regression Results Table (with VIFs)

Predictor	B	SE	β	t	p	VIF
(Constant)	0.665	0.302		2.200	0.030	
System Engagement	0.069	0.110	0.064	0.631	0.529	1.23
Reporting Practices	0.026	0.141	0.019	0.181	0.857	1.18
Ordering Process	0.087	0.064	0.109	1.366	0.175	1.35
Inventory Management Practices	0.156	0.126	0.113	1.242	0.217	1.25
Supply Chain Forecasting and Demand	0.521	0.082	0.512	6.363	<.001	1.16
User Experience	0.350	0.093	0.312	3.762	<.001	1.19

Dependent Variable: Supply chain performance.

Regression analysis was conducted to examine the effect of eLMIS utilisation practices on healthcare supply chain management performance (Table 4). The model was statistically significant ($R = 0.649$, $R^2 = 0.422$, $F(6,108) = 13.132$, $p < .001$), indicating that the set of utilisation predictors explained 42.2% of the variance in supply chain performance.

The regression coefficients table shows that:

- Supply chain forecasting and demand ($B = 0.521$, $\beta = 0.512$, $t = 6.363$, $p < .001$) and user experience ($B = 0.350$, $\beta = 0.312$, $t = 3.762$, $p < .001$) were significant positive predictors of supply chain performance.
- System engagement, reporting practices, ordering process, and inventory management practices did not reach statistical significance ($p > .05$).
- Multicollinearity was not a concern, as all variance inflation factors (VIFs) ranged from 1.16 to 1.35 (well below the conventional threshold of 5).

Conclusion

This study addressed three objectives: (1) determining eLMIS utilisation patterns in Ndola facilities. The study found that eLMIS utilisation significantly improves healthcare supply chain performance by supporting key functions such as ordering, inventory management, dispensing, and data entry, leading to better data management, faster decision-making, and improved resource allocation. (2) identifying key HSCM performance indicators. The study found it enhances inventory tracking and reporting, contributing to improved stock availability, reduced stockouts, and greater responsiveness in the supply chain. Key performance indicators such as stock levels, order accuracy, lead times, flexibility, customer

satisfaction, and wastage rates are used to assess performance, though expanding these metrics could provide a more comprehensive evaluation. (3) assessing the effect of eLMIS on supply chain management. The regression analysis demonstrated that eLMIS utilisation practices explain 42.2% of the variance in supply chain performance ($R^2 = 0.422$). The findings confirm that while eLMIS is regularly used and valued for improving stock availability and order management, challenges remain in user training and data quality, suggesting targeted interventions are needed for optimisation.

Recommendation

The recommendations emphasise strengthening eLMIS utilisation and overall healthcare supply chain performance through targeted capacity building, inclusive system design, and improved data management practices. This includes implementing tailored training and staff orientation programs to enhance accurate data entry, engaging all age groups in system use, and promoting accountability in logistics data handling. To improve supply chain monitoring, facilities should expand performance indicators, adopt more frequent reporting cycles, and benchmark performance against neighboring institutions. Enhancing eLMIS efficiency further requires regular system evaluations, user-friendly interfaces, and routine data cleaning or auditing to ensure high data quality. For future research, attention should be given to integrating eLMIS with other healthcare systems and examining organizational factors such as leadership, resources, and change management that influence successful implementation and sustainability.

Limitations

This study's limitations include its cross-sectional design, which precludes causal inference; the restriction of the sample to pharmacy and laboratory staff, which may not capture all eLMIS user experiences; reliance on self-reported data, which is subject to recall and desirability bias; and the focus on a single district, which may limit generalisability to other contexts. Future research should include a broader range of users and longitudinal data.

Conflict of Interest

The authors declare that they have no conflicting interests.

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Ethical considerations

Ethical approval sought from the Humanities and Social Sciences Research Committee (HHRSC) at the University of Zambia (UNZA) and the relevant health facilities in the Ndola District. By adhering to these ethical considerations and obtaining necessary approvals, the

study aims to conduct research in a responsible and ethical manner, ensuring the well-being and rights of all participants are protected. (Ref no. HSSREC-2025-APR-008).

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