ASSESSMENT OF THE IMPLEMENTATION PROCESS OF THE ELECTRONIC HEALTH COMMODITY MANAGEMENT INFORMATION SYSTEM IN LUSAKA DISTRICT HEALTH FACILITIES

BY

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GSB19212002

A proposal submitted to the University of Zambia in partial fulfilment of the requirements for the award of the degree of Masters in Business Administration

THE UNIVERSITY OF ZAMBIA

GRADUATE SCHOOL OF BUSINESS

LUSAKA

2023

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DECLARATION

I, Gamariel James Simpungwe, do hereby declare that this piece of work is my own, and that all the work of other persons has been duly acknowledged, and that this work has not been previously presented at this university and indeed other universities for similar purposes.

Signature (Candidate) ..... Date: 4th January 2024

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CERTIFICATE OF APPROVAL

This dissertation by Gamariel James Simpungwe is approved as fulfilling part of the requirement for the award of the degree of Master of Business Administration with the Graduate School of Business, University of Zambia.

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ABSTRACT

Over the past decade, the Ministry of Health (MOH) in Zambia has experienced health commodity inventory management challenges that resulted in stock outs, expiry and pilferage of life-saving medicines. A weak Logistics Management Information System (LMIS) was cited as a major factor causing the inability of Supply Chain (SC) users to make sound data-based SC decisions. An evaluation of the paper-based LMIS attributed the lack of accurate, good-quality data captured and reported at Service Delivery Points (SDPs) to the laborious nature of the paper-based manual processes that required human resources, time and stationery. To address this challenge, the recommendation was to automate the system by implementing the electronic Logistics Management Information System (eLMIS). The eLMIS was envisaged to ease the data capture and reporting processes at SDP leading to an increase in data visibility, access and data-based SC decision making. The SC managers would at the press of a button have readily available supply status updates to aid aversion of stock imbalance and be equipped to plan re-supply. Currently, the facility level eLMIS is rolled out to 51% (1,643/3200) of public health SDPs while the central edition is rolled-out countrywide. While the reporting rates are in the ninetieth percentile, SDPs continue to experience stock imbalances, expiries and instances of pilferage (eLMIS reports, 2023).

A key question: Working on the assumption that the design of the LMIS is ideal, how effective was the rollout process of the eLMIS executed? Otto et. al., (2015) in a discussion paper focused on Africa, explains the five pillars of health systems noted to have a direct impact on the success of ICT innovation implementation in Africa. These foundational elements are infrastructure, governance, healthcare financing, supply chain management, and human resources for health. Building on the five pillars, to successfully establish and scale up an automated LMIS, the critical prerequisites are data and interoperability standards, local capacity, policy and regulatory environments, an appropriate business model, alignment of partnerships and priorities, and monitoring and evaluation. While some prerequisites are cross-cutting, there is a need for further refinement of other prerequisites depending on the specific country context.

This study set out to establish if the implementation process for the eLMIS is yielding the desired system and end-user outcomes. The study evaluated the prerequisites outlined by Otto et. al., (2015) by engaging key stakeholders at all levels of the SC in managing health commodities and supporting implementation. While the findings noted important successful attributes, several significant issues include threats to sustained operations resulting from leadership and policy implementation gaps, limited dissemination of critical information among stakeholders, lack of clarity of roles among eLMIS stakeholders, funding resource challenges, and donor dependence.

DEDICATION

This dissertation is dedicated to my wife and children, for their support and encouragement throughout this education journey. I am grateful for unwavering support when the days were long and the nights cold that you kept the fire burning urging me on to keep working harder.

ACKNOWLEDGEMENTS

I am grateful to the Graduate School of Business for the opportunity to pursue this professional development course that has been of tremendous value to my personal development.

I express my sincere gratitude to Dr. Attridge Mwelwa who has helped me to overcome challenges and given advice on drawing up the dissertation competently. I experienced significant hurdles in securing approval to undertake data collection which drained my core energy and discouraged me. She was on hand to help remain focused.

I acknowledge my wife Veronica Simpungwe for her endless support and faith in me. She has stood by me during my study endeavors and taken care of me when searching for information. I think that my dissertation would have been of poorer quality without her.

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LIST OF ABBREVIATIONS AND ACRONYMS

ARVs	Anti-retroviral drugs
ART	Anti-Retroviral Therapy
EDT	Electronic Dispensing Tool
eLMIS	Electronic Logistics Management Information System
EMRs	Electronic medical records
ERP	Enterprise resource planning
EPI	Expanded Program for Immunisation
FESC	Facility Electronic Stock Control Card
GBD	Global Burden of Disease
HRH	Human Resources for Health
ICT	Information Communication and Technology
ISP	Internet Service Provider
IT	Information Technology
LMIS	Logistics Management Information System
MBA	Master of Business Administration
MDGs	Millennium Development Goals
MOH	Ministry of Health
MOHSS	Ministry of Health and Social Services
SaTP	Sustainability and Transition Plan
SDPs	Service Delivery Points
SC	Supply Chain
SCM	Supply Chain Management
SCMP	Supply Chain Management Portal
SDGs	Sustainable Development Goals
SIAPS	Systems for Improved Access to Pharmaceutical and Services
SMS	Short Messaging Service
TWG	Technical Working Group
TCO	Total Cost of Ownership
UNICEF	United Nations International Children's Emergency Fund
USAID	United States Agency for International Development
USCDC	US Center for Disease Control
WHA	World Health Assembly
WHO	World Health Organisation
ZAMMSA	Zambia Medicines and Medical Supplies Agency

CHAPTER ONE

INTRODUCTION

1.1 Overview

Health commodity availability is an essential part of comprehensive healthcare services. An efficient supply chain (SC) is critical in ensuring an uninterrupted supply of health commodities. A supply chain requires effective maintenance of linkages between financing, forecasting, procurement, warehousing and distribution. These fundamental features require constant coordination using an efficient and effective Logistics Management Information System (LMIS) (WHO, 2020). A well-designed LMIS by function captures logistics data at various levels of the supply chain and reports it into a central repository. The LMIS enables data processing and presentation of tailored information depending on the level of operation in the supply chain (USAID | DELIVER PROJECT, Task Order 4, 2012).

Over the years, the world has experienced increased demand in the range and volume of pharmaceutical products attributed to the increased Global Burden of Disease (GBD) (Murray & Lopez, 2013). Patient-centred supply chains boost confidence in healthcare systems. The beginning and end points of the supply chains for medical and healthcare products are patients. Patient-centred supply chains aim to ensure access to high-quality pharmaceuticals at fair costs when and when they need them. Supply chain operations require understanding consumer product consumption trends, trends in patient disease, and how or where patients use healthcare services. For this, investments in the expansion of information management capabilities are necessary. By understanding market expectations, just like any business would, users of supply chains will be able to more effectively target their investments, reduce waste, and ultimately better serve the needs of their patients and consumers. The operational components of a health logistics system include picking the right products, planning and buying them, and warehousing, storage, and distribution. These elements must be supported by financial management, supervision, and human resources. Effective coordination between the components prevents supply delays that could impede patients' access to vital drugs, vaccinations, and clinical therapies that could save their lives. Information management has an impact on operational decision-making, planning, and resource allocation in a supply chain.

Increased complexity of health commodity management using a laborious and time-consuming paper-based LMIS is compounded by challenges in availability of supply chain skilled staff. A key intervention to address this supply chain inefficiency has been the automation of the paper-based LMIS tools (Lessa, et al., 2015). Innovations significantly influence how development challenges are handled. Innovations in developed countries are seemingly easier to implement because they have readily available skilled human resources, IT infrastructure, financial resources etc. These innovations developed for high-income country settings cannot be directly transferred to low- or middle-income countries. They require adaptation to suit such environments otherwise they would yield poor performance results due to inadequacies such as infrastructure, unskilled staff etc.

Increased communication capability using fibre optic and cellular networks has created the potential to support the automation of supply chain information systems in many low-income nations. At all stages of the supply chain, digital technology innovation streamlines the collecting and reporting of logistical data (United Nations Conference On Trade and Development, 2021). Electronic systems increase efficiency in data management of large volumes, quality and visibility. This processed data has also enabled program managers to identify healthcare financing, governance, human resource, service delivery and infrastructure needs (USAID | DELIVER PROJECT, Task Order 4, 2012; Otto, et al., 2015).

At service delivery points (SDPs), LMIS are mostly on paper. Electronic technologies, such as Excel spreadsheets and online information systems, have largely superseded paper-based reports. Cellular Short Messaging Service (SMS) is being used by several country programs to report essential data items from the SDP.

While the benefits of electronic systems are generally acknowledged across all sectors of the economy, implementation presents significant challenges which pose a high risk of failure. Digitization benefits and desired outcomes can only be fully realized if implementation processes are guided (DELIVER, 2006). Countries implementing these technologies have had important experiences of failures and accomplishments with useful learning outcomes. Among the notably obvious threats, are poor implementation strategy, high attrition of trained staff leading to a knowledge gap, inadequate funding for infrastructure development, Information Technology (IT) deployment, system rollout and maintenance, political will, strong leadership and governance, and end-user buy-in are some of the common critical challenges, especially in low-income countries (Campbell, et al., 2009; Tamirat, 2018).

These experiences have raised awareness of the need for adequately skilled human resources, standard operating procedures, and funding for implementation and maintenance among other requirements to ensure efficiently sustained operations of the electronic system. Inventory and data management policies, reporting, and ordering processes are key basic requirements in the design of the electronic LMIS architecture. As part of supporting the sustainability goal, the LMIS must make use of technology that is both simple to set up and maintain appropriate to the environment and acceptable to users at all levels (Wright, et al., n.d.).

1.2 Background

In the recent past, the Ministry of Health (MOH) in Zambia experienced high levels of expiries and stock outs for health commodities. This was attributed to weak supply chain management that prompted MOH with assistance from cooperating partners to undertake the redesign and rollout of the national logistics system in 2006 beginning with the Anti-retroviral medicine logistics system.

The standardized paper-based logistics system was designed to ensure accurate data is recorded at the SDP level and reported on a regular basis to ensure data-driven supply chain decisions result in health commodity availability at the right time, place, quantity and quality. This system required health facility staff to manually calculate reorder quantities, using logistic data captured at the respective facility, print and mail hard copy reports to Zambia Medicines and Medical Supplies Agency (ZAMMSA). The reports are submitted monthly as was the resupply

of medicines and medical supplies. Manual/ paper-based systems are most often the starting point for resource-limited environments albeit the challenge of managing large volumes of data which may be a laborious and time-consuming process. To improve efficiency in the LMIS by reducing human error and relieving the staff of manual workload for an already constrained human resource, MOH with support from cooperating partners initiated the conversion of the paper-based business process into an electronic Logistics Management Information system (eLMIS) with added enhancements. Using the eLMIS, data from the electronically transmitted health facility reports deposited centrally is used to determine the individual facility re-order quantities using an inbuilt algorithm. ZAMMSA then picks, packs and delivers commodities based on the system output.

Figure 1. 1 Benefits of MOH-eLMIS. Source USAID eSCMIS PROJECT. https://publications.jsi.com/JSIInternet/Inc/Common/_download_pub.cfm?id=16475&lid=3

Figure 1 above illustrates the major benefits of an electronic LMIS. A significant advantage for resource-limited environments is that health facilities would not need to buy stationary to print, hand-record and transmit logistics information to the next level for consideration. The logistics data captured as they attend to patients is used to calculate reorder quantity by the system using an automated algorithm. The reduced human interface in data management reduces the chances of error which increases data quality. Automation allows for the visibility of facility-level stock status by supervisors which in turn increases accountability. Since data is keyed in using preset descriptions, data entry is easier and allows for the user to attend to other duties. The data in the system could be used for further analysis to determine the supply chain performance of a facility, district, province, region or country as a whole. This information can be used to make future supply chain decisions. Automated systems can also be engineered to use data from other systems for supply chain management analytics.

MOH with support from partners deployed the eLMIS in 23% (664/2,878) of health facilities nationwide by the end of 2019 (Strengthening High Impact Interventions for an AIDS-free Generation (AIDSFree) Project, 2018). The system evaluation results showed improved data visibility across the supply chain, high reporting rates, good data quality and high order processing rates (Strengthening High Impact Interventions for an AIDS-free Generation

(AIDSFree) Project, 2018). These improvements are comparable to outcomes obtained following eLMIS deployed in Ethiopia where supervisors are able to access real-time stock inventory and improved product traceability at all levels for decision-making. As at September 2023, eLMIS was deployed in 1,643 facilities representing approximately 51% national coverage. Figure 2 below shows the distribution of eLMIS deployment throughout the country. The facilities deployed include all high patient volume sites such as hospital levels 1-4 and large health centres. The MOH with support from USAID has continued to roll out to meet the 1,800 facility target. Currently, MOH has received any funding commitment to deploy to the balance of health facilities estimated to be approximately 1,600.

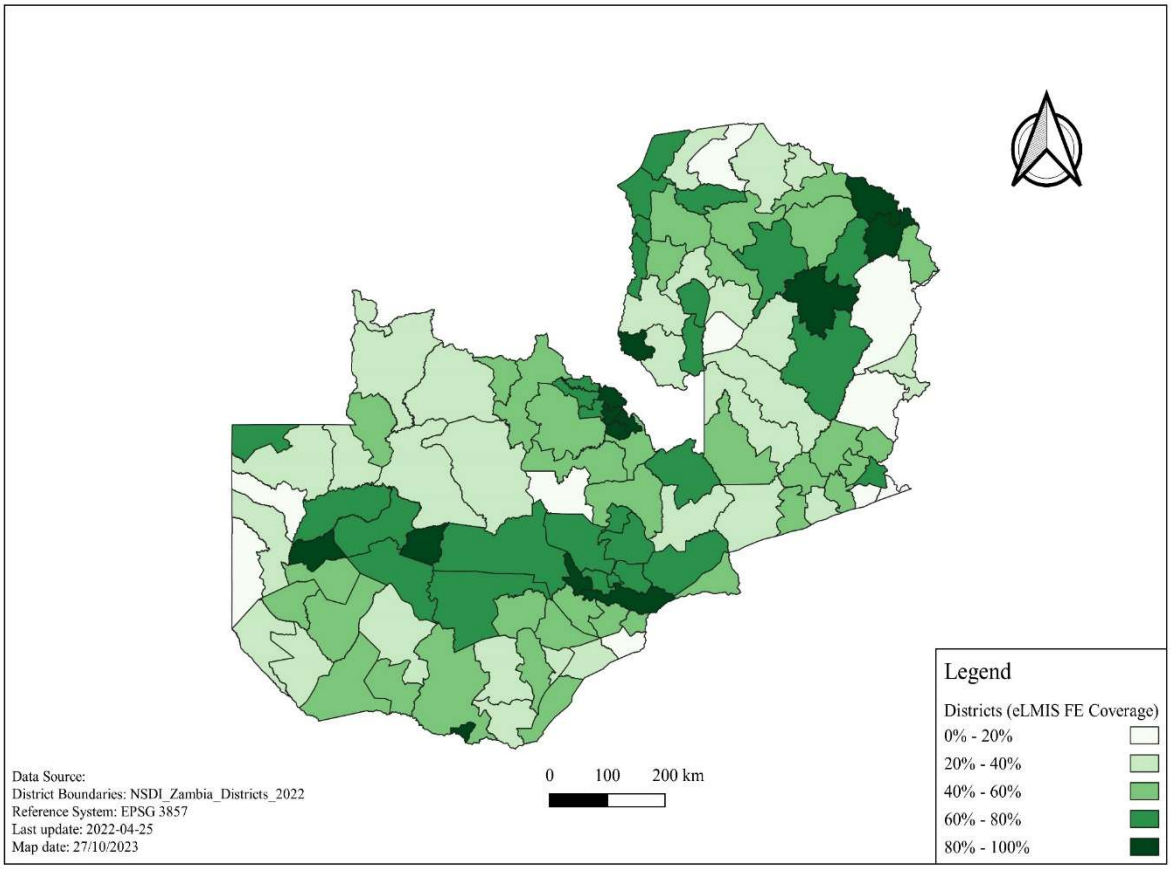

Figure 1. 2 Facilities deployed with eLMIS Facility Edition as of 30th September 2023. (Source USAID eSCMIS Project)

The e-health policy must be in place to guide data management and use (Otto, et al., 2015). Broadly, deployment of the automated system begins with Software development involving the end user to ensure all their desired enhancements are incorporated into the system to make their work easier. The infrastructure into which the Software is deployed is very pivotal. Available Information Communication and Technology (ICT) infrastructure such as hardware and networking, will have a bearing on the investment required to bring the facility up to a minimum level for deployment. In other words, the less infrastructure available the more capital investments are required.

Figure 3 below shows a concept of how the various critical supply chain elements integrate into the logistics management information system to facilitate decision-making. In this framework, the eLMIS is dependent on precursor interventions under program inputs. These will determine the needs for technology, human resources and end-users to process commodities through the system. These are directly influenced by economic, political, legal, technical, socio-cultural, competition, and demographic factors. To ensure impactful supply chain outcomes are achieved, sustainable operations for critical events must be optimized throughout the framework processes.

