ANALYSIS OF LABORATORY LOGISTICS MANAGEMENT INFORMATION SYSTEM FOR HIV/AIDS COMMODITIES IN SELECTED PUBLIC HEALTH FACILITIES IN ETHIOPIA

By

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Advisor : Shiferaw Mitiku (PhD)

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Declaration

I, Fozia Mohammed, declare that the study titled "ANALYSIS OF LABORATORY LOGISTICS MANAGEMENT INFORMATION SYSTEM FOR HIV/AIDS COMMODITIES IN SELECTED PUBLIC HEALTH FACILITIES IN ETHIOPIA" is my original work and has not been presented for a degree in any other university, and that all sources of materials used for the study have been duly acknowledged.

Declared by:

Fozia Mohammed

Sign_____

Date_____

C E R T I F I C A T E

This is to certify that this research work, "ANALYSIS OF LABORATORY LOGISTICS MANAGEMENT INFORMATION SYSTEM FOR HIV/AIDS COMMODITIES IN SELECTED PUBLIC HEALTH FACILITIES IN ETHIOPIA", undertaken by Fozia Mohammed for the partial fulfillment of Masters of Art in Logistics and Supply Chain Management, is an original work and not submitted earlier for any degree either at this University or any other University.

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Shiferaw Mitiku (PhD)

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Fozia Mohammed,

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Acronyms and Abbreviations

LMIS:	Logistics Management Information System
HIV:	Human Immunodeficiency Virus
AIDS:	Acquired Immunodeficiency Syndrome
VL:	Viral Load
EID:	Early Infant diagnosis
IPLS:	Integrated pharmaceutical logistics system
ART:	Antiretroviral Therapy
PFSA:	Pharmaceuticals Fund & Supply Agency
WHO:	World Health Organization
USAID:	United States Agency for International Development
LSAT:	Logistics System Assessment Tool
LIAT:	Logistics Indicator Assessment Tool
JSI:	John Snow Inc.
AARHB:	Addis Ababa Regional Health Bureau
SPSS:	Statistical package for social sciences
PMTCT:	prevention of mother-to-child transmission
VCT:	voluntary counseling and testing
IFRR:	Internal Facility Report and Request
RRF:	Report and Request Form
FEFO:	First Expire First out

Abstract

Laboratory logistics management information system is the management of laboratory commodities in a systematic and standardized way by collecting, processing and utilizing timely logistics data. This is mainly to notify quantification, procurement, storage and distribution of Laboratory commodities. The main objective of the research is to analyze the practices of logistics management information system in the supply of HIV/AIDS laboratory commodities in VL/EID testing at different health facilities in Ethiopia. Quantitative and qualitative Facility based Cross-sectional data on the use of LMIS on HIV/AIDS laboratory commodities of the viral load and early infant diagnosis (VL/EID) commodities for 13 Abbot and 6 Roche machine analyzers throughout the country from June 2018 to Sep 2018 were collected. Accordingly both parametric and non-parametric tests, specifically descriptive statistics like mean, frequency & percentage and Non-parametric tests like Kendal's Wallis coefficient of concordance model were fitted. Target facilities under this study have a practice of logistics management information system for VL/EID laboratory commodities with medium managerial contribution. And, it is found out that 10(29.4%) stock out and 7(20.6%) overstock commodities for Abbot Machine, while 7(30.4%) stock out and 4(17.4%) overstock for Roche Machine. The majority of the facilities included in this study have technology, infrastructure & budget constraints in using LMIS. Provision of advanced IT support and re-designing the existing infrastructure can minimize the problem.

***Key Words**: ETHIOPIA, LMIS, VL/EID, HIV/AIDS.*

CHAPTER ONE

INTRODUCTION

This chapter introduces the background, statement of the problem, objectives, significance, scope, limitation and delimitation of the study, definition of terms & organization of the study in detail.

1.1. Background of the study

Logistics is a branch of management that deals with planning, implementing and controlling the best and cost effective flow and storage of goods or services from source to end user (Bilal, 2015). Particularly, laboratory logistics management information system (LMIS) is the systematic and standardized way of managing laboratory commodities by collecting, processing and utilizing timely logistics data to notify quantification, procurement, storage and distribution of laboratory commodities or reagents (Bilal, 2015). Thus, a logistics management information system is a scheme of records and reports for the collection, organization, and presentation of logistics data gathered transversely from each levels of the system (Tilahun, 2016).

Basically, LMIS grants the way through which people collect, manage, and report information which is essential to support sound and objective logistics decision making. On the other hand, ensuring an uninterrupted supply of commodities and identifying any problems in the supply pipeline are the main purpose of this decision making. Besides, data provided through the LMIS also help to inform policy and product selection decisions (Bilal, 2015). Moreover, decision makers can get accurate, timely, and appropriate data, such as stock on hand, losses and adjustments, consumption, demand, issues, shipment status, and information about the cost of commodities managed in the system from a well-functioning LMIS (William, 2016).

An effective logistics system facilitates to impart adequate and appropriate supplies to health providers so as to increase their professional satisfaction, motivation, and morale. Equally important, motivated staffs are vital to deliver a higher quality of service. A health center with a logistics system that provides a reliable supply of commodities will be chosen by most people for its best service; and customers feel more confident about the health program when they have a constant supply of commodities (Tilahun, 2016). In general, a properly operating LMIS reduces the likely hood of stock outs and overstocks which will lead to the wastage of scarce resources and then to product expiration (Cox, 1999).

Typically, LMIS is expected to collect the three essential data items that are needed to make logistics decisions, namely: stock on hand; quantities dispensed to user or used in a given period of time (consumption); and losses and adjustments to stock for purposes other than use (expiry, damage, wastage, theft, etc.). These data are then recorded on stock-keeping records, transaction records, and consumption records. Finally, the data are used at the facility and are reported to higher management levels for re-supply and decision purposes. At last, those information provided will be processed and reported back to lower-level facilities as a feedback to encourage and improve the performance of the logistics system accordingly (USAID, 2011).

It is obvious, that there exists a rising demand within the global health community to look for ways for improving access to diagnostics for HIV without diminishing the quality of patient care. In the HIV treatment scenario; testing for initial diagnosis, staging and ongoing monitoring throughout treatment are the basic activities what an infected individual requires. For low and middle-income country populations, and in particular for patients in peri-urban and rural settings, it can be a challenge to achieve timely diagnosis of infants under 18 months (early infant diagnosis or EID), viral load (VL) monitoring and CD4 staging. Access to VL, despite the clinical consensus on the importance of VL testing for detecting virological failure, is severely limited in many resource-limited settings. Different medical laboratory testing technology developers have responded to the need for increased access to robust, quality-assured diagnostics in resource-limited settings in order to facilitate early

detection and treatment of HIV and a number of optimized solutions are emerging or in pipeline (William, 2016).

