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Anwar Milulu , [Stanley Mwita](#) * , [Namanya Basinda](#)

Posted Date: 12 May 2024

doi: 10.20944/preprints202405.0734.v1

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Article

Electronic Logistic Management Information System in Public Health Facilities and Its Implications for the Medicine Supply Chain in Singida District Council, Tanzania

Anwar Milulu ^{1†}, Stanley Mwita ^{2+,*} and Namanya Basinda ¹

¹ Department of Community Medicine, School of Public Health, Catholic University of Health and Allied Sciences, Mwanza, 33102, Tanzania.

² Department of Pharmaceutics and Pharmacy Practice, School of Pharmacy, Catholic University of Health and Allied Sciences, Mwanza, 33102, Tanzania.

* Correspondence: stanleymwita@gmail.com

† Shared first authorship.

Abstract: Effective management of the medicine supply chain is crucial for ensuring the availability of essential medicines and supplies in public health facilities. This study aimed to determine the utilization of the electronic logistic management information system (e-LMIS) in public health facilities and its implications for the medicine supply chain. A mixed-methods approach, combining both quantitative and qualitative data collection methods was used. The study was conducted in 106 healthcare providers from 35 public health facilities in Singida District. Six key informants were interviewed in a qualitative method. Of 106 participants, (62.3%) said they were somehow competent in e-LMIS utilization. In in-depth interviews, respondents underscored the system's utility for tracking stock levels, procurements, and managing orders. Staff shortage and lack of customized training were mentioned as major challenges, hindering efficiency in managing drug supplies. This study highlighted the positive impact of e-LMIS on various aspects of the medicine supply chain, including the timely submission of orders and enhanced inventory management. Sustained management support and regular utilization of the e-LMIS system are crucial for building and maintaining competence among healthcare providers, thereby optimizing the medicine supply chain and ultimately improving healthcare delivery.

Keywords: electronic logistics management information system; health facilities; medicine supply chain; Tanzania

1. Background

Effective management of the medicine supply chain is crucial for ensuring the availability of essential medicines and supplies in public health facilities [1]. The logistics management information system ensures commodity availability, facilitates service-seeking in the community, and enhances the quality of care [2]. Competence in the Electronic Logistic Management Information System (e-LMIS) is essential for supporting the supply chain by enabling effective system utilization, encompassing skills such as data management, procurement, and distribution of medicines [3]. In the supply chain cycle of health commodities, procurement, distribution, and inventory management are crucial stages that can significantly impact the products' accessibility and affordability for end-users [4].

The main drivers associated with an effective supply chain are demand management, institutional framework, good governance, and management involvement in decision-making regarding e-LMIS implementation [5]. The functionality of health facility management teams is crucial for overseeing daily operations and medicine supplies, especially in the context of quality healthcare service delivery [6]. However, the majority of healthcare workers in public health

facilities in developing countries often lack competence in information systems due to barriers such as lack of information technology training, workload, and the availability of the Internet, computers, and electricity [7]. Despite the introduction of the e-LMIS in Tanzania, the medical commodities supply chain is still a challenge [5,8].

User competence is paramount for the successful implementation of eLMIS [9]. Given the fact that e-LMIS is implemented in the context of low-resource settings, there is a need to evaluate its impact on medicine supply chain performance. However, there is a scarcity of research that has been conducted to assess the competence of healthcare workers at public health facilities. Thus, this study aimed to determine the utilization of e-LMIS in public health facilities and its implications for the medicine supply chain in Singida District Council, Tanzania. By addressing this research gap, evidence-based solutions can be developed to improve e-LMIS management and enhance the availability of essential medicines in public health facilities.

2. Methodology

2.1. Study Area

The study was conducted in Singida District Council, part of Tanzania's Singida Region. Singida District Council is responsible for public services in the district, located between latitudes 30 and 70 south of the equator and longitudinally between 330 and 350 east of Greenwich. It shares borders with Mkalama District to the north, Manyara and Dodoma regions to the east, Ikungi District to the south, and Singida Municipality to the west. The district covers an area of 3,787 square kilometers and serves a population of about 304,616 as of the 2022 population census [10]. Within the district are 39 health facilities, including hospitals, health centers, and dispensaries.