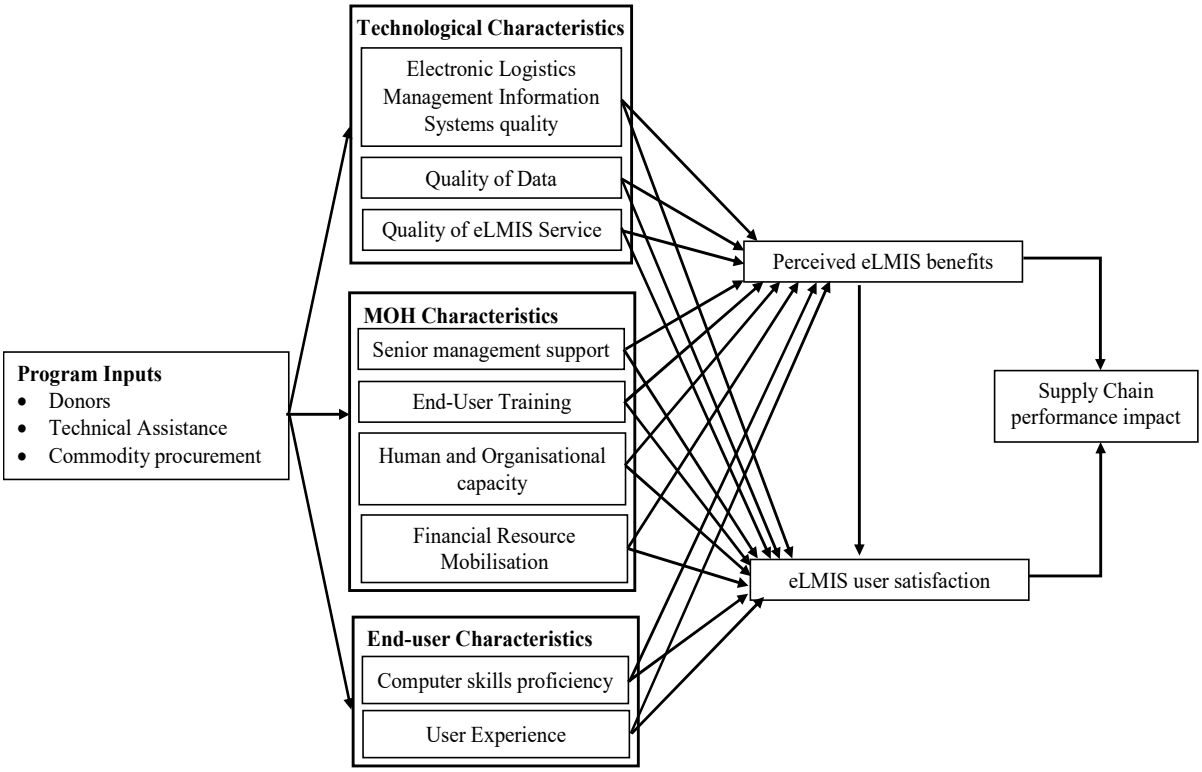

Figure 1.3 Conceptual framework - Illustration of relationships between key variables in the eLMIS implementation process

Currently, implementation of the eLMIS is dependent on donors and implementing partners for funding and provision of health commodities especially ARVs, HIV Test kits and reproductive health commodities. As seen in Figure 1.3 above, the interventions are implemented into the MOH national supply chain system targeting operations, governance and end-users as a deliberate system-strengthened approach which also considers sustainability beyond the available donor. TA support through the USAID-funded implementing project provides software programming and enhancements, hardware procurement and installation, and supply chain technical support. The project also works with MOH to provide technical supportive supervision during facility-level system deployment and after-service support using a hotline managed by the project. The staff routinely examine the data quality on the system to ensure conformity to set standards and institute interventions as needed to address data quality issues.

MOH senior management is responsible for the provision of leadership through a policy framework. They are expected to also the lead in mobilisation of resources from partners. MOH

plays an active role by authorizing staff to travel and be hands-on involved in eLMIS deployment. End-user computer proficiency varies among staff. Basic computer skills training is administered where needed for the users so they are able to use the eLMIS which is designed to be an intuitive application. All these interventions have a direct impact on user perception and satisfaction. And ultimately supply chain performance. If the users consider the system complex, not user-friendly, and lacking support, then it is likely that they will revert back to the paper-based system. The inverse holds.

An automated system is only as good as its users. It is important to consider the potential limitations and challenges of an automated system. Available skilled human resources in ICT are key in deployment, maintenance and periodic upgrades to remain cutting edge. The end-users themselves need basic IT skills to efficiently use the system and possibly address tier-1 issues. This skill set limits system operational downtime. These prerequisites require adequate funding to ensure a successfully implemented eLMIS. which is a major challenge in resource-limited environments. Public sector funding is highly contested by different sectors of the economy (Campbell, et al., 2009). Funding for interventions perceived not to be directly related to the provision of healthcare services to the patient may often be underfunded especially in situations where supply chain-ICT leads are not part of the budget and planning committees to advocate for funding support (Kayikci, 2018).

Other critical factors with a bearing on the implementation of electronic systems are the presence of committed leadership and political will from the government to provide advocacy and ownership of the system; the right attitude to ensure the system is optimized to derive its full potential; change management to carefully reorient users to accept, appreciate and develop data use culture for decision making (Baker & Halim, 2007).

Middle to low-income countries have limited funding resources which is exacerbated by the ever-decreasing support from donors. Reduced funding has a direct influence on the choice between adopting a proprietary electronic software which requires annual licensing fees and carries additional costs for adaptation to suit country-specific user requirements or opting for an open-source platform which may not have cutting-edge advanced features as the proprietary version (Kayikci, 2018). Sub-Saharan African countries such as Namibia, Tanzania and Zambia have opted for free, open source software platforms which are then enhanced to meet individual country needs (USAID | DELIVER PROJECT, Task Order 4b, 2012). These countries have leveraged the already existing mature paper-based LMIS to build electronic systems. This is particularly important in that minimal disruptions of the paper-based business process occur. This ultimately reduces the cost of training or orientation of end users at the operational level (Mabirizi, et al., 2018).

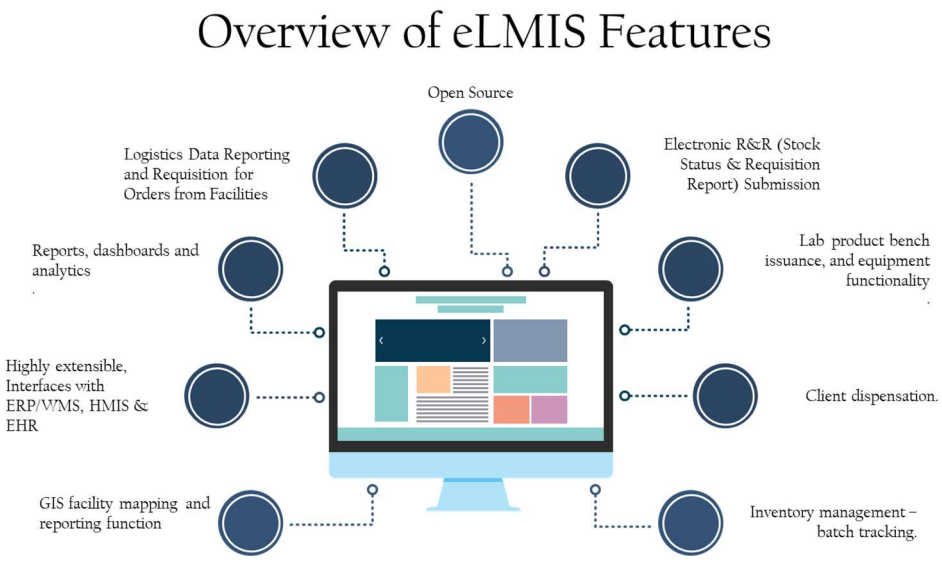

Figure 1. 4 MOH eLMIS design features. Source USAID eSCMIS Project

A significant feature of the eLMIS is essentially that it is an open source code which means it is non-proprietary. MOH does not pay license fees and can make enhancements without being required to make any payments. It is a mimic of the paper-based national logistics system. The paper supply chain forms are replicated in the system. By maintaining the business process MOH reduces the need for re-training as there is essentially not much difference besides automation. Increased stock visibility ensures accountability and targeted supervision as information is available at the click of a button. Commodity trace and tracking features using batch and expiry dates allow for coordinated stock withdrawal, quarantine and reverse logistics in case of product discontinuation. Commodities dispensed can be traced up to the patient.

Post-deployment activities in Zambia included supportive supervision to ensure adequate utilization of the system, staff training, routine maintenance, regular upgrades and repair of Soft- and hardware as recurrent expenditure. These were primarily funded by the donor while MOH provided the human resources in deployment and provision of technical support supervision. Significant investment in end-user training in eLMIS operations continued to be hindered by high attrition rates in the public health sector leading to a brain drain of skilled users. This trend has been observed across African countries implementing eLMIS leading to underutilization, reduced transfer of knowledge through on-job training, poor implementation in the use of data for decision making and loss in investment (Abrar, 2018). Lamers et al., (2017) postulate that in some instances, donor-funded projects are initially implemented using highly skilled individuals from developed countries whose focus is to meet deliverables with or without local participation. Collaboration with local staff to transfer knowledge is the least of their priorities. The transition discussion is only initiated close to the end of the life of the project (Olsson, et al., 2017).

Further consequences of underutilization have been a lack of updated inventory records, incomplete and poor data quality, late and low reporting rates, and the inability of managers to access data in real-time to facilitate decision-making. These weaknesses in the supply chain have resulted in stock outs, overstocks and expiries of medicines and medical supplies in public

health facilities which have subsequently limited the provision of comprehensive healthcare services (Hazemba, 2006).

1.3 Research Aim

This research seeks to determine how the eLMIS implementation strategy adopted by MOH promotes system optimization and long-term sustainability at health facilities in the Lusaka district.

1.4 Research Problem

ICT policy guidance, leadership, infrastructure, funding resources, IT expertise, and end-user human resources are fundamental requirements for implementing a robust eLMIS. Stakeholder involvement in the policy formulation process, dissemination, and education highlighting potential changes in business processes and expected beneficial outcomes is key in ensuring end-user buy-in and realization of the full potential of the system. Without a doubt, a lack of stakeholder involvement will limit the acceptance and utilization of the system. It is imperative that supervisory-level staff spearhead policy implementation by availing necessary information and support in proactively addressing implementation challenges. Data use culture has been a challenge at all levels of the MOH supply chain in Zambia. Data underutilization compounded by poor quality or incompleteness undermines the quality of supply chain decisions. The lack of knowledge and appreciation of the value and importance of good quality data and its impact on data-driven decisions in the supply chain are attributable challenges to be considered in this study. Since 2014, MOH Zambia has generated vast amounts of health logistics data that in its current raw form has had minimal use and application. However, if processed, the outputs in tailored formats can be consumed and enrich supply chain decision-making.

Rollout of an eLMIS requires significant financial investment in ICT Software and hardware infrastructure and capacity building. Other costs are external services like project management, software setup or customization, user testing, data migration, and change management. Recurring expenditures such as ongoing user and system support, data server hosting services, system administration (including security and backup), updates, internet service provision for users, and new user training must be factored into the yearly budgets. To date, the aforementioned costs have been funded solely by the United States Agency for International Development (USAID). MOH's contribution has been the provision of human resources to participate in deployment activities only. This current financing arrangement makes the system vulnerable as there are no signed agreements on co-financing, resource mobilisation from other stakeholders and policy changes within MOH aimed towards taking over full ownership and leadership of the system implementation and operating costs.

Implementation of the system requires full participation and agreement among the end-users, champions, MOH senior management technocrats, and funders. This must be guided by a project charter which is aligned with the national e-health strategy and ICT policies. The first project charter was signed by MOH and stakeholders in 2014. Six years later, the technical

leadership in implementation and maintenance remains with the implementing partner due to limited technical and human resource capacity within MOH. There are no policy changes to facilitate the update of the current human resource structure to include ICT officers focused on eLMIS implementation.

LMIS automation is expected to have alleviated workload challenges with paper-based systems and improved efficiency. Assessment by stakeholders shows unoptimized use of eLMIS, poor data quality, and low use of data for decision-making. These challenges may be attributed to lack of individual skill in the use of computers, increased workload due to duplicate data entry into different electronic tools at facilities, minimal to no MOH supportive supervision, internet connectivity challenges, electricity supply challenges, system downtime, IT equipment failure etc. In the absence of a help desk to obtain information on the benefits of using the eLMIS, training and technical support staff appreciation of the eLMIS is diminished.

1.5 Research Objectives

1. To determine efficiency and effectiveness in the eLMIS implementation process to ensure sustainability
2. To establish end-user understanding and appreciation of their roles and responsibilities in the optimized use of the system
3. To establish the effectiveness of end-user technical and supervisory support mechanisms post-deployment

1.6 Research Questions

The study will address the following specific research questions:

1 What factors impact MOH's ability to roll out eLMIS in a sustained approach countrywide?
2 Is the eLMIS design and implementation process adequately meeting facility-level staff inventory management training and information needs?
3 What challenges limit the optimized use of the system, and access to technical and management support?

1.7 Significance of the study

This study will highlight the important key factors critical for the successful implementation of a sustainable eLMIS in a resource-limited environment. It will elucidate the impact of stakeholder involvement or lack thereof in eLMIS implementation; policy development around resource mobilisation, infrastructural development, strategic human resource planning and skills developed in alignment with new technological development and integration of feasible commercial supply chain principles into the public sector.

1.8 Scope of the study

MOH eLMIS deployment strategy targeted high-volume health facilities nationwide where 80% of all patients on Anti-Retroviral Therapy (ART) are managed. This study focuses only on facilities where eLMIS is deployed and operational within the Lusaka District catchment area.

The study will evaluate the procedures used in the implementation process of the eLMIS in relation to the supply chain operations at the health facility level and MOH headquarters. It will not include an evaluation of the eLMIS architecture. The personnel interviews will target staff who use the eLMIS to manage health commodities regardless of whether they received formal training or on-the-job training. District supervisory level and MOH headquarters staff will be engaged to establish the extent of their overall involvement in eLMIS deployment and maintenance.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

The core of the health-related Sustainable Development Goals (SDGs), universal health coverage, is made possible by the use of digital technologies. The global strategy on digital health 2020-2025 encourages international cooperation and knowledge sharing in digital health by aligning nations and stakeholders to act collectively upon global opportunities to improve health and work toward this goal while addressing challenges, identifying and communicating risks, and focusing on threats associated with this use. Regardless of the circumstances, this purpose promotes action on shared opportunities and challenges that are pertinent to all stakeholders and countries.

Strong health systems are centred on effective health information systems. They support customer satisfaction, health surveillance, client and program management, and information strategy. The implementation of automated logistics management information systems which are seen to be more responsive and effective than paper-based systems has been supported by several funders as part of the effort to improve health information systems. The sustainability of these investments is a major challenge since many donor-driven initiatives rely more on country ownership. The approach encourages countries to own, modify, and strengthen their digital health strategy in a way that best meets their vision, national context, health situation and trends, available resources, and core values. This helps national digital health policies be implemented more effectively. It promotes the creation of a national strategy on digital health through the engagement of all key supply chain stakeholders.

This literature review examines earlier work done in LMIS automation and implementation focusing on prerequisites, procedures, and strategies needed to address possible challenges to achieving successful implementation of an effective, efficient and sustainable public sector eLMIS. This review contrasts Zambia's experience with other countries undertakings to establish common features, challenges and mitigation measures for implementing a sustainable eLMIS.

2.2 Digital Health Strategy

In its 2005 resolution on eHealth, the World Health Assembly (WHA) advised Member States to take into account devising a long-term strategic strategy for developing and implementing eHealth services. Countries would establish the framework for health information and communication technologies, promote fair, affordable, and universal access to their benefits. Countries and stakeholders were urged to concentrate their efforts on creating an action plan to implement the suggested vision, developing a framework for evaluating the implementation and advancement of eHealth, and creating a consistent eHealth vision that is in line with a country's health priorities and resources. At the time of this report, more than 120 Member

States, including low- and middle-income nations had developed action plans and strategies (World Health Assembly, 2005).
The 66th WHA adopted the eHealth standardization and interoperability resolution passed by the Health Assembly in 2013. The Assembly encouraged Member states to consider employing relevant country level policies and legislative mechanisms related to their respective national eHealth plans (World Health Assembly, 2013).
A global strategy on digital health, specifies key sectors which the World Health Organisation (WHO). The strategy was created as a result of a consultation process and includes discussions in online public forums, technical consultations, meetings of the WHO regional committees, and the Executive Board during its 146th session (World Health Assembly, 2018). The seventy-third World Health Assembly approved the worldwide plan on the Global strategy on digital health for 2020–2025, whose goal is empowering patients and realizing the vision of health for all, this global strategy aims to strengthen health systems by using digital health technology for consumers, experts in the medical field, employers, and industry (World Health Assembly, 2020).

The strategy focuses on leadership and governance; investment and operations; services and applications for scaling up; integration and sustainability. It encourages maintenance of data privacy, security, interoperability, digital infrastructure; health workforce; legislation; ethics policies and compliance; and a people-centered approach. Defining principles and coming to cross-sectoral and international agreements for data sharing, the quality and accuracy of health data, and the prioritization of investment plans and policies are all actions that should be taken to strengthen governance. By developing robust and sustainable governance mechanisms and increasing the capacity for digital health on a global and national scale, this strategy seeks to improve the governance of digital health at both the national and international levels. The goal of governance for digital health is to improve the capacities and competencies required for nations to advance, invent, and scale up digital health innovations. The strategic goal encourages the upholding of high standards for data privacy, security, interoperability, and safety both inside and beyond the health industry. Defining principles and coming to cross-sectoral and international agreements for data sharing, the quality and accuracy of health data, and the prioritization of investment plans and policies are all actions that should be taken to strengthen governance. Principles for the moral use of health data in large data analytics and artificial intelligence should also be included.
Additionally, it seeks to advance research on the use of digital health in the healthcare industry as well as measurement and monitoring of it. The research program should take into account the requirement to enhance and share data and knowledge regarding the application of digital health at all levels. To support its safe implementation, to create and encourage accountability, and to justifiably explain the financial investment, research on and assessment of the outcomes and impacts of digital health are crucial. The need to encourage the creation and testing of technologies, processes, and infrastructures that get around barriers to applying digital health to health goals should also be on the table (World Health Organisation, 2021).

2.3 National level Digital Health Strategy

The global strategy encourages countries to make the decision to integrate digital health into their national health systems and commit to doing so. It acknowledges that each country is responsible for its own digital health action plan based on the strategy, within its specific national context. As they work toward the health-related Sustainable Development Goals, nations will implement digital health in a way that is sustainable, respects their sovereignty, and best fits their culture and values, national health policy, vision, goals, needs for health and well-being, and available resources (World Health Organisation, 2021). In so doing, digital health initiatives must have an integrated strategy to be successful. Digital technologies are necessary for and enable universal health coverage and sustainable health systems. To realize their full potential, digital health efforts must be included in the health and digital health ecosystems. They must also be directed by a solid plan that combines technological, organizational, financial, and leadership resources. This plan of action's foundational strategy promotes coordination between numerous parties. These actions should be governed by robust governance structures. The strategy should have a technique that can be used to achieve a variety of health objectives and is backed by standards and an architecture that enables this integration. Despite having the best of intentions, historically poorly integrated or fragmented digital health initiatives sometimes result in vertical or isolated information and communications technology solutions that frequently cause information fragmentation and, as a result, poor service delivery (Mjelva, 2017).

The global plan encourages the responsible use of digital technology as digital public goods that are adaptable to many countries and circumstances to help address significant health system challenges, ensuring that no one is left behind in terms of access to digital resources. It encourages the protection of people, populations, healthcare professionals, and systems from false information and the misuse of information, malicious cyber activities, fraud and exploitation, inappropriate use of health data, racism, and human rights violations within the bounds established by international treaties binding the Member States. The digital determinants of health, including digital learning, equipment accessibility, and internet and internet connectivity, are becoming more and more important as digital health becomes more widely accepted. The global strategy emphasizes the importance of working with all stakeholders and sectors at all levels, as well as the requirement to include digital foundations in national objectives. The global approach encourages syntactic and semantic interoperability with WHO norms and standards as the cornerstone of health information in order to ease information sharing in a networked society (World Health Organisation, 2021).