It is released that targets of testing 90 percent of people living with HIV/AIDS, placing 90 percent of those with HIV/AIDS on antiretroviral therapy, and ensuring that 90 percent of those on antiretroviral therapy are virally suppressed (UNAIDS, 2014). These 90-90-90 targets made laboratory diagnostics are considered as a keystone for national efforts toward the epidemic control of HIV (William, 2016).

1.2. Statements of the Problem

According to the Ethiopia Demographic and Health Survey (EDHS, 2016), the national HIV prevalence among adult people aged from 15-49 years was 1.5 percent. The prevalence was 1.9 percent and 0.9 percent among females and males respectively. The HIV prevalence among 15 to 24 years was low for both sexes, but young women have a two to six fold higher HIV prevalence than young men (ranging from 15-17 years: 0 percent males vs 0.2 percent females to 20-22 years: 0.1 percent males vs. 0.6 percent females. In women the HIV prevalence peaked earlier and become higher 3.7 percent between 30-34 years while in men peaked slowly and reached high 3 percent between 35-39 years. The number of people living with HIV by 2o14 was estimated at 769,600 of whom 458,100 (59.5%) and 311,500 (40.5%) were females & males respectively (FMOH, 2011).

Antiretroviral (ARV) drugs and HIV tests like screening test as well as molecular tests (VL/EID) are both relative newcomers to public health logistics systems, and they have particular characteristics that often require making adaptations to the supply chain through which they are managed. The special nature of ARV drugs and HIV tests influences the design of the inventory control and logistics management information systems, the design of the storage and distribution networks, and the process for implementing upstream and downstream functions (USAID, 2006).

To tackle such a big issue, special focus for the efficiency of logistics management of the scarce resources is required. Accordingly, the application of Logistics Management Information System (LMIS) is important for all public health commodity distribution systems and is especially critical for Human Immunodeficiency Virus/Acquired

Immunodeficiency Syndrome (HIV/AIDS) commodities that have high value and requires special handling procedures (Tilahun, 2016). Without LMIS implementation; programs will undoubtedly let the valuable resources for wastage through prolonged and frequent stock outs, overstocks and losses (William, 2016). A well implemented LMIS reduces the likely hood of stock outs and overstocks that can waste scarce resources and lead to product expiration, especially given the short shelf life of HIV test kits (Cox, 1999).

In developing countries like Ethiopia, managing supply chains in support of laboratory services is a big challenge (Bilal, 2015) because of expanding programs for HIV/AIDS, TB and malaria require strong and supportive laboratory services that depend on the availability of the required commodities to perform critical tests, where most tests requiring multiple commodities to be available simultaneously (USAID, 2011).

According to a study conducted recently, the Ethiopian laboratory LMIS is weak and showed that about 60.5 percent health facility were stocked out for at least one antiretroviral treatment (ART) monitoring and tuberculosis (TB) (Cox, 1999) laboratory reagents consistently being hampered by several systemic challenges that caused frequent stock outs of critical commodities, thus impeding continuous and quality testing for patients (UNICEF, 2012). Currently, the country has designed integrated pharmaceutical logistics systems (IPLS) for all public health commodities including essential drugs, family planning, malaria, laboratory services, nutrition, TB-leprosy and HIV/AIDS commodities (UNICEF, 2012).

As a result, having a big deal of hard currency invested on these scarce resources (antiretroviral treatment (ART) and laboratory reagents), and HIV/AIDS is the major focus in our country; a satisfactory result has not been resulted in the entire operation. Therefore, the researcher is interested to assess the current status of the existing LMIS being applied in the supply of HIV/AIDS laboratory commodities throughout the country's health facilities.

1.3. Research Objective

The general objective of this study is to analyze the practices of LMIS on the supply of HIV/AIDS laboratory commodities in health facilities in Ethiopia.

Specifically, the study aims:-

1. To assess the practices of Laboratory LMIS for VL/EID commodities in testing HIV/AIDS health facilities in Ethiopia.
2. To identify factors that constrains the implementation of LMIS in VL/EID laboratory commodities in testing HIV/AIDS health facilities of Ethiopia.
3. To examine the stock status of key VL/EID commodities in HIV/AIDS testing health facilities in Ethiopia

1.4. Research Questions

1. How LMIS is being practiced in the supply of HIV/AIDS laboratory commodities in HIV/AIDS testing health facilities in Ethiopia?
2. How factors constrain the implementation of LMIS in VL/EID testing health facilities of Ethiopia?
3. What is the stock status of key VL/EID laboratory commodities in HIV/AIDS testing health facilities of Ethiopia?

1.5. Significance of the Study

The outcome of this project is to improve the management of laboratory commodity logistics system in health facilities in Ethiopia. Moreover, the expected deliverables of this project is to provide reliable, accurate and manageable information that will help for decision making. Consequently, customers can have uninterrupted services with regard to laboratory commodity. Furthermore, it aspires to avert resource wastage and reduce supply chain of commodities inconsistency.

Reliable monitoring of the quality of laboratory LMIS of this project is expected to reduce the frequency of stock out, over stock and lose of laboratory commodities; Detect and organize available commodities on the shelf as early as possible; Apply the principle of first expire first out (FEFO) and Minimize the wastage of laboratory reagents and resources.

1.6. Scope of the Study

Quantitative and qualitative cross-sectional study using structured questionnaire, focuses on the implementation of LMIS on HIV/AIDS laboratory commodities by focusing on the viral load and early infant diagnosis (VL/EID) reagents and supplies with a total of 34 in number and covers 13 Abbot and 6 Roche machine analyzers in the total of 18 VL/EID testing sites throughout the country from June, 2018 to Sep, 2018. Other qualitative measurement tools are also employed from the WHO laboratory logistics assessment tool, training on LMIS, stock out status, availability and storage condition.

1.7. Delimitation of the Study

The efficiency and effectiveness of Logistics Management Information System (LMIS) on the supply of HIV/AIDS laboratory commodities in health facilities in Ethiopia can be best studied by considering the quality of designed system applied, technical knowhow and behavior of human resource used, the practice currently followed and other factors that affect the entire system directly and indirectly all health facilities throughout the country. However, because of subject matter, time and budget constraint, the researcher limits the objective to assess the LMIS practices in some selected health facilities chosen.