2.2. Study Design, Study Population

This study employed a mixed-methods approach, combining both quantitative and qualitative data collection methods. The study was conducted from July to September 2023. Quantitatively, it utilized a descriptive cross-sectional study design through surveys. Qualitatively, key informant interviews were conducted. A total of 106 healthcare workers were selected as the study's sample size based on the Taro Yamane Formula for population sampling. The study focused on healthcare providers responsible for using and managing the e-LMIS in public health facilities within Singida District. This included nurses, medical officers, pharmaceutical personnel, and staff involved in the medicine supply chain management process.

Participants included healthcare providers in public health facilities in Singida District who had received training on e-LMIS. They were selected based on their willingness to participate and their availability during data collection. Six key informants were also selected purposefully for in-depth interviews.

2.3. Data Collection Method

2.3.1. Quantitative Data Collection

Quantitative data for this study were collected through a structured questionnaire and a competence assessment tool. A team of three trained research assistants administered the questionnaires, ensuring the effective collection of data. The structured questionnaire was administered in interviews with participants.

2.3.2. Qualitative Data Collection

Qualitative data for this study were collected through in-depth interviews with key informants. During these interviews, digital recorders were used to ensure that no valuable information was missed. Prior permission to use a voice recorder was obtained from participants.

Six key informants were purposefully selected for in-depth interviews. Two in-charges were randomly selected from two dispensaries, two key informants from two health centers, and the remaining two participants from the district hospital. These key informants provided valuable insights into the factors influencing the competence of healthcare workers in utilizing e-LMIS and its impact on the management of the medicine supply chain in health facilities in Singida District.

2.4. Data Management and Analysis

2.4.1. Quantitative Data Management and Analysis

Data were coded, entered, cleaned, and analyzed using the Statistical Package for Social Studies (SPSS) version 26. Demographic characteristics, e-LMIS utilization, and competence were analyzed using descriptive statistics. Means, standard deviations, frequencies, and percentages, were used as appropriate.

2.4.2. Qualitative Data Management and Analysis

Qualitative data obtained from in-depth interviews underwent content analysis, following a structured process. Initially, audio files were transcribed verbatim and translated into English. The data were organized by categorizing and familiarizing information from the interview transcripts, grouping responses under each relevant topic and unique question. Repeating concepts, patterns, and ideas were then identified, with repeating words or ideas being observed and classified. Inductive coding was employed, and codes were assigned to categories. This coding process was carried out separately by two individuals to minimize intercoder variability, and codes with a high degree of agreement were retained. Subsequently, data concepts were synthesized into overarching themes to provide a deeper understanding of the data. These resulting themes were then described, and the relationships between them were interpreted. To facilitate this qualitative data analysis process, NVivo 11 software was utilized.

2.5. Ethical Consideration

The study obtained ethical approval from the Joint Catholic University of Health and Allied Sciences and Bugando Medical Centre Research and Ethics Review Committee, with permit number CREC/691/2023. Permissions were also obtained from relevant authorities and informed consent was sought from study participants. Confidentiality and privacy were strictly maintained during the data collection process.

3. Results

3.1. Results from the Quantitative Method

3.1.1. Background Information of the Study Participant

The study encompassed 106 healthcare providers from 35 health facilities in Singida District. The mean age of the participants was 32.7 (SD = 7.6) years. Half of the respondents were male, the majority had diploma education (51.9%), worked at dispensaries (76.4%), were clinical officers (40.6%), and more than one-third were facility in charge. The majority of participants (55.7%) reported having one to two years of experience with e-LMIS. (Table 1).

Table 1. The background information of the study participant (N=106).

Background Information	Frequency	Percent
Age Category of the participant		
15-25	11	10.4
26-35	78	73.6
36-45	8	7.5

Above 45	9	8.5
Mean age \pmSD	32.7 \pm 7.6	
Sex of the participant		
Male	53	50.0
Female	53	50.0
Educational level		
Certificate	46	43.4
Diploma	55	51.9
Bachelor	5	4.7
Facility level		
Dispensary	81	76.4
Health Center	13	12.3
Hospital	12	11.3
Job Title		
Medical Doctor	3	2.8
Clinical officer	43	40.6
Nurse	40	37.7
Medical Attendant	3	2.8
Other; specify	17	16.0
Roles and Responsibilities		
Facility in charge	39	36.8
Store in charge	34	32.1
Medicine Dispenser	19	17.9
Prescriber	14	13.2
Working experience in the e-LMIS		
One to two years	59	55.7
Three and more years	47	44.3

3.1.2. Competence and User Perceptions of e-LMIS Utilization

Most respondents (62.3%) said they were somehow competent in e-LMIS utilization, and 42.5% reported being very confident in fulfilling e-LMIS duties. All participants had access to either a computer. Further, most respondents (80.2%) reported that e-LMIS is friendly and easy to use. The majority of participants (62.3%) reported placing orders once per quarter. Regarding the timeliness of request revisions (R&R) sent to council supervisors, 67.9% submit their orders within the stipulated time. (Table 2).

Table 2. Competence and user Perceptions of e-LMIS utilization.

Variable/Response	Frequency	Percent
Level of Competence in Utilization of e-LMIS		
Very Competent	3	2.8
Competent	34	32.1
Somehow Competent	66	62.3
Not Competent	3	2.8
Confidence in fulfilling e-LMIS duties		
Very confident	45	42.5
Confident	43	40.6
Somehow confident	17	16.0
Not confident at all	1	0.9
Access to Technology (Facility has computer)		
Yes (observed)	106	100.0

No	0	0
System Perceptions		
e-LMIS user friendly and easy to use		
Yes	85	80.2
No	21	19.8
Orders Placed per Quarter (3 months)		
1 time	66	62.3
2 times	27	25.5
More than 2 times	<u>13</u>	<u>12.3</u>
Timeliness of R&R Revisions		
Yes	72	67.9
No	34	32.1

3.2. Results from In-Depth Interview

In this study, six participants were interviewed to gain insights into their experiences with the e-LMIS and its impact on drug availability within their healthcare facilities.

3.2.1. Theme 1: Competence with e-LMIS

Participants' interactions with the e-LMIS system reveal insights into their daily use and specific applications. Participant 6 emphasized their daily reliance on the system, particularly for checking drug availability.

Participant 6: *"I use the system daily, mainly for checking drug availability during this period."*

Participant 3 emphasized the system's utility for tracking stock levels and managing orders. This specific use case underscores the e-LMIS system's pivotal role in maintaining an accurate inventory and streamlining the procurement process. It enables users to stay informed about stock levels, ensuring timely replenishment and preventing stock outs.

Participant 3: *"I use it mainly for tracking stock levels and managing orders."*

In addition to daily use, participants employ the e-LMIS system for specific use cases, such as tracking stock levels, managing orders, and identifying overstocked items. Participant 2's description of their role in medical supply procurement demonstrates this specificity. They clarified how requests are submitted and approved through the system, highlighting its essential role in their responsibilities.

Participant 2: *"In my role, when the relevant department needs to procure medical supplies, they identify what is required and submit the requests to administration. We then review the availability of funds to approve the orders for necessary items."*

Despite varying competence levels, participants candidly expressed the challenges stemming from their competence levels when engaging with the e-LMIS system. Participant 1 underscored the limiting impact of inadequate specialized training on their effective utilization of the system, emphasizing the significance of tailored instruction.

Participant 1: *"The lack of specialized training limits my ability to fully utilize the system effectively."*

Participant 4 identified a staff shortage as a major challenge, hindering efficiency in managing drug supplies.

Participant 4: *"The main challenge is the shortage of staff. We have a heavy workload, and sometimes it's difficult to find someone who can assist when needed, which can affect efficiency."*

Further, participants exhibited areas of strength and expertise within their utilization of the e-LMIS system. Participant 3 excelled in tracking drug availability during specific periods, signifying a valuable skill for ensuring timely access to essential medications.

Participant 3: *"I would say I feel most proficient in managing the general drug orders."*

Participant 5 demonstrated competence in identifying both drug availability and overstocked items, underscoring their effectiveness in optimizing inventory levels.

Participant 5: *"In finding drug availability and identifying overstocked items, I feel proficient."*

3.2.2. Theme 2: Factors Influencing Competence

Participants cited several factors contributing to their competence in using e-LMIS. Among these factors, regular usage of the system was highlighted as instrumental in building competence. Competence in navigating the complexities of the LMIS system is a dynamic process that participants attribute to continuous skill development. As Participant 5 emphasized, competence emerges through consistent engagement with the system, marked by regular data entry and vigilant monitoring of available items.

Participant 5: *"Competence comes from using it regularly, entering data, and checking the available items in the system."*

Training and support, both from experienced colleagues and the Ministry of Health, played pivotal roles in refining their abilities. Participant 2 underscored the importance of cooperative relationships with colleagues who possessed both training and practical experience in using the system. This collaborative learning environment contributed significantly to participants' capacity to effectively navigate the e-LMIS system.

Participant 2: *"The main contributing factor has been the cooperation and support I receive from my colleagues who have both training and experience in using the system. Training provided by fellow pharmacists and the Ministry of Health has been valuable."*

Additionally, the presence of educational resources played a pivotal role in supporting informants' competence levels. The availability of training sessions and guidebooks was identified as beneficial.

Participant 1: *"We received training, and we also have guidebooks that help. These resources serve as valuable references for troubleshooting and skill development."*

Furthermore, management support was acknowledged as a significant influence on competence. The role of management in encouraging the utilization of e-LMIS was noted to be pivotal in boosting competence. This support was seen as a catalyst for increasing the adoption and effective use of e-LMIS.

Participant 5: *"Management support helps improve our services," underscoring the pivotal role of leadership in this context."*

Access to experienced pharmacists, especially for consultation when facing system-related issues, proved invaluable. The reliance on consultation with the regional pharmacist exemplified how such support mechanisms aided participants in resolving challenges and optimizing their utilization of the e-LMIS system.

Participant 4: *"I consult with the regional pharmacist if I have any issues or concerns regarding the system. Consulting with experienced pharmacists when facing issues or concerns is essential."*

3.2.3. Theme 3: e-LMIS Implications on Medicine Supply Chain

Competence in utilizing the e-LMIS system yields a range of positive outcomes that significantly influence the efficiency of the drug supply chain. Respondents noted that orders were received promptly, and the drugs requested aligned with what was delivered. This marked an improvement from the past when discrepancies were common.

Participant 6: *"We now receive drugs on time, and the drugs we order are the ones we receive."* These positive outcomes underscore the significance of competence in e-LMIS utilization. Participants described how their competence played a vital role in preventing stock outs and enhancing decision-making processes. The real-time insight not only prevents stock outs but also streamlines resource allocation by ensuring that orders align with actual requirements, rather than relying on manual records and guesswork.

Participant 1: *"e-LMIS has positively affected decision-making because I can access real-time information. This allows me to make informed decisions based on the current situation, which is more efficient than relying on manual records. We have not experienced stock outs for a long time because we receive accurate information."*

Furthermore, competence directly influences the decision-making processes of participants, enabling them to make strategic choices regarding which items to order.

Participant 5: "e-LMIS influences my decisions in that I know what to do next time, like whether to order a certain item or not."

Participant 1: "e-LMIS has positively affected decision-making because I can access real-time information"

3.2.4. Theme 4: Strategies for Improvement

Participants stressed the significance of regular training programs and capacity-building initiatives. They advocated for the provision of consistent and structured training to strengthen skills in navigating the e-LMIS system effectively. Such training programs, tailored to the needs of healthcare workers, can play a pivotal role in keeping participants updated on system advancements, best practices, and emerging trends.

Participant 6: "I think regular training should be provided to strengthen skills in how to use the system. I believe they should refresh us if there are any updates."

Participant 1: "Dedicated training programs would be extremely beneficial."

Additionally, participants offered insightful recommendations for system enhancements. One prominent suggestion was the automation of certain items' inclusion in the e-LMIS system. The automation would not only streamline processes but also mitigate the risk of errors, as items vital to healthcare operations would already be integrated into the system. Such enhancements can simplify the workflow for healthcare workers, reduce the burden of data entry, and further enhance the overall efficiency of the e-LMIS system.

Participant 5: "It would be good if, for example, certain items that should be in the hospitals were automatically in the system."

Moreover, informants proposed simplifying the e-LMIS system itself, making it more user-friendly. Given its extensive functionalities, simplification was seen as a means to enhance user experiences.

Participant 3: "Another way is to improve the system itself. It's quite extensive, so if there's a way to simplify it, that would be helpful." This suggestion aligns to make the system more accessible and efficient.

4. Discussion

The effectiveness of the various procedures and aspects of the supply chain system, such as storage, transportation, planning, and forecasting, depends greatly on the logistics management information system [11]. This study assessed the competence of e-LMIS among public healthcare workers and its implications for medicine supply chain performance. The majority of study participants in the present study reported being at least somehow competent in utilization and confident in their supply chain duties using e-LMIS. This is consistent with the previous study conducted in Ethiopia, where about 95% of respondents reported being satisfied with their ability to use e-LIMS for inventory management and managing day-to-day activities [12].

In-depth views highlighted several factors that influence competence in the utilization of e-LIMS. Participants cited several aspects contributing to their competence in using e-LMIS. These factors were regular usage of the system, training, and support, both from experienced colleagues and the Ministry of Health, and the presence of educational resources. Other factors were management support and access to experienced pharmacists for consultation when facing system-related issues. Previous studies reported training, educational status, availability of automated record systems, supportive supervision, and years of work experience in supply chain management as factors associated with competence in the utilization of e-LIMS [2,13]. The competence in electronic recording and reporting among healthcare workers impacts medicine supply chain performance by reducing errors and task burden, saving time, influencing the availability of drugs, and improving reporting rates [14,15]. A previous study revealed that e-LMIS contributes to data accessibility at 94.9%, reduction of quantification challenges at 57.6%, improved the quality of data by 77.9%, and inventory management of health products to optimum levels, with a decrease in expiry-related losses [16].

A prior study reported that eLMIS provided real-time health commodity data from user units. The data were essential for medicine supply chain performance as they are used for the planning and management of health commodities, informing the quantification, forecasting, and pipeline monitoring of commodities at all levels of care and decision-making [17]. In this study, competence in utilizing e-LMIS emerges as a critical factor in preventing stockouts and influencing decision-making processes. Real-time insights provided by the system enable participants to anticipate demand accurately, thereby avoiding situations where essential drugs are unavailable. This not only ensures continuous availability but also optimizes resource allocation, minimizing waste and maximizing efficiency. Two key issues limiting competence in e-LMIS utilization reported in this study were shortages of staff and a lack of customized training for health workers. Prior research has identified several limitations, including complexities within the system, an inadequate workforce, authorities' and users' accountability, and an inadequate structure to facilitate the organization and management of the health supply chain system [16,18]. In-depth interviews with study participants revealed that regular training programs, capacity-building activities, system automation, and simplification are effective ways to enhance the impact of e-LMIS on the medicine supply chain.

Certain limitations should be taken into account while considering the results reported in this research. The cross-sectional design used provides a snapshot of e-LMIS utilization but doesn't capture long-term trends or establish causality. Self-reporting bias could potentially affect the accuracy of participants' responses, particularly in assessing their competence levels. The study's area focus on Singida District may restrict the generalizability of findings to other healthcare contexts within Tanzania. Nonetheless, this study serves as a valuable foundational resource for future research and policy development in healthcare supply chain management in the region, offering insights into how to enhance e-LMIS utilization effectively.

5. Conclusion

This study found that an adequate proportion of healthcare providers demonstrated competence in utilizing the e-LMIS. Moreover, the study highlighted the positive impact of e-LMIS on various aspects of the medicine supply chain, including the timely submission of orders and enhanced inventory management. However, challenges such as staff shortages and inadequate training were identified as barriers to the system's optimal functioning. Sustained management support and regular utilization of the e-LMIS system are crucial for building and maintaining competence among healthcare providers, thereby optimizing the medicine supply chain and ultimately improving healthcare delivery.

Contributors: Conceptualization: A.M. and S.M.; Methodology, A.M. and N.B.; Supervision, S.M.; Data curation, A.M.; Formal analysis: S.M. and N.B.; Writing—original draft, A.M. and S.M.; Visualization, N.B.; Writing—review and editing: N.B. and S.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study obtained ethical approval from the Joint Catholic University of Health and Allied Sciences and Bugando Medical Centre Research and Ethics Review Committee, with permit number CREC/691/2023. Permissions were also obtained from relevant authorities and informed consent was sought from study participants. Confidentiality and privacy were strictly maintained during the data collection process.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Acknowledgments: The authors thank the healthcare workers who participated in this study.

Conflicts of Interest: The authors declare no conflicts of interest.

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