Recognize the pressing need to address the important challenges that the least developed countries face when using digital health technologies. A suitable enabling environment, sufficient resources, infrastructure to support the digital transformation, education, human capacity, financial investment, and internet connectivity, as well as issues with legacy infrastructure, technology ownership, privacy, security, and other concerns, are major obstacles that developing nations encounter when interacting with and gaining access to new digital health technologies. Although it is vital to acknowledge the creative role that digital

technologies may play in enhancing the health system, it is also crucial to assess their contributing impacts and make sure that such expenditures do not unjustly drain funds from other, non-digital ways.

According to WHO guidelines (2019), the increased interest in digital health has also been accompanied by implementations that have been carried out without a detailed analysis of the body of research on advantages and drawbacks. The excitement for digital health has also led to a profusion of transient initiatives and an overwhelming array of digital technologies, with little knowledge of their effects on healthcare systems and people's well-being. According to the Bellagio eHealth Assessment Group of the WHO, a thorough eHealth evaluation is required to provide evidence and encourage the proper integration and use of technology in order to enhance health and reduce health inequities (WHO, 2019).

Over the last decade, the world has experienced an increase in the global disease burden for both communicable and non-communicable diseases representing ten and twenty-four per cent respectively. North America makes up fourteen percent of the world's population distribution with thirty-seven percent of the world's health professionals compared to sub-Saharan Africa representing about eleven percent of the world's population with only three percent of health professionals (Institute for Health Metrics and Evaluation, 2019). Other health professional disparities are geographic dispersion and skill set. A global shortage of roughly 2.4 million doctors, nurses, and midwives is believed to exist, with thirty-six out of 57 countries experiencing a major lack of health professionals being located in sub-Saharan Africa. In North America and sub-Saharan Africa, respectively, fifty per cent and less than one per cent of the world's financial resources for healthcare are devoted to financing healthcare (World Health Organisation, 2006).

Increased disease burden demands increased quantities of health commodities and added responsibility to manage larger data volumes for use in decision-making. A robust supply chain is capable of adequately responding to meet the increased demand for medicines and medical supplies by facilitating the provision of increased volumes of health commodities in the health system. Seamless commodity movement through the health system is only possible with the use of a logistics management information system to coordinate the exchange of information between supporting activities. The demand for technologies to manage large volumes of logistics data to ensure an uninterrupted supply of health commodities at the last mile has influenced many countries to automate their paper-based logistics management information systems (LMIS) to maintain quality standards throughout the supply chain and achieve desired health outcomes. This analogy is supported by a study undertaken to understand the role and application of IT in managing and curbing e-risks of automated supply chain systems. It highlights the benefits of automated systems including their ability to efficiently capture, organize, store, analyze, transmit and present data to enable streamlined supply chain decisions, increase organizational competitiveness, improve service levels, reduce inventory and lower supply chain expenses (Varma & Khan, 2014). While an efficient eLMIS is considered to be more responsive and effective than a manual laborious paper-based system, the transition process requires careful consideration of the implementation process to ensure sustained

operation. Many programs in African nations are still in the pilot stage and unable to be scaled up due to a number of structural and institutional flaws that are typically not fully addressed. This ultimately leads to inadequate benefits at great cost to donors by way of lost investments in supply chain systems strengthening and institutional constraints (Skoll Foundation, 2013).

The jointly developed guidelines for the selection of an electronic solution for logistics management information systems by GAVI and the Global Fund, general considerations are recommended with a note to take country-specific context into account before arriving at a final decision (The Global Fund, 2019). Prior to making an investment in a digital LMIS, the guidelines advise assessing the country's readiness with an emphasis on the state of the supply chains as they currently stand as well as the reach and reliability of mobile and broadband networks. By having a thorough understanding of the issues and limitations that exist today and what they might be in the next five to ten years, decision-makers can select the optimal LMIS for their needs and capabilities today as well as for the state they want to achieve in the future. To select and implement the LMIS, thorough planning, adequate resources, and careful consideration of several criteria are required. To ensure the LMIS implementation's success, the country must have a fully functional robust supply chain business process in place during automation. All key stakeholders such as health program staff, IT experts, and supply chain users must be available and ready to work collaboratively. This initiative should have unwavering political and financial support from the central government, donors and implementing partners.

One consideration when purchasing an LMIS application is to be aware of the total cost of ownership (TCO), which will also include the licensing or service fees and the outside services necessary for project management, software configuration or customization, support for user testing, data migration, and change management. Projected yearly operating costs for future years should also be included in the TCO. Operating costs cover all ongoing user and system support, hosting services, system administration (including security and backup), upgrades, provision of user hardware and internet access, and ongoing new user training. The TCO should be utilized to generate funding for the initial investments as well as to allocate cash from the national budget for ongoing running expenses because it is essential for sustainability.

To enable more thorough analysis, improved processes, and end-to-end supply chain visibility throughout the health system, digital LMIS should be made interoperable with health information systems to allow deeper analysis and comparisons between program service data and product usage or stock availability. A digital LMIS should, whenever possible, be linked with supplier enterprise resource planning (ERP) software to enable automated ordering and to track the status of order fulfilment as well as program e-registries, electronic medical records (EMRs), or hospital management systems to automatically gather dispensing or utilization data.

Other programs should be involved in defining the requirements so that a single integrated application can be deployed to manage all health products if the Ministry of health is looking to acquire and implement an eLMIS to manage its program's commodities. This strategy avoids unneeded redundancies, allows for cost-sharing between initiatives and economies of scale,

and is simpler to support over the long run. As long as the LMIS supports program- and product-specific data requirements, processes, reports, and other elements, an integrated LMIS does not necessitate the integration of distribution channels for all health products.

An effective approach to secure buy-in is to inform key stakeholder how they will benefit, what their responsibilities will be, when they will be trained, how they will be supported, and how performance will be measured. There should be engaged, committed professionals at every level who can work as change agents among their colleagues and are actively involved in the decision-making process for the new system. There should be user support resources for post-deployment guidance and mentoring, troubleshooting, problem-solving, and other uses. Any new system's TCO should have trustworthy funding in order to take into consideration the long-term investment that change management represents. Furthermore, structures must be put in place and the LMIS should not be stagnant.

Around the world, nations are investigating the frameworks that will best manage digital health and how they may use digital strategies across governments to improve the delivery of healthcare. In order to provide direction in digital health that is both aligned with the Zambian context and associated with the World Health Organization's (WHO) global digital health framework, the Ministry of Health of Zambia produced a third iteration of the National eHealth Strategy. The national infrastructure, the applications and services that are essential to the transformation of healthcare delivery, leadership and governance, investment and sustainability, workforce for digital health, legislation policy & and compliance, standards & and interoperability, and national infrastructure (MOH, 2022).

Through the execution of programs for healthcare interventions, cooperating partners in Zambia promote digital health efforts. Unfortunately, the national budget for the public sector does not currently fund the roadmaps for future growth and development of digital interventions in the healthcare systems. In regards to this, stakeholders have regularly mentioned the need for urgent improvements in sustainability as a critical element that was included in the most recent strategy to ensure the continued and successful implementation of projects even after funding from cooperating partners has stopped.

2.4 Legal framework governing digital health

In Zambia, has a broad set of laws governing the field of digital health, and a number of rules and regulations serve as guides. Although there are numerous laws in place to regulate digital health and guarantee compliance, many of them were just recently passed. As a result, their influence and the widespread implementation of some of their proposals have not yet been fully realized. There are other sections that have not yet been implemented, such as the position of Data Commissioner stipulated by the Data Protection Act, which would require oversight of the data governance for the health sector (MOH, 2022).

The legal provisions include:

The Electronic Government Act of 2021, "An Act to enhance the management and promotion of electronic Government services and processes; establish the Electronic Government

Division in the Office of the President and provide for its powers and functions; facilitate access to electronic Government services to improve service delivery, administrative functions and productivity in order to enhance citizens access to Government services and information; and provide for matters connected with, or incidental, to the foregoing."

The Cyber Security and Cyber Crimes Act No.2 of 2021, "An Act to provide for cyber security in the Republic; provide for the constitution of the Zambia Computer Incidence Response Team and provide for its functions; provide for the constitution of the National Cyber Security Advisory and Coordinating Council and provide for its functions; provide for the continuation of the Central Monitoring and Co-ordination Centre; provide for the protection of persons against cybercrime; provide for child online protection; facilitate identification, declaration and protection of critical information infrastructure; provide for the collection of and preservation of evidence of computer and network related crime; provide for the admission; in criminal matters, of electronic evidence; provide for registration of cyber security service providers; and provide for matters connected with, or incidental to, the foregoing."

The Data Protection – Act No. 3 of 2021, "An Act to provide an effective system for the use and protection of personal data; regulate the collection, use, transmission, storage and otherwise processing of personal data; establish the Office of the Data Protection Commissioner and provide for its functions; the registration of data controllers and licensing of data auditors; provide for the duties of data controllers and data processors; provide for the rights of data subjects; and provide for matters connected with, or incidental to, the foregoing."

Electronic Communications and Transactions Act of 2021, "An Act to provide a safe and effective environment for electronic transactions; promote secure electronic signatures; facilitate electronic filing of documents by public authorities; provide for the use, security, facilitation and regulation of electronic communications and transactions; promote legal certainty and confidence, and encourage investment and innovation in relation to electronic transactions; regulate the National Public Key Infrastructure; repeal and replace the Electronic Communications and Transactions Act, 2009; and provide for matters connected with, or incidental, to the foregoing."

Policy documents which guide the digital health sector include the National Health Policy 2013, Zambia National Health Strategic Plan 2017-2021, and Smart Zambia Electronic Government Master Plan 2018-2030. While these documents provide operational guidance in the digital health space, some legal and policy inadequacies have been noted in interoperability, data hosting, registration requirements for regulated activities, data privacy and governance, medical confidentiality and cyber security, and liability for organizations, users, and consumers of health information systems' data. A draft interoperability framework is currently being developed because of how crucial interoperability is to the delivery of digital health services.

The Digital Health Technical Working Group (TWG), whose goal is to offer technical supervision, advice, coordination, and monitoring of the implementation of Zambia's digital health system, is in charge of managing digital health within a single-tier governance framework.

The National Digital Health Strategy's aims are achieved through the use of information, communication, and technology (ICT), which is developed and managed by the Digital Health TWG. The TWG's main responsibilities include, ensuring that all e-Health Systems used in

health are created, purchased, and managed in accordance with best practices; Best practices are followed in the creation, acquisition, and administration of all e-Health Systems used in the healthcare industry; the TWG is in charge of providing effective governance for digital health initiatives supporting MOH clinical and other activities. This is accomplished through providing leadership and guidance to digital health systems; analyzing the MOH's and partners' digital health initiatives in terms of service delivery, data utilization, and reporting from a scientific and technological standpoint; making recommendations for e-Health evaluation frameworks and methodologies, as well as contributing to a fair assessment of digital health systems and their effects on national economies; and fostering standardization and interoperability in digital health systems.

The Zambian government has adopted the policy intervention of partially zero-rating ICT infrastructure to lower the cost of purchasing infrastructure as the key to accelerating the adoption of technology across diverse sectors in order to promote ICT infrastructure development in the nation (World Bank, 2020). This is helpful for Zambia's successful adoption of digital health. The national fiber optic network is being built with money from the government as well. Significant parts of the nation are now connected to the government's administrative center thanks to the government network. As part of the government-wide area network program, this infrastructure will offer connectivity to some healthcare facilities across the nation; as of August 2022, 17 hospitals were connected to the government area network.

Zambia has substantial 2G coverage, with 93% of the population covered; nevertheless, the nation has gaps in 3G (53% of the population covered) and 4G (43% of the population covered), making it difficult to provide internet capacity to reach health institutions that serve more than half the population. An opportunity exists for the provision of remote services with satellite communication infrastructure. These things work together to create the network infrastructure required to support digital health. To allow the digital health agenda, power access must still be solved. The potential for digital health applications to promote universal health access ranges from making health data easily accessible to decision-makers, enabling them to effectively plan and provide health services, to facilitating the delivery of health services locally and remotely. Apps for national data analytics as well as community-based applications for digital health have been implemented in Zambia (MOH, 2022).

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2.5 Global view of eLMIS implementation

The approach taken by Bangladesh is comparable to the recommendations by Otto et. al., in mimicking the paper-based business model and ensuring system interoperability with the already existing SCMP. The timelines outlined in the roadmap factored in when support from partners would cease and by when the Bangladesh government staff should have been trained in the use of the system to ensure continuity. Key notable challenges from Bangladesh’s

experience implementing the eLMIS were ICT infrastructure, staff retention, lack of feedback on the system functionality from the supervisors and apathy towards review and utilization of data in decision-making by the end-users (Kibria, 2017). Interventions incorporated included automated periodic emails and text messages to mobile phones to remind and encourage users at all levels. These messages are tailored to what the system identifies as needing action at that point by the facility such as submission of the report, status update on the submitted report or stock imbalance report showing needed action to ensure commodity availability (USAID, 2016).

The Myanmar government successfully maintained a manual system for vaccine management for several years before deciding to automate the LMIS. This was necessitated by the delay in the transmission of information urgently needed for quick supply chain decisions. This was also compounded by the challenge of lack of visibility of stock movement in the vaccine supply chain. Real-time monitoring of the cold chain is impossible. With support from the United Nations International Children's Emergency Fund (UNICEF), the Myanmar government in selecting an appropriate eLMIS. The process included identifying the goals and features of an eLMIS; and mapping current systems (UNICEF, 2018). This time-consuming assessment process led to the conclusion that creating a new eLMIS strategy for the Expanded Program for Immunization (EPI) that could be connected with other systems was appropriate. Drawing from lessons learnt using the paper-based system, Myanmar's expectations were improved data use for supply chain management, identifying key performance indicators and using data visualization through dashboards. Myanmar appreciated the importance of securing financing to implement and maintain an eLMIS. To ensure that the eLMIS system chosen can be maintained over the long term, decision-makers must be fully informed of the initial and ongoing costs, including software and maintenance, licensing and data protection, and user support. The government also considered establishing a framework and method for information technology (IT) governance within the Ministry of Health to manage the coordination and use of systems through the creation and application of policies, rules, and operational processes. The complexity of real-time cold chain equipment and vaccine stock temperature monitoring was done.

A study by Tung et al., (2008), on the acceptance of eLMIS in Taiwan following its introduction to reduce operational costs shows the importance of an appropriate design of the system to ensure ease of use, avoidance of drastic changes from paper-based system as key precursors to promote end-user desire to use the system more than perceived financial cost. These findings can be compared to those of a study in Tanzania showing a link between the sustainability of the eLMIS and user satisfaction based on the quality of information captured, system operations, usefulness and other supporting conditions such as training, system enhancements and internet access (Omary & Kalinga, 2017). It must be noted here that both the Taiwanese and Tanzanian study focus were limited to post-deployment end-user evaluation and did not take into account the evaluation of precursor interventions such as policy formulation to guide data management, financing, capacity building, strategic planning, management structure and development of ICT infrastructure as a prerequisite to a sustainable

eLMIS. Additional information is required for a holistic evaluation of key factors in the sustainability of an eLMIS.

In Uganda, poor infrastructure, lack of equipment, poor internet connectivity, inadequately skilled staff and/or insufficient resources for training staff across the MOH, and lack of synergies between stakeholders running vertical programs were noted as key challenges in the successful implementation and maintenance of the eLMIS. Instead of integrating with the already existing systems by way of enhancement and strengthening systems, partners opted to establish vertical systems managed by their appointed implementers (Management Sciences for Health, 2020; Lugada, et al., 2022). This approach is attributed to a lack of confidence in the governance structure of the host government. By the nature of their varying business models of operation, vertical programs are unsustainable as management does not mimic government processes. This presents a challenge for system interoperability, synergies in pooled resource mobilisation, advocacy and transition of leadership and ownership.

According to a study by Kolher (2014) on the relationship between good pharmaceutical governance systems supporting global health and the Millennium Development Goals (MDGs), corruption and the lack of robust pharmaceutical governance structures were noted as serious obstacles to the provision of drugs and medical supplies at the facility level in Uganda. The expectation for an automated LMIS is that supply chain practitioners will have readily available, accurate and detailed data to inform their decisions. Data use in Health supply chain management decision-making was also non-existent. Without considering the prospect of interoperability, each of the multiple vertical LMISs that were deployed at the sub-district level in Uganda was designed to be a stand-alone system. Each system's data collection is compartmentalized and cannot be used by another system to provide real-time consumption information, stock levels, or other crucial variables. This implies that there is no regular distribution of reports to the numerous stakeholders in the health supply chain and no sharing of information on supply chain performance at various levels. The MOH continues to be faced with challenges of weak supportive supervision to end-users which is an important avenue for development and sharpening of IT skills, optimization of eLMIS use and development of data use culture to encourage analysis using data.

According to Chindove and Mdege (2012), Ghana’s paper-based reports were often late or inaccurate due to a lack of supervisory oversight. In Guatemala, reporting rates were at 90% using standardized paper-based forms. Some facilities in Ghana and Guatemala developed their forms which did not follow standard format which led to poor supply chain performance due to incomplete, inaccurate and late submission. In contrast, reporting rates for Nepal using standardized paper-based LMIS increased from 36 – 92%. In Uganda however, electronic LMIS yielded improved data quality, accuracy, and completeness even though this data was inaccessible to other stakeholders.

A quantitative study by Tamirat (2018) in Ethiopia, found that the system is not used often by health workers in the management of the health commodity LMIS. This was attributed in part to challenges in its usability as a result of system functionality. Perceptions of high cost among

policymakers in automation and deployment for a low-income country such as Ethiopia have had a significant bearing on advocacy for resource mobilisation which subsequently negatively impacts sustainability when transitioning to MOH. Like Uganda, automation did not take into consideration the possibility of integrating and interoperating with other software. This means the system operates vertically with no exchange of information between systems and transfer to a central repository. In a study by Tewfik (2018) in Ethiopia, frequent electricity power cuts, software, hardware, and infrastructural challenges were challenges experienced during the implementation of the electronic LMIS in approximately 31% of health facilities. Currently, sub-Saharan Africa is experiencing challenges in providing stable and sufficient electricity. In contrast to the study done by Tamirat (2018), this study found that data used for decision-making was 94.9% for the facilities visited. However, health centres used data more for other functions except for operational decisions. Hospitals were found to be better at using data for decision-making regarding operations. Data quality was found to be high in two-thirds of the hospitals and health centres sampled. User acceptance for the system was 85%, of which 97.4 % considered the data well-presented and 94.9% found it intuitive. Ninety-eight per cent of respondents were able to use the system and considered it capable of providing data visibility, and easy-access logistics information. Over 90% of respondents found the dashboard interface capable of providing adequate, accurate and complete information. Eighty-four per cent thought that the electronic system reduces workload compared to the paper-based system.

A descriptive qualitative study by Karuri et al., (2012) was undertaken to establish factors affecting the acceptance and use of web-based routine health information systems in Kenya. The study identified inadequate infrastructure, low computer proficiency, inadequate human resources, lack of training of users, lack of proactive leadership, poor data quality and poor attitude as major barriers to system implementation. The results show that there is limited or lack of technical expertise in software development and maintenance in Kenya. Lack of skilled technical capacity in low-income countries resulting in longer system downtime affects the confidence and perception of the usability of the system. Namibia and Zambia have both been dependent on expatriate technical support to ensure software and hardware challenges are addressed (Mabirizi, et al., 2018; Strengthening High Impact Interventions for an AIDS-free Generation (AIDSFree) Project, 2018). A significant flow in the implementation process was to roll out the tool as a final product before adequate testing for software bugs, and enhancement needs were addressed. This has the potential to diminish user confidence and discourage the use of the system. Lack of computer skills and the perceived notion of exposure to inefficiencies among health workers were seen as significant barriers.

The Malawi government rolled out the eLMIS in 2017. Over 95% of health facilities are implementing the system covering all program areas unlike in Namibia which is only covering ART. Rollout of eLMIS was necessitated by the lack of facility-level accurate timely data needed to inform supply chain decisions using a paper-based system (RHSC, 2022). This gap was attributed to inadequate human resources, lack of infrastructure, and ICT. The country's intervention to address the human resource constraints is continued training, supportive supervision, and advocacy for data use. Malawi further established a linkage between eLMIS and DHIS2. The exchange of information between systems has broken the siloed status of

systems and therefore increased visibility, reduced duplication among stakeholders, and synergies in the efficient use of limited resources resulting in increased commodity availability (OpenLMIS, 2022).

The Ministry of Health and Social Services (MOHSS) in Namibia implemented four systems to manage health commodity supply chain information in the public sector at different levels. Facility-level staff use an electronic dispensing tool (EDT) to manage dispensing and antiretroviral medicines inventory. Facility EDT is linked to a national EDT database which is a central repository for data. Health facility stocks and inventory movement data are managed at the service delivery point by the Facility Electronic Stock Control Card (FESC). Data from the FESC is transmitted to the central repository. The Pharmaceutical Management Information Dashboard integrates all three systems and the warehouse management tool into one dashboard which is used for analysis and information dissemination throughout the health system. Before the implementation of the electronic dashboard, central-level supervisors had no data visibility of supply chain performance at lower levels to aid decision-making. The paper-based system required a manual unstructured method of requesting individual facility stock information through phone calls. Strengthening data culture by use of the automated system continues to be an ongoing process as users develop their skills in the use of the system. As is the case in many African countries, inadequate human resource at health facilities in Namibia continues to be a challenge and a threat to sustained operations of the eLMIS. The LMIS automation process in Namibia involved key stakeholders from the onset. This included high-level MOHSS leadership aimed at securing political will and adoption of the system. The design was aligned with MOHSS' current and future needs with minimal changes to the business process flow from the paper-based processes. Implementation was done in a phased approach which included end-user training, monitored and evaluation. The automation process included implementing an e-learning module, pre-service training at higher institutions for students and in-service training. Initial investment costs for software and hardware procurement, installation, equipment, and software maintenance were funded by donor support. The electronic system increased reporting rates marginally from 85% to 97% of ART facilities while the facility stock status improved by 51% (Mabirizi, et al., 2018). Despite the notable gains in efficiency, MOHSS is still experiencing the challenge of failure by staff to use the FESC consistently.

The MOH in Zambia has a four-tier system which is made up of the national, provincial, district and health facility levels. MOH rolled out the eLMIS to operate at all levels of the supply chain. Unlike Namibia, the eLMIS interface with the Warehouse Management System (WMS) happens centrally at Zambia Medicines and Medical Supplies Agency (ZAMMSA). Health workers are only required to be trained on one system which limits the cost of training compared to Namibia where facility-level staff manage two systems (John Snow Inc. R&T, 2018). The eLMIS in Zambia is designed to store national data at a central repository similar to Namibia. This ensures that data is readily available to all supply chain users to inform decision making as is the case in Namibia. The eLMIS in Zambia continues to be enhanced to remain cutting-edge and provide end-to-end data visibility on a signal dashboard with adaptive analytics. The eLMIS design in Zambia is broader and more extensive compared to Namibia

as it is used to manage reproductive health, laboratory reagents, equipment and supplies, malaria, anti-retroviral drugs (ARVs), essential medicines and supplies, and until recently COVID-19 commodities. MOH has made significant strides to expand coverage to include TB by the end of 2022 (AIDSFree Project, 2018). MOH staff are burdened by the use of two systems at the facility level. The eLMIS in Namibia is restricted to the management of antiretroviral medicines only. At the same time, health staff are still required to use paper-based LMIS to capture and report logistics information manually. The use of electronic and manual LMIS simultaneously is a challenge for an already human resource-constrained MOH in Namibia. A study undertaken by Konduri et al., (2018) noted the need for stakeholder engagement from inception by engaging the users for their input at the design stage and during the implementation phase to secure ownership. Namibia and Zambia's implementation approach did ensure that the end-users who were pivotal in the successful implementation of the system were fully engaged. This strategy made them feel part of the design of the system. As was done in Namibia and Zambia, minimal changes to the paper-based business process during automation have had a significant impact on confidence among the end-user to implement the system as it mimics what is already known in the paper-based tools. Open-source electronic platforms are cheaper than paper-based systems. However, hardware, software customization, and technical resources increase costs. Funding challenges among low-income countries have led to dependence on donor support for procurement and deployment. Zambia is also experiencing funding challenges due to limited resources and dependence on donor support.

MOH in Kenya, Namibia and Zambia experience human resource and funding challenges hence highly reliant on donor support. The Namibian government has acknowledged the need to commit central government funding towards the maintenance of the electronic LMIS. To this end, MOHSS committed itself to cover operational costs, system maintenance, software updates, and enhancements (Mabirizi, et al., 2018). MOH in Zambia developed a sustainability and transition plan aimed and providing a detailed roadmap to stakeholders on the need to put in place specific interventions in preparing the government to take full control of the system. While this document was finalized as approved by MOH, implementation remains a challenge.

2.6 Theoretical review – Sustainability in the implementation of an eLMIS

In a study by Woltering et al., (2019), The failure of e-solutions to be implemented at scale has been linked to the design of pilots suitable only in ideal environments which ignores the context in which the system would need to be implemented. By not factoring in the present-day challenges, rolling out to scale is hindered by neglected circumstances. The failure is also attributed to a lack of clearly outlined techniques in the implementation process which defines scale and the mechanisms to achieve it.

Otto et. al., (2015) in a discussion paper focused on Africa, explains the five pillars of health systems noted to have a direct impact on the success of ICT innovation implementation in Africa. These foundational elements are infrastructure, governance, healthcare financing, supply chain management, and human resources for health. Building on the five pillars, to

successfully establish and scale up an automated LMIS, the critical prerequisites are data and interoperability standards, local capacity, policy and regulatory environments, an appropriate business model, alignment of partnerships and priorities, and monitoring and evaluation. While some prerequisites are cross-cutting without any variances, there is a need for further refinement of other prerequisites depending on the specific country context.

Africa and developing nations around the world are experiencing a Human resources for health (HRH) crisis, which is characterized by a shortage of qualified health professionals and their unequal distribution and poor performance (Ahmat, et al., 2022). To address this challenge, training new staff for eventual recruitment and implementing a retention strategy to avert attrition is an ideal but long-term solution. Otto et. al., in their presentation, highlighted the consideration to automate LMIS an important short to medium-term intervention which optimizes the current human resource available by increasing efficiencies in logistics management thereby providing relief to the health worker to focus on their core duties. The increased volume of data needing to be entered on the logistics forms increases the risk of data errors which ultimately leads to bad supply chain decisions. Automating reduces manual day-to-day routine processes thereby allowing them to focus on other analysis duties resulting in improved accountability. Electronic systems increase data visibility, reduce stock imbalances, overstocks, and expiry of essential medicines

Previously cited articles have supported the notion of automation as a requirement to achieve efficiencies in service delivery. Conversion from paper to electronic format comes with a range of challenges such as end-user IT skillset, change management resulting in poor acceptability and data use culture, cybersecurity and IT infrastructure. These challenges are also mentioned in a study in Benin which aimed to establish the possible benefits of IT in pharmaceutical service delivery. Findings which can be generalized to low-income developing countries include lack of IT infrastructure, lack of IT education, poor network services, electricity supply challenges, financing to support implementation efforts, and poor governance structures (Edoh & Teege, 2011).

Financing is a critical pre-requisite for automating a logistics management information system which affects a range of requirements such as recruitment or retaining human resources, capacity building training, infrastructural development, ICT software and hardware etc. Increasingly in recent years, donors have taken an approach to encourage increased stakeholder involvement, systems alignment and integration with existing systems in the implementation process to ensure ownership and leadership from the outset (Moucheraud, et al., 2017). Otto et. al., (2015) supported the idea with recommendations to make use of existing infrastructure, plan for system interoperability, strengthen rather than ignore local capacity, consider the needs of specific policies and regulations, use a sustainable business model, form thoughtful partnerships that align with national and local priorities, and set up a reliable monitoring and evaluation system.

An effective MOH-led governance structure is a critical requirement for a sustainable eLMIS. Proactive leadership and ownership by the host government is an important stimulus for

stakeholder buy-in across the supply chain. Strong governance facilitates advocacy in resource mobilisation and policy which clearly outlines roles and responsibilities for specific activities to support the transition process. An example of strong governance is leadership, ownership and minimal disruptive approach used by the Bangladesh government in the implementation of eLMIS with funding support from USAID, through the Systems for Improved Access to Pharmaceutical and Services (SIAPS) program. The eLMIS was developed to manage pharmaceuticals in response to the inability to track supply chain performance due to a lack of real-time and poor data quality hampering data-driven supply chain decisions. Bangladesh maintained its business process by designing the automation based on an established mature paper-based LMIS. The web-based eLMIS was integrated into an existing Supply Chain Management portal (SCMP) providing facility-level inventory visibility, and interactive and easy-to-use analytics. The SCMP was developed using local expertise as a deliberate strategy aligned towards sustainable interventions which would allow for ease of transfer of the system to the government (Humayun, 2014).

2.7 Literature Review Summary

The literature review undertaken has elucidated key common findings across the various countries implementing the eLMIS. The findings support the basic pillars which apply to all countries intending to implement eLMIS. The global drive towards automation and maintenance of LMIS in the public sector was observed to be dependent on donor funding for the initiation of eLMIS. Measures to redress this funding imbalance are only seen towards the end of the life of the implementing partner. Political will and government support must be secured from the onset by involving high-level policy decision-makers and end-users for their input. The lack of MOH leadership and dedicated resources to this intervention is a threat to sustainability as it poses a challenge of ensuring buy-in from the outset. In all instances, inadequate or unavailable ICT infrastructure has limited the extent to which the system can be deployed. The presence of other e-tools supported by different implementing partners has raised challenges of interoperability resulting in siloed systems which do not share information for comprehensive national-level supply chain decision-making. This highlights the need for host governments to establish strong and streamlined e-tool policies to provide a forward-looking approach to new technologies and data management. An eLMIS is only as good as its users. In this case, the end-user input can be a barrier or success for the system. This review has shown that change management strategies are very key in ensuring that the eLMIS is optimally used. Even with a more efficient tool, in some instances, staff preferred to continue using the manual system. This can be attributed to the lack of appreciation of the value that the tool brings, limited knowledge in the use of IT equipment, lack of IT training, complexity of the system design, and lack of technical support in case of system failure. Suboptimal use of the system was noted to have resulted in a lack of or poor data.

Capacity building, skills and knowledge transfer are important steps in the transition process before final handover for leadership**.** Inadequate human resources for health was noted as a cross-cutting challenge which directly impacts eLMIS implementation for all countries reviewed. The review shows an inclination towards the need for countries to have a strong,

well-established LMIS which is later mimicked in the e-system design with minimal changes to the business process. This was noted as a key intervention to promote user acceptance.

Table 2. 1 Literature Review Matrix

No.	Author(s), Year, Title, Journal	Purpose	Methodology	Findings
1	Chindove, S. and Mdege, N. (2012). Logistics Data Collection and Reporting for Essential Medicines in Developing Countries	To analysis of impact of interventions designed to standardize collection and reporting of logistics data	Desk reviewed articles, relevant publications and contacts working in the field.	Improved quality and availability of data for decision making; Improved commodity availability; Reduced error rates in forecasting and demand planning, and significantly reduced decision lead time.
2	Mabirizi, D., et al., (2018). Implementing an Integrated Pharmaceutical Management Information System for Antiretrovirals and Other Medicines. Global Health: Science and Practice, 6(4), pp.723-735.	To study the implementation of an integrated Pharmaceutical management information in MoHSS, Namibia.	Desk review of documents, assessment and technical reports, from the Pharmaceutical Management Information.	Negative attitudes, lack of computer experience; Data use for decision making new phenomenon; Change management; phased approached to accommodate staff previous not exposed to electronic systems; Specific MOH needs identified and incorporated for ownership and user acceptance; human resource challenge; donor dependence for funding and technical support.
3	Tamirat, D. (2018). Diagnosing The Level Of Supply Chain Automation At Pharmaceutical Fund And Supply Chain Agency Central Office.	To diagnose the level of supply chain management information system automation.	Descriptive research study	Lack of system use; slow implementation pace; system not easy to use; low acceptance; high implantation costs; Donor dependence for implementation is not sustainable
4	Konduri, N., et al., (2018). Digital health technologies to support access to medicines and pharmaceutical services in the achievement of sustainable	To understand implementation approach of selected digital health technologies in resource-constrained countries	Descriptive review of internal project documentation on various digital health tools on the conceptual and	Harness and build on existing governance structures. The use of data for decision making at all levels needs to be cultivated and sustained through multi-stakeholder partnerships. System integration and interoperability is the next

	development goals. DIGITAL HEALTH, 4, pp.1-20.	implementer perspective	implementation approach.	developmental phase in information technology. Stakeholder engagement is critical to ownership and sustainability of the system.
5	Tewfik, S. (2018). The Assessment of e-LMIS Implementation and User Satisfaction for Pharmaceutical Management in Public Health Facilities of the Addis Ababa Regional Health Bureau.	To assess effectiveness of the e-LMIS implementation at hospitals and health centers	Description of study using qualitative and quantitative approach	Stakeholder engagement; Strong technical support and OJT is key; Software and hardware maintenance plans; Alternative measure for support services such as internet and electricity supply; Good data quality and visibility is key to ensure accurate decision making

CHAPTER THREE
METHODOLOGY

3.1 Introduction

This chapter aims to provide a logical and systematic explanation of how this research problem was addressed. The research design, study location, study population, study sample, sampling strategy, data collection tools, pre-testing of research tools, data collection processes, data analysis, and ethical issues are all covered in this chapter.

3.2 Research Design

This was a descriptive cross-sectional study following a qualitative approach to assessing the sustainability framework centred on policies, financing, capacity building infrastructure, attitudes, opinions and behavior towards the implementation process of the eLMIS.

3.3 Study area or Site

This study was undertaken in government-owned health facilities in Lusaka District which have the eLMIS deployed at their sites. This is with the exception of military health facilities due to security reasons. The study also included interviews of key supply chain stakeholders using or managing the implementation of the eLMIS based in Lusaka.

3.4 Study population

The targeted population for this study were public sector health facilities as well as key supply chain stakeholders involved in the use or implementation of the eLMIS in Lusaka district. The health facilities population excluded military sites due to the sensitive nature of their operations.

The following are other key stakeholders supporting eLMIS included in the study:

a. Directorate of Clinical Care and Diagnostic Services - Pharmaceutical Services Unit, MOH
b. Directorate of Information Communication and Technology, MOH
c. Directorate of Logistics, ZAMMSA
d. Directorate of Policy and Planning, MOH
e. USAID GHSC PSM
f. USAID eSCMIS Project
g. Churches Health Association of Zambia
h. USAID
i. US Center for Disease Control (CDC)
j. Lusaka Provincial Health Office-MOH
k. Lusaka District Health Office-MOH

3.5 Study sample

Sample size for health facility in Lusaka district was calculated using Taro Yamane formula (Yamane, 1967) with 5% error of margin.

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

Where,
n = sample size
N = population size (28)
K = Constant (1)
e = level of significance (0.05)

$n = 16/ (1 + 28(0.05)^2)$

= 15

3.6 Sampling techniques

Selection of Health facilities

The systematic sampling technique was used in the selection of health facilities included for this study. The selection interval was determined using the following formula:

k = N/n

Where:
n=Sample size
N= population size
k=size of selection interval

k = 16/15

= <u>1</u>

For each health facility sampled, interviews were administered to staff who are directly involved with the day-to-day use of the system as key informants. These were either pharmacy or laboratory staff.

Selection of other supply chain stakeholders for inclusion in study

a. All 11 targeted key stakeholder organisations involved in use or implementation of the eLMIS were purposefully selected for inclusion in the study
b. Interviews were administered to the senior most available manager whose role involves supply chain activities supporting MOH.

3.7 Data collection procedure and time line

Before initiating this study, research approvals were obtained from the following:

a. University of Zambia Ethics Committee
b. Ministry of Health, Permanent Secretary
c. Lusaka Provincial Health Office, MOH
d. Lusaka District Health Office, MOH

Copies of the approval letters are included in the appendix section.

Structured questionnaires for interviews at central and health facility levels were designed to collect qualitative data. Data collection took 2 months to complete due to unavailability of key informants owing to their busy schedules. The following were focus areas for data collection:

a. Governance and support
b. Financing
c. Design and implementation process of the eLMIS
d. Training and access to eLMIS
e. Individual knowledge and understanding of eLMIS operations
f. Establish level of proficiency in the use of eLMIS
g. Perception of eLMIS
h. Use of eLMIS data to inform decision making
i. Technical support for software and hardware challenges

3.8 Data analysis instruments and procedures

The first interview was conducted to help refine the questionnaire to address any complicated, vague or misleading questions to ensure all the questions asked were completed correctly. The data collected at the end of each interview was checked for completeness and clarity of responses provided. Data was cleaned, coded and entered in Stata/MP 14.2 Version 29 Jan for analysis. Graphs, tables and simple percentages were generated and analysed. Thematic and content analysis was used to analyze the data.

3.9 Ethical considerations

This study was undertaken in an open and honest professional manner complying with protocol to ensure informed consent is secured before conducting health facility staff and stakeholder interviews. The researcher upheld the principle of integrity by fully disclosing all information necessary to health facility management and stakeholder staff of any potential benefits, risks, inconveniences or obligations associated with the study which are important for their knowledge before their approval.

The methodology involved interviewing senior MOH supply chain managers, cooperating partners and health facility staff. Formal approval of the protocol was obtained from the University of Zambia Ethics Committee and MOH before data collection began. The study followed strict procedures for data collection, storage and access. No other forms of recording devices such as cameras were used to capture data besides the hard copy templates on which data was captured. The records were accessible only to the health facility management for spot checks at any time on request. No personnel and/or healthcare provider's identification information was recorded on any of the data collection tools.

CHAPTER FOUR

PRESENTATION OF FINDINGS

4.1 Overview

This chapter presents the findings of the study on the eLMIS implementation process in public sector health facilities in Lusaka District, Zambia. The presentation of the findings is based on the following research questions.

1 What specific mechanisms are in place to ensure the eLMIS implementation process is aligned with MOH policy and planning, and supports MOH self-reliance?
2 Is the eLMIS design and implementation process adequately meeting facility-level staff inventory management training and information needs?
3 What challenges do the users experience in accessing timely technical and management support in the use of the system?

4.2 Demographic characteristics of respondents

The distribution of respondents by level of operation in health commodity management is illustrated in Table 4.1 below. Government contributed the highest number of respondents at 81% (21/26). The Donor and Implementing partner/NGO respondents represented 8% (2/26) and represented 12% (3/26) respectively. All donors and Implementing partner/ NGO respondents were from the national/central level.

For levels of operation, the majority of respondents were health facilities representing 58% (15/26), followed by 35% (9/26) at the national/central level, while provincial and district levels contributed 4% (1/26) each.

Table 4. 1 Distribution of respondents by organisation and level of operation

	Management level of interviewee function					
Organisation	**National/ Central level**	**Provincial Level**	**District level**	**Health Facility**	**Total**	**Percentage**
Government	4	1	1	15	21	81%
Donor	2	0	0	0	2	8%
Implementing partner/NGO	3	0	0	0	3	12%
Total	**9**	**1**	**1**	**15**	**26**	**100%**
Percentage	35%	4%	4%	58%	100%	

Of the government cohort, 71% (15/21) were from the health facility level, 19% (4/21) national/ central level while provincial and district levels contributed 5% (1/21) each as shown in Figure 4. 1 below.

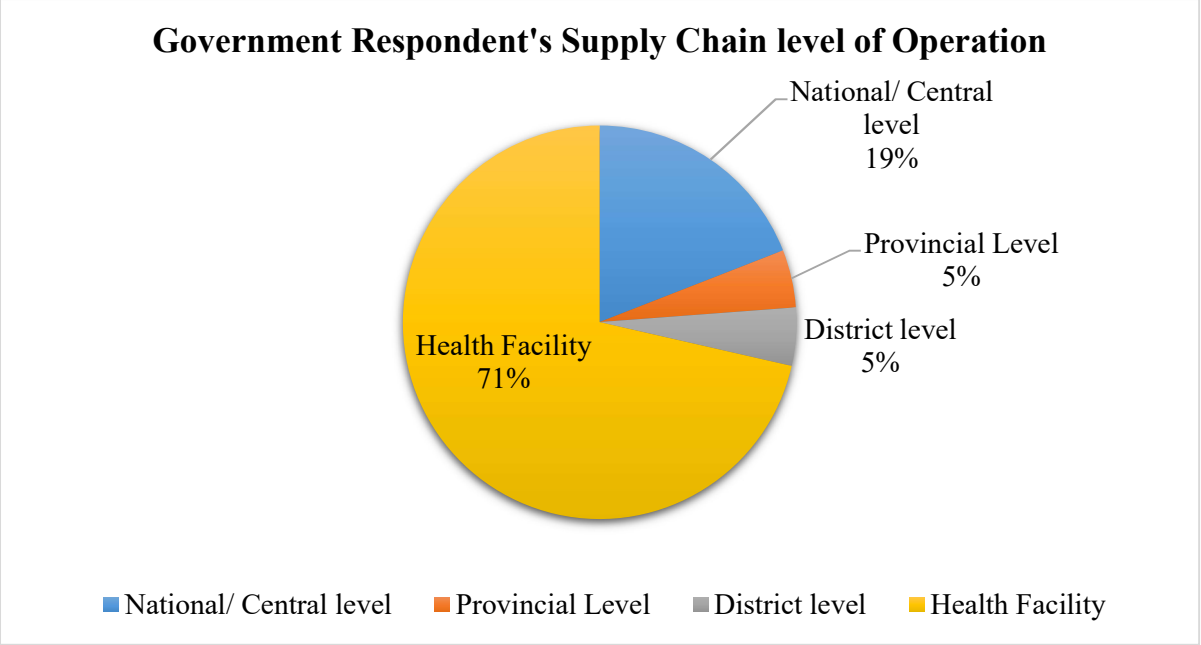


Figure 4 1 Distribution of government respondents by level of operation

Figure 4.2 below tabulates the respondent's years of experience in the management of the health commodity management system by level of operation. The findings show that the highest range of years of experience using eLMIS was >2yrs-5yrs representing 54% (14/26) of all respondents. The majority of these respondents were from health facilities representing 58% (8/14) of respondents. Years of experience > 5 years was 23% (6/26) of which 50% (3/6) were from the national level and 50% (3/6) from the health facility level. Years of experience 1-2 years had 19% (4/26) of which 60% (3/5) were from health facility level, 20% (1/5) national level and 20% (1/5) district level. One (1) staff member from a health facility had experienced less than 1yr representing 4% (1/26).

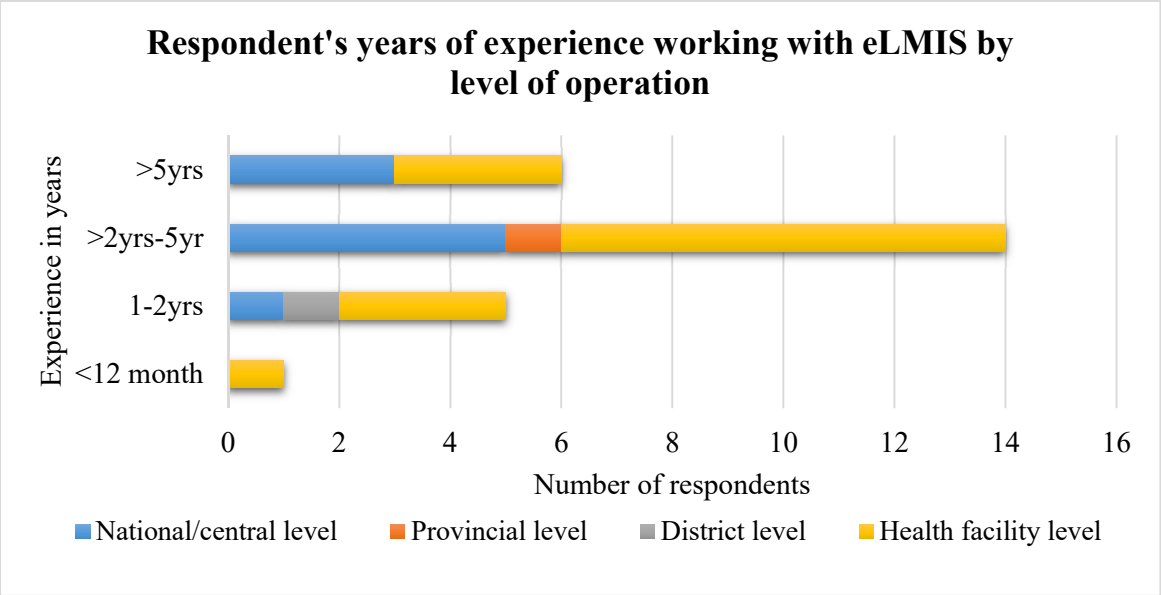


Figure 4.2 Years of experience in use of eLMIS by level of operation

4.3 Factors that impact MOH's ability to rollout eLMIS in a sustained approach countrywide

4.3.1 eLMIS governance

No respondent could attest to the existence of a MOH-led eLMIS governance structure within MOH. Results show that 62% (16/26) of respondents were certain that no such structure exists while 38% were uncertain. Figure 4.3 below illustrates this distribution of responses by level of operation.

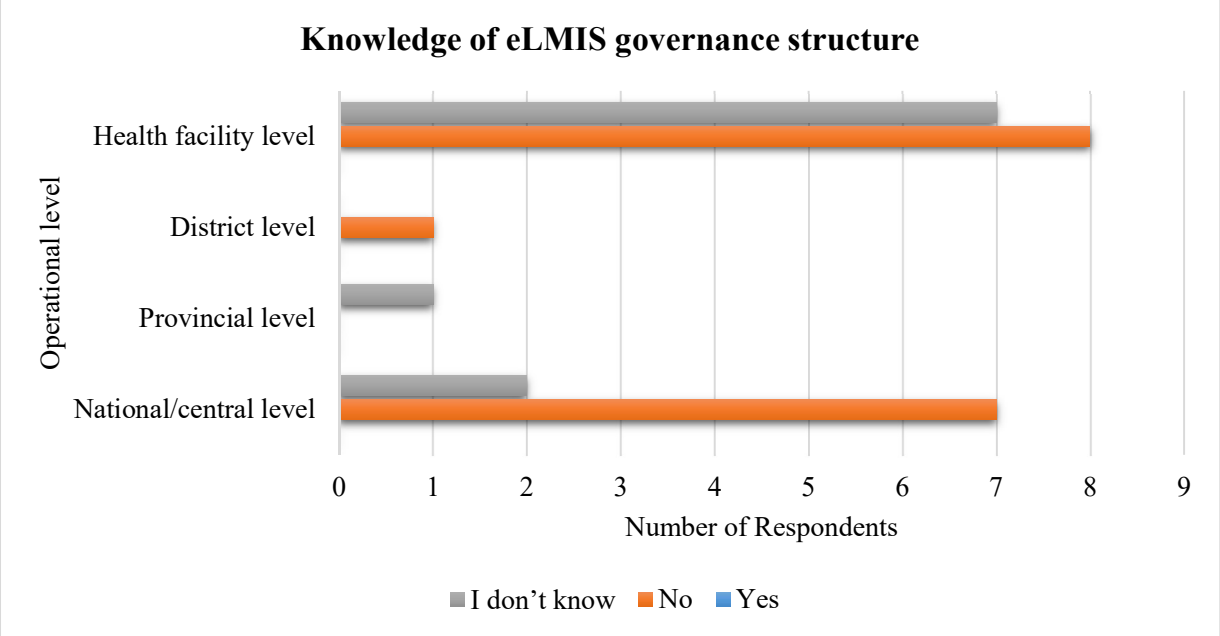


Figure 4.3 Knowledge of MOH led governance structure

4.3.2 Stakeholder roles in eLMIS governance

Supply chain management had the highest score of 58% (15/26) followed by health systems financing at 15% (4/26). Systems strengthening was 12% (3/26) while ICT and monitoring and evaluation had 4% (1/26) each. Notably, government involvement was stated in all categories except ICT. The donor role was only mentioned in health systems financing. Figure 4.4 below shows the respondent's understanding of their respective organization's role in health commodity management about the implementation of the electronic health

commodity management system.

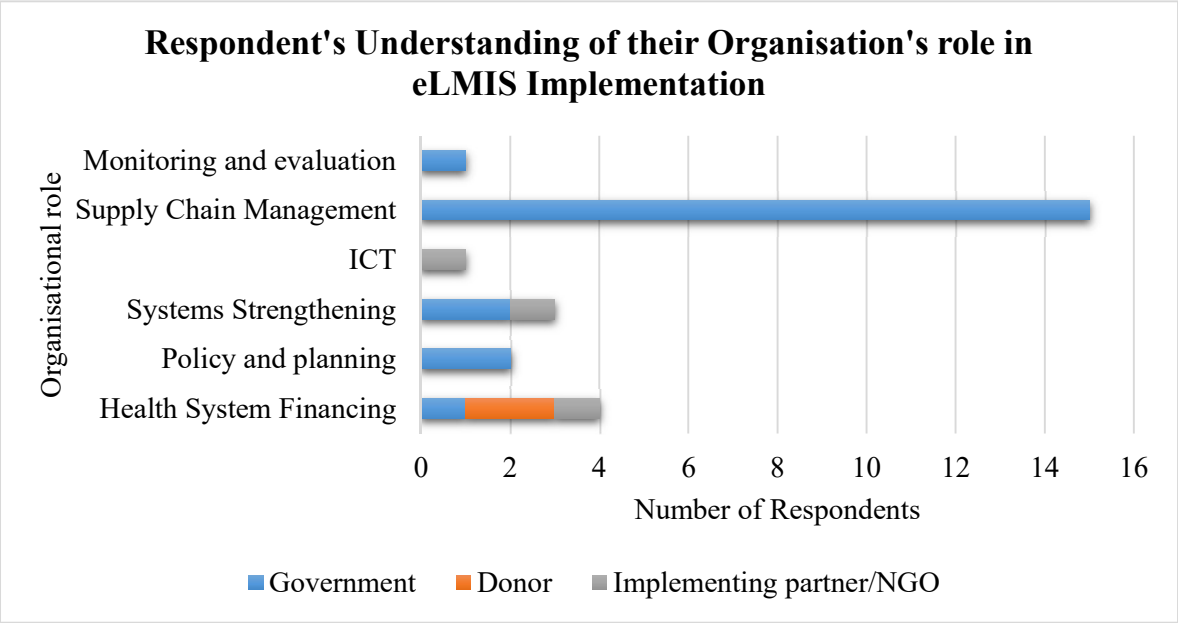


Figure 4.4 Respondent's knowledge of organizational roles in eLMIS governance

4.3.3 eLMIS policy guidance development and dissemination

The following are responses received on awareness of MOH policy direction on eLMIS use in the management of health commodities in public health facilities. As illustrated in Table 4.2 below, only 23% (6/26) of respondents were able to attest to having read and understood the policy directive to roll out eLMIS countrywide. These were from the national level cohort. Fifty percent (13/26) of respondents had not seen the policy while 27% (7/26) did know there was such a policy in existence.

Table 4. 2 Knowledge of eLMIS policy guidance

	Policy guidance on eLMIS as official LMIS tool			
Organisation type	**Yes**	**No**	**Don't know**	**Total**
National/ central level	6	2	1	9
Provincial level	0	1	0	1
District level	0	1	0	1
Health facility	0	9	6	15
Total	**6**	**13**	**7**	**26**
%	23%	50%	27%	100%

4.3.4 eLMIS Sustainability and Transition plan (SaTP)

In 2020, MOH with support from the donor-funded implementing partner developed and approved the SaTP and directed immediate implementation. The SaTP is a comprehensive guidance document that addresses a broad range of key interventions from governance, finance, capacity building, and human resources aimed and preparing the MOH to develop internal structures, capacity and processes to take over technical and management leadership roles from the implementing partner before or beyond the current available project and funding comes to an end. A copy of the letter is provided in the appendix.

The study established that only 27% (7/26) of respondents were aware of the existence of the SaTP. All of the seven respondents were from the national/central level cohort. Three were from the government (14%), one (50%) from donors and three from the implementing partner group (100%). Table 4.3 below shows the distribution of responses on Knowledge under understanding of the MOH-approved Sustainability and Transition plan of responses:

Table 4. 3 Knowledge of existence of the SaTP among key supply chain actors

	Knowledge of existence of the MOH approved SaTP		
Level of Operation	**Yes**	**No**	**Total**
National/ central level	7	2	9
Provincial level	0	1	1
District level	0	1	1
Health facility	0	15	15
Total	**7**	**19**	**26**
Percentage	27%	73%	100%

In further interviews of the respondents who are aware of the SaTP existence, 57% (4/7) stated they have read it and understand the contents of the document while 43% (3/7) are only aware it exists. None of the respondents was able to provide an informed response about the extent of implementation of the SaTP at the time of the interview. None of the respondents were able to provide a copy of the SaTP on request.

4.3.5 Appreciation of cost of eLMIS facility deployment

This assessment was restricted to supervisor-level staff who would be more concerned with planning and budgeting for the deployment of the system. Service delivery point staff were not included. As shown in Table 4.4 below, only 27% (3/11) of respondents, all of which are from the national level were aware of the deployment costs for eLMIS at facility level. On further analysis, it was noted that none of the knowledgeable respondents was a government employee.

Table 4. 4 Knowledge of eLMIS deployment cost to health facility

	Knowledge of eLMIS facility edition deployment costs		
Level of Operation	**Yes**	**No**	**Total**
National/central level	3	6	9
Provincial level	0	1	1
District level	0	1	1
Total	**3**	**8**	**11**
Percentage	27	73	100

4.3.6 eLMIS implementation funding

The findings show that 69% (18/26) respondents were of the understanding that funding for eLMIS implementation is solely from the donor while 31% (8/26) thought that both MOH and the donor contribute towards eLMIS implementation and maintenance, although the larger proportion of funding still comes from the donor. Figure 4.5 below shows the responses on knowledge of eLMIS funding source.

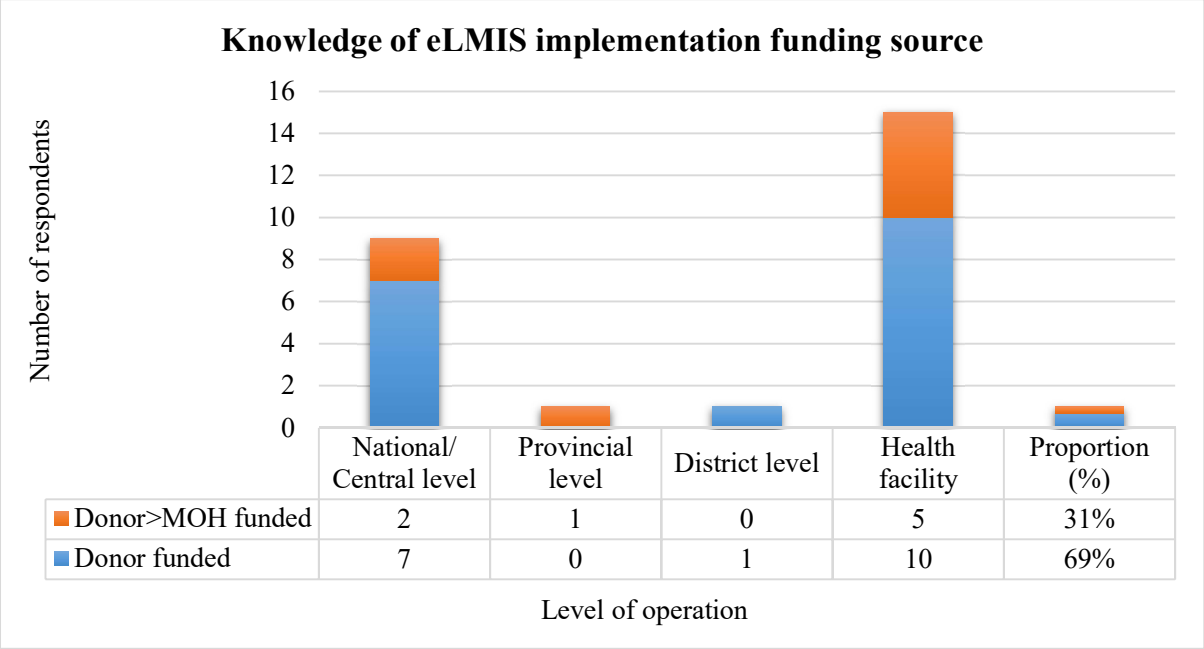


Figure 4.5 Knowledge of source of funding for eLMIS implementation

4.3.7 Resource mobilisation

Only 12% (3/26) of respondents are aware of MOH-led eLMIS implementation resource mobilisation activities. All respondents are from the national level representing the government, donors and an NGO. It was established that this intervention has only been undertaken this year for the first time and a response is yet to be received from be donor. No domestic revenue resourcing has been done as the budget for 2024 has already been finalized

for approval by parliament. This means any intentions to request for budgetary inclusion can only happen next year for the 2025 budget. By which time the project will have ended.