1.8. Limitation of the Study

Even though this study is conducted all over the country, only 11 health facilities are included into consideration out of the total 18 health facilities in the country. In addition, since the study is a cross sectional, it assesses the situation only over the study period irrespective of the dynamic nature of the case over time. Therefore, the above two reasons are the possible limitations of the study.

1.9. Definition of Terms/ Operational Terms

Stock keeping records (Bin card): The minimal information that should be collected on stock records for Pharmaceuticals and other health products. It includes:- product name, beginning stock balance, stock on hand, receipts, issues, losses/adjustments, closing & ending balance & transaction reference.

Transaction records (Stock card): It's a database for keeping transaction records. It includes the order of all items involved in the transaction.

Consumption records: The daily use record book used to make entries of all products dispensed on a daily basis & used as a forecasting data for quantification purpose.

Stock on Hand: Quantities of usable stock available at a particular point in time.

Losses: Losses are the quantities of products removed from the stock other than in the provision of services to patients or issuing to another facility (e.g. expiry, lost, theft, or damage) and are recorded as negative numbers.

Adjustments: are quantities of a product received from or issued to anyone. An adjustment may also be a correction due to an error in mathematics & recorded as negative or positive number.

CD4: is a glycoprotein found on the surface of immune cells such as T helper cells, monocytes, macrophages, and dendrite cells.

Early infant diagnosis (EID): The test for diagnosing HIV/AIDS in infant and children below 18 months.

Viral load- is a term that people living with HIV use to express about how much virus is in their blood.

1.10. Organizations of the Thesis

This research report is arranged into five chapters. The first chapter briefs the background, research problem, objectives, questions, scope, delimitation, limitations, and definition of terms and organization of the study. While the second chapter reviews the related literatures and the theoretical & empirical framework of the study. The next two chapters focus on the research design and method of the study, analysis and interpretation of data. Finally, the last chapter deals with the summary of findings, conclusions and recommendation.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter summarizes the review of theoretical and empirical literatures, conceptual framework of the study and identified literature gap.

2.1. Theoretical Literature Review

2.1.1. Definitions of Logistics

According to the Council of Logistics Management (1998), logistics owes its origins to the military that have long recognized the importance of logistical activities for national defense. The military definition of logistics encompasses supply items as well as personnel. It is reported that the term logistics became part of the military lexicon in the 18th century in Europe. The logistics office was responsible for encamping and quartering the troops and stocking supply depots (Kumurya, A. 2015).

The logistics concept began to appear in the business related literature in the 1960s under the label of physical distribution, which had a focus on the outbound side of the logistics system. During the 1960s, military logistics began to focus upon engineering dimensions of logistics-reliability, maintainability, configuration management, life-cycle management, continuing supply support, etc with increased emphasis upon modeling and quantitative analysis. In contrast, the business or commercial applications were usually more focused upon consumer nondurable goods related to marketing and physical distribution of finished products. The engineering related logistics, as practiced by the military, attracted attention among businesses that produced industrial products that had to be maintained with repair parts over the life cycle of the product, for example, generators, airplanes, manufacturing equipment, and so on. In fact, engineers developed a separate professional organization called the Society of Logistics Engineers, which has had active participation from both the military and commercial enterprises (Kumurya, A. 2015).

The business or commercial sector approach to logistics developed into inbound logistics (materials management to support manufacturing or operations) and outbound logistics (physical distribution of finished goods to support marketing) during the 1970s and 1980s. Then, in the 1990s, the business or commercial sector began to view logistics in the context of a supply or demand chain that linked all of the organizations from the vendor's vendor to the customer's customer (Gleissner & Femerling, 2013).

On the other hand, logistics is the planning, organization, and control of all activities in the material flow, from raw material until final consumption and reverse flows of the manufactured product or goods to satisfy customers, i.e. to provide a good customer service at low cost and capital with petite environmental consequences (Jonsson & Mattsson, 2005).

Logistics is defined as meeting the seven activities or Seven R's; which are activities that are related to receive the right product or service in the right quantity, in the right quality, in the right place, at the right time, delivering to the right customer, and doing this at the right cost (Shapiro & Heskett, 1985).

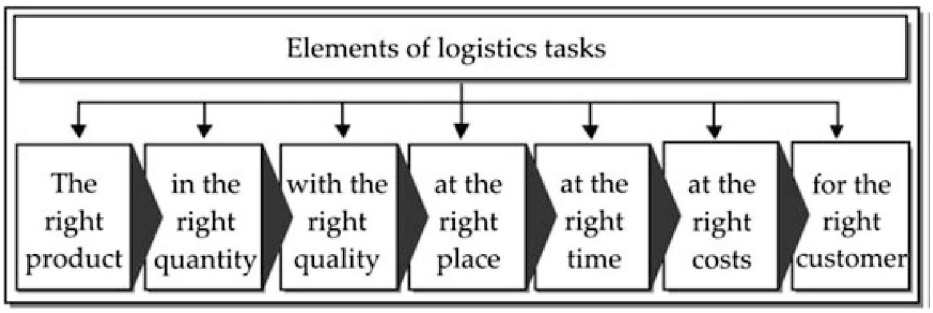

Fig. 2.1: Elements of Logistics Tasks (Cf. Klaus 2002)

On the other hand, logistics management is the subset of supply chain management that plans, implements and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information from the point of origin to the point of consumption in order to meet customer's requirements. Logistics management activities include inbound and outbound transportation management, fleet management, warehousing, materials handling, order fulfillment, logistics network design, inventory management, supply/demand planning, and management of third party logistics services providers (CSCMP, 2004).

The logistics function also includes sourcing and procurement, production planning and scheduling, packaging and assembly, and customer service which are involved in all levels of planning and execution strategic, operational, and tactical. Logistics management is an integrating function which coordinates and optimizes all logistics activities, as well as integrates logistics activities with other functions, including marketing, sales, manufacturing, finance, and information technology (CSCMP, 2004).

2.1.2. Dimension of Logistics Management

The importance of logistics to the ultimate success of a military campaign has been well recognized and documented. For more than thousands of years, war referred to logistical functions and their relationships with strategy and tactics. Basically, logistics deals with satisfying the customer. Every one of us is in the economic system on the one hand customer and on the other hand a supplier. Even an employee is a supplier for its company. It delivers its achievement. This implies that management must first understand what those requirements are before a logistics strategy can be developed and implemented to meet them. Products are not usually any longer manufactured today, where they are needed. Therefore they must be transported to the customers. Products are today manufactured, where it is most inexpensive. Logistic processes can be seen by different sides which comprises many components. In fact, some are major while the others are supportive activities (Dorn C, 2003).

Fig 2.2: Logistics Components (Dorn C, 2003)

Logistics is the universal pipeline that plans and coordinates the delivery of products and services to customers all over the world. Logistics professionals manage and coordinate activities in this global pipeline to ensure an effective and efficient flow of materials and information from the time a need arises until it is satisfied, where so many activities are involved even though one includes the other. However, some of the major activities involved in logistics include: Inventory Management, Transportation Management and Product Distribution (Council of Logistics Management, 1998)

2.1.2.1. Inventory Management

Inventory management deals with balancing the cost of maintaining additional products on hand against the risk of not having those items when the customer wants them (i.e. the cost of lost sales). This task has become more complex as firms have gradually lowered inventory levels. The challenge in this situation is to manage the rest of the logistics system to accommodate the lack of inventory so that customer service does not suffer. However, all of the interest in reducing inventories notwithstanding, the fact remains that inventory management is still necessary for serving customers in many markets (Dorn C, 2003).

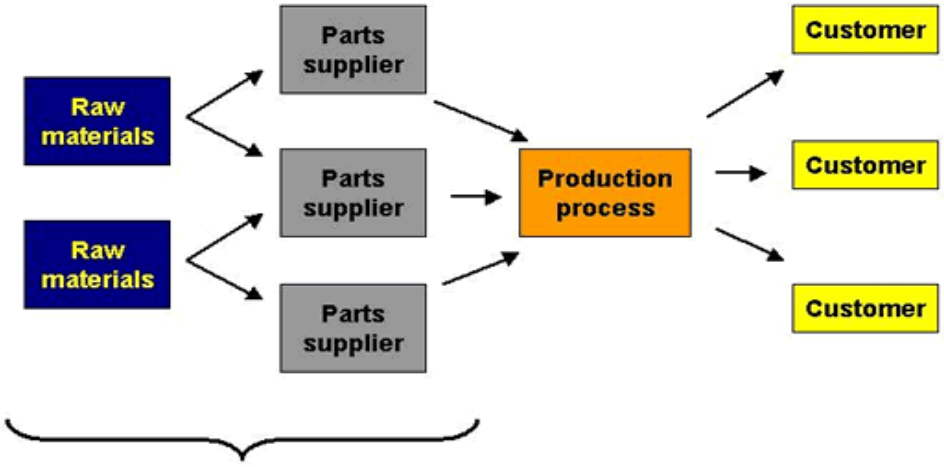

Fig 2.3: Materials management (Dorn C, 2003)

2.1.2.2. Transportation

Transportation refers to the physical movement of goods from a point of origin to a point of consumption. It can involve raw materials being brought into the production process and/or finished goods being shipped out to the customer. Transportation has assumed a greater role

in many logistics systems for two reasons. First, the liberalization of transportation laws in many countries has provided opportunities for knowledgeable managers to obtain better service at lower prices than they could in the past. Second, as inventory levels have dropped in response to the popularity of just-in-time (JIT) strategies, transportation is frequently used to offset the potentially damaging impact on customer service levels that would otherwise result from those inventory reductions (Dorn C, 2003).

2.1.2.3. Physical Distribution

Companies experience greater management challenges at finished goods that they are more concerned with the flow of end production line to the customer. As shown in the fig below, logistics in this situation is sometimes referred to as physical distribution and is a perspective in many consumer goods manufacturing firms (Dorn C, 2003).

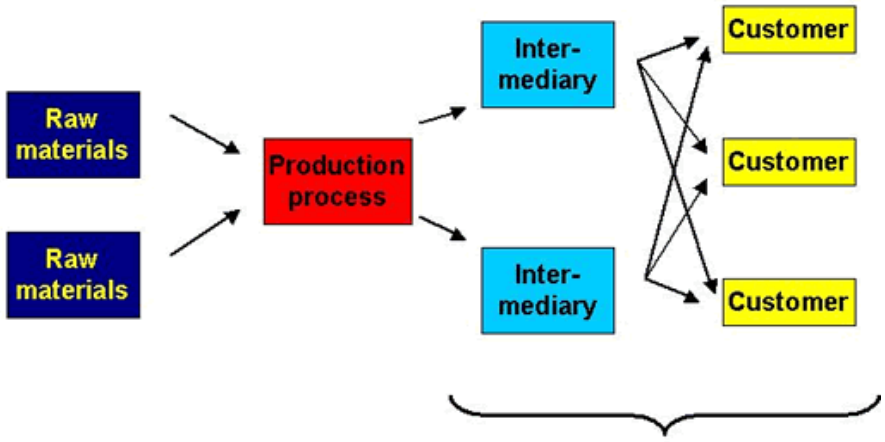

Fig 2.4: Physical Distribution (Dorn C, 2003)

2.1.3. Logistics Management Information System

LMIS is the process of managing laboratory commodities in a systematic and standardized way that including the collection of data required to manage commodities; where Laboratory commodities include reagents, consumables, supplies, and equipment. The main tools used for recording data are stock cards, requisition forms, registers, and report templates/formats which should be generated periodically. The extensive number of commodities used by laboratories makes logistics management more complex (Pharasi B, 2007).

A well-functioning LMIS will often produce much of the same data on commodity availability and products flows that could be gained from an assessment in which the LIAT is used. Stakeholders with only limited funds for conducting evaluations may choose to analyze LMIS data instead of conducting a facility-based survey as a cost-savings measure. It is important to note, though, that such a decision assumes the LMIS contains accurate information from all facilities in a system. For its part, the LIAT is not only used to collect data on product availability, but also to support these findings. The LIAT helps determine stock out rate, how to met LMIS reporting requirement, type of training and supervision for staffs, storage conditions and how LMIS records are being maintained routinely & accurately (USAID, 2006).

LMIS is a system that provides the data required to maintain inventory control system , such as quantity at hand at service delivery point, quantity received and quantity used within a reporting period, number of people that were served per the period and the quantity of the commodity required to bring it to the accepted level (maximum level) per time in the reporting period. In order to achieve the required level of achievement, forms and documentation are used to move items from one point to another within the health facility and to other facilities, track usage, maintain records and produce reports on the logistics system. The data collected through LMIS helps the facility to determine if the stock available at the facility is enough to serve its patients or whether to make an emergency order to the supplying facility or not before the order interval, when there will be comparison of stocks available to established maximum stock level and order the quantity needed to bring stock levels to maximum (Emmanuel U *et al*, 2017).

An LMIS helps personnel collect and manage the information necessary to support sound and objective decision making in managing the supply chain; the goal of this decision making is to ensure an uninterrupted supply of commodities and to identify any problems in the supply pipeline. The LMIS is composed of all the forms and documentation used to maintain records and produce reports on the logistics system. An effective LMIS makes regular and timely information available to decision makers. Information is used to make short-term resupply decisions and long-term procurement and program management decisions. Timely and accurate commodity data are critical for logistics system performance (BITRI, 2015).

Specifically, Antiretroviral (ARV) drugs and HIV tests are both relatively new ideas to public health logistics systems, and they have unique characteristics that often require making adaptations to the supply chain through which they are managed. The special natures of ARV drugs and HIV tests influence the design of the Inventory Control and Logistics Management Information Systems, the design of the storage and distribution networks, and the process for implementing upstream and downstream functions. Because the programs that use these commodities, voluntary counseling and testing (VCT), prevention of mother-to-child transmission (PMTCT), and antiretroviral therapy (ART) are still evolving in the way services are being provided. Hence, the special characteristics of HIV tests and ARV drugs affect the current logistics practice, supply chain performance and system design (USAID, 2006).

2.2. Empirical Literature Review

Many researchers have conducted studies aiming at assessing the status of LMIS as applied on HIV/AIDS and TB Laboratory commodities in different public health facilities.

According to a cross-sectional descriptive study conducted in Ethiopia by Desale, to assess the status of laboratory LMIS used for managing HIV/AIDS and TB laboratory commodities, reports used in LMIS (IFRR and RRF) have multiple portions arranged as columns requiring various data sets (such as the beginning balance, quantity received, loss and adjustments, and ending balances) and involving additional computations (consumption, quantity needed to reach maximum stock level). Evaluation of those report formats in two review periods between Dec 2013 to Mar 2014 showed that 24 (92.6%) and 21 (87.5%) of facilities had completed data items on RRF and IFRR, respectively. However, a total of 24 (92.6%) facilities reported stock out for one or more of Laboratory commodities within six months while 22 (84.6%) facilities reported that HIV/AIDS and TB laboratory commodities were not refilled as per their request (Desale, 2011).

Even though most of the health facilities were using stock/bin cards for all HIV/AIDS and TB laboratory commodities in main pharmacy store, almost half of them were not updated with accurate information matching with the physical count done at time. In addition, most of the facilities (60.5%) were stocked out for at least one ART monitoring and TB laboratory reagents and the highest stock out rate was for chemistry reagents. Besides, expired ART monitoring laboratory commodities were found in 25 (73.5%) of facilities and there existed a

well-designed logistics system for laboratory commodities with trained pharmacy personnel and good distribution of standard LMIS formats and established inventory control procedures; however, majority of laboratory professionals were not trained in LMIS (Desale, 2011).

Another study also supported the above idea that there was a well-functioning logistics management information system in Ethiopia for laboratory commodities in most health facilities; and stock out was a common problem which might be caused due to lack of practicing max-min inventory system, weak quantification/forecasting, shortage of funding and requested quantity not received in the right time. Particularly, out of 42 HIV/AIDS items/reagents, 15 (35.7%) were out of stock from which 46.7% were hormone reagents and followed by Clinical Chemistry (40%) in stock out. And the frequency of stock out, under stock and over stock of laboratory commodities at the time of assessment were 35.7%, 23.8% and 9.5% respectively. In addition, among the total participants 15(83.3%) of the respondents did not have in-service training on LMIS (Bilal M, 2015).

A study conducted in Lesotho showed that, majority (67%) of laboratories had no stock cards and thus did not conduct a physical inventory of reagents and supplies; where indicators used to assess inventory management practices for laboratory commodities were the formula used to calculate orders, current stock levels, availability of basic reagents and supplies, occurrence of stock-outs and the presence of expired items. The study resulted that 67 percent of the laboratories assessed did not have a set minimum stock level for reagents and consumables at which orders needed to be placed, while 83 percent reported that they did not have maximum stock levels for reagents and consumables. Some laboratories used to send reports to the Central Laboratory and District level on stock status, and only 17 percent of the sites reported that the forms they complete are integrated with the Hospital Management Information System (Pharasi B, 2007).

Regrettably, all laboratories didn't have written guidelines for storage of laboratory supplies as per their specifications and poor storage facilities. One third of them were found not to store reagents in accordance with first expiring-first out (FEFO) practice and none of them practiced the separation of damaged/or expired supplies from usable ones. Items were not also stored at appropriate temperatures due to refrigerators being too full and space not being available (Pharasi B, 2007).

Another facility based cross-sectional descriptive study conducted in Nigeria stated that all of the facilities assessed (100%) were found to use stock/bin cards and consumption registers for all HIV/AIDS laboratory commodities managed; which is better than 70% reported in a similar study in Malawi by Butao *et al*, 2009 and 50% reported by Desale *et al*. (2013) in their study in Ethiopia. Even though this result shows that the application of LIMS is much more efficient in Nigeria; population size is too small (only 17 centers) that may not be a representative throughout the country. The difference may be due to availability of stock/bin cards in all the facilities. Majority of stock/bin cards were updated with accurate information matching with the physical count done at the time of visit. And all of them received laboratory consumables more than the quantity requested or ordered for (Emmanuel U *et al*, 2017).

Majority of stock/bin cards were updated with accurate information matching with the physical count done at the time of visit and the average accuracy of stock/bin cards matched with physical count as observed was about 85%. All the assessed facilities were currently using standardized LMIS forms for reporting, requesting and ordering commodities; and ten (29%) of the study participants reported having problem correctly filling bi-monthly to report and request for commodities (Emmanuel U *et al*,2017).

Another facility based descriptive cross-sectional study conducted to assess the status of IPLS implementation for HIV/AIDS monitoring and TB diagnostic commodities in public health facilities in Addis Ababa revealed that the level of trained/skilled professional turnover is the concerning issue; the level of institutional ownership and supportive supervision too weak; the level of coordination among the different stakeholders involved in the system is poor; accountability and system for monitoring and evaluation of performances and gaps in the system is still a big concern. Besides, the level of motivation and commitment to properly and timely conduct operations in IPLS is too weak. Besides, the study found out that the availabilities of IPLS recording and reporting formats (bin cards, and IFRR and RRF) were reported in 92.6% of facilities; while the utilization of bin cards were 33.5% in hospital and76.5% in health centers. It also showed that 24 (96%) of facilities reported one or more reagents stocked out during the last six months; but 10 (41.6%), 12 (54.5%) and 11(46.7%) of facilities were reported stock out of SGPT, BD

vacationer tube and 1% Carbol Fuchsin respectively on the day of the visit. Additionally, the assessment showed 7 (43.8%), 9 (64.7%) and 9 (69.8%)of facilities reported stock out of SGOT, SGPT and Acid alcohol, respectively (Tilahun A *et al*, 2016)

A study conducted in Uganda to evaluate health commodity management and the performance of the national logistics system for health commodities revealed that less than half of Ugandan health facilities had stock outs of the commodities surveyed in the six-month period preceding the survey. However, at district hospitals, many of the stock outs were stayed for longer time. In addition, many of the facilities that had stock outs during the survey period were not keeping their stock cards up to date. The most common reason given by facilities for the occurrence of stock outs was that a higher level facility did not send the commodities in time. Some items were significantly overstocked at all levels while others were under stocked at all levels. But the other commodities were stocked appropriately on the day of the survey, with lower stock levels at the higher level facilities and higher stock levels at the lower level facilities. Although the majority of facilities reported using stock cards, a smaller percentage of facilities were actually found to be using the cards on the day of the survey **(**Uganda Health Facilities Survey, 2002).

Regarding the schedule of making orders, approximately one-quarter of the facilities place commodity orders about every two months as they are assessing their commodity needs to place orders, which is the same frequency as the new pull system protocol. At all levels of the system both in government and nongovernment facilities except district warehouses and some district hospitals, health commodities are not routinely managed by staff trained in logistics. However, staffs at higher levels of the logistics system are more likely to have received formal training in logistics management than staff at lower levels. So, many staff learns to perform daily logistics tasks informally on the job. Supervisory visits occur regularly and include limited monitoring of logistics tasks such as record keeping and stock management. Supervision is more routine at the lower levels of the health care system **(**Uganda Health Facilities Survey, 2002).

Another study in Ghana conducted to assess Implementation of IPLS showed that availability of IPLS formats for recording and reporting-bin cards, internal facility report and requests (IFRR), and report & request forms (RRF) was reported in 92.6% facilities and regular update of formats for IFRR and RRF was 61.5% facilities. Utilization of bin cards on health centers and Hospitals was 76.5% and 33.3% respectively and 92.6% facilities reported stock out (Darko E *et al*, 2014).

Management support for IPLS implementation was significantly associated with improved data quality and utilization of IFRR. There exists a well-designed logistics system for laboratory commodities with trained pharmacy personnel, distributed standard LMIS formats and established inventory control Procedures. However, majority of laboratory professionals were not trained in LMIS. Expired ART monitoring laboratory commodities were found in 73.5% of facilities. Among which only 25% & 20.8% of them were updated with accurate information matching to the physical count done at the time of visit for Hospitals and Health centers respectively. The study also found out that order fulfillment of laboratory commodities were 25% (Darko E *et al*, 2014).

Generally, since all reviewed studies showed the general commodities of HIV/AIDS but not specifically on VL/EID, the researcher is more desirous to find out the LMIS practice in line with VL/EID in particular.

2.3. Conceptual Framework of the Study

This study focuses on the basic LMIS parameters on VL/EID testing facilities to show the practices on the day to day activities of testing facilities like Training of professionals in LMIS, Stock Availability by Commodity Type, Reported stock outs during the last 6 months, Stock outs at the time of visit and Logistics Management Information System.

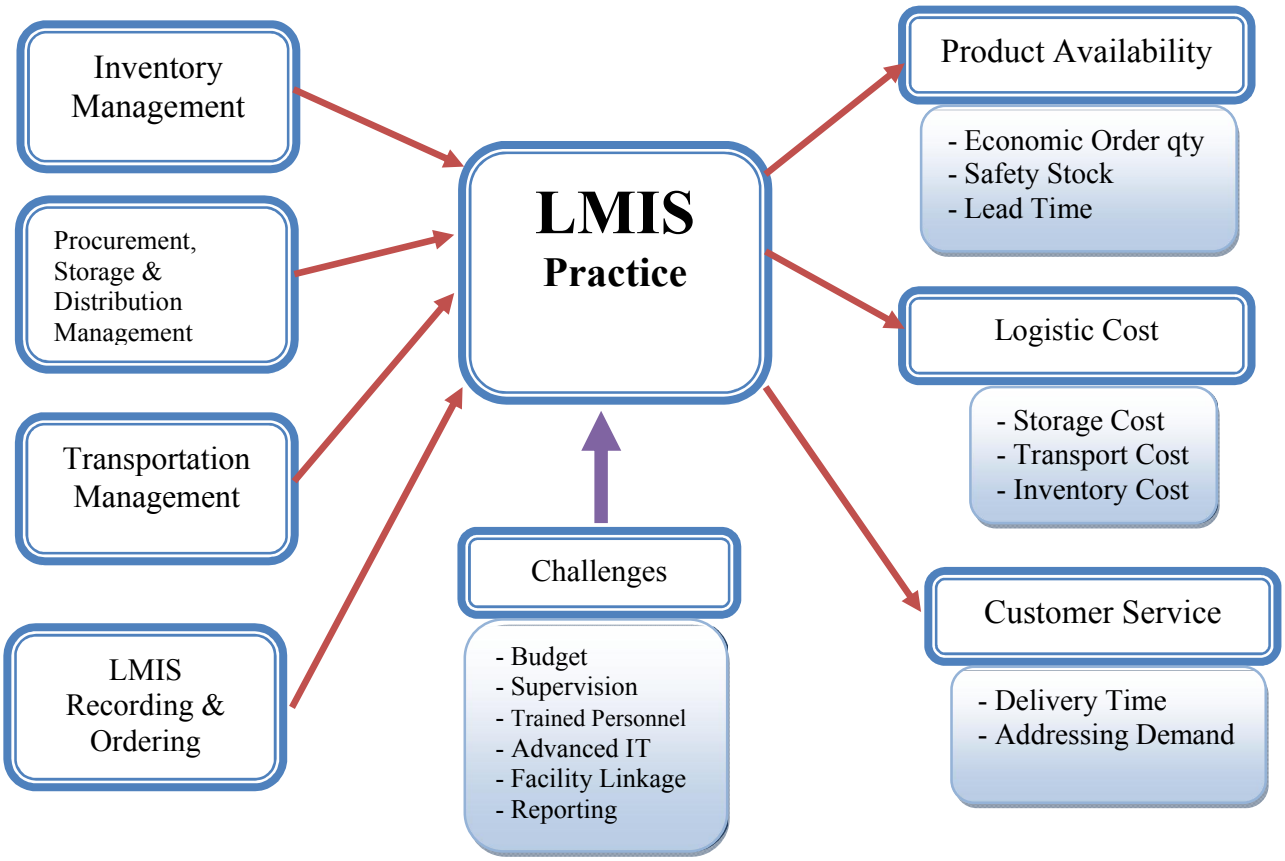

Fig 2.5: Conceptual Model for Assessing LMIS Practice [Own Depicted, 2018]

2.4. Identified Literature Gap

To the knowledge of the researcher, no prior study has been conducted with trust area of VL/EID commodities significantly with the Ethiopian context. Hence, all the reviewed studies showed the general commodities of HIV/AIDS as a whole but not specifically on VL/EID. However, as Laboratory commodities need special handling, storage condition and distribution, a further investigation is required on VL/EID. Thus, the researcher wanted to find out and fill this gap in literature.

Viral load diagnosis measures HIV genetic material called RNA from virus particles called virions in the blood plasma. A viral load Machine is used to test the amount of HIV virus in a sample of blood. This is usually reported as the number of copies per milliliter (copies/ml).

Viral load monitoring for HIV is the regular measurement of the viral load of individual HIV-positive people as part of their personal plan for treatment of HIV/AIDS. In Ethiopia, there are 18 sites (health facilities) that have been conducting the diagnosis of Viral Load/Early Infant Diagnosis (VL/EID) where each site have at least one of the two known VL/EID machines namely Abbot and Roche machines. The Abbot machine requires 34 laboratory commodities and the Roche machine requires 23 laboratory commodities. Each machine can operate only if the full list of commodities are fulfilled, otherwise if a single item is missed, diagnosis is not possible. Besides, one item of commodity for one machine can't be used by the other.

Accordingly, there are 19 viral load/Early infant diagnosis (VL/EID) in 18 sites of health facilities from which 13 are Abbot machines and 6 are Roche machines.

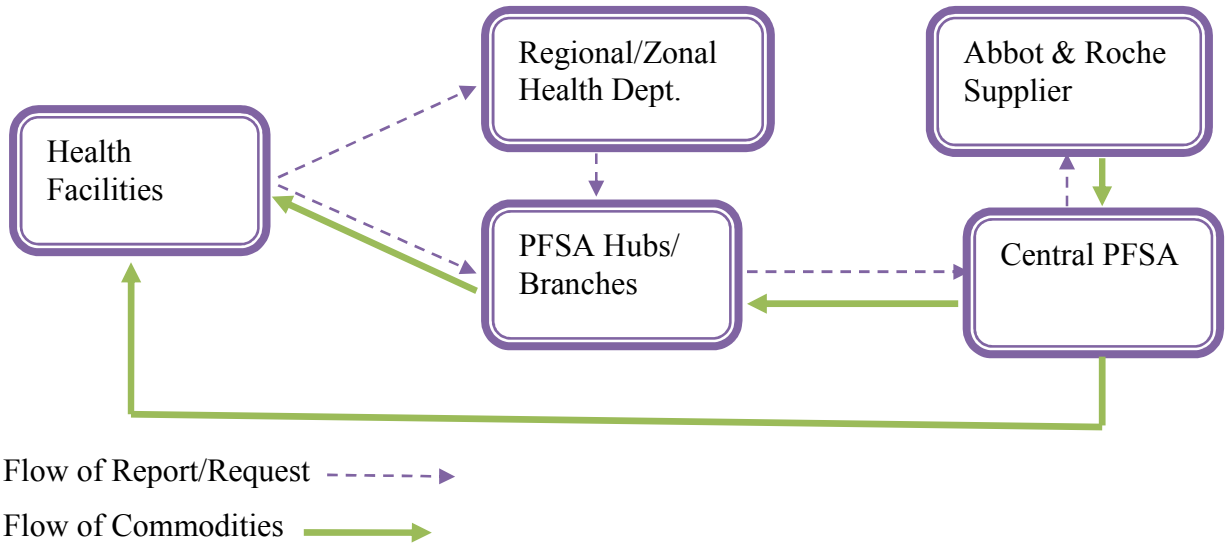

Fig 2.6: Flow of Laboratory Commodities and Information in LMIS [Own Depicted, 2018]

CHAPTER THREE

METHODS OF THE STUDY

This chapter briefly describes the research design, sampling techniques applied, the population area including the data sources, ethical consideration, method of data analysis & presentation and Validity & reliability test.

3.1. Description of the Study Area

Ethiopia covers an area of 1,126,829 km², with a population of more than 90 million inhabitants that makes the country the second-most populous nation in Africa followed by Nigeria (WORLD FACT, 2018).

There are around 18 viral load testing health facilities throughout the country to work the HIV viral load testing for ART monitoring and evaluation (EPHI, 2017).

3.2. Research Approach and Design

This study was a facility based cross-sectional descriptive study. Both quantitative and qualitative data collection methods were employed. Primarily, a set of questionnaire (survey) was distributed to 46 laboratory professionals to assess laboratory LMIS. In addition, interviews were used to collect primary data from persons responsible for managing laboratory commodities at different levels at PFSA using structured questions. Add to this interview was applied to triangulate the data collected from questionnaire and secondary sources. Furthermore, reviews of stock keeping records (documentation) and observation of physical inventory (participant observation) of HIV/AIDS laboratory commodities available were made at the time of visit to the facilities from June to August, 2018.

3.3. Population and Sample Design

The study population is laboratory professionals of selected HIV/AIDS testing health facilities in Ethiopia involved in the supply chain of HIV/AIDS laboratory commodities. This includes public health facilities providing laboratory services for VL/EID diagnosis, monitoring and treatment services. Accordingly, there are 60 professional working in 18 medical institutions throughout the country in relation to HIV/AIDS laboratory commodities.

Table 1.Roche Machine Sites

No.	Name of Health facilities	Location/region
1	Ethiopian Public Health Institute	Addis Ababa
2	Federal Police Referral Hospital	Addis Ababa
3	Debre Markos University Hospital	Amhara region
4	Gondar University Hospital	Amhara region
5	Debre Birhan Hospital	Amhara region
6	Jimma University Hospital	Oromia region

Source: (EPHI, 2017)

The above table (Table 1) shows the list of six health facilities found in different regions of the country having Roche Machine for testing VL/EID.

Table 2: Abbott Machine Sites

No.	Name of Health facilities	Location/region
1	Ethiopian Public Health Institute	Addis Ababa
2	ALERT Hospital	Addis Ababa
3	Addis Ababa Regional Lab	Addis Ababa
4	Black Lion Hospital	Addis Ababa
5	Amhara Public Health Institute (APHI)	Amhara region
6	Dessie Regional Lab	Amhara region
7	Mekelle Regional Lab	Tigray region
8	Adama Regional Lab	Oromia region
9	Harer Regional Lab	Harari region
10	Hawassa Regional Lab	South nations and nationality
11	Nekemte Regional Lab	Oromia region
12	Gambella Regional Lab	Gambella region
13	Armed Force Teaching Hospital	Addis Ababa

Source: (EPHI, 2017)

Table 2 shows the list of 13 health facilities found in different regions of the country having Abbot Machine used for testing VL/EID; where Ethiopian Public Health Institute (EPHI) is the only health facility having both types of testing machines.

Table 3: Number of Staff per Region and Sites

Region	Name of Health Facility	Roche	Abbot	Remark
Addis Ababa	**Ethiopian Public Health Institute(EPHI)**	7	7	
	Federal Police Hospital	3		
	ALERT Hospital		1	
	Addis Ababa Regional laboratory		2	
	Black Lion Hospital		3	
	Armed Force Teaching Hospital(AFTH)		3	
Amhara	**Debre Markos Hospital**	3		
	UOG University of Gondar Hospital(UOG)	3		
	Debre Birhan Hospital	2		
	Amhara Public Health Institute(APHI)		4	
	Dessie Regional Lab.		5	
Oromia	**Jimma University Hospital**	3		
	Adama Regional Lab.		2	
	Nekemte Regional Lab.		2	
Tigray	**Tigray Public Health Institute(TPHI)**		2	
Harari	**Harar Regional Lab.**		2	
Gambella	**Gambella Regional Lab.**		2	
South	**Hawassa Public Health Institute**		4	

Source: (EPHI, 2017)

Table 3 shows the number of staff working at each machine found at different health facilities within the country working on testing of VL/EID.

Inclusive Criteria: - Priority was given to those sites having professional staff of three and more. This was because of the reason that, from experience, as the number of workers assigned at each site become less (one or two), workers would be overloaded and information would be less organized. As a result, those sites with a staff number of three and more was included in the study irrespective of the type of machine they have.

Exclusive Criteria: Consequently, those sites having staff number of two or less was excluded from the population of the study.

However, Black Lion Hospital was excluded because of unwillingness and two other sites namely, Adama and Gambella Regional Laboratory were included instead with special case.

Accordingly, out of the total 60 professionals working on the HIV/AIDS and related commodities, 46 (11 sites) of them were selected as the population of the study based on the above criteria.

3.4. Data Source and Type

Semi-structured questionnaire were customized from tools for logistics system assessment developed by USAID/DELIVER. The qualitative section of the questionnaire was adopted from LSAT (Logistics service assessment tool) while the quantitative section was adopted from LIAT (Logistics Indicator Assessment Tool). Data sources were from interview, document review and questionnaires.

3.5. Data Procedure

A structured questionnaire which was originally developed by JSI/DELIVER (2009) and logistics system assessment tool (LSAT) but adapted for this study was used to collect quantitative information from the health facilities. In addition to the information collected through interview and structured questionnaire, physical counts of the laboratory commodities will also be done in order to assess data quality by comparing the actual counts with available stock-keeping records. Inventory stock-keeping records were also being checked for accuracy.

3.6. Ethical Considerations

The study was first approved by Addis Ababa University (AAU) Institutional Review Board of the Faculty and research and ethical committee of the Addis Ababa Regional Health Bureau before the study, and then a letter informing the facility administrators was written from the Addis Ababa University, School of Commerce and the Addis Ababa Regional Health Bureau (AARHB). There was a high degree of confidentiality during data collection and no name of any health facility and participating subjects was disclosed in the result instead the aggregate result of the facilities and summary of results was projected.

3.7. Method of Data Analysis and Presentation

The quantitative data were coded and analyzed using SPSS version 20 software. Then, descriptive statistics mainly frequency, mean and percentage statistics were computed and results were presented using tables and graphs. Besides, non-parametric test mainly Kendall's Wallis coefficient of concordance model was computed. The qualitative portions of the study were analyzed using qualitative analysis technique (re-listening to the tape recorders several times, transcribing data, categorizing, reducing and finally writing the report by narrating the finding).

3.8. Validity and Reliability Test

A set of samples questionnaire was distributed to three selected health facilities found in Addis Ababa to test the validity of the research questionnaire as a pilot test. Accordingly, the sample questionnaire was distributed to three Logistic Experts and their comments were incorporated.

To deal with the correlation between measuring variables, Cronbach's alpha value is the most common internal consistency reliability coefficient to check whether the designed tools under each categories measure the intended variable or not. The Cronbach's alpha value should be at least 0.7 for the reliability of a designed tool to be scaled as 'adequate', and at least 0.8 to be scaled as 'good'. (Garson, 2006)

Accordingly, the Cronbach's alpha values for each variable fell within 0.7 to 0.8 which were considered as good as shown in the table below.

Table 4: Reliability Test

No	Variables of the study	No of Respondent	No of items	Cronbach's Alpha
1	LMIS data sync. formats	10	5	.739
2	Reporting formats	10	4	.771
3	Ordering & receiving	10	4	.841
4	Managerial activities	10	3	.736
5	Standard stock level use	10	4	.752

Source: - Pilot Questionnaire Result 2018

CHAPTER FOUR

RESULTS, DISCUSSION AND INTERPRETATION

This research was an assessment of the practices of LMIS on the supply of HIV/AIDS laboratory commodities in health facilities in Ethiopia. The result of the research is discussed as follow.

4.1. Socio Demographic Characteristics of the respondents

A total of 46 laboratory professionals were involