UPTAKE OF ELECTRONIC LOGISTIC MANAGEMENT INFORMATION SYSTEM OF ANTI-TUBERCULOSIS COMMODITIES AT PUBLIC HEALTH FACILITIES IN KILIMANJARO REGION, TANZANIA

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UPTAKE OF ELECTRONIC LOGISTIC MANAGEMENT INFORMATION SYSTEM OF ANTI-TUBERCULOSIS COMMODITIES AT PUBLIC HEALTH FACILITIES IN KILIMANJARO REGION, TANZANIA

By

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A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Pharmacy in Pharmaceutical Management at

Muhimbili University of Health and Allied Sciences

October 2024

CERTIFICATION

The undersigned certifies that they have read and hereby recommends for examination by the University of Muhimbili Health and Allied Sciences a dissertation entitled **"Uptake of Electronic Logistic Management Information System of Anti-Tuberculosis Commodities at Public Health Facilities in Kilimanjaro Region, Tanzania"** in partial fulfillment of the requirements for the degree of Master of Science in Pharmaceutical Management of Muhimbili University of Health and Allied Sciences.

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(Co-supervisor)

Date: _____

DECLARATION AND COPYRIGHT

I, **Suzanne M. Nyalagu**, declare that this dissertation is my own original work, and that it has not been submitted for a similar degree in any other University.

Signature..... Date…….....

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DEDICATION

I dedicate this work to my beloved family, my dad the Late Dr Isaac Kusekwa Nyalagu, my mom Mrs. Lucy Vumilia Nyalagu and my Co-workers for the encouragement, love, ideas, moral support and inspiration that were at the center for my continued and sustained commitment to my academic career throughout the course of this study. I therefore feel greatly indebted to this wonderful family for its strategic support. Therefore, successful completion of this study also become their lifelong success. Thank you very much and may God bless them all.

ABSTRACT

Background: Efficient management of Anti-TB commodities is crucial for sustaining an uninterrupted supply chain. Utilizing an electronic health system like the Electronic Logistic Management Information System (eLMIS) is essential for improving supply chain performance, ensuring adequate quantities, and enhancing healthcare outcomes. Tanzania has recently adopted eLMIS for managing Tuberculosis (TB), aiming to address challenges of the conventional paper-based system by enhancing data visibility and quality. However, there's limited literature on its uptake in healthcare facilities.

Objective: This study aimed to assess the uptake of the Electronic Logistic Management Information System (eLMIS) for anti-TB commodities in public health facilities within the Kilimanjaro region of Tanzania.

Materials and methods: This cross-sectional study utilized both quantitative and qualitative methods. For quantitative analysis, the study targeted public health facilities in Kilimanjaro specifically dedicated to managing TB. The focus was on assessing the uptake of eLMIS, crucial for inventory tracking and stock monitoring of anti-TB commodities. For qualitative insights, pharmacists and laboratory technicians directly involved in anti-TB commodity management and eLMIS utilization were interviewed. Data collection was done using data abstraction form and interviewer guide. Quantitative data was analyzed using stata 18, and for qualitative, step-by-step content qualitative analysis approach was utilized.

Results: A total of 19 public health facilities were included in the analysis. All the surveyed facilities had established eLMIS, however only 37% of the facilities utilized eLMIS for both pharmacy and lab commodities management, while 63% only used it for lab commodities. The findings from this study indicated varying degrees of availability of anti-TB commodities across pharmacy and laboratory items, with notable stock outs observed within 12 months, particularly for essential medications like Isoniazid (INH) 100mg and Gene Xpert MTB/RIF. The study on factors affecting the uptake of the eLMIS for anti-TB commodities in Public Health Facilities

(PHF) at the study site identified several significant challenges. These challenges included system disturbances, technical issues like poor internet connectivity and data input errors, inadequate user training, integration system challenges, and user perceptions and attitudes.

Conclusion: The study revealed that while a considerable proportion of public health facilities in the Kilimanjaro region have adopted the eLMIS for anti-TB commodities management, its utilization remains suboptimal. The availability of anti-TB commodities varied across pharmacy and laboratory. Challenges affecting the uptake of eLMIS included system disturbances, technical issues such as poor internet connectivity, inadequate user training, integration system challenges, and user perceptions.

Variability in availability of Anti –TB commodities may have caused low detection of TB patients also emerging of Multi drug resistance Tuberculosis due to stock outs of anti TB commodities. Addressing these challenges is imperative for enhancing system functionality and optimizing inventory management in public health facilities, thereby ensuring the consistent availability of anti-TB commodities for effective tuberculosis management.

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ABBREVIATIONS

AOR	Adjusted Odds Ratio
CI	Confidence Interval
EHR	Electronic Health Record
eLMIS	Electronic Logistic Information System
ICT	Information Communication and Technology
LIAT	Logistic Indicators Assessment Tool
LMICs	Lower and Middle-Income Countries
MNH	Muhimbili National Hospital
MoH	Ministry of Health
MSD	Medical Store Department
MUHAS	Muhimbili University of Health and Allied Sciences
NTLP	National Tuberculosis and Leprosy Programme
OR	Odds Ratio
SPSS	Statistical Package for Social Sciences
TB	Tuberculosis
UTAUT	Unified Theory of Acceptance and Use of Technology
SOPH	School of Pharmacy
INH	Isoniazid
PHF	Public Health Facilities
IDI	In Depth Interview

DEFINITION OF TERMS

Anti-TB Commodities: Refers to essential supplies for tuberculosis treatment and diagnosis, encompassing medications and diagnostic equipment. These are critical for combating tuberculosis and ensuring effective management of the disease.

Commodity Availability: Represents the extent to which essential commodities, such as medicines and diagnostic tools, are present and accessible in healthcare facilities within a specified timeframe. It reflects the readiness of facilities to provide necessary services to patients.

Electronic Health Record (EHR): An electronic repository of patient health information, systematically collected and stored in digital format. It enables healthcare providers to access comprehensive medical data, facilitating better-informed decision-making and continuity of care for patients.

Electronic Logistic Management Information System (eLMIS): A sophisticated electronic adaptation of the conventional Logistic Management Information System (LMIS), designed to streamline data collection, processing, reporting, and decision-making processes within the healthcare supply chain. It leverages technology to optimize logistics and improve supply chain management efficiency.

First-line Anti-TB Medicines: Essential medications prescribed as the initial treatment for drug-susceptible tuberculosis patients. These include Isoniazid, Rifampicin, Pyrazinamide, and Ethambutol, forming the cornerstone of tuberculosis therapy.

Order Filling Rate: Indicates the uptake of requested items that are accurately supplied, reflecting the effectiveness of the supply chain in meeting demand with the correct commodities and quantities.

Public Health Facilities: Healthcare establishments owned and operated by governmental authorities, aimed at providing essential health services to the population. These facilities play a vital role in delivering accessible and affordable healthcare to communities.

Stock Status: Refers to the extent to which healthcare facilities maintain inventory levels according to predetermined plans for essential commodities within a specified reporting period. It gauges the adequacy of stock levels to meet demand and ensure uninterrupted service delivery.

TB Management: Encompasses the comprehensive approach to tuberculosis diagnosis, treatment, and control measures. It involves strategies for early detection, appropriate therapy, patient monitoring, and preventive interventions to effectively manage tuberculosis cases and curb disease transmission.

Uptake of eLMIS: Represents the successful adoption and integration of electronic Logistic Management Information System (eLMIS) into routine healthcare operations. It is evaluated quantitatively through indicators such as commodity availability, stock status, and order filling rate, reflecting the extent of system utilization and its impact on supply chain performance.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Tuberculosis (TB) remains a major global health concern it is 10.0 million people are to develop TB in 2019, particularly in high-prevalence areas of developing countries despite effective management, prevention and control (1)(2). Efficient management of anti-TB commodities such as medicines, laboratory reagents, and supplies is an essential component of TB management and control programs to guarantee a sustainable and uninterrupted supply chain of the commodities (3). Ensuring good performance of anti-TB commodity stock management is one of the crucial approaches to averting TB disease. Tanzania is among the 30 WHO-identified high TB burden countries globally; in 2019, a total of 82,166 cases of all types of TB were notified(4) and In 2020, Tanzania reported that about 26,800 people died from TB(5)

To date, health sectors in many Low- and Middle-Income Countries (LMICs) are in transition from conventional paper-based records to electronic records (6). The use of an electronic records system to improve the performance of supply chains is an essential strategy for health programs to maintain adequate quantities and quality of healthcare commodities and achieve better health outcomes (7). eLMIS is a revolutionary cost-effective approach to ensuring the security and accuracy of reporting data, as well as an uninterrupted supply chain of Anti-TB commodities (8). Moreover, eLMIS improves stock management and decision-making, reduces stock-outs and user workload, generates cost savings, simplifies data handling, and improves health outcomes of the individuals (9). In addition, the eLMIS facilitates the users in obtaining and storing the right data, in the right quantity and quality, at the right place, and for the right cost (10).

In Tanzania, one of the targets of the National Tuberculosis and Leprosy Strategic Plan 2020-2025 is to ensure that all healthcare facilities dedicated to TB management can successfully report their monthly reports in the eLMIS (11). Tanzania officially launched the eLMIS in 2015 to support the aggregating, reporting, and visualization of data collected from conventional-

based LMIS. The eLMIS was established for all vertical public health programs including the National Tuberculosis/Leprosy Program. In this regard, the eLMIS for anti-TB commodities is specific for TB commodities and hence it is different from other vertical public health programs commodities (12). The introduced eLMIS for anti-TB commodities is still being run in parallel with the conventional paper-based system (3). The conventional paper-based system has been facing some data quality issues such as incomplete records; failure to update bin cards (BCs), unnecessary stock-outs, overaged stock, expired stock; and poor storage practices (10,13,14). Since the eLMIS addresses similar aspects as the conventional paper-based system its uptake may encounter similar challenges as those of the conventional paper-based system. Understanding the factors affecting the uptake of eLMIS is imperative to fix the challenges and enhance its uptake at healthcare facilities and institutions dedicated to providing care and treatment for TB. Moreover, this was indirectly help in the fight against TB through effective and efficient management of anti-TB commodities.

1.2 Problem statement

Tanzania introduced the eLMIS to overcome the challenges associated with the conventional paper-based system including ensuring an uninterrupted supply of anti-TB commodities and the effective use of the data**.** eLMIS is crucial to guarantee the security and accuracy of reporting data, as well as an uninterrupted supply chain of Anti-TB commodities. Despite these anticipated significances, the uptake and implementation of eLMIS can be a complex and overwhelming task within healthcare facilities (15). Furthermore, its uptake requires a gradual and consistent implementation to enable the users and the facilities to work and adapt the system (15).

Currently, the eLMIS is implemented in parallel with the conventional paper-based system and within similar contextual challenges. The implementation of eLMIS requires trained and sufficient staff who can consistently update and correctly match the information in the electronic system to that from conventional paper-based system, sustainable power supply, and strong network connectivity. Inconsistencies and incorrect information in the eLMIS can lead to decreased confidence in the reliability and validity of the records and ultimately poor

availability of anti-TB commodities (10). As a result, incorrect decisions are made about ordering frequency and quantity as well as inaccurate stock records.

Studies conducted to assess the impact of the eLMIS in other vertical health programs commodities showed promising success. For instance, the uptake of eLMIS in Zambia impacted the service delivery of the ARV logistics system through improved reporting rate, data accuracy and stock status; increased supply chain visibility; and reduced stock-out and supply chain supervision cost (8). In Tanzania, the eLMIS has been reported to increase stock availability and reduce the stock-out rate of vaccines (16). Furthermore, the low uptake of eLMIS has been due to a lack of training for healthcare workers, insufficient infrastructure including computers, poor eLMIS software, poor ICT skills, lack of regular, supportive supervision, and inadequate fund and qualified staff(17). However, since the inception of the eLMIS in Tanzania, there has been no study reported about the impact and contribution of the uptake of eLMIS of anti-TB commodities by healthcare facilities dedicated to managing TB. Therefore, it is against these circumstantial concerns the present study was to assess the uptake of eLMIS for anti-TB commodities and factors affecting its uptake in public health facilities in Tanzania.

1.3 Rationale

Assessing the uptake of the eLMIS of anti-TB commodities is essential to effectively monitor and evaluate the quality of this system in improving the quality of TB care at the health facility. In Tanzania, the eLMIS for anti-TB commodities has yet to replace the conventional paper-based recording system hence the two systems are used in parallel. As a result, the eLMIS relies on conventional paper-based records whereby the data from the conventional paper-based are entered into the electronic system. In this accord, it is imperative to assess the uptake of the eLMIS of anti-TB commodities and identify the factors affecting its uptake. Understanding the factors influencing the uptake of the eLMIS can provide a way forward to effectively implementing the uptake of the system. As a result, the findings will help implementers and policy makers (National Tuberculosis and Leprosy Program (NTLP) and the Ministry of Health (MoH)) on deciding viability of transitioning the eLMIS as a replacement for the conventional paper-based system.

1.4 Research questions

1. What is the proportion of public health facilities using eLMIS for anti-TB commodities management in Kilimanjaro region?
2. What is the status of availability of anti-TB commodity at public health facilities that are using eLMIS in the Kilimanjaro region?
3. What are the factors affecting the uptake of eLMIS for anti-TB commodities at public health facilities in the Kilimanjaro region, and how do they affect the uptake of eLMIS?

1.5 Objectives

1.5.1 Main objective

To assess the uptake of electronic logistic management information system of anti-TB commodities at public health facilities in Kilimanjaro region in Tanzania.

1.5.2 Specific Objectives

1. To determine the proportion of public health facilities using eLMIS for anti-TB commodities management in the Kilimanjaro region.
2. To determine the availability of anti-TB commodities at public health facilities that are using eLMIS in the Kilimanjaro region.
3. To explore the factors affecting the uptake of the eLMIS **of** anti-TB commodities at public Health facilities in the Kilimanjaro region.

1.6 Conceptual Framework for the Study

The study adopts the Unified Theory of Acceptance and Use of Technology (UTAUT) model as its conceptual framework. This model, renowned for explaining technology usage behavior, posits that behavioral intention determines technology uptake. It identifies four key factors influencing technology acceptance: performance expectancy, effort expectancy, social influence, and facilitating conditions. These factors are moderated by demographic variables such as age, gender, and experience.

The conceptual framework defines the relationship of the factors that impact the uptake of electronic Logistic Management Information Systems (eLMIS) for anti-TB commodities (see Fig. 1). These factors include Management Factors: Inadequate supportive supervision, funding, staffing, and training; Information System Factors: Infrastructure adequacy, ICT literacy, perceived ease of use, and user satisfaction; and the demographic factors: Age, gender, education level, professional position, and experience.

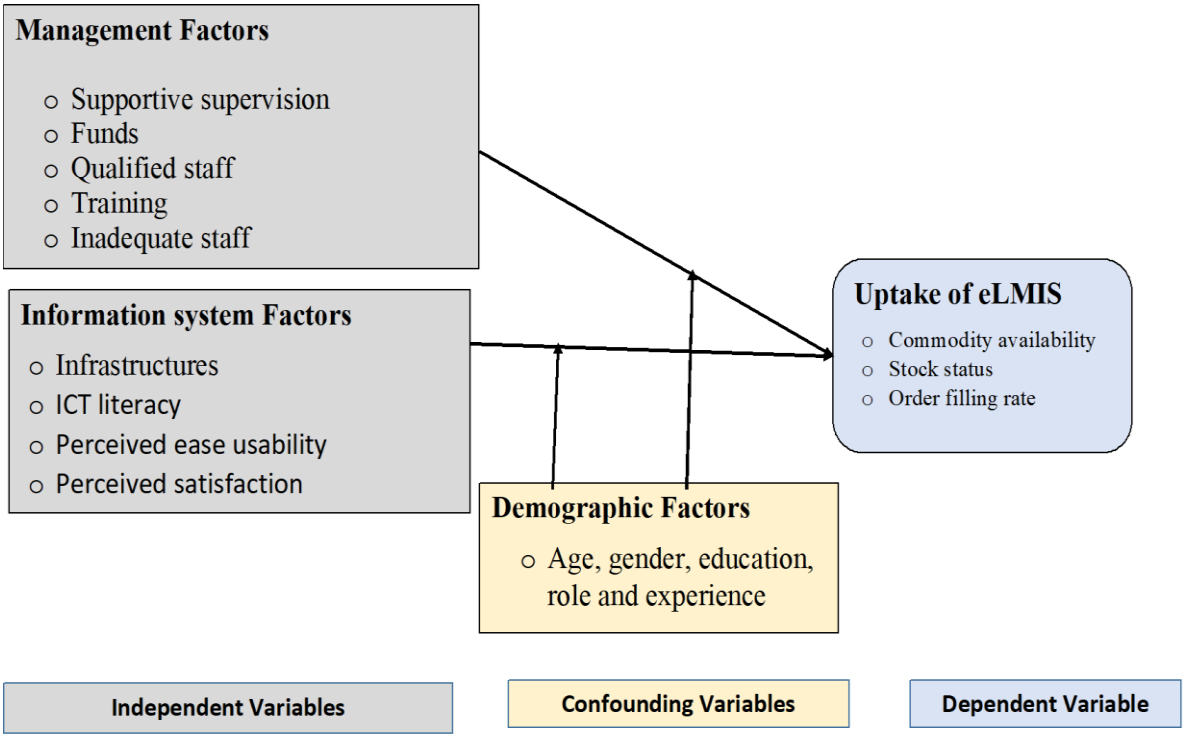


Figure 1: Conceptual Framework for this Study

1.7 Literature Review

1.7.1 Uptake of Electronic Health Systems of anti-TB commodities by health facilities

The availability and effective function of eLMIS at health facilities have a significant impact on the efficient management of medical commodities such as anti-TB commodities. A study conducted in Uganda to assess the status and performance of the supply chain system across all levels of health facilities found that only 6% of the health facilities were using eLMIS. Further, 42% of the health facilities were reported to have had computers installed. Only 33.3% of health facilities lacked eLMIS, according to different Ethiopian research that evaluated the LMIS performance for program medications in 23 public health facilities. However, 66.7% of hospitals had functioning eLMIS.

1.7.2 Impact of eLMIS on the Availability of anti-TB Commodities at health facilities

Health **care** sectors in most of the LMICs are undergoing a significant transition from conventional paper-based health records to electronic health records(6). The eLMIS as one of the components of electronic health records helps to improve the performance of medical supply chains to ensure an uninterrupted supply of adequate quantities of healthcare commodities including anti-TB commodities(7,8). The eLMIS has been shown to improve stock management by reducing stock-out and hence improves the availability of anti-TB commodities (9). Attain good control of TB requires the availability of adequate and well-managed anti-Tb commodities whenever needed by health workers to ensure the uninterrupted continuum of care and treatment for all patients with TB. A systematic review of the integrated pharmaceutical logistic system in Ethiopia found that 92.6% of health facilities with functional eLMIS had stock-out for one or more commodities and 60.5% of health facilities were stocked out for at least one TB laboratory commodities. In this study, it was concluded that the use of eLMIS brought a significant improvement to the medical supply chain of Ethiopia despite various challenges faced by the system (18).

1.7.3 Factors Affecting the Uptake of eLMIS for Anti-TB commodities in health Facilities

Factors affecting the Uptake of eLMIS for Anti-TB commodities are divided into three parts namely Management factors, Information system factors and Demographic factors.

1.7.3.1 Management Factors

Training, qualified personnel, sufficient personnel, funding, and encouraging supervision are examples of management elements that can significantly affect the adoption of electronic health records. A study on the utilization of healthcare information among healthcare workers in Kenya found that inadequate qualified staff and inadequate staff training on the use of ICT infrastructures were the factors that compromised the quality and use of information(19). Another study in Kenya on the assessment of the factors affecting the implementation of electronic health records among health workers in Kenya found that adequate staff and supportive supervision were the factors that improved the adoption of the system (20). A qualitative finding of the study on the factors affecting user satisfaction with eLMIS in Tanzania found that inadequate training affected the use of eLMIS (21)(22). Lack of staff training affected the health data management and reporting system among healthcare workers in Botswana. Moreover, the use of supportive supervision in districts and facilities was found to improve health programs (23). Supportive supervision was also shown to significantly improve data quality and utilization of the Integrated Pharmaceutical Information System (IPIS) in Ethiopia (14)(24). In India, a study on the factors affecting the adoption of electronic health record found that lack of training and insufficient funds were factors affecting the use of electronic health records among nurses (25)(26).

1.7.3.2 Information system Factors

Knowledge and skills; ease of use system; user satisfaction; and availability of infrastructures such as computers, software and internet connectivity are necessary for the process of uptake of the electronic health system. Evidence from a qualitative study **conducted in Tanzania** on the factors affecting user satisfaction with eLMIS, found that poor internet connectivity affected the use of eLMIS (21). A study in Botswana on the health data management and reporting system found that the limited functionality of the electronic management system was affected by the

lack of maintenance of computer software(23). According to a Kenyan research on healthcare professionals' use of information, 64% of users had inadequate ICT understanding, and 11% of users used information poorly(19). Regarding the usability of the electronic health system, a study done in India on the factors affecting the adoption of electronic health records revealed that only 33% of participants were able to use the system. Also, a lack of computer skills and perceived difficulty to use the software affected the use of electronic health records among nurses (25).

1.7.3.3 Demographic Factors

Demographic factors such as age, gender, education level, job position and work experience can have a confounding effect on the factors affecting the uptake of electronic health systems. Studies have shown that user experience has a significant influence on the uptake of electronic health systems(25,27). A systematic review of the factors affecting the mature use of electronic medical records found that having experience positively improved the use of the system (27). On the other hand, lack of experience had a negative impact on the use of electronic health records among users in India (25). Furthermore, age, education level, gender and job position were found to influence the adoption of electronic health systems among the general population in the Kingdom of Saudi Arabia (28). A study on the factors affecting the use of electronic patient records among general practitioners in Ireland found that younger age and male gender were more likely to use electronic patients record than the female elderly age (24).

CHAPTER TWO
2.0 MATERIAL AND METHODS

2.1 Study design

This was a health facility-based cross-sectional design employing mixed methods (quantitative and qualitative) for data collection and analysis. The study was conducted from October 2023 to January 2024. Quantitative methods employed to determine the uptake of eLMIS at public health facilities in the selected study site. The qualitative approach employed an exploratory qualitative research design. This design is chosen due to its effectiveness in exploring complex phenomena, such as the factors affecting the uptake of the eLMIS for anti-TB commodities. Qualitative methods allow for an in-depth understanding of participants' perspectives and experiences, which aligns with the study's aim to uncover nuanced insights into the challenges and facilitators influencing eLMIS adoption at public health facilities in the Kilimanjaro region.

2.2 Study area

As of the 2022 Tanzania Population and Housing Census, the Kilimanjaro Region boasts a substantial population of approximately 1,861,934 million people (29). This demographic density underscores the significance of effective healthcare systems, particularly in managing diseases like tuberculosis that pose significant public health challenges.

This study was conducted at health facilities offering TB management at the selected Districts in the Kilimanjaro Region, Northern Tanzania. The region comprises of seven administrative districts, each contributing to the region's healthcare landscape. However, due to the constraints of scope and resources, this study specifically targets four districts namely, Moshi Municipal Council, Rombo, Hai, and Siha District Councils, which were selected randomly from the total list of administrative areas.

Within the selected districts, there are a total of 79 Public health facilities dedicated to the diagnosis and treatment of tuberculosis. These facilities serve as vital nodes in the healthcare network, providing essential services to the local population. Moreover, the region is home to the National Super Specialized Hospital for Tuberculosis Management, known as Kibong`oto

Infectious Diseases Hospital, which is located in Siha District Council. This hospital plays a pivotal role in the region's healthcare infrastructure, offering specialized care and expertise in combating tuberculosis and other infectious diseases.

2.3 Study population

For quantitative, the study population comprises public health facilities within the Kilimanjaro region of Tanzania that are specifically tasked with managing tuberculosis. These facilities serve as the focal points for the distribution and management of anti-TB commodities. Given the importance of effective logistics management in ensuring the availability and accessibility of these commodities, the study aimed at assessing the uptake of the electronic Logistic Management Information System (eLMIS) among these facilities. This system is integral in streamlining inventory tracking, supply chain management, and stock monitoring of anti-TB commodities.

For qualitative, the study targeted pharmacists and laboratory technicians or laboratory scientists directly involved in anti-TB commodity management and utilizing the eLMIS at public health facilities in the Kilimanjaro region. This selection is justified as these professionals possess firsthand experience and insights into the operational dynamics and challenges associated with eLMIS utilization within their respective facilities.

2.4 Inclusion and Exclusion Criteria

2.4.1 Inclusion criteria

Inclusion criteria for selecting health facilities in this study were: i) Public health facilities dedicated to managing TB; ii) The facility must have been providing TB management for more than 2 years at the time of data collection; iii) The facility must have been using eLMIS for at least 1 year at the time of data collection iv) The selected participants must be pharmacy heads, pharmacy store managers, and health workers who are directly involved with eLMIS and the whole logistic supply chain of the selected facility.

2.4.2 Exclusion criteria

Exclusion criteria for this study included i) Private health facilities, and ii) Facilities providing only one TB service: either diagnosis or treatment.

2.5 Sample Size and Sampling Technique

2.5.1 Sample Size

For quantitative approach, there finite number of the public health facilities and hence the sample size calculation for a finite population was used to generate a representative statistically significant sample. A simplified Yamane formula below was used (30).

$$n = \frac{N}{1 + N(e^2)}$$

Where n is the sample size, N is the population size, and e is the level of precision assumed to be **0.2.** Since there are **79** public health facilities in the Kilimanjaro region dedicated to managing TB then N is **79**.

$n = \frac{79}{1+79(0.2^2)} \approx$**19**

Therefore, the study focused on **19** selected public health facilities within the region to gather comprehensive data on the implementation of eLMIS and the availability of anti-TB commodities.

For qualitative approach, eight (8) in-depth interviews (IDIs) were conducted to capture a comprehensive range of perspectives. The sample size was determined based on the principle of information saturation, ensuring that data saturation is achieved, whereby no new information or themes emerge from additional interviews. This approach ensures the depth and richness of data necessary for the qualitative analysis.

2.5.2 Sampling Technique

For quantitative, Sampling Technique: To ensure a comprehensive understanding of the factors influencing the uptake of the Electronic Logistics Management Information System (eLMIS) for anti-TB commodities in the Kilimanjaro region, a rigorous sampling strategy was imperative. The following sampling methods and procedures were employed for the quantitative aspect of the study:

District Selection: Out of the seven districts comprising the Kilimanjaro region, four districts were randomly selected using a lottery method. This random selection ensures representation from various geographic areas within the region, enhancing the generalizability of the findings.

Health Facility Sampling: Simple random sampling was utilized to select the required sample size of health facilities. A sampling frame was created by compiling a comprehensive list of all primary public health facilities in the selected districts. Each facility was assigned a unique number for identification purposes. A computer-based random number generator was employed to randomly select health facilities from the sampling frame. This method ensures an unbiased selection process, minimizing the potential for sampling bias.

Participant Selection: From each participating health facility, at least one human participant meeting the inclusion criteria was selected (pharmacist and or lab technician). The criteria for participant selection were clearly defined and to include individuals directly involved in the management or utilization of the eLMIS for anti-TB commodities.

For qualitative, a purposive sampling was employed to select participants who have direct experience with the eLMIS in anti-TB commodity management. This method allows for the targeted selection of individuals with relevant expertise and ensures the representation of diverse perspectives within the study population.

2.6 Variables

2.6.1 Dependent variables

Uptake of Electronic Logistic Management Information System for managing anti-TB commodities. Categorical responses (Yes/No) for questions regarding the presence of eLMIS, implementation status.

2.6.2 Independent variables

Facility Information: Facility Type, Implementation Status of eLMIS, and Training Status of Healthcare Providers (HCPs) on eLMIS

Respondent Information: Age to be measured numerically responses for age and experience in years, Sex, Position/Role in Facility, Role in eLMIS, Experience (years)

Implementation and Usage of eLMIS: Established eLMIS system, Management of anti-TB commodities through eLMIS, Training status of personnel responsible for utilizing eLMIS, Efficiency in managing anti-TB commodities through eLMIS, Challenges encountered in eLMIS implementation

Availability of Anti-TB Commodities: Stock status of anti-TB commodities, Frequency of stock outs within 12 months, Orders received in correct quantities and with correct items, Compliance with stock plan

Status and Mechanisms: Instances of stock outs or shortages reported, Mechanisms to monitor and address stock outs or shortages, Contribution of eLMIS to timely and accurate reporting of commodity levels, Comparison of availability between facilities using eLMIS and those not, Feedback mechanisms for communication of issues related to commodity availability

Commodity Inventory: Tracking of anti-TB commodities via eLMIS, Stock levels (adequate, low, out of stock), Frequency of stock replenishment

Ordering and Delivery Process: Process for ordering anti-TB commodities through eLMIS, Time taken from order placement to delivery, Bottlenecks in the ordering process

Data Integration: Integration of eLMIS with existing inventory systems, Discrepancies between eLMIS data and data in other systems, Steps taken to resolve discrepancies

Monitoring and Reporting: Frequency of monitoring anti-TB commodities, reporting mechanism for stock levels, Actions taken based on monitoring reports.

2.7 Data collection procedures

For the quantitative part, the researcher used the data abstraction form (observation indicators checklist) to collect information on commodity availability, stock status, and order filling rate by record review of the data from the eLMIS software. Also, the researcher collected other quantitative information from participants by using a data abstraction form consisting of relevant questions and items.

For the qualitative part, Data was collected through in-depth interviews (IDIs). This method offers a conducive environment for participants to express their perspectives, experiences, and perceptions regarding the eLMIS without constraints. IDIs enable probing and clarification of responses, facilitating a comprehensive exploration of the factors influencing eLMIS uptake.

2.8 Data collection tools

For quantitative, data abstraction form was used to collect relevant data from the selected facilities. This was adapted from the Logistics Indicators Assessment Tool (LIAT) (31,32) and the AIDSFREE Zambia eLMIS report of 2018 (33). It comprised of information on the uptake of eLMIS of anti-Tb commodities: availability of anti-TB commodities; stock status, and order filling rate. The following list of anti-TB commodities were assessed: i) First-line anti-Tb drugs are in the form of a single or fixed combination of the following: Isoniazid (INH), Rifampicin (R), Pyrazinamide (Z), and Ethambutol (E). Thus, the medicines include INH100mg, E100mg, E400mg, and Z500mg, (R75H50)mg, (R150H75)mg, (R75H50Z150)mg and (R150H75Z400E275)mg .ii) Anti-TB diagnostics and reagents/supplies which include microscope, frosted end microscope slide, wooden applicator, filter paper, 1% carbon fuchsin, oil immersion, 1% Auramine O in alcohol, Phenolic solution for Auramine, 0.5% or 3% acid alcohol solution, 0.3% or 0.1% methylene blue, Falcon tube and Gene Xpert MTB/RIF. The determination of the number of facilities with availability of in-stock Status relied on physical inventory checks, where the presence of anti-TB commodities at public health facilities utilizing the electronic Logistics Management Information System (eLMIS) was assessed and marked as available or not. Concurrently, the number of facilities experiencing stock-outs within the past 12 months was derived from records documenting instances where stocks of specific items were depleted within the designated timeframe. The number of facilities observed stocked per plan was noted through comparison between actual inventory levels and predetermined stocking plans. Furthermore, to ascertain number of health facilities receiving orders correctly based on quantity and quality ordered, a thorough verification process cross-referencing quantities documented in eLMIS with procurement records was conducted, ensuring accuracy in assessing order fulfillment.

For qualitative, the primary data collection tool was the in-depth Interview Guide (IDI guide). Tool has been developed in English language and then translated into the local Kiswahili language. Forward and backward translation of the tools was done by two independent translators to ensure its conceptual equivalent. This guide comprises structured questions organized into thematic sections, including background information, system familiarity and training, perceived benefits, barriers to uptake, user feedback and suggestions, recommendations for improvement, and future outlook. These questions are designed to elicit detailed responses regarding participants' experiences and perceptions related to eLMIS adoption.

2.9 Pre-testing (data abstraction tool)

The data collection tools (checklist, structured questionnaire and interview guide) was piloted at four (4) health facilities which were not involved in this study. The purpose of piloting the tools is to ensure their correctness and clarity to the respondents.

2.10 Trustworthiness

Trustworthiness was ensured through the application of various criteria: credibility, conformability, transferability, dependability, and conformability. These criteria were addressed through rigorous data collection, analysis, and interpretation processes, as well as transparent reporting of findings to enhance the study's reliability and validity.

2.11 Data management

To ensure data quality assurance the following were considered: the data collection tools were piloted; the data was collected in the same Kiswahili language; and the interviews were conducted only by the researcher to maintain the consistency of the information. Moreover, the tools were reviewed by the supervisors and other selected postgraduate students to ensure the internal validity of the study. Furthermore, the questionnaire was cleaned after every day of data collection before being entered into database software to ensure the accuracy and completeness of the information collected.

The quantitative data was entered into an electronic database developed using Excel (spread sheet). Then, the Excel dataset was transferred/converted to Stata for windows version 18 for analysis. For the qualitative part, the audio taped information was saved on the researcher's computer and password secured.

2.12 Data Analysis

For quantitative methods, the statistical analysis was performed using Stata 18. The variables were precisely organized, categorized, and coded for analysis. The study encompassed 19 public health facilities, whose characteristics were summarized using frequency and proportion, and presented through a frequency distribution table. Data analysis was further done to address the specific objectives. Firstly, to determine the proportion of public health facilities using eLMIS for anti-TB commodities management, descriptive statistics were employed, and proportions were calculated based on the utilization of eLMIS for the enrolled facilities, the facilities were classified whether use eLMIS or not. Secondly, to assess the availability of anti-TB commodities at these facilities, descriptive statistics were again utilized, revealing varying degrees of availability across pharmacy and lab items. Additionally, statistical analysis was performed to compare facilities utilizing eLMIS for reporting with those that do not, highlighting differences in stock outs. Furthermore, feedback mechanisms for eLMIS-related issues were explored, indicating prevalent digital communication channels such as official emails and WhatsApp groups among users.

For qualitative part, data analysis employed qualitative analysis framework whereas step-by-step Thematic analysis was used. Audio recordings of the interviews were encrypted and transcribed verbatim. Transcriptions were translated from Swahili to English to ensure consistency and accuracy in analysis. Systematic coding/categorization and interpretation of data to identify key categories and patterns related to the factors influencing eLMIS uptake. Analysis was done thoroughly to ensure validity and reliability of the emerging results (Contents/Themes).

2.13 Ethical issues

In this study, ethical clearance was sought from the Research and Ethics Committee (Institution Review Board) of the Muhimbili University of Health and Allied Sciences. Subsequently, the Institutional Review Board issued support letters to all concerned study facilities. Moreover, the researcher employed introduction letter to request permission from the Kilimanjaro region authorities to conduct this study.

The study participants were provided with written information about the purpose, scope and benefits of the study as well as their voluntary participation. All eligible study participants were requested to provide written consent before responding to the questionnaire and the interview. Names and other identifiers of the facilities assessed, and participants were kept confidential and password secured throughout the process of data collection, analysis, and dissemination of the findings.

2.14 Limitation and mitigation

The potential limitation encountered in the study was the reliance on self-reporting for data collection. Despite utilizing both quantitative and qualitative methods, data on eLMIS utilization and challenges were primarily obtained through interviews with pharmacists and laboratory technicians. This approach might introduce bias or inaccuracies due to participants' subjective perceptions or recall errors. To mitigate this limitation, efforts were made to ensure utilizing structured data abstraction forms and interviewer guides, and cross-verifying responses. Additionally, triangulation of data sources and verification against existing records to enhance the reliability and validity of the findings was made, thereby minimizing the impact of potential reporting biases on the study outcomes.

2.15 Dissemination plan

The researcher will disseminate the findings of this study into three platforms. Firstly, the researcher will present the findings of this study via voice viva at the School of Pharmacy of Muhimbili University of Health and Allied Sciences. Secondly, the dissertation book(s) will be submitted and kept in the MUHAS library special reserve section to be accessible by students and other researchers. Thirdly, the findings of this study will be published in a peer-reviewed journal to share the findings with a network of scientists elsewhere in the world.

CHAPTER THREE

3.0 RESULTS

3.1 Characteristics of public health facilities enrolled in the study

A total of 19 public health facilities were enrolled in the study. Of these, dispensaries represent 21.1% (n=4), health centers constitute 52.6% (n=10), district hospitals encompass 15.8% (n=3), and tertiary hospitals make up 10.5% (n=2) of the total. Regarding the location of these facilities, 31.6% (n=6) are situated in urban areas, while another 31.6% (n=6) are in semi-urban regions, with the remaining 36.8% (n=7) located in rural settings. Notably, all participating facilities currently have access to the eLMIS, representing 100.0% (n=19). However, in terms of staff training, only 5.3% (n=1) of facilities report currently having no trained staff, while 31.6% (n=6) have trained one staff member, and the majority, 63.2% (n=12), have trained more than one staff member on the eLMIS system. (Table 1)

Table 1: Characteristics of public health facilities enrolled in the study (n=19)

Characteristics	Number	Percentage
Facility level		
Dispensary	4	21.1
Health center	10	52.6
District hospital	3	15.8
Tertiary hospitals	2	10.5
Location of the facility		
Urban	6	31.6
Semi-urban	6	31.6
Rural	7	36.8
Current have eLMIS access		
Yes	19	100.0
No	0	0.0
Number of staffs received trained on eLMIS		
None	1	5.3
One	6	31.6
More than 1	12	63.2

3.2 The uptake of eLMIS for anti-TB commodities management

Out of the total sample size of 19 public health facilities surveyed were using eLMIS, however its utilization was not implemented accordingly, between 19 facilities, only 36.8% (n=7) utilized eLMIS for both pharmacy and lab commodities management. However, a larger proportion, 63.2% (n=12) utilized eLMIS only for Lab commodities (Fig. 2).

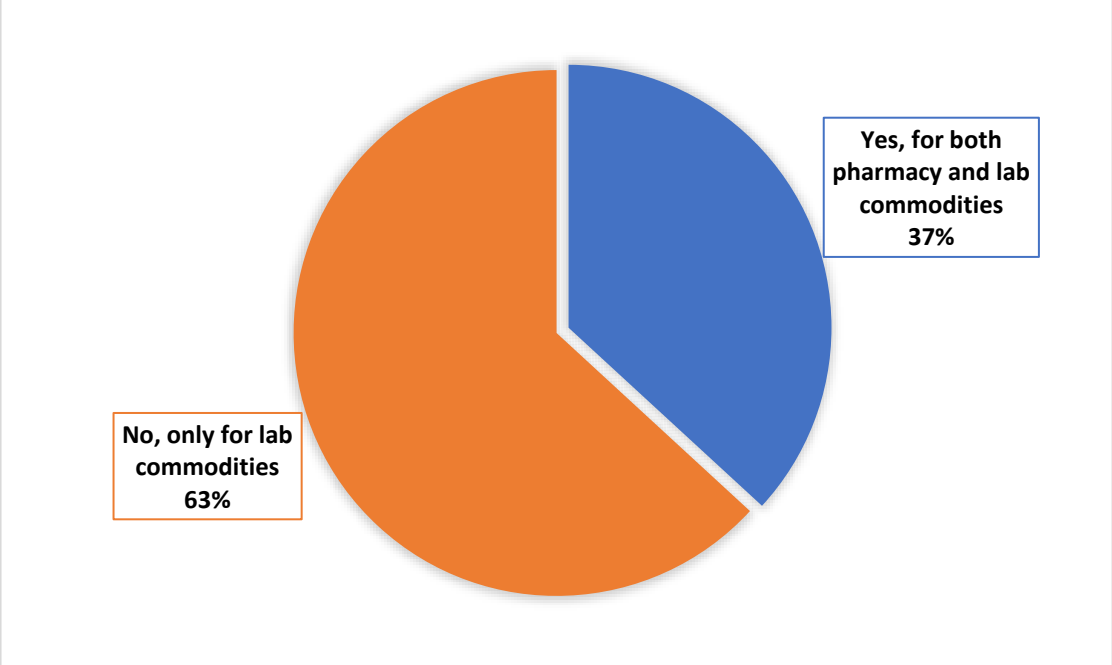


Figure 2: The uptake of eLMIS for anti-TB commodities management (n=19)

3.3 Anti-Tuberculosis Stock out Management and Reporting Efficiency using eLMIS

Findings revealed that 68% (n=13) of facilities experienced stockouts within the past 12 months, with 79%(n=15) implementing mechanisms like monthly stock monitoring to address shortages. Additionally, 63%(n=12) of facilities reported commodity levels accurately and timely. Notably, facilities utilizing eLMIS reported fewer stockouts compared to those not utilizing it (Table 2).

Table 2: Anti-Tuberculosis Stock out Management and Reporting Efficiency using eLMIS (n=19)

Questions/checklist items	Number (%)	Comments
Instances of stockouts or shortages reported	13(68.4)	68% of facilities reported stockouts in the past 12 months
Mechanisms to monitor and address stockouts/shortage within framework	15(78.9)	79% address stockouts within framework i.e. monthly stock monitoring; emergency orders
Timely and accurately reporting TB commodities	12(63.2)	63% accuracy in reporting commodity levels

3.3 The availability of anti-TB commodities at public health facilities that are using eLMIS

A varying degree of availability of the anti-TB commodities across pharmacy and lab items was observed. Notably, INH 100mg exhibited 68.4% availability in stock, with 52.6% experiencing stockouts within 12 months. Similarly, essential medications like E 100mg and E 400mg showed 42.1% and 15.8% availability respectively. Lab items demonstrated relatively better availability, with LED Microscope and Frosted End Microscope Slide both at 89.5%. However, certain items such as Gene Xpert MTB/RIF showed lower availability, with only 26.3% of facilities having them in stock. Overall, while some commodities met stocking targets, others faced significant stockouts, indicating potential challenges in the supply chain management of anti-TB medications and equipment within these facilities (Table 3).

Table 3: The availability of anti-TB commodities at public health facilities that are using eLMIS (n=19)

Items	Facilities with availability/stock Status of anti-TB commodities n (%)	Facilities experiencing stock-outs within 12 months n (%)	Facilities with commodities stocked per plan n (%)	Facilities receiving correct commodities as per order n (%)	Facilities receiving correct commodities as per order n (%)
Pharmacy Items					
INH 100mg	13(68.4)	10(52.6)	7(36.8)	17(89.5)	17(89.5)
E 100mg	8(42.1)	2(10.5)	7(36.8)	9(47.4)	9(47.4)
E 400mg	3(15.8)	0(0.0)	3(15.8)	3(15.8)	3(15.8)
Z 500mg	3(15.8)	0(0.0)	3(15.8)	3(15.8)	3(15.8)
(R75H50) mg	3(15.8)	3(15.8)	9(47.4)	12(63.2)	12(63.2)
(R150H75) mg	15(78.9)	5(26.3)	12(63.2)	17(89.5)	17(89.5)
(R75H50Z150) mg	9(47.4)	1(5.3)	9(47.4)	10(52.6)	10(52.6)
(R150H75Z400E275) mg	17(89.5)	5(26.3)	15(78.9)	18(94.7)	18(94.7)
Lab Items					
LED Microscope	17(89.5)	1(5.3)	17(89.5)	17(89.5)	17(89.5)
Frosted End Microscope Slide	19(100)	3(15.8)	17(89.5)	19(100)	19(100.0)
Wooden Applicator	18(94.7)	1(5.3)	18(94.7)	18(94.7)	18(94.7)
Filter Paper	14(73.7)	4(21.1)	14(73.7)	16(84.2)	16(84.2)
1% Carbon Fuchsin	13(68.4)	5(26.3)	9(47.4)	15(78.9)	15(78.9)
Oil Immersion 1	18(94.7)	2(10.5)	18(94.7)	18(94.7)	18(94.7)
% Auramine O in Alcohol	5(26.3)	0(0.0)	5(26.3)	6(31.6)	5(26.3)
Phenolic Solution for Auramine	5(26.3)	0(0.0)	5(26.3)	6(31.6)	5(26.3)
0.5% or 3% Acid Alcohol Solution	15(78.9)	4(21.1)	14(73.7)	16(84.2)	16(84.2)
0.3% or 0.1% Methylene Blue	14(73.7)	3(15.8)	13(68.4)	16(84.2)	16(84.2)
Falcon Tube	12(63.2)	6(31.6)	10(52.6)	13(68.4)	13(68.4)
Gene X-pert MTB/RIF	5(26.3)	14(73.6)	2(10.5)	6(31.6)	7(36.8)

Common Feedback mechanisms for eLMIS-related issues by users

Of 16 public health facilities, revealed significant feedback mechanisms concerning eLMIS-related issues. Predominantly, 63.2% (n=12) of users utilized official emails and participated in Stakeholders WhatsApp groups to convey their concerns. Additionally, 52.6% (n=10) opted for commenting within the eLMIS section. A smaller portion, 31.6% (n=6), relied solely on phone calls for feedback. These findings underline the prevalence of digital communication channels, particularly emails and WhatsApp groups, in addressing eLMIS-related matters among users in public health facilities (Fig.3).

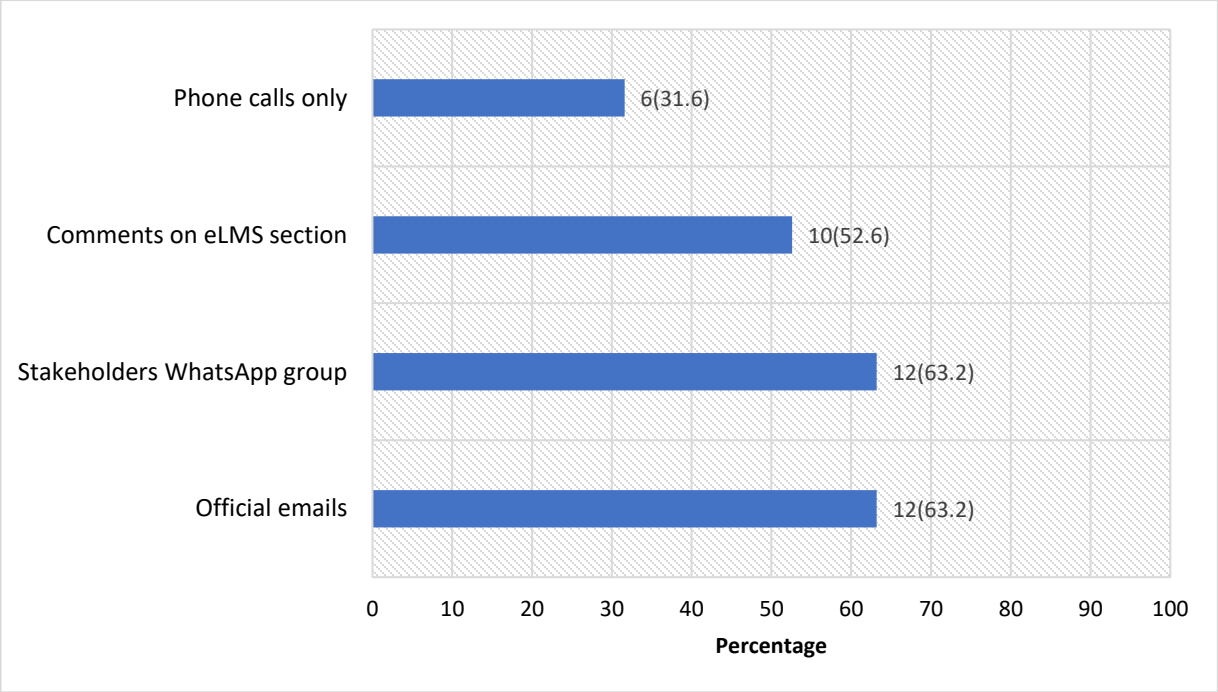


Figure 3: Common Feedback mechanisms for eLMIS-related issues by users at the studied public health facilities (n=19)

3.4 Factors affecting the uptake of the eLMIS for anti-TB commodities at public Health facilities

With this context, IDI was conducted with eight participants to explore factors affecting the uptake of the eLMIS for anti-TB commodities at the study.

3.4.1 Sociodemographic characteristics of IDI participants

Among the eight participants, the majority were male (75%, n=6), with ages ranging from 33 to 45 years old. Professionally, the participants represented a diverse background, including pharmacists (75%, n=6), laboratory scientists/technologists (25%, n=2). Their experience in working with electronic Logistics Management Information Systems (eLMIS) varied between 2 to 20 years, with the majority having over 5 years of experience (87.5%, n=7). Responsibilities within the eLMIS framework were diverse, encompassing reporting, requesting, forecasting, verifying, and approving, indicating a comprehensive engagement with the system across different operational roles. (Table 4).

Table 4: Socio-demographic characteristics of IDI participants (n=8)

Participant Number	Sex	Age (years)	Professional	Experience Working with eLMIS	Responsibility
PN. 1	Male	37	Pharmacist	9 years	Reporting, Requesting, Forecasting, Verifying & Approving
PN. 2	Male	35	Lab scientist	10 years	Reviewing & Approval at DMO Level
PN. 3	Male	41	Pharmacist	10 years	Reporting, Requesting & Forecasting
PN. 4	Female	33	Pharmacist	6 years	Reporting, Requesting, Forecasting, Verifying & Approving
PN. 5	Male	33	Pharmacist	8 years	Reporting, Requesting, Forecasting, Verifying & Approving
PN. 6	Female	45	Laboratory Technologist	2 years	Verifying & Approving
PN. 7	Female	38	Pharmacist	10 years	Reporting, Requesting, Forecasting, Verifying & Approving
PN. 8	Male	45	Pharmacist	20 years	Reporting, Requesting, Forecasting, Verifying & Approving

3.4.2 The Emerged Themes and sub-themes

A total of six major themes with twelve sub-themes and thirty-six codes emerged as shown in Table5. These include Limited User Training and Preparation, Integration System Challenges, Infrastructure and Connectivity Issues, User Perceptions and Attitudes, Efficiency and Reporting Challenges, and Feedback Mechanisms and User Involvement (Table 5).

Table 5:Themes, sub-themes and codes

S/N	Themes	Sub-themes	Codes
1	Limited User Training and Preparation	Lack of official Training	• Users unfamiliar with the system • Need for hands-on training sessions • Need for periodic refresher training
		Lack of SOPs and learning materials	• Inadequate training materials • Lack of user manuals/documentation • Absence of training resources
2	Integration system challenges	Absence of Integration system	• Absence of integration with other health systems • Failure to merge information • Difficulties in integrating systems
		Lack of compatibility	• Incompatibility with existing systems • Lack of interoperability
3	Infrastructure and Connectivity Issues	Limited Availability of Devices	• Insufficient availability of computers • Electricity-related problems • Poor internet connectivity • System slowdown due to internet/internal issues
		Power Supply Issues	• Electricity-related problems • Unstable power supply
4	User Perceptions and Attitudes	Positive Perceptions	• User appreciation for system functionalities despite limitations
		Negative perceptions	• Challenges in accessing real-time data affecting user satisfaction • Lack of confidence in data accuracy • Frustration with system downtime
5	Efficiency and Reporting Challenges	Order Submissions Delay	• Order submission delays due to system/internet issues • Time constraints in report preparation/reviewing affecting accuracy • Suggestions for staffing improvements to enhance efficiency • Incorrect deliveries.
		Reporting system errors	• Data entry errors •Errors in unit conversions • Inefficiencies in report generation • Delivery discrepancies • Constant and continuous list updates
6	Strategies and Opportunities	Utilization of MSD WhatsApp Groups	• WhatsApp groups for issue sharing updates • System feature for suggestions/complaints • Updates/enhancements based on user feedback
		User Engagement	• User involvement in feedback mechanisms • Influence of user feedback on system improvements • User resistance to change

<u>Theme 1</u>: Limited User Training and Preparation

Insufficient training contributes significantly to challenges faced in utilizing ELMIS. Participants said the lack of continuous training, users' unfamiliarity with the system, and the necessity for hands-on training sessions and periodic refresher courses to ensure proficiency. The absence of standardized operating procedures (SOPs) and learning materials exacerbates the training gap, hindering optimal system utilization. Comprehensive learning materials are crucial for effective user training, emphasizing the need for user manuals/documentation and adequate training resources to address these challenges.

Lack of official Training

Insufficient training contributes significantly to the challenges faced in utilizing eLMIS. Participants emphasized the lack of continuous training, users' unfamiliarity with the system, the necessity for hands-on training sessions, and periodic refresher courses. One participant said,

> *"We lack continuous training to effectively work with eLMIS, as I know regular training is paramount to ensure that users are not only familiar with the system but also confident in navigating its complexities. Without ongoing education, users are left to struggle on their own, which inevitably leads to errors and inefficiencies." - (IDI participant 2)*

Another participant reported the lack of continuous training, users' unfamiliarity with the system, and the necessity for hands-on training sessions and periodic refresher courses. The participant said,

> *“We lack continuous training to effectively work with ELMIS. Regular training is paramount to ensure that users are not only familiar with the system but also confident in navigating its complexities. Without ongoing education, users are left to struggle on their own, which inevitably leads to errors and inefficiencies (IDI participant 8).*

Another participant stated that,

> *"Without sufficient technical support, even minor errors in data input can snowball into major setbacks, affecting the overall efficiency of the system. It's imperative that we have reliable assistance to troubleshoot and rectify these issues promptly." - (IDI participant 5)*

Lack of SOPs and learning materials

The absence of standardized operating procedures (SOPs) and learning materials exacerbates the training gap. Participants cited inadequate training materials, the lack of user manuals/documentation, and the absence of training resources. The absence of comprehensive learning materials greatly hampers our ability to effectively train users, leaving them ill-equipped to utilize the system to its full potential. One participant noted,

> *"The absence of comprehensive learning materials greatly hampers our ability to effectively train users, leaving them ill-equipped to utilize the system to its full potential. We desperately need detailed manuals and resources to facilitate proper training and ongoing skill development." - (IDI participant 6)*

Another participant stated that,

> *We desperately need detailed manuals and resources to facilitate proper training and ongoing skill development (IDI participant 6).*

<u>Theme 2</u>: Integration system challenges

Integrating the electronic Logistics Management Information System (eLMIS) with other vital health systems, such as electronic health management, procurement, and billing systems, is paramount for ensuring smooth data flow and effective management. However, despite its importance, several challenges impede seamless integration and hinder overall system efficiency. Participants emphasized the significance of system integration in facilitating efficient inventory management and underscored the critical need for interoperability to address compatibility issues.

Absence of Integration

Participants claimed at lacking integration of eLMIS with other health systems such as electronic health management system, procurement and hospital billing system is crucial for all-in-one data flow and management. However, participants highlighted challenges such as the absence of integration with other health systems, failure to merge information effectively, and difficulties in integrating systems. One participant expressed,

> *"The eLMIS not integrated with other systems to facilitate data flow between departments, which in turn undermines our efforts towards efficient inventory management when it comes to procurement issues, hospital billing and hospital health management system. Integration of eLMIS would provide better solutions to bridge these gaps and facilitate smoother information which not yet implemented which undermines our efforts towards efficient inventory management" - (IDI participant 4)*

Lack of compatibility

Compatibility issues further exacerbate integration challenges. Participants noted incompatibility with existing systems and a lack of interoperability, hindering the seamless exchange of information. Incompatibility issues between systems only serve to complicate matters further, making it difficult to synchronize data accurately and efficiently. One participant remarked,

> *"Incompatibility issues between systems only serve to complicate matters further, making it difficult to synchronize data accurately and efficiently. Without interoperability, we're constantly grappling with data discrepancies and inefficiencies." - (IDI participant 7)*

***Theme 3*: Infrastructure and Connectivity Issues**

The availability of adequate infrastructure significantly impacts ELMIS utilization. Challenges such as limited availability of devices and unstable power supply hinder system access and functionality, affecting timely inventory management. The scarcity of available devices severely limits our access to the system, impeding our ability to manage inventory in a timely manner. Participants emphasized the need for addressing infrastructure challenges to ensure uninterrupted system usage and data integrity.

Limited Availability of Devices

The availability of adequate infrastructure significantly impacts eLMIS utilization. Participants cited challenges such as insufficient availability of computers, printers, scanners, routers and electricity-related problems, hindering system access and functionality. One participant highlighted,

> *"The scarcity of available devices severely limits our access to the system, impeding our ability to manage inventory in a timely manner. It's frustrating to know that we could be more efficient if only we had the necessary devices like computers, routers and sometime electricity goes off." - (IDI participant 1)*

Another participant stated that,

"Struggling with poor internet connectivity while attempting to update delivery lists significantly disrupts our workflow, making smooth operation nearly impossible. It's frustrating to constantly deal with these obstacles, especially when accuracy and timeliness are crucial." - (IDI participant 3)

Power Supply Issues

Unstable power supply further exacerbates infrastructure challenges. Participants noted electricity-related problems and unstable power supply as significant barriers to system functionality and data management. One participant said, "Frequent power outages disrupt system usage and compromise data integrity, affecting overall efficiency.

> *"Unstable power supply further exacerbates infrastructure challenges. Frequent power outages disrupt system usage and compromise data integrity, affecting overall efficiency. Unstable power supply further exacerbates our challenges, adding another layer of complexity to an already precarious situation. Without reliable electricity, our ability to access and utilize the system is severely compromised (IDI participant 8).*

<u>Theme 4</u>: User Perceptions and Attitudes

Despite challenges, users appreciate certain functionalities of eLMIS, recognizing its potential to streamline inventory management processes. However, negative perceptions prevail due to various system limitations, impacting user satisfaction and confidence in the system. System downtime, data inaccuracies, and challenges in accessing real-time data contribute to user frustration, highlighting the importance of addressing these issues to improve user perceptions and attitudes towards the system.

Positive Perceptions

Despite challenges, users appreciate certain functionalities of the eLMIS. Participants expressed positive perceptions regarding system functionalities, acknowledging its potential benefits despite limitations. One participant mentioned,

> *"While there are undoubtedly challenges, users appreciate certain functionalities of the system that have the potential to streamline inventory management processes. Recognizing these positives motivates us to persevere despite the obstacles." - (IDI participant 3)*

Negative perceptions

However, negative perceptions also prevail due to various system limitations. Participants cited challenges in accessing real-time data, lack of confidence in data accuracy, and frustration with system downtime, impacting user satisfaction. One participant noted, "System downtime and data inaccuracies contribute to user frustration, undermining confidence in the system."

> *"Despite recognizing the potential benefits, users are often frustrated by the challenges in accessing real-time data and the lack of confidence in data accuracy. These concerns contribute to a sense of dissatisfaction and hinder our overall trust in the system." - (IDI participant 5)*

Theme 5*: *Efficiency and Reporting Challenges

Efficiency and reporting face challenges primarily due to delays in order submissions and system errors in reporting. Addressing order submission delays is critical to ensuring timely procurement and distribution of TB commodities. Participants emphasized the need for improved reporting mechanisms to address data entry errors and inefficiencies in report generation, ensuring reliable reports for informed decision-making.

Order Submissions Delay

Efficiency and reporting face challenges primarily due to delays in order submissions and system errors in reporting. Addressing order submission delays is critical to ensuring timely procurement and distribution of TB commodities. Participants emphasized the need for improved reporting mechanisms to address data entry errors and inefficiencies in report generation, ensuring reliable reports for informed decision-making. Participant said,

> *"Addressing order submission delays has been critical issue and resulting to the failure to ensure timely deal with procurement and distribution of TB commodities as results of stockouts for unnecessarily. Efforts to address order submission delays are crucial for ensuring that TB commodities are procured and distributed in a timely manner, ultimately improving patient care outcomes. Streamlining this process is essential for efficient inventory management." - (IDI participant 2)*

Reporting system errors

System errors in reporting further hinder efficient inventory management. Participants highlighted data entry errors, inefficiencies in report generation, and the need for improved reporting mechanisms. One participant remarked, "System errors and data inaccuracies compromise the reliability of generated reports, hindering informed decision-making."

> *"Addressing inefficiencies in report generation is essential for maintaining accurate records and making informed decisions regarding inventory management. Without reliable reporting systems, we're operating blindly, which is unacceptable in a healthcare setting." - (IDI participant 6)*

<u>Theme 6</u>: Strategies and Opportunities

Utilization of feedback mechanisms such as MSD WhatsApp groups provides valuable avenues for issue sharing and system improvement suggestions. Active user involvement in feedback mechanisms is essential for identifying system gaps and implementing effective solutions. Participants said the significance of user engagement in driving positive changes and enhancing system functionality through collaborative efforts.

Utilization of MSD WhatsApp Groups

Utilization of feedback mechanisms such as MSD WhatsApp groups provides valuable avenues for issue sharing and system improvement suggestions. Active user involvement in feedback mechanisms is essential for identifying system gaps and implementing effective solutions. Participants said the significance of user engagement in driving positive changes and enhancing system functionality through collaborative efforts. One participant mentioned,

> *"MSD WhatsApp groups play a vital role in facilitating communication among users, providing a platform for issue-sharing, suggestions, and updates on system enhancements. Leveraging these channels effectively can significantly improve user engagement and system performance." - (IDI participant 4)*

User Engagement

Active user involvement in feedback mechanisms is essential for system improvement. Participants emphasized the influence of user feedback on system enhancements and highlighted the importance of user engagement in driving positive changes. One participant said, "User involvement in feedback mechanisms is crucial for identifying system gaps and implementing effective solutions.

> *"Active user involvement in feedback mechanisms is essential for driving meaningful improvements in the system. By listening to user concerns and implementing relevant suggestions, we can work towards a more user-friendly and efficient ELMIS." - (IDI participant 7)*

CHAPTER FOUR

4.0 DISCUSSION

4.1 Discussion of the key findings

It was found that a large portion of the public health facilities implemented eLMIS, but its utilization was not fully implemented. Specifically, 36.8% of the facilities utilized eLMIS for both pharmacy and lab commodities management, while 63.2% only used it for lab commodities. The findings from this study indicated varying degrees of availability of anti-TB commodities across pharmacy and laboratory items. Notably, some essential medications such as INH 100mg were more availability in stock to about seventy percent of the facilities, and more than fifty percent experiencing stockouts within 12 months. Lab items showed relatively better availability, with certain items like LED Microscope and Frosted End Microscope Slide. However, commodities like Gene Xpert MTB/RIF showed lower availability, with only 26.3% of facilities having them in stock. Moreover, findings regarding anti-tuberculosis stockout management and reporting efficiency using eLMIS indicated that a significant portion of facilities experienced stockouts within 12 months. The study on factors affecting the uptake of the electronic Logistics Management Information System (eLMIS) for anti-TB commodities in PH facilities at the study site identified several significant challenges. These challenges included system disturbances, technical issues like poor internet connectivity and data input errors, inadequate user training, integration system challenges, and user perceptions and attitudes. Addressing these challenges is crucial for optimizing system functionality and improving inventory management processes.

The uptake of eLMIS

Most facilities do not fully utilize eLMIS with around thirty-seven percent of the facilities in this study were found utilizing eLMIS for both pharmacy and lab commodities management, while about sixty three percent only used it for lab commodities. This indicates a gap in its implementation for comprehensive anti-TB commodity management, suggesting room for improvement and targeted interventions to enhance efficiency and effectiveness. The findings of this study align with previous research conducted in other regions, particularly in Uganda and

Ethiopia. In Uganda, a study revealed that only 6% of health facilities were using eLMIS, indicating a low adoption. However, the availability of computer hardware in Ugandan health facilities was higher at 42%, suggesting potential infrastructure differences between the two regions (34). Likewise, a study in Ethiopia reported that 39% of health facilities had eLMIS, with varying levels of functionality across different facility types. Notably, hospitals had a higher functional rate of eLMIS compared to health centers, which echoes the disparities observed in the Kilimanjaro region (18). The similarities observed in eLMIS uptake indicate broader challenges in implementing electronic systems for logistics management in healthcare settings. These challenges may stem from issues related to infrastructure, resource availability, training, and institutional support. However, differences in the functional status of eLMIS across different types of health facilities highlight the need for context-specific interventions. For instance, while hospitals may have higher access to eLMIS, ensuring its functionality remains a concern. Meanwhile, health centers may require more support in terms of infrastructure and training to improve eLMIS utilization.

The availability and management of anti-TB commodities in eLMIS

The findings of this study reveal important insights into the availability and management of anti-TB commodities within public health facilities. Disparities in availability among different types of commodities, with certain medications facing more pronounced stockouts compared to laboratory items. This aligns with previous research highlighting challenges in maintaining consistent stock levels of essential medications in LMICs (6). However, it's notable that despite the challenges, the availability of some laboratory items like microscopes remained relatively high, suggesting potential areas of strength within the supply chain management system.

Furthermore, the study accentuates the significance of digital communication channels in addressing eLMIS-related issues among users. The prevalence of feedback mechanisms such as official emails and WhatsApp groups indicates a growing reliance on digital platforms for communication and problem-solving within healthcare settings. This reflects broader trends towards digitization in the management of healthcare systems, which can enhance efficiency and facilitate timely responses to supply chain challenges (7,8).

Comparing these findings with previous research, similarities emerge in the overall goal of eLMIS implementation, which is to improve the performance of medical supply chains and ensure the uninterrupted availability of healthcare commodities, including anti-TB medications. Studies from other LMICs, such as Ethiopia, have also shown improvements in stock management and availability of essential commodities with the adoption of eLMIS (9). However, differences exist in the specific challenges and outcomes observed. For instance, while the current study identifies significant stockouts of certain medications like INH 100mg, previous research in Ethiopia reported higher rates of stockouts for laboratory commodities (18). These differences may stem from variations in healthcare infrastructure, supply chain dynamics, and implementation strategies across different regions.

Factors affecting the uptake of the eLMIS for anti-TB commodities

The current study revealed challenges such as system disturbances, technical issues, limited user training, integration system challenges, and user perceptions affecting the uptake of eLMIS. These challenges are consistent with previous research findings in various settings, indicating similarities in the factors hindering the adoption of electronic health records (EHRs). For instance, studies in Kenya (19) highlighted inadequate staff training and supportive supervision as factors compromising the quality and use of information. Similarly, previous study in Tanzania (21) , lack of appropriate training impacted the skills for data interpretation and utilization, affecting user satisfaction with eLMIS. These similarities emphasize the importance of addressing training and supervision inadequacies to enhance the uptake and utilization of electronic systems.

Differences from previous findings: While some challenges align with previous research, such as inadequate training and technical issues, specific contextual factors may differ. For example, the study in Botswana (23) highlighted the impact of software maintenance on system functionality, which may not be explicitly mentioned in other studies. Additionally, demographic factors such as age, gender, education level, and work experience may influence the uptake of electronic systems differently across various regions. For instance, studies in Saudi Arabia (28)and Ireland (24) indicated varying effects of demographic factors on the adoption of

electronic health systems among different populations. Understanding these contextual differences is essential for tailoring interventions to address specific challenges in eLMIS uptake effectively.

Addressing the identified challenges in eLMIS uptake is crucial for improving inventory management processes and ensuring the efficient distribution of anti-TB commodities in public health facilities. Investing in comprehensive user training programs and supportive supervision can enhance user skills and confidence in utilizing the system. Moreover, addressing technical issues such as internet connectivity and software maintenance is essential for ensuring system reliability and functionality. By incorporating lessons from previous research and considering contextual factors, policymakers and healthcare stakeholders can develop targeted strategies to overcome barriers and promote the effective adoption of eLMIS in TB commodity management.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The study revealed that while a considerable proportion of public health facilities in the Kilimanjaro region have adopted the eLMIS for anti-TB commodities management, its utilization remains suboptimal. The availability of anti-TB commodities varied across pharmacy and laboratory items, with notable stockouts observed within 12 months, particularly for essential medications like INH 100mg and Gene Xpert MTB/RIF. Challenges affecting the uptake of eLMIS included system disturbances, technical issues such as poor internet connectivity, inadequate user training, integration system challenges, and user perceptions. However, facilities utilizing eLMIS reported fewer stockouts compared to those not utilizing it, indicating its potential for improving inventory management processes. Addressing these challenges is imperative for enhancing system functionality and optimizing inventory management in public health facilities, thereby ensuring the consistent availability of anti-TB commodities for effective tuberculosis management.

5.2 Recommendations

Ministry of health and pharmaceutical companies Providing ongoing technical assistance and comprehensive training programs can improve users' proficiency in utilizing eLMIS effectively.

Expand research scope: Future studies should consider larger sample sizes and explore additional factors influencing TB commodity management to provide a more comprehensive understanding and inform targeted interventions. By implementing these recommendations, healthcare systems can overcome existing challenges and optimize TB commodity distribution, ultimately contributing to improved patient care outcomes in the Kilimanjaro region and beyond.

The findings underline the importance of continuous monitoring and evaluation of eLMIS implementation to identify gaps and inform targeted interventions. By addressing barriers to adoption and functionality, healthcare systems can strengthen their capacity to manage TB

commodities effectively, ultimately improving patient outcomes and reducing the burden of tuberculosis in the Kilimanjaro region and beyond.

The findings have several implications for policy and practice. Addressing the identified challenges, such as technical issues and insufficient training, is crucial for enhancing the uptake and effectiveness of eLMIS in managing anti-TB commodities. Strengthening feedback mechanisms through digital platforms can improve communication and facilitate timely responses to system-related issues. Furthermore, efforts to integrate eLMIS with existing health infrastructure should be prioritized to ensure seamless functionality and interoperability. Overall, addressing these challenges is essential for optimizing TB commodity distribution and improving patient care outcomes in the Kilimanjaro region.

It is recommended to strengthen feedback mechanisms: Establishing robust digital platforms for feedback and issue resolution can facilitate timely responses to system-related challenges and enhance user engagement.

Promote system integration: Efforts should be made to integrate eLMIS with existing health infrastructure to ensure interoperability and seamless data exchange, thereby improving overall system functionality.

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APPENDICES

Appendix I: Informed Consent (English)

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES (MUHAS)

DIRECTORATE OF RESEARCH AND PUBLICATIONS

MUHAS: INFORMED CONSENT

STUDY NUMBER: _____

CONSENT FORM FOR PARTICIPATING IN A RESEARCH STUDY

Introduction

You are invited to take part in a research study because of your extensive experience in Electronic Logistic Management of Ant-TB commodities at your facility. The study is being conducted by Suzanne M. Nyalagu from Muhimbili University of Health and Allied Sciences (MUHAS) as part of her postgraduate study in Pharmacy in Pharmaceutical Management. The study is supervised by Prof. Godeliver Kagashe and Dr. Rogers Mwakalukwa from MUHAS, located in Dar es Salaam, Tanzania.

Participation in this research study is voluntary, and it is open only to those who choose to participate. Please carefully read this consent form and take your time to decide. If you agree to participate, you will be asked to sign and date this form, and you will receive a copy for your records. If there is anything you do not understand, please feel free to ask for clarification.

Research Title: "Uptake of Electronic Logistic Management Information System of Anti-Tuberculosis Commodities at Public Health Facilities in Kilimanjaro Region, Tanzania"

Purpose of the study

The purpose of this study is to assess the uptake of electronic logistic management information systems of anti-TB commodities at public health facilities in Kilimanjaro region in Tanzania.

Participation

You have been selected to participate because you meet the criteria for the subject matter of this study. Questionnaire and/or Interviewer guides will be used, and your privacy will be maintained to the best extent possible. The researcher hopes that you will be willing to share your information. If you have any questions about the research, you can ask them at any time.

Confidentiality

Confidentiality is of utmost importance in this study. All information and issues related to your participation will be treated as confidential. Your information will not be accessible to unauthorized individuals. Once the interview process is complete, the information will be securely discarded to maintain research confidentiality. Additionally, your name will not be used in the written copy of the research findings to protect your confidentiality.

Right to refuse or withdraw

You have the right to refuse or withdraw from this study. You are under no obligation to discuss anything you do not wish to, and you may end the interview at any time. However, your viewpoints are highly valuable for this study.

Benefits

There are no direct benefits to you for participating in this study. However, your involvement will provide valuable information for future interventions aimed at improving the management of the Electronic Logistic Management Information System of Anti-Tuberculosis Commodities at health facilities.

Risks

There are no anticipated risks associated with participating in this study, although some of the questions asked may be personal and could potentially evoke emotions and require your attention.

Whom to contact

If you have any questions about the study, you can contact the Chairperson of the Research and Publications Committee at MUHAS, located at P.O. Box 65001, Dar es Salaam, Tanzania. The contact number is 255 0222151596.

Declaration

By signing this form, you acknowledge that you have read and understood its contents. Your questions have been answered, and you agree to participate in this study. However, you have the right to withdraw your participation at any time, even during the interview.

Interviewee's Signature: _____Date: _____ Time: _____

Interviewer's Signature: _____Date: _____Time: _____

THANK YOU FOR YOUR CONSENT

Appendix II: Informed Consent (Kiswahili)

CHUO KIKUU CHA AFYA NA SAYANSI SHIRIKISHI MUHIMBILI

KURUGENZI YA UTAFITI NA MACHAPISHO

MUHAS: FOMU YA RIDHAA YA KUSHIRIKI UTAFITI

NAMBARI YA FOMU: _____

FOMU YA RIDHAA YA KUSHIRIKI KATIKA UTAFITI

Utangulizi

Unakaribishwa kushiriki katika utafiti huu kutokana na uzoefu wako mkubwa katika utekelezaji wa Mfumo wa Taarifa za Kielektroniki za Usimamizi wa Dawa na Vifaa Tiba vya Kupambana na Kifua Kikuu katika Vituo vya Afya. Utafiti huu unafanywa na Suzanne M. Nyalagu kutoka Chuo Kikuu cha Afya na Sayansi Shirikishi Muhimbili (MUHAS) kama sehemu ya masomo yake ya shahada ya uzamili wa Famasia katika Usimamizi wa Dawa. Utafiti huu unasimamiwa na Prof. Godeliver Kagashe na Dkt. Rogers Mwakalukwa kutoka MUHAS, iliyoko Dar es Salaam, Tanzania.

Ushiriki katika utafiti huu ni wa hiari, na unafunguliwa tu kwa wale ambao wanachagua kushiriki. Tafadhali soma kwa uangalifu fomu hii ya ridhaa na chukua muda wako wa kuamua. Ikiwa unaafikiana kushiriki, utaulizwa kusaini na kutia tarehe fomu hii, na utapokea nakala kwa

ajili ya kumbukumbu yako. Ikiwa kuna chochote usichokielewa, tafadhali jisikie huru kuuliza ili upate ufafanuzi.

Kichwa cha Utafiti: "Utekelezwaji wa Mfumo wa Taarifa za Kielektroniki za Usimamizi wa Dawa na Vifaa Tiba vya Kupambana na Kifua Kikuu katika Vituo vya Afya vya Umma katika Mkoa wa Kilimanjaro, Tanzania"

Lengo la utafiti

Lengo la utafiti Lengo la utafiti huu ni kutathmini utekelezaji wa Mfumo wa Kielektroniki wa Usimamizi wa Taarifa za Dawa na Vifaa Tiba vya Kifua Kikuu katika vituo vya afya vya umma mkoani Kilimanjaro nchini Tanzania.

Ushiriki

Umechaguliwa kushiriki kwa sababu unakidhi vigezo vya somo la utafiti huu. Dodoso and mwongozo wa mahojiano vitatumika, na faragha yako itahifadhiwa kwa kiwango cha juu kinachowezekana. Mtafiti anatumai kuwa utakuwa tayari kushiriki habari zako. Ikiwa una maswali yoyote kuhusu utafiti huu, unaweza kuyauliza wakati wowote.

Usiri

Usiri ni muhimu sana katika utafiti huu. Taarifa yote na masuala yanayohusiana na ushiriki wako yatatendewa kwa siri. Taarifa yako haitapatikana na watu wasioidhinishwa. Mara baada ya mchakato wa mahojiano kukamilika, taarifa itafutwa salama ili kudumisha usiri wa utafiti. Aidha, jina lako halitatumika katika nakala iliyoandikwa ya matokeo ya utafiti ili kulinda usiri wako.

Haki ya kukataa au kujiondoa

Una haki ya kukataa au kujiondoa katika utafiti huu. Hauko chini ya wajibu wa kujadili chochote usichotaka, na unaweza kumaliza mahojiano wakati wowote. Walakini, maoni yako ni ya thamani sana kwa utafiti huu.

Faida

Hakuna faida moja kwa moja kwako kwa kushiriki katika utafiti huu. Walakini, ushiriki wako utatoa habari muhimu kwa jitihada za baadaye za kuboresha kuboresha usimamizi wa Mfumo wa Taarifa za Kielektroniki za Usimamizi wa Dawa na Vifa Tiba vya Kifua Kikuu kwenye vituo vya afya.

Hatari

Hakuna hatari zinazotarajiwa zinazohusiana na ushiriki katika utafiti huu, ingawa baadhi ya maswali yanayoulizwa yanaweza kuwa ya kibinafsi na yanaweza kusababisha hisia na kuhitaji tahadhari yako.

Mtu wa kuwasiliana naye

Ikiwa una maswali yoyote kuhusu utafiti, unaweza kuwasiliana na Mwenyekiti wa Kamati ya Utafiti na Uchapishaji katika MUHAS, anapatikana kwenye Sanduku la Posta 65001, Dar es Salaam, Tanzania. Nambari ya mawasiliano ni 255 0222151596.

Tamko

Kwa kusaini fomu hii, unatambua kwamba umesoma na kuelewa yaliyomo. Maswali yako yamejibiwa, na unaafikiana kushiriki katika utafiti huu. Walakini, una haki ya kujiondoa kushiriki wakati wowote, hata wakati wa mahojiano.

Sahihi ya Mhojiwa: _____Tarehe: _____ Muda: _____
Sahihi ya Mhoji:_____ Tarehe: _____ Muda: _____

ASANTE KWA RIDHAA YAKO

Appendix III: Data Abstraction Form (English)

PART ONE: General Information:

a. Facility Information:

Item	Response
1.1 Facility Name	
1.2 Facility Type	
1.3 Location (District/Region)	
1.4 Implementation Status of eLMIS	Implemented / Not Implemented
1.5 Training Status, number of HCPs attended training on eLMIS	

b. Respondent Information:

Items	Response
1.6 Age	
1.7 Sex	
1.8 Position/Role in Facility	
1.9 Role in eLMIS	
1.20 Experience (years)	

PART TWO: Public Health Facilities implementing eLMIS for Anti-TB Commodities

No.	**Questions**	**Response (Yes/No)**	**Comments**
2.1	Is there an established eLMIS system in place at this public health facility?		
2.2	Are anti-TB commodities currently managed through the eLMIS?		
2.3	Are there trained personnel responsible for utilizing the eLMIS for anti-TB commodities?		
2.4	Has the implementation of the eLMIS system continues as efficiency in managing anti-TB commodities?		
2.5	Are there persisting challenges, any has been encountered in the implementation of the eLMIS for anti-TB commodities?		

2.6 If eLMIS has been implemented please provide response to the following

	Response
2.6.1 Currently using eLMIS?	
2.6.2 Date of eLMIS Implementation	
2.6.3 Frequency of eLMIS Usage	Daily / Weekly / Monthly
2.6.4 User Feedback on eLMIS	Positive / Negative / Neutral
2.6.5 Issues Encountered during Usage	
2.6.6 Accuracy of Data Entered into eLMIS	
2.6.7 Data Validation Measures Implemented	
2.6.8 Data Security and Confidentiality Measures	
2.8.9 Current prevailing challenges:	

PART THREE: The availability of anti-TB commodities at public health facilities that are using eLMIS.

a. Anti-TB commodity, Stock Status, and Order Filling as per eLMIS records

SN	Item	Currently in stock	Stock out within 12 months	No. of stock out within 12 months	Stocked per plan	Orders received in correct quantities	Orders received with correct items
	Code	**0 No 1 Yes**	**0 No 1 Yes**		**0 No 1 Yes**	**0 No 1 Yes**	**0 No 1 Yes**
Pharmacy Items							
3.1	INH100mg						
3.2	E100mg						
3.3	E400mg						
3.4	Z500mg						
3.5	(R75H50) mg						
3.6	(R150H75) mg						
3.7	(R75H50Z150) mg						
3.8	(R150H75Z400 E275) mg						
Lab items							
3.9	LED Microscope						
3.10	Frosted end microscope slide						
3.11	Wooden applicator						
3.12	Filter paper						
3.13	1% carbon fuchsin						
3.14	Oil immersion 1						
3.15	% Auramine O in alcohol						
3.16	Phenolic solution for Auramine						

3.17	0.5% or 3% acid alcohol solution						
3.18	0.3% or 0.1% methylene blue						
3.19	Falcon tube						
3.20	Gene Xpert MTB/RIF						

b. Status

Questions/checklist items	**Response (Yes/No)**	**Frequency/Details**
Are there any instances of stockouts or shortages of anti-TB commodities reported by facilities using eLMIS?		
What mechanisms are in place to monitor and address stockouts or shortages within the eLMIS framework?		
Has the eLMIS contributed to timely and accurate reporting of anti-TB commodity levels?		
Are there differences in the availability of anti-TB commodities between facilities utilizing eLMIS and not?		
What feedback mechanisms exist for facilities to communicate issues related to the availability of anti-TB commodities through eLMIS?		

Appendix IV: Data Abstraction Form (Kiswahili)

FOMU YA KUCHUKUWA DATA

SEHEMU YA KWANZA: Taarifa za kituo:

a. Taarifa za Kituo:

Namba	**Kipengele/swali**	**Jibu**
1.1	Jina la Kituo	
1.2	Aina ya Kituo	
1.3	Eneo (Wilaya/Mkoa)	
1.4	Hali ya Utekelezaji wa eLMIS	Imetekelezwa / Haijatekelezwa
1.5	Hali ya Mafunzo, idadi ya Wahudumu wa Afya walioshiriki mafunzo ya eLMIS	

b. Taarifa za Mpokeaji:

Nambari	**Kitu**	**Majibu**
1.6	Umri	
1.7	Jinsia	Me/Ke
1.8	Jukumu/Nafasi yako kazini	
1.9	Jukumu lako katika kutumia eLMIS	
1.20	Uzoefu (miaka)	

SEHEMU YA PILI: **Vituo vya Afya vya Umma vinavyotumia eLMIS kwa Bidhaa za Kifua Kikuu**

Hapana.	**Swali**	**Jibu (Ndiyo/Hapana)**	**Maoni**
2.1	Je, kuna mfumo wa eLMIS uliowekwa katika kituo hiki cha afya cha umma?		
2.2	Je, bidhaa za kupambana na kifua kikuu zinasimamiwa kupitia eLMIS kwa sasa?		
2.3	Je, kuna wafanyakazi waliofundishwa wanaowajibika kutumia eLMIS kwa bidhaa za kupambana na kifua kikuu?		
2.4	Je, utekelezaji wa mfumo wa eLMIS unaendelea kama njia ya ufanisi katika kusimamia bidhaa za kupambana na kifua kikuu?		
2.5	Je, kuna changamoto zozote zile ambazo mmekuwa mkikutana nazo katika utekelezaji wa eLMIS kwa bidhaa za kupambana na kifua kikuu?		

2.6 Ikiwa eLMIS imetekelezwa, tafadhali toa majibu kwa yafuatayo

Namba	**Swali**	**Majibu**
2.6.1	Je, Unatumia eLMIS kwa sasa?	
2.6.2	Je kituo kimeanza lini kutumia mfumo wa eLMIS?	
2.6.3	Je Unatumia eLMIS mara ngapi?	Kila siku / kila wiki / kila mwezi
2.6.4	Maoni ya Mtumiaji kuhusu eLMIS	Chanya / Hasi /Wastani
2.6.5	Je kuna matatizo yoyote uliokutana nayo wakati wa Matumizi ya mfumo huu?	
2.6.6	Je data zinaingizwa kwa usahihi katika eLMIS?	
2.6.7	Je Hatua za Kuthibitisha Data Zilizotekelezwa unafanyika?	
2.6.8	Je Hatua za Usalama na Usiri wa utunzwaji wa Data unafuatwa?	
2.8.9	Je unaweza kunielezea Changamoto Zinazojitokeza hivi sasa kuhusu huu mfumo wa eLMIS?.	

SEHEMU YA TATU: **Upatikanaji wa dawa na vifaa tiba vya kupamban a na Kifua Kikuu, idadi na ujazaji wa uagizaji kulingana na rekodi za eLMIS**.

a. Bidhaa za Kifua Kikuu, Hali ya Hisa, na Utoaji Amri kulingana na rekodi za eLMIS

Namba	Vifaa tiba	Zipo kwa sasa?	Ziliisha ndani ya miezi 12?	Zimeisha mara ngapi ndani ya miezi 12	Inapatikana kwa mpango?	Oda imepokelewa ikiwa na bidhaa Sahihi?	Oda imepokelewa ikiwa na kiasi Sahihi cha bidhaa?
	Code	**0 Hapana 1 Ndiyo**	**0 Hapana 1 Ndiyo**		**0 Hapana 1 Ndiyo**	**0 Hapana 1 Ndiyo**	**0 Hapana 1 Ndiyo**
Dawa							
3.1	INH100mg						
3.2	E100mg						
3.3	E400mg						
3.4	Z500mg						
3.5	(R75H50) mg						
3.6	(R150H75) mg						
3.7	(R75H50Z150) mg						
3.8	(R150H75Z400E275) mg						
Vifaa Tiba na Vitendanishi							
3.9	LED Microscope						
3.10	Frosted end microscope slide						
3.11	Wooden applicator						
3.12	Filter paper						
3.13	1% carbon fuchsin						
3.14	Oil immersion 1						
3.15	% Auramine O in alcohol						

3.16	Phenolic solution for Auramine						
3.17	0.5% or 3% acid alcohol solution						
3.18	0.3% or 0.1% methylene blue						
3.19	Falcon tube						
3.20	Gene Xpert MTB/RIF						

b. Uhalisi wa uwepo/upatikanaji wa vifaa tiba

Swali/Vipengele vya ukaguzi	**Jibu (Ndiyo/Hapana)**	**Mara ngapi/Ufafanuzi**
Je, kuna taarifa yoyote ya kutokuwepo kwa bidhaa za kupambana na TB au upungufu ulioripotiwa na vituo vinavyotumia eLMIS?		
Je kuna mbinu zozote zilizopo za kufuatilia na kushughulikia upungufu au kutokuwepo kwa bidhaa za kupambana na TB ndani ya mfumo wa eLMIS?		
Je, eLMIS imechangia kuripoti kwa wakati na kwa usahihi viwango vya bidhaa za kupambana na TB?		
Je, kuna tofauti katika upatikanaji wa bidhaa za kupambana na TB kati ya vituo vinavyotumia eLMIS na vile visivyotumia?		
Ni njia gani za mrejesho zinazotumika vituoni kuwasiliana kwenye masuala yanayohusiana na upatikanaji wa bidhaa za kupambana na TB kupitia eLMIS?		

c. Ufuatiliaji wa vifaa tiba:

Swali	**Majibu**
Je orodha ya bidhaa za kifua kikuu zinazofuatiliwa zimo kwenye eLMIS?	
Hali ya Stock	Vya kutosha / Havitoshi / Vimeisha
Je bidhaa zinaagizwa kwenye mfumo kila baada ya muda gani?	

d. Mchakato wa Kuagiza na Utoaji:

Swali	**Majibu**
Je Mchakato wa Kuagiza Bidhaa za Kifua Kikuu unafanyika kupitia eLMIS?	
Je muda kiasi gani hutumika kutoka Kuweka Agizo hadi kufika wa bidhaa?	
Je kuna Vizuizi vyovyote katika Mchakato wa uagizaji bidhaa?	

e. Uhusiano wa data katika mfumo wa eLMIS na mingine:

Swali	**Majibu**
Je utaratibu wa uagizwaji bidhaa za kifua kikuu unafanyika kupitia mfumo wa eLMIS?	
Je kuna tofauti yeyote iliopo kati ya Data ya eLMIS na za mifumo mingine?	
Je kuna hatua zozote zilizochukuliwa kurekebisha tofauti hizo? Hatua zilizochukuliwa kusuluhisha Tofauti	

f. Ufuatiliaji na Kuripoti:

Swali	**Majibu**
Je utaratibu wa kufuatilia Bidhaa za Kifua Kikuu hufanyika mara ngapi?	
Je utaratibu wa Kuripoti kwa Viwango vya bidhaa zilizopo hufanyika mara ngapi?	
Je kuna hatua zozote hatua zozote zilizowahi kuchukuliwa kulingana na Ripoti za Ufuatiliaji wa bidhaa za kupambana na kifua kikuu?	

g. Maoni/Maelezo Zaidi**:**

Je kuna maelezo yoyote ya ziada unayoona kuwa yanafaa katika utafiti huu
Je una Mapendekezo yoyote ya Kuboresha kwenye mfumo huu au utafiti huu kwa ujumla?

Appendix V: Interviewer Guide (English)

IDI Guided questions on factors affecting the uptake of eLMIS for anti-TB commodities at public Health facilities in the Kilimanjaro region

Introduction:

Thank you for participating in this important study that aims to explore the factors affecting the uptake of eLMIS for anti-TB commodities at public Health facilities in the Kilimanjaro region. Your insights will contribute to the understanding of eLMIS implementation impacted on anti-TB commodities at the study sites. This interview will take approximately 30-45 minutes and will be recorded with your permission. Your identity will be kept confidential throughout the study.

1. **Background:**

a. Can you provide an overview of your role and responsibilities in the context of anti-TB commodity management at the public health facility?

b. How long have you been involved in utilizing the Electronic Logistic Management Information System (eLMIS) for anti-TB commodities?

2. **System Familiarity and Training:**

a. How comfortable and familiar are you with the features and functionalities of the eLMIS?

Probing: Can you identify any specific aspects of the eLMIS that users found challenging or confusing?

3. **Perceived Benefits:**

a. From your perspective, what are the key benefits of using the eLMIS for managing anti-TB commodities?

b. How has the eLMIS improved the efficiency of commodity management compared to the previous manual system?

Probe questions

. Can you provide specific examples or instances where the eLMIS has resulted in positive outcomes?

. Have there been any unanticipated benefits or challenges associated with the use of eLMIS?

4. **Barriers to Uptake:**

Focusing on there any specific factors at the individual, organizational, or system level that hinder the optimal utilization of the eLMIS

Technical issues

a. Can you share any challenges or difficulties encountered while using the eLMIS system?

b. In your opinion, are there specific features of the eLMIS that contribute to its ease or difficulty of use?

c. How well is the eLMIS integrated with other existing health information systems in your facility?

Probe: Have there been any instances of data inconsistencies or integration challenges between the eLMIS and other systems?

d. From your perspective, how user-friendly is the eLMIS in your daily work?

Probe: Are there any specific aspects of the eLMIS that you find particularly user-friendly or challenging?

. Are there any concerns about data security or privacy that have been raised by users?

Organizational:

b. What type of training did you receive before using the eLMIS, and how effective was it in preparing you for its implementation? Probing: Have there been any refresher training sessions since the initial implementation? What type of training have you received regarding the use of the eLMIS for anti-TB commodity management?

c. Can you describe any challenges or successes related to supervision in the context of eLMIS utilization?

d. Please elaborate on any specific challenges related to infrastructure that have had a noticeable impact on the use of the eLMIS?

e. Please share with me any infrastructure-related challenges hindering the optimal use of the eLMIS? Probe: electronic devices? network or internet issues?

Behavioral:

a. How would you rate your knowledge and skills or healthcare staff in your facility regarding the use of the eLMIS?

Probe: any knowledge/skills issues that affected the effectiveness of the eLMIS? ICT literacy among healthcare staff impact the adoption and use of the eLMIS?

b. What are the prevailing perceptions and attitudes among healthcare staff regarding the eLMIS for managing anti-TB commodities?

5. **User Feedback and Suggestions:**

a. Can you share any feedback received/heard from users about their experiences with the eLMIS?

b. What suggestions or recommendations do you have, or have you received, for improving the eLMIS and its implementation? • i. How actively are users involved in providing feedback, and what mechanisms are in place for continuous improvement?

• ii. Are there any plans for updates or enhancements to the eLMIS based on user feedback? Please elaborate if any

6. **Recommendations for Improvement:**

a. Based on your experience, what recommendations do you have for improving the effective uptake of the eLMIS for anti-TB commodities?

b. How can the system be enhanced to better meet the needs of public health facilities in the Kilimanjaro region?

7. **Future Outlook:**

a. What changes or developments do you foresee in the utilization of eLMIS for anti-TB commodities in the future?

b. Are there any emerging technologies or strategies that could further enhance the management of anti-TB commodities?

Appendix VI: Interviewer Guide (Kiswahili)

Mwongozo wa Maswali Kuhusu Mambo Yanayoathiri Kukubalika kwa eLMIS katika kuratibu TB katika taasisi za Afya za Umma katika Mkoa wa Kilimanjaro.

Utangulizi:
Asante kwa kushiriki katika utafiti muhimu unaolenga kuchunguza mambo yanayoathiri kukubalika kwa eLMIS kwa bidhaa za kupambana na TB katika Vituo vya Afya vya Umma katika Mkoa wa Kilimanjaro. Mchango wako utachangia uelewa wa utekelezaji wa eLMIS unaowaathiri bidhaa za kupambana na TB katika maeneo ya utafiti. Mahojiano haya yatakuchukua kama dakika 30-45 na yatarekodiwa kwa idhini yako. Utambulisho wako utabaki kuwa siri kamili wakati wa utafiti.

1. Historia:
a. Je, unaweza kutoa muhtasari wa jukumu lako na majukumu yako katika muktadha wa usimamizi wa bidhaa za kupambana na TB katika kituo cha afya cha umma?
b. Umehusika kwa muda gani katika kutumia Mfumo wa Usimamizi wa Logistiki eLMIS kwa bidhaa za kupambana na TB?

2. Ufahamu na Mafunzo ya Mfumo:
a. Uko vizuri kiasi gani na unafahamu vipengele na utendaji wa eLMIS?
b. Je, unaweza kutambua vipengele maalum vya eLMIS ambavyo watumiaji wanakutana navyo kama changamoto au kuchanganyikiwa?

3. Manufaa Yanaonekana:
a. Kutoka kwa mtazamo wako, ni faida gani kuu za kutumia eLMIS katika usimamizi wa bidhaa za kupambana na TB?
b. Vipi eLMIS imeboresha ufanisi wa usimamizi wa bidhaa ikilinganishwa na mfumo wa mwanzo wa mwongozo? Maswali ya Kupenyeza: Je, unaweza kutoa mifano au matukio maalum ambapo eLMIS imesababisha matokeo chanya? Je, kumekuwa na faida au changamoto zisizotarajiwa zinazohusiana na matumizi ya eLMIS?

4. Vizuizi au changamoto:
Kuzingatia vipengele maalum kwenye ngazi ya mtu binafsi, shirika, au mfumo unaokwamisha matumizi bora ya eLMIS.

Sababu za kiteknoloji/ufanisi wa mfumo eLMIS:
a. Je, unaweza kushiriki changamoto au matatizo yoyote uliyokutana nayo wakati wa kutumia mfumo wa eLMIS?
b. Kwa maoni yako, je, kuna vipengele maalum vya eLMIS vinavyochangia urahisi au ugumu wa matumizi?
c. Je, eLMIS inaunganishwaje vizuri na mifumo mingine ya habari ya afya iliyopo katika kituo chako? Kupenyeza: Je, kumekuwa na hali yoyote ya kutofautiana kwa data au changamoto za kuunganisha kati ya eLMIS na mifumo mingine?

d. Kutoka kwa mtazamo wako, je, eLMIS inavyofaa kwa mtumiaji katika kazi yako ya kila siku? Kupenyeza: Je, kuna vipengele maalum vya eLMIS unavyoona ni rahisi au changamoto kutumia? Je,
kuna wasiwasi wowote kuhusu usalama wa data kwa watumiaji?

Sababu za kiusimamizi/taasisi:
a. Aina gani ya mafunzo uliyopata kabla ya kutumia eLMIS, na ni kwa kiasi gani ilikuwa na ufanisi katika kukufanya uwe tayari kwa utekelezaji wake? Kupenyeza: Je, kumekuwa na vikao vya mafunzo tena tangu kuanzishwa kwa awali? Ni aina gani ya mafunzo umepokea kuhusu matumizi ya eLMIS katika usimamizi wa bidhaa za kupambana na TB?
b. Je, unaweza kuelezea changamoto au mafanikio yoyote yanayohusiana na usimamizi katika muktadha wa matumizi ya eLMIS? c. Tafadhali eleza changamoto maalum zinazohusiana na miundombinu ambayo imekuwa na athari inayojulikana kwenye matumizi ya eLMIS? d. Tafadhali shiriki nami changamoto zozote zinazohusiana na miundombinu inayokwamisha matumizi bora ya eLMIS? Kupenyeza: vifaa vya umeme? maswala ya mtandao au intaneti?

Sababu binafsi:
a. Unaweka kiwango gani cha maarifa na ujuzi au wafanyakazi wa afya katika kituo chako kuhusu matumizi ya eLMIS? Kupenyeza: Je, kuna masuala yoyote ya maarifa/uwezo yaliyoathiri ufanisi wa eLMIS? Je, usoma wa habari za habari za ICT kati ya wafanyakazi wa afya una athari kwa ushiriki na matumizi ya eLMIS? b. Ni mtazamo na mitazamo gani inayopatikana kati ya wafanyakazi wa afya kuhusu eLMIS katika usimamizi wa bidhaa za kupambana na TB?

5. Maoni na Mapendekezo ya Mtumiaji:
a. Je, unaweza kushiriki maoni uliyopokea/ulisikia kutoka kwa watumiaji kuhusu uzoefu wao na eLMIS? b. Ni mapendekezo gani au maoni unayo au umepokea kwa ajili ya kuboresha eLMIS na utekelezaji wake?
i. Je, watumiaji wanashiriki kwa aktivi katika kutoa maoni, na ni njia gani zilizowekwa kwa ajili ya kuboresha endelevu?
ii. Je, kuna mipango ya kusasisha au kuboresha eLMIS kulingana na maoni ya watumiaji? Tafadhali eleza kama ipo.

6. Mapendekezo ya Kuboresha:
a. Kulingana na uzoefu wako, unatoa mapendekezo gani ya kuboresha kukubalika kwa eLMIS kwa bidhaa za kupambana na TB?
b. Jinsi gani mfumo unaweza kuboreshwa ili kukidhi vyema mahitaji ya vituo vya afya vya umma katika Mkoa wa Kilimanjaro?

7. Mtazamo wa Baadaye:
a. Mabadiliko au maendeleo gani unayotarajia katika matumizi ya eLMIS kwa bidhaa za kupambana na TB siku zijazo? b. Je, kuna teknolojia au mikakati inayojitokeza inayoweza kuimarisha zaidi usimamizi wa bidhaa za kupambana na TB?

Appendix V: Ethical Clearance Approval

UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

OFFICE OF THE DIRECTOR – RESEARCH, PUBLICATIONS AND INNOVATION

Ref. No.DA.282/298/01.C/1898 Date: 08/09/2023

MUHAS-REC-09-2023-1898
SUZANNE MILEMBE NYALAGU
SCHOOL OF PHARMACY
MUHAS

RE: APPROVAL FOR ETHICAL CLEARANCE FOR A STUDY TITLED: UPTAKE OF ELECTRONIC LOGISTIC MANAGEMENT INFORMATION SYSTEM OF ANTI-TUBERCULOSIS COMMODITIES AT PUBLIC HEALTH FACILITIES IN KILIMANJARO REGION TANZANIA

Reference is made to the above heading,

I am pleased to inform you that the Chairman has on behalf of the University Senate, approved ethical clearance of the above-mentioned study, on recommendations of the Senate Research and Publications Committee meeting accordance with MUHAS research policy and Tanzania regulations governing human and animal subjects research.

APPROVAL DATE: 08/09/2023
EXPIRATION DATE OF APPROVAL: 08/09/2024

STUDY DESCRIPTION:
Purpose:
The purpose of this facility based cross-sectional study is to assess the uptake of electronic logistic management information system of anti TB commodities at public health facilities in Kilimanjaro region in Tanzania.

The approved protocol and procedures for this study is attached and stamped with this letter, and can be found in the link provided:
https://irb.muhas.ac.tz/storage/Certificates/Certificate%20-%2014844.pdf and in the MUHAS archives.

The PI is required to:

1. Submit bi-annual progress reports and final report upon completion of the study.
2. Report to the IRB any unanticipated problem involving risks to subjects or others including adverse events where applicable.
3. Apply for renewal of approval of ethical clearance one (1) month prior its expiration if the study is not completed at the end of this ethical approval. You may not continue with any research activity beyond the expiration date without the approval of the IRB. Failure to receive approval for continuation before the expiration date will result in automatic termination of the approval for this study on the expiration date.
4. Obtain IRB amendment (s) approval for any changes to any aspect of this study before they can be implemented.
5. Data security is ultimately the responsibility of the investigator.
6. Apply for and obtain data transfer agreement (DTA) from NIMR if data will be transferred to a foreign country.
7. Apply for and obtain material transfer agreement (MTA) from NIMR, if research materials (samples) will be shipped to a foreign country,
8. Any researcher, who contravenes or fail to comply with these conditions, shall be guilty of an offence and shall be liable on conviction to a fine as per NIMR Act No. 23 of 1979, PART III section 10 (2)
9. The PI is required to ensure that the findings of the study are disseminated to relevant stake holders.
10. PI is required to be versed with necessary laws and regulatory policies that govern research in Tanzania. Some guidance is available on our website https://drp.muhas.ac.tz/.

Dr. Nahya Salim Masoud,
Chairperson, MUHAS Research and Ethics Committee

Muhimbili University of Health and Allied Sciences
DIRECTOR
Research, Publications & Innovations
Box 65001

Appendix VI: Ethical Clearance Approval

JAMHURI YA MUUNGANO WA TANZANIA
OFISI YA RAIS
TAWALA ZA MIKOA NA SERIKALI ZA MITAA

MKOA WA KILIMANJARO
Anwani ya Simu: 'REGCOM' KILIMANJARO
Simu Na. Moshi +255(027)-2754236/7
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Nukushi Na. 027-2753248 na 027-2751381

OFISI YA MKUU WA MKOA,
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S.L.P. 3070,
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Unapojibu tafadhali taja:

Kumb. Na. DC.109/228/01'J'/4

17 Novemba, 2023

Mkurugenzi wa Manispaa,
S.L.P 318,
MOSHI;

Mkurugenzi Mtendaji,
Halmashauri ya:
HAI, ROMBO, MOSHI, MWANGA, SIHA na **SAME;**

Mkurugenzi Mtendaji,
Hospitali ya Rufaa Kanda (KCMC)
S.L.P 3010,
MOSHI;

Mganga Mfawidhi,
Hospitali ya Rufaa Mkoa (Mawenzi)
S.L.P 3054,
MOSHI;

Hospitali Maalumu ya Magonjwa Ambukizi - Kibong'oto (KIDH);
S.L.P *12*
Sanya Juu
SIHA

Yah: **UTAMBULISHO WA UTAFITI UNAOHUSU MATUMIZI YA MFUMO WA TAARIFA ZA USIMAMIZI WA BIDHAA ZA KUTIBU KIFUA KIKUU KATIKA VITUO VYA AFYA VYA UMMA ZILIZOPO NDANI YA MKOA WA KILIMANJARO**

Tafadhali husika na somo tajwa hapo juu.

2. Mwanafunzi **Suzanne Milembe Nyalagu** wa Chuo Kikuu cha Afya na Sayansi Shirikishi Muhimbili amepata kibali cha kufanya utafiti ikiwa ni sehemu *ya* masomo yake.

3. Utafiti wake unalenga kuangalia matumizi ya mfumo wa taarifa za usimamizi wa bidhaa za kutibu Kifua Kikuu katika vituo vya afya vya umma: ***"UPTAKE OF ELECTRONIC LOGISTIC MANAGEMENT INFORMATION SYSTEM OF ANTI-TUBERCULOSIS COMMODITIES AT PUBLIC HEALTH FACILITIES IN KILIMANJARO REGION TANZANIA"***