4.3.8 eLMIS facility ready infrastructure

On ICT infrastructure adequacy, 77% (20/26) of the respondents stated that the MOH has the inadequate infrastructure to effectively manage eLMIS implementation. 23% (6/26) of staff were unable to provide informed responses attributed to their limitation in interaction with service delivery points to be able to ascertain. Additional information provided was that MOH facilities are only now automating their business processes. Most of the ICT infrastructure is only being developed now in response to the president signing the statutory instrument No. 43 of 2023 which aims to promote the adoption and uptake of ICT in all public institutions countrywide.

4.4 Does eLMIS design and implementation process adequately meet health facility staff inventory management training and information needs?

4.4.1 End-user capacity building strategy

It was established that MOH does not have a formal pre- or in-service eLMIS end-user capacity-building strategy. All trainings are dependent on the implementing partner for coordination and funding. Table 4.5 below shows types of training and end-user perception. On-job-training had the highest number of respondents trained at 53% (8/15). Classroom and peer training each had 20% (3/15) while job-aids was 7% (1/15).

Only, 47% (7/15) of respondents expressed satisfaction with all training except classroom training. This was attributed to the fact that it is more theory-based compared to the other trainings which are hands-on. The majority of respondents, 53% (8/15) felt the training did not provide them with the knowledge they required to effectively utilize eLMIS.

Table 4. 5 eLMIS skills development training adequacy perception

	Training adequately equips with eLMIS knowledge?		
Type of eLMIS training received	**Yes**	**No**	**Total**
Classroom	0	3	3
On-job-training	5	3	8
Peer-to-peer	1	2	3
Job-aid	**1**	**0**	1
Total	**7**	**8**	**15**
Percentage	47%	53%	100%

4.4.2 End-user basic computer proficiency

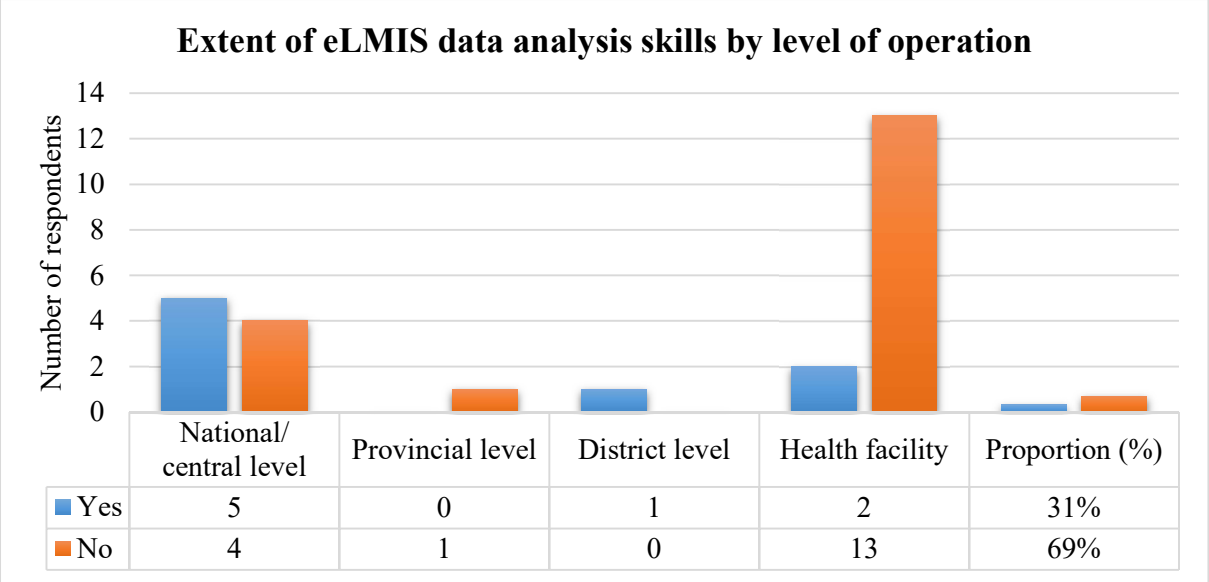
An important prerequisite for optimized use of the system is basic literacy in the use of computers. The study findings from respondent interviews shown in Table 4.6 below indicate that the majority of the respondents were skilled in basic computer operations representing 53% (8/15) followed by moderately skilled staff at 40% (6/15) and highly skilled staff at 7% (1/15). The highest level of proficiency was the rating 'Good' at 47% (7/15). The other two ratings, 'moderate' and 'very good' each had approximately 27% (4/15).

Table 4. 6 Computer proficiency self-evaluation versus eLMIS extent of ease of use

	Computer literacy				
eLMIS self-evaluated proficiency	**Moderately skilled**	**Skilled**	**Highly skilled**	**Total**	**Percentage**
Moderate	1	2	1	4	27%
Good	3	4	0	7	47%
Very good	2	2	0	4	27%
Total	**6**	**8**	**1**	**15**	
Percentage	40%	53%	7%	100%	

4.4.3 eLMIS data analytics capacity

Only 31% (8/26) of respondents possess analytics skills while the majority of respondents representing 69% (18/26) do not have analytical skills to process data in eLMIS for use in supply chain management decision-making. Only 56% (5/9) of respondents working at the national level were forecasting and supply planning decisions based on analyzed logistics information from eLMIS possessed analytics skills. The provincial-level respondent, whose expected role is to provide supervisory support to the district leadership on health commodity inventory management and supply chain systems strengthening had no data analytics skills. The district staff respondent was able to analyze data from eLMIS to inform decision-making. At the health facility level, only 13% (2/15) of respondents had data analytics skills while 87% (13/15) did not. Figure 4.6 below illustrates the responses recorded.



	National/ central level	Provincial level	District level	Health facility	Proportion (%)
Yes	5	0	1	2	31%
No	4	1	0	13	69%

Figure 4.6 Extent of data analytics skills by level of operation

4.4.4 Frequency of data analysis to inform decision making

Monthly analysis is highest at 50% (4/8) whereas quarterly and daily are each rated 25% (2/8). Figure 4.7 below shows a two-way tabulation of the frequency of data analysis among the respondents who possess analytics skills.

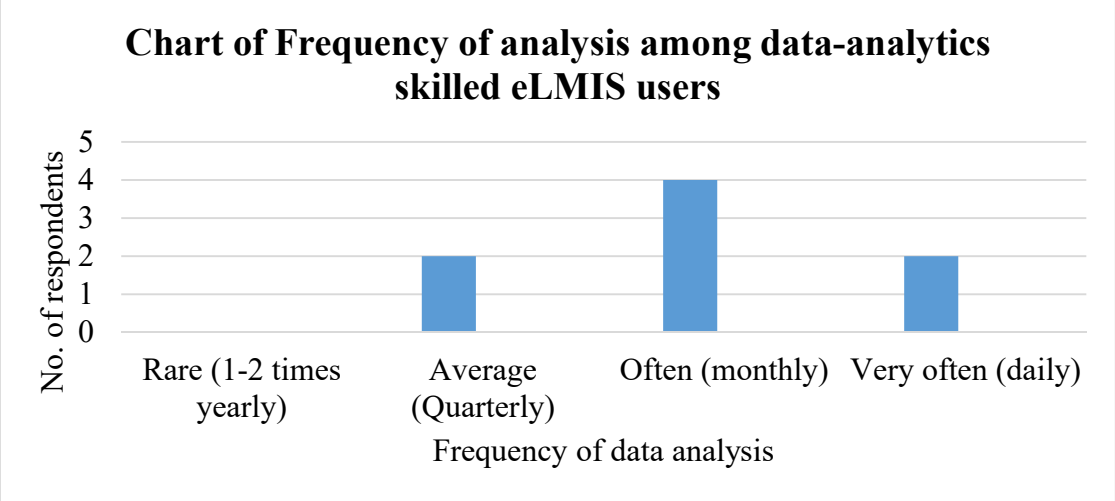


Figure 4.7 Frequency of data analysis

4.4.5 eLMIS Data use

As shown in table 4.7 below, 42% (11/26) of respondents stated that they base their SC decisions on data from eLMIS while 58% (15/26), the majority don't use eLMIS data in decision making. No response was given on what data set is used to inform supply planning.

Table 4. 7 Data use

	eLMIS data use for SC decision making		
Organisation type	**Yes**	**No**	**Total**
National/ central level	6	3	9
Provincial level	0	1	1
District level	1	0	1
Health facility	4	11	15
Total	**11**	**15**	**26**
Percentage	42%	58%	100%

4.4.6 eLMIS Data quality

As shown in table 4.8 below, the majority of respondents stated the data quality was moderate representing 54% (14/26). A further 15% (4/26) considered the data quality as good while 31% (8/26) said poor.

Table 4. 8 Perception of data quality by user level

	eLMIS data quality			
Organisation type	**Good**	**Moderate**	**Poor**	**Total**
National/ central level	3	3	3	9
Provincial level	1	0	0	1
District level	0	1	0	1
Health facility	0	10	5	15
Total	4	14	8	26
Percentage	15%	54%	31%	100%

4.4 What challenges limit optimized use of the system, access to technical and management support?

4.5.1 Human Resources availability to manage eLMIS by level of operation

National/ Central level
According to the responses shown in Table 4.9 below, the majority of the respondents i.e. 54% (14/26), said the central level was moderately staffed to manage eLMIS implementation and maintenance, 23% (6/26) said it was inadequately staffed while 19% (5/26) and 4% (1/26) said understaffed and adequate respectively.

Table 4. 9 Perception of National/ central level staffing levels

	Central level eLMIS HR adequacy				
Level of Operation	**No staff**	**Inadequate**	**Moderate**	**Adequate**	**Total**
National/ central level	0	2	6	1	9
Provincial level	0	1	0	0	1
District level	0	0	1	0	1
Health facility	5	3	7	0	15
Total	5	6	14	1	26
%	19%	23%	54%	4%	100%

Provincial level

Table 4.10 below shows 81% (21/26) of respondents stated inadequate staffing levels, 15% (4/26) stated Understaffed while 4% (1/26) stated moderate.

Table 4. 10 Perception of Provincial level staffing levels

	Provincial level eLMIS HR adequacy			
Level of Operation	**No staff**	**Inadequate**	**Moderate**	**Total**
National/ central level	3	5	1	9
Provincial level	1	0	0	1
District level	0	1	0	1
Health facility	0	15	0	15
Total	4	21	1	26
%	15%	81%	4%	100%

Health facility level

Findings as outlined in table 6 below on health facility HR status shows only two rating provided in the responses. The majority was 54% 14/26 stated very low HR while 46% (12/26) stated low.

Table 4. 11 Perception of Health facility level staffing levels

	Health facility level eLMIS HR adequacy		
Organisation type	**No staff**	**Inadequate**	**Total**
National/ central level	8	1	9
Provincial level	0	1	1
District level	1	0	1
Health facility	5	10	15
Total	14	12	26

%	54%	46%	100%

4.5.2 eLMIS acceptance

An important indicator for partner acceptance is technical and mentorship support toward the implementation of the system at all levels of the supply chain.
Table 4.13 below shows that 67% (6/9) of the national-level respondents stated that no support was being received from partners while 33% (3/9) stated partial support was being received.
The provincial respondent acknowledged partner support while the district representative stated otherwise.
At the health facility level, 60% (9/15) stated no support was being provided, 33% (5/15) stated partial support and 7% (1/15) stated support was being received.
Overall, 62% (16/26) of all respondents stated no support was being provided. A further 31% (8/26) stated that support was only partially provided while 8% (2/26) stated no support was received at all.

Table 4.12 Perception of partner technical and material support

	Partner Technical and Material Support			
Organisation type	**Supported**	**Partially supported**	**Not supported**	**Total**
National/ central level	0	3	6	9
Provincial level	1	0	0	1
District level	0	0	1	1
Health facility	1	5	9	15
Total	2	8	16	26
%	8%	31%	62%	100%

4.5.2 eLMIS Usability

This assessment was limited to health facility respondents. The majority of respondents consider eLMIS as being fair to operate which represents 40% (6/15), moderate and easy 27% (4/15) each and only 7% (1/15) considered it hard.

Table 4.13 Perception of eLMIS usability

eLMIS perceived usability		
Rating	**Frequency**	**Percent**
Hard	1	7%
Moderate	4	27%
Fair	6	40%
Easy	4	27%

	15	100%

4.5.2 eLMIS outage

Another important measure is usefulness of the system is accessibility challenges. In this case we set out to establish if users experience challenges accessing the web-based version of eLMIS and how often this happens. From the responses recorded,

Table 4.13 Frequency of eLMIS outage

How often do eLMIS occur?

eLMIS outage	Weekly	Monthly	Quarterly	Yearly	Total	Percent
Yes	4	5	1	0	10	67%
No	0	0	0	5	5	33%
Total	4	5	1	5	15	100%
Percent	27%	33%	7%	33%	100%	

4.5.2 eLMIS Ownership

The findings show that 35% (9/26) of respondents thought that the system is Donor-owned. Only 31% (8/26) thought that MOH owned the eLMIS. About 19% (5/26) of respondents stated it was co-owned between the donor and MOH while 15% did not know who owns the system.

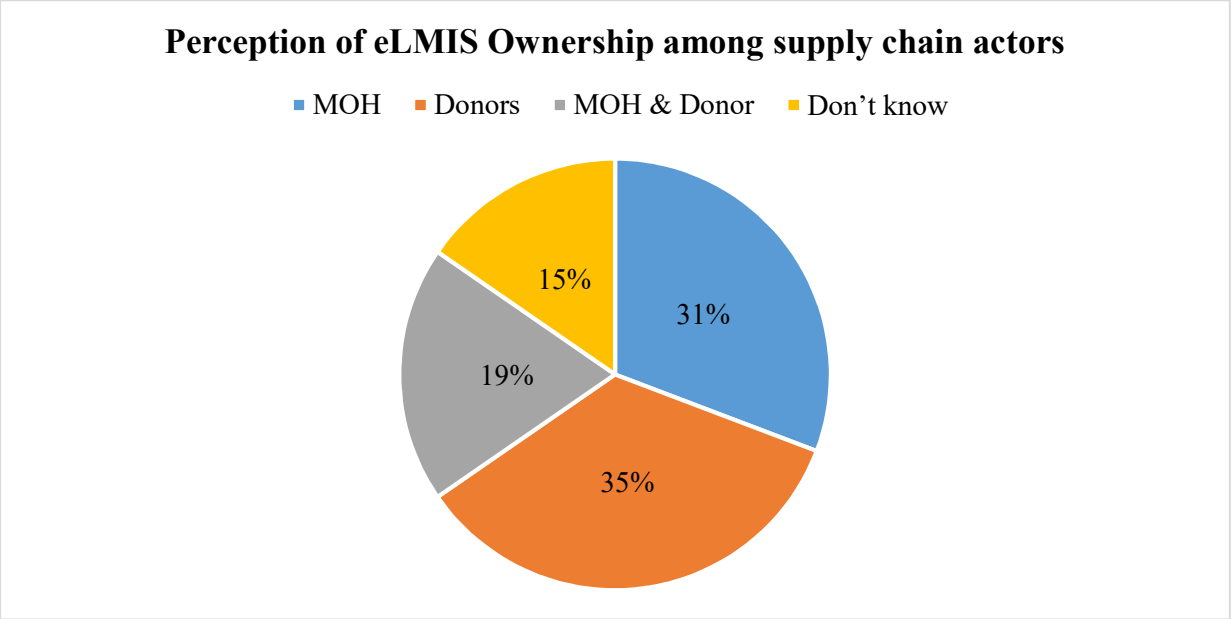


Figure 4.8 Perception of the eLMIS ownership among SC stakeholders

4.5.3 ICT technical resource

Currently, the eLMIS technical expertise is siloed with the implementing partner. The partner desires to transfer technical skills to MOH assigned staff. However, the study established that MOH ICT was unable to dedicate staff to focus on eLMIS due to limited staffing. According

to the respondent(s), the current MOH ICT structure does not take into account the management of each e-tool as a separate structure. The respondent stated the following, “currently, MOH is hosting several e-tools. As such, it is impractical for MOH to assign Software Developers and other management staff to fully focus on each system.”

This limits the partner’s ability to transfer knowledge and skills to MOH ICT.

CHAPTER FIVE

DISCUSSION

5.1 Overview

The findings are analyzed and discussed in this chapter with respect to the objectives. The study's primary goal was to determine how the eLMIS implementation strategy adopted by MOH promotes system optimization and long-term sustainability at the health facility level in the Lusaka district. The study provided significant insight into sustainability issues around governance, policy, funding, human resource development, and communication among key stakeholders.

5.2 Factors that impact MOH's ability to rollout eLMIS in a sustained approach countrywide

Demographic characteristics

By design, the research approach ensured that it enlisted staff from all levels of the supply chain involved in eLMIS implementation or used information from the system for decision-making. At the national level, respondents from MOH were at the policy policy-making level and had informed insight into government procedures. The highest MOH management level the research team was able to engage with was the Assistant director. Zambia Medicines and Medical Supplies Agency was included by virtual of its mandate to store and distribute health commodities to all public sector health facilities. Determination of resupply quantities is dependent on eLMIS.

Donor informants operate at the national level working with host ministry policy or technocrat-level counterparts in supporting health-related interventions through the provision of Technical assistance or resources for implementation either directly or through implementing partners. Selected implementing partners/ NGOs are funded by different donors to undertake specific supply chain systems strengthening interventions or projects in support towards eLMIS working with MOH policy, technocrat and service delivery point staff during deployment. Service delivery point staff were pharmacy and laboratory staff who utilize the eLMIS daily. They are the core users of the system and generate the basic data which is then used throughout the supply chain for decision making. eLMIS optimized use and associated challenges begin at this level of operation and so information from this basic level is of great importance in review of the implementation processes. Overall, the majority of respondents were from MOH representing each level of the supply chain. Ninety-six percent (96%) of all respondents had at a minimum 2 years of experience using the system which provided us expectation that the respondents had a good understanding of the operations of the system.

eLMIS was the first initiative of its kind to be implemented in Zambia in 2014. As would be expected, MOH did not have a pre-existing capacity or structures designed to manage such a system.

Governance

Donors are acknowledged for their encouragement of developing countries to take up innovation initiatives making use of domestic resources. These initiatives are copied from developed countries with well-developed ICT infrastructure and users who are already well-cultured in the use of these technologies. Replicating initiatives from high-income countries to resource-limited countries with limited exposure to such technologies requires significant infrastructural and end-user behavioural changes. Effective implementation requires a strategic management approach to guide the complex transformation interventions to ensure stakeholder buy-in from the beginning.

As an innovation in Zambia with limited local expertise available, eLMIS design and implementation was initially fully donor-funded through a partner as planned. Software development work was done using expertise sourced from outside the country in the initial phase of the project. The expectation would be that further system enhancements and implementation activities are transitioned as MOH establishes technical staff positions to co-create and maintain the system. This has however not been possible as MOH has not established a core management team to focus on eLMIS implementation and management. As noted from the study findings, the lack of an established MOH-led governance structure has had a direct bearing on the perception of leadership and ownership of the system. Respondents highlighted the fact that all eLMIS-related activities such as deployment and maintenance have been undertaken through the implementing partner. The partner-established eLMIS help desk is funded and managed by the partner staff only with no MOH representative. All system operational challenges continue to be addressed by implementing partner staff validating the perception that this innovation is donor funded and owned.

Funding

Generally, the study shows that sustainability status is weak due to inadequate funding and human resources to scale up the system nationwide. Currently, only one donor is funding the implementation and maintenance of up to 1,800 health facilities. Approximately 1,200 health facilities are unfunded for eLMIS deployment. While the implementing partner has available information to assist MOH management in lobbying for additional funding support, there has not been a proactive approach from MOH showing leadership and ownership of the system by way of resource mobilisation. This inertia has adversely impacted perceptions and possible buy-in from stakeholders.

Being heavily dependent on outside funding to support this intervention is unsustainable especially since Zambia, a middle-income country will soon be expected to graduate from donor financing. In recent years, some donors supporting the health sector have mentioned their intentions to reduce future funding. This is expected to put pressure on the already stretched limited resources and subsequently impact the central government's ability to implement an eLMIS budget line which requires at least two years to initiate before approval. This considering that funding for the current project comes to an end in less than a year raises

significant questions which MOH senior management must consider as a priority. Currently, there is no strategic plan outlining how the nation will use its resources to continue providing health services once it transitions from donor support.

Knowledge of eLMIS implementation costs among supervisors was limited to national-level staff. For users to fully appreciate the investment costs and plan for maintenance as the system is transitioned, MOH leadership must disseminate the annual expenditures to central, provincial and district MOH management teams. With the recent announcement of the Ministry of Health embarking on a devolution process which will see district and sub-district health facilities management being delegated to Local Authorities, this information must be made public for the relevant structures to factor into their planning cycle.

Key funding issues not at the health facility level include but are not limited to maintenance of ICT equipment and infrastructure, deployment costs, reliable internet access, site technical assistance etc.

Stakeholder roles in eLMIS support

It is evident from the findings that stakeholders are aware of the existence of a robust eLMIS being implemented in the MOH supply chain to manage health commodities. Stakeholders continue to derive benefits from the use of the system at all levels to inform supply chain decision-making. Unfortunately, there is a lack of clarity among stakeholders on what roles they can play in support towards eLMIS implementation. The absence of MOH leadership has resulted in stakeholders not being fully aware of what the government's strategic plan for the system is and what roles are available for their support.

Following the transition of the eLMIS supportive supervision role from implementing partner to MOH, no policy direction has been made available to the provincial, district and health facility staff guiding how to integrate this activity into routine operations. As such, no MOH budget line has been established at the province or district levels leaving this intervention dependent on partner support. The lack of active supportive supervision of the end users led to an increase in unresolved facility challenges and some cases abandonment of the system. The extent of system abandonment was not quantified during this study but the financial implication includes but is not limited to donor funding investment loss, and lack of commodity data visibility which can lead to stockouts, expiries, pilferage and inaccurate supply chain decisions due to missing or poor quality data being used as basis for decision making. This has far-reaching consequences such as reduced donor confidence which may result in the withdrawal of donor support.

Policy guidance

The study findings show a lack of knowledge of the existence of a policy decision for eLMIS to be an official e-tool to manage health commodities in health facilities. All respondents at province, district and health facility levels were unaware of it. This raises questions about the policy dissemination and implementation process within MOH. In the absence of policy guidance, the supervisory levels are unable to plan and budget for eLMIS-supporting activities. This also impacts staff attitude towards their obligation to use the system.

Sustainability and Transition Plan (SaTP)

In 2020, the SaTP was developed and approved by MOH to guide the transfer of technical and management leadership from the implementing partner to MOH. This would require capacity-building MOH counterparts in the architectural design of the system, regular operational activities, human resource management, deployment operations and maintenance. However, at the time of this study, it was established that the sustainability plan had not been implemented due to a lack of MOH active involvement. The current eLMIS sustainability status is in a precarious situation in that while some system implementation activities have continued, they remain unofficial and dependent on the implementing partner. This is against the expected sustainability plan milestone for policy implementation and full leadership assumed by MOH.

To move the concept of sustainability to actualization, MOH must strategize the integration and institutionalization of eLMIS as a continuous process. Through a policy directive, dedicated staff can be assigned to focus on resource mobilisation to finance day-to-day operations; soft- and hardware procurement, deployment and maintenance; implement a capacity-building strategy for staff on routine and new enhancements, and ensure increased data use for decision making.

Leadership and Ownership

The research findings show a varying understanding of the system's attributes by the level of respondent operation. Notably, certain information may not be relevant to all levels of operation. Basic information is critical for all users in fostering understanding and appreciation of the system and implementation process. For instance, knowledge of the system ownership is important for all stakeholders. This study found that only national-level respondents were aware of who owns the eLMIS. This shows a significant communication challenge within MOH to disseminate information throughout the supply chain. The lack of information flow down the system was also noted in knowledge regarding funding sources and mobilisation. It is apparent that the further away staff workstations are from MOH headquarters the less information is provided. Information gap due to infrequent engagements between levels of the supply chain has contributed to the perception that eLMIS support is only from the implementing partner and that is donor-owned..

System design, infrastructure deployment process and technical support

eLMIS was purposefully developed on an open-source platform at inception taking into account the challenge of annual licenses and other enhancement-associated fees in-line with the desires of the host government to have a scalable eLMIS best suited for limited resources country such as Zambia. The system design ensures it conforms to the National ICT Policy and e-Health Strategy designed to guide and mainstream the use of ICTs in health and other related sectors and provides clear operational guidelines that will drive growth and transformation through the effective use of ICTs. The study noted that within MOH, the implementing partner has provided more leadership in ensuring the system continues to conform to the set policy standards. The ICT directorate does not have a hands-on approach to the operations of the eLMIS due to human resource constraints. The current workforce structure does not have a designated position to direct and coordinate eLMIS implementation work at any level of the system. Implementation processes continued to be coordinated by implementing partners with MOH being consulted or informed.

The study established that the system design process actively involved the participation of the end-users to ensure their requirements were included. The country-specific infrastructural and human resource landscape was taken into consideration to ensure the system is best suited for the county. Before the development of the eLMIS, the end-users had no experience using an automated LMIS. The initial design was dictated to the users by mimicking the paper-based LMIS. Following the rollout, the MOH with support from the implementing partner undertook a nationwide user requirement assessment which generated important information on user requirements that over the years have been incorporated into the system. This has resulted in the system remaining updated with the current data needs of the users as well as policy decision-makers. It was discovered that end users thought highly of the system's usability and that it was reasonably intuitive. Users thought that the use of the system improved their ability to do their jobs more efficiently. The majority of respondents perceived usability as a key indicator for the reliability of the system which is a positive inference of their preference to continue its use provided all needed continued support from the ministry. Nearly all of the interviewees expressed the significance of the system to their everyday operations and asked for additional training in data analytics. A noted inhibition which affected user satisfaction perception was the lack of ICT resources to effectively utilize the system. Access to reliable internet services has adverse effects and demoralized users. Some Internet Service Providers (ISPs) have poor coverage which requires the users to physically carry the servers to a location where the signal is stronger to submit reports. This effort requires time and in some instances transport. It also puts the ICT equipment at risk of damage or loss due to multiple handling. In areas with good internet coverage, the provision of internet bundles is very limited and still dependent on the partner. MOH has not included this facility in its district-level budgets. Another major factor which impacts user satisfaction is the availability of adequate and fully functional computers. Larger facilities with multiple storage and dispensing points have to rely on available limited number of available computers which are often in use.

MOH-ICT infrastructure was not designed to accommodate innovations such as eLMIS. All eLMIS hardware deployments so far undertaken have been procured by the implementing

partner. MOH-ICT is not adequately funded by the central government to maintain ICT equipment or other infrastructure.
The implementing partner's deliberate approach to involve MOH staff during deployment and provision of technical support services to the end-user has been key in building skills among MOH staff who have developed to become champions and super users. Although not sufficient in numbers, the champions and super users are vital in timely addressing tier 1 and 2, system or user challenges at the facility level as opposed to the previous situation where all system support was dependent on central-level implementing partner staff. An additional challenge which is a threat to peer-to-peer skills transfer and support is the lack of resources such as electronic tools to remotely log into the client server, lack of internet access or bundles, transport to visit sites needing assistance etc. This has discouraged the champions and super users from applying their knowledge and skills in addressing challenges being experienced by staff.
Tier 3 (software development) challenges remain with the implementing partner. Only recently, MOH did not have adequate software programmers to be oriented in eLMIS development work. Transition to these highly technical skills takes time and dedication. Considering the remaining timeline for the implementing partner (< 12 months), it is important for MOH to fast-track the transfer of skills to their staff to guarantee software management continuity beyond the life of the project.

Capacity building and training

The MOH with support from the implementing partner has continued to build end-user capacity in eLMIS with approximately 5,000 health workers receiving in-service training. However, due to high attrition due to staff movement and recent recruitment exercises, the number of trained and recruits implementing these skills is much lower hence the need for continuous in-service training. Respondents interviewed recommended refresher training to help them remain updated with new enhancements to the system. The most preferred training method was job-on-training as it creates a more practical engagement for the learner to grasp the concepts better. This approach requires an adequate number of trainers and material resources for facility visits. Continued dependence of implementing partner staff to undertake this intervention remains a challenge as they do not have adequate human and material resources. Integrating this activity into routine district supervisors, eLMIS champions and super-users' responsibilities and providing them with the necessary resources to communicate and undertake facility site visits is the most feasible and sustainable approach.

Intuitive design, increased access to technology gadgets and proficiency in computer use among graduating students have made learning to operate eLMIS easy. There is a need to review and update the eLMIS training curriculum to be incorporated into the supply chain management course for in-service training and public institutions. This reduces the need for additional funding specifically for eLMIS training.

The essence of a logistics management information system is to avail information for decision-making to ensure commodity availability whenever needed by the client. The eLMIS generates

a significant amount of data annually which is infrequently analyzed to help identify risks and assist in anticipating future supply challenges. This is attributed to the limited analytics skills among stakeholders. The lack of data analytics has a bearing on data use. Because there is no use for the data, attention to detail in data capture to ensure the utmost quality is potentially compromised. Data quality remains a significant challenge attributed to unstandardized data requirements due to the same products with multiple pack sizes. While both manual and automated tools can greatly increase the availability of logistics data, real-time reporting and built-in features that make it easier to check data and identify errors and missing data make automated systems more likely to produce high-quality logistics data more quickly than laborious manual systems. Linking health facility access to good data reporting is a salient way of ensuring the timely submission of accurate data.

Human resource inadequacy was noted as a significant challenge which is not unique to Zambia. While recruitment of additional staff may be the best solution, this is a long-term intervention which requires sustained funding resources. For a resource-limited country, a more feasible option is to integrate supply chain management activities into already existing positions. By design, eLMIS's objective is to improve the efficiency of the health worker and supply chain performance which ultimately results in commodity availability and increased accountability. Strengthening the use of eLMIS for pharmacy and laboratory staff whose main responsibility is to provide clinical services to the patients accords them more time to execute their primary tasks with less time spent on paper-based inventory management.

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

This study has brought to light significant flaws in the eLMIS implementation process that endanger the system's sustainability and significantly undermine donor investments to strengthen the supply chain for health commodities. The lack of MOH ownership and leadership in policy guidance is a significant limitation in facilitating stakeholder buy-in. In the absence of strong policy implementation measures such as monitoring and evaluation, central-level management remains oblivious to the outcomes of the system implementation at lower levels resulting in missed opportunities to derive the optimal potential of the system to support strengthening the supply chain. Without the mobilisation of resources, the eLMIS is at risk of total collapse at the end of the current donor support. It is imperative that MOH urgently develops a financing mechanism involving donors and the central government to sustain operations in the short to long term.

Continuous infrastructural development and maintenance is a crucial requirement for all ICT interventions. Notably, Health facilities encounter issues with infrastructure, software, and hardware when implementing eLMIS. Approximately 67% of health facilities experience at least one eLMIS outage every quarter. This can be attributed mainly to poor internet connectivity and intermittent electricity power supply. The latter has also caused damage to computer equipment when the power supply is restored.

Nearly all of the interviewees expressed how important the system is to their daily lives and asked for additional training. The general eLMIS perception as a usefulness e-tool can be extrapolated as an indicator of system reliability and measure of attitude suggesting the users' willingness to continue using the system provided all supporting mechanisms by the ministry are implemented. Other attributes include reduced mathematical errors, missing information prompts and automated analysis and feedback.

It is of great importance to increase transparency by educating stakeholders about the SaTP and providing a comprehension outline of required activities to ensure the system is rolled out and sustained optimally. The SaTP interventions are designed to strengthen the implementation process by addressing policy, funding, human resource, and capacity-building gaps.

6.2 Recommendations

Based on literature review and the study findings, the following are key recommendations which if implementing will address challenges impact effective implementation of the eLMIS.

i. MOH will spearhead resource mobilisation plan to secure donor and domestic for eLMIS deployment and maintenance in the near to long term. The plan should establish and set precise and attainable targets.
ii. To ensures equitable and sustainable financing through domestic sources by updating the current Mid-Term Expenditure Financing (MTEF) to ensure routine inclusion of eLMIS financing
iii. To guarantee unmistakable ownership, leadership, and end-user buy-in, MOH should execute the adopted policy for all levels to use eLMIS as the official e-logistics system.
iv. MOH should also establish a governance structure and designate staff members to oversee eLMIS deployment coordination and operations.
v. A sustainability plan is a guide that sustainability
vi. The sustainability and transition plan, which sets clear, measurable and realistic objectives to improve supply chain human resources, capacity building, financial mobilisation, soft- and hardware maintenance, etc., should be MOH-led implemented in collaboration with all stakeholders with the utmost priority.

6.4 Suggested further study

Lusaka is considered the most urban town in Zambia. The city hosts the MOH headquarters, donors and implementing partners. The city has accessible roads, comparatively better ICT infrastructure, better internet communication quality and a higher proportion of MOH staffing in the country. The proximity of health facilities to these institutions and services does place them at an advantage to be able to access support and quicker resolution of operations issues. There would be a significant difference in the findings of this research if the study is replicated in another district. This undertaking would provide evidence of what specific variables unique to the location have an impact on eLMIS implementation. This would inform MOH and supporting partners to factor in the identified issues during implementation.

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Available at:
https://publications.jsi.com/JSIInternet/Inc/Common/_download_pub.cfm?id=18286&lid=3
[Accessed 15 January 2022].

Wright, C., Durry, P., Jackson, S. & Thomas, M., n.d. Critical Success Factors for Developing digital LMIS, s.l.: s.n.

APPENDICES

Appendix I: MOH approval to deploy eLMIS nationwide

All correspondence should be addressed to the
Permanent Secretary
Telephone: +260 211 253020/5
Fax: +260 211 253344

REPUBLIC OF ZAMBIA
MINISTRY OF HEALTH

In reply please quote:
No.....
MH/72/4/21

NDEKE HOUSE
P. O. BOX 30205
LUSAKA

8 January, 2019

REF: REALIGNMENT OF SUPPLY CHAIN LOGISTICS MANAGEMENT INFORMATION SYSTEMS

Reference is made to the above subject.

The Ministry of Health recognizes the potential for digital technologies to transform and strengthen the health system as envisioned in the current National Health Strategic Plan 2017 – 2021 and outlined in the eHealth Strategy 2017-2021.

This serves to inform you that following the feedback from the Procurement and Supply Chain Technical Working Group and internal Ministerial consultations, it has since been decided that the eLMIS will be enhanced to meet the current supply chain business requirements and integrated into the Electronic Health Records (E.H.R) system to allow for end to end continuity of care.

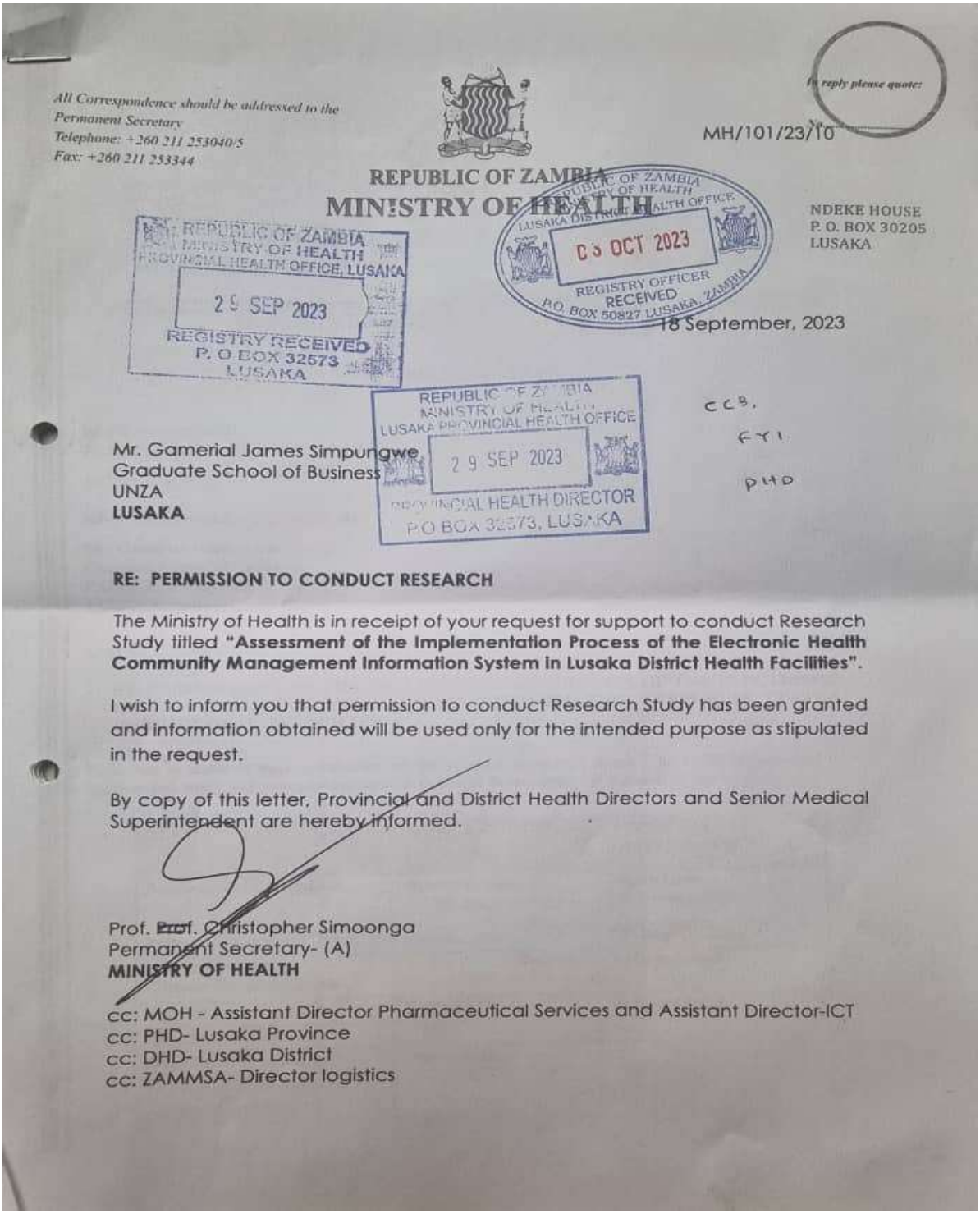
The ministry has further decided to deploy the eLMIS country wide for efficient supply chain management to enhance data integration and avoid duplication of effort.

A meeting will be called to define the road map and implementation plan at a date to be communicated.

Accept assurances of my Ministry 's highest regard.

Dr. Jabbin Mulwanda
Permanent Secretary – Health Services
Ministry of Health

Appendix II: MOH data collection approval letter



All Correspondence should be addressed to the
Permanent Secretary
Telephone: +260 211 253040/5
Fax: +260 211 253344

In reply please quote:

MH/101/23/10

REPUBLIC OF ZAMBIA
MINISTRY OF HEALTH

NDEKE HOUSE
P. O. BOX 30205
LUSAKA

REPUBLIC OF ZAMBIA
MINISTRY OF HEALTH
PROVINCIAL HEALTH OFFICE, LUSAKA
29 SEP 2023
REGISTRY RECEIVED
P. O BOX 32573
LUSAKA

REPUBLIC OF ZAMBIA
MINISTRY OF HEALTH
LUSAKA DISTRICT HEALTH OFFICE
05 OCT 2023
REGISTRY OFFICER
RECEIVED
P.O. BOX 50827 LUSAKA, ZAMBIA

18 September, 2023

REPUBLIC OF ZAMBIA
MINISTRY OF HEALTH
LUSAKA PROVINCIAL HEALTH OFFICE
29 SEP 2023
PROVINCIAL HEALTH DIRECTOR
P.O BOX 32573, LUSAKA

CCB.
FYI
PHD

Mr. Gamerial James Simpungwe
Graduate School of Business
UNZA
LUSAKA

RE: PERMISSION TO CONDUCT RESEARCH

The Ministry of Health is in receipt of your request for support to conduct Research Study titled **"Assessment of the Implementation Process of the Electronic Health Community Management Information System in Lusaka District Health Facilities"**.

I wish to inform you that permission to conduct Research Study has been granted and information obtained will be used only for the intended purpose as stipulated in the request.

By copy of this letter, Provincial and District Health Directors and Senior Medical Superintendent are hereby informed.

Prof. Christopher Simoonga
Permanent Secretary- (A)
MINISTRY OF HEALTH

cc: MOH - Assistant Director Pharmaceutical Services and Assistant Director-ICT
cc: PHD- Lusaka Province
cc: DHD- Lusaka District
cc: ZAMMSA- Director logistics

Appendix III: Informed Consent Form

Dear Sir/Madam,

My name is Gamariel Simpungwe, a Pharmacist by profession and working in the public health sector providing support towards strengthening supply chain for health commodities. I am undertaking this research as part of my dissertation requirement towards attaining an MBA. This research is aimed at getting a better understanding of factors in the implementation process that impact sustainability of the automated logistics management information system and what interventions are required to ensure successful implementation. The findings of this research will form the basis for further synthesis to develop appropriate recommendations on what specific interventions in support of the Ministry of Health and supply chain stakeholders to attain maximum benefit and a sustained system. The success of this study is dependent on the information you as a key supply chain stakeholder is willing to provide. we hope to hear your experiences and expertise on the aforementioned thematic area. The discussion will take at most one hour. That said, you are kindly requested to be as honest as possible to ensure that the information captured is reliable and accurate.

and I will take notes during the discussion; we will not record this discussion. Later, I will review the notes from the discussion to develop insights. If you do not understand any question, please feel free to ask for clarity

Confidentiality

Your participation is voluntary with no penalty for refusing to take part. All the information recorded will be kept with the strictest of confidence. Your identity will not be referred to by name or any other why possible which would draw association to you.

Risks, discomfort and benefits

This is a verbal interview with no risk to you if you agree to participate. Your honesty is valuable in identifying success points and areas needing improvement in support of optimized implementation and maintenance of the automated logistics management information system.

Who to contact

This proposal has been reviewed and approved by HSSREC which is a committee whose task it is to make sure that research participants are protected from harm. If you wish to find out more about the IRB, contact

Dr. Jason Mwanza, Chairperson, Humanities and Social Sciences, Research Ethics Committee, University of Zambia, P.O. Box 32279, Lusaka.

Consent to participate

Deciding whether or not to take part in the interview is voluntary and up to you. If you decide not to be involved, you will not lose any rights. You are free to reject answering any questions, skip questions, or stop the interview at any point in time.

Appendix IV: Certificate of Informed Consent

I have read and understand the information given above or it has been read to me. I have had the opportunity to ask questions about it and any questions I asked have been answered to my satisfaction. I consent voluntarily to be a participant in this study.

_____ _____

Respondent's signature Date *(dd/mm/yyyy)*

_____ _____

Interviewer's name Date *(dd/mm/yyyy)*

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands.

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this ICD has been provided to the participant.

Names of Researcher: _____

Date: _____

(*dd/mm/yyyy*)

CONTACTS FOR QUESTIONS:

Gamariel Simpungwe
Phone: +260966591111
gamasimp@gmail.com
Physical address: Plot#2882, Waterfalls, Off Mission drive, Chongwe, Zambia

Appendix V: Central level Questionnaire

This survey is being conducted as part of the Master of Business Administration (MBA) degree dissertation at the University of Zambia. The survey is focused on evaluating how effective, efficient and sustainable the eLMIS implementation process has been in the public-sector in Zambia. The survey will request your opinion on possible interventions you would suggest to improve the process. Your opinions are confidential and cannot to be linked to you. All responses are anonymous; hence respondents cannot be identified. ***You may submit the completed survey electronically via or e-mail or return it in hard copy in a sealed envelope for confidentiality***. For questions please contact; Gamariel Simpungwe, gamasimp@gmail.com; phone +260 966 591 111

Instructions

i. Please select an option(s) to indicate your opinion to the statement under each section.
ii. Provide text in the box to give other thoughts on barriers to or potential solutions to specific pharmaceutical Supply Chain Management (SCM) best practices as noted in the question.

Date of data collection (dd/mm/yyyy):_____

Data collector initials:_____

Name of organisation interviewee is employed:	☐ Government	*(=1)*
	☐ Donor	*(=2)*
	☐ Implementing partner/NGO	*(=3)*
	☐ If other specify	*(=4)*
Years of experience working in management health commodities:	☐ National level (Donor, NGO etc.)	*(=1)*
	☐ Central level (i.e. MOH HQ, ZAMMSA etc.)	*(=2)*
	☐ Provincial	*(=3)*
	☐ District	*(=4)*
	☐ Service deliver point	*(=5)*
Years of experience working in management health commodities:	☐ <12 months	*(=1)*
	☐ 1year - 2years	*(=2)*
	☐ >2years – 5years	*(=3)*
	☐ >5years	*(=4)*
What role do you play in the national supply chain for health commodities within your organization? (*Select all that apply*)	☐ Forecasting and Quantification	*(=1)*
	☐ Commodity provision	*(=2)*
	☐ Systems strengthening Technical Assistance	*(=3)*
	☐ Warehousing and Distribution	*(=4)*
	☐ Monitoring and Evaluation	*(=5)*
	☐ Others, please specify_____	*(=6)*

eLMIS Implementation - Governance and Support

Leadership and system support refers to the internal and external support required for eLMIS optimization to ensure quality logistics data flows between the different levels of the system and used in supply chain decision making.

1. What governance structure exists to manage eLMIS implementation? Please provide as much detail of key positions and their roles as well as stakeholders involved?

   _____

   _____

2. Are you aware of government policy which provides guidance on development and implementation of e-health tools in MOH?
   ☐ Yes, (=1)
   ☐ No, skip to Q5 (=0)
3. Describe the process for policy development and implementation around e-health tools in MOH?

   _____

   _____

4. Who at MOH is overall responsible for coordinating eLMIS among the stakeholders?

   _____

   _____

5. What do you think about the effectiveness of the eLMIS implementation process and its sustainability?

   _____

   _____

6. Are you well vest with the MOH approved sustainability and transition plan?
   ☐ Yes (=1)
   ☐ No, skip to Q8 (=0)
7. To what extent is the SaTP implemented thus far?

   _____

   _____

8. What role does your organisation play in supporting the deployment and maintenance process for eLMIS?

   _____

   _____

Financing

9. Do you know the cost of deploying eLMIS at different sized health facilities?
   ☐ Yes (=1)
   ☐ No (=0)
10. Briefly describe the funding proportions by stakeholder towards eLMIS implementation?

    _____

    _____

11. What in your opinion is the extent of MOH funding contribution specifically towards eLMIS implementation?

    _____

    _____

12. What funding mobilisation activities has MOH undertaken to lobby support from stakeholders for implementation and maintenance of eLMIS?

_____

_____

Infrastructure

13. What in your opinion is the ready status of IT equipment in health facilities for eLMIS implementation?

_____

_____

14. Is the available IT infrastructure adequate or suitable for eLMIS?

_____

_____

15. What is MOH policy guidance on interoperability for all e-tools implemented for use in supply chain management?

_____

_____

_____

Supply chain management

16. Does MOH have a supply chain skills building strategy? If so, please give brief description?

_____

_____

17. Are you skilled performing SC analysis using eLMIS data?
☐ Yes (=1)
☐ No (=0)

18. How often does MOH senior management utilize eLMIS data for supply chain decision making?

_____

_____

Human resources for health

19. Could you describe the MOH supply chain human resource status at central, district and health facility levels?

_____

_____

20. What measures has government put in place to ensure that eLMIS IT (programming and networking) management skills and knowledge is transferred from partners to the government?

_____

_____

Perception of eLMIS

20. What is your impression of eLMIS usability?
☐ Very hard *(=1)*
☐ Hard *(=2)*
☐ Moderate *(=3)*

☐ Fair *(=4)*
☐ Easy *(=5)*

21. What is your impression on the acceptance of eLMIS among MOH senior management? Explain why?
    ☐ Supported *(=1)*
    ☐ Moderately supported *(=2)*
    ☐ Not supported *(=3)*
22. What is your impression on the acceptance of eLMIS among partners/donors? Explain why?
    ☐ Supported *(=1)*
    ☐ Moderately supported *(=2)*
    ☐ Not supported *(=3)*
23. How do you rate the eLMIS data quality?
    ☐ Very poor *(=1)*
    ☐ Poor *(=2)*
    ☐ Moderate *(=3)*
    ☐ Good *(=2)*
    ☐ Very good *(=3)*
24. Do you use eLMIS data for high level decision making?
    ☐ Supported *(=1)*
    ☐ Moderately supported *(=2)*
    ☐ Not supported *(=3)*
25. What in your opinion are the top three ***good*** attributes of eLMIS?

    _____

    _____

26. What in your opinion are the top three ***no so good*** attributes of eLMIS?

    _____

    _____

27. How has the use of eLMIS impacted on your day-to-day workload?

    _____

    _____

28. Please explain how implementation of the eLMIS has impacted on national commodity management? -

    _____

    _____

29. What do you understand is your role in ensuring the continued operation of eLMIS?

    _____

    _____

(***For all except MOH, USAID and eSCMIS***)?

30. Do you know who owns the eLMIS in Zambia?

    _____

    _____

31. Who in your opinion funds the deployment and maintenance of the eLMIS?

    _____

    _____

Appendix VI: Health Facility Level Questionnaire

Questionnaire no.: _____

This survey is being conducted as part of the Master of Business Administration (MBA) degree dissertation at the University of Zambia. The survey is focused on evaluating how effective, efficient and sustainable the eLMIS implementation process has been in the public-sector in Zambia. The survey will request your opinion on possible interventions you would suggest to improve the process. Your opinions are confidential and cannot to be linked to you. All responses are anonymous; hence respondents cannot be identified. ***You may submit the completed survey electronically via or e-mail or return it in hard copy in a sealed envelope for confidentiality***.

For questions please contact; Gamariel Simpungwe, gamasimp@gmail.com; phone +260 966 591 111

Instructions

iii. Please select an option(s) to indicate your opinion to the statement under each section.

iv. Provide text in the box to give other thoughts on barriers to or potential solutions to specific pharmaceutical SCM best practices as noted in the question.

Date of data collection (*dd/mm/yyyy*):_____

Data collector initials:_____

Interviewee position at the facility:	☐ Facility in-charge	*(=1)*
	☐ Pharmacist	*(=2)*
	☐ Laboratory	*(=3)*
	☐ Nurse	*(=4)*
	☐ If other specify	*(=5)*
Years of experience working in management health commodities:	☐ < 12 months	*(=1)*
	☐ 1 year - 2 years	*(=2)*
	☐ >2 years – 5 years	*(=3)*
	☐ > 5 years	*(=4)*
How many staff are involved in the management of health commodities at this facility?	☐ 1	*(=1)*
	☐ 2	*(=2)*
	☐ 3	*(=3)*
	☐ 4	*(=4)*
	☐ 5	*(=5)*
Training and access to eLMIS support		
32. To what extent are you familiar with the eLMIS?	☐ Not familiar	*(=1)*
	☐ Somewhat	*(=2)*
	☐ Moderately	*(=3)*
	☐ Well	*(=4)*

	☐ Very well	*(=5)*
33. What kind of training/orientation have you received in the use of eLMIS?	☐ Formal classroom training	*(=1)*
	☐ On-job-training	*(=2)*
	☐ Peer-to-peer mentorship	*(=3)*
	☐ Job-aid (self-taught)	*(=4)*
	☐ If other specify	*(=5)*
34. How long ago did you receive the training/ orientation in the use of eLMIS?	☐ <1yr	*(=1)*
	☐ 1yr-2yrs	*(=2)*
	☐ 2yrs – 5yrs	*(=3)*
	☐ >5yrs	*(=4)*
35. Have you had any refresher/ update trainings ever since the first training/orientation?	☐ Yes	*(=1)*
	☐ No	*(=0)*
36. Was the initial training adequate to equip you with the knowledge and skills you need?	☐ Yes	*(=1)*
	☐ No	*(=0)*

37. What additional support do you think is missing from the training/orientation process?

_____

_____

IT Support

38. How do you rate your computer literacy?	☐ Unskilled	*(=1)*
	☐ Weak	*(=2)*
	☐ Moderately competent	*(=3)*
	☐ Competent	*(=4)*
	☐ Expert	*(=5)*

39. What IT support is available to you?

_____

_____

40. How responsive is the IT support in addressing your eLMIS operational challenges?	☐ Very fast	*(=1)*
	☐ Fast	*(=2)*
	☐ Moderate	*(=3)*
	☐ Fair	*(=4)*
	☐ Slow	*(=5)*
41. Do you experience eLMIS outage? If YES, how frequently? _____ _____	☐ No	*(=1)*
	☐ Yes	*(=0)*

Perception of eLMIS

42. What is you impression on the usability of the eLMIS	☐ Very hard	*(=1)*
	☐ Hard	*(=2)*

☐ Moderate *(=3)*
☐ Fair *(=4)*
☐ Easy *(=5)*

43. What is your greatest challenge in the use of eLMIS?

_____

_____

44. What is your rating of data quality in eLMIS? briefly explain your rating?

_____

_____

☐ Very poor *(=1)*
☐ Poor *(=2)*
☐ Moderate *(=3)*
☐ Good *(=4)*
☐ Very good *(=5)*

45. Do you have sufficient SCM tools to record inventory at the facility?

☐ Yes *(=1)*
☐ No *(=0)*

46. If no to Q14, what tools are lacking?

_____

_____

47. Does the facility have adequate IT infrastructure to capture and report logistics data timely?

☐ Yes *(=1)*
☐ No *(=0)*

48. If No to Q16, what infrastructure or support is needed?

_____

_____

49. Who do you think is responsible for provision of IT infrastructure and equipment to your facility?

_____

_____

50. What factors contribute towards late/non reporting in eLMIS?

_____

_____

51. What in your opinion are the top three ***good*** attributes of eLMIS?

_____

_____

52. What in your opinion are the top three ***not so good*** attributes of eLMIS?

_____

_____

53. How has the use of eLMIS impacted on your day-to-day workload?

_____

_____

54. Please explain how the use of eLMIS has impacted on commodity management at your facility? -

_____

_____

55. What support do you receive from your supervisor in the use of the eLMIS?

_____

_____

56. What supply chain decisions do you use eLMIS data for?

_____

_____

57. What do you understand is your role in ensuring the continued operation of eLMIS?

_____

_____

58. Do you know who owns the eLMIS in Zambia?

_____

_____

59. Who in your understanding funds the deployment and maintenance of the eLMIS?

_____

_____

60. What do you understand is the role of government in the implementation and maintenance of eLMIS?

_____

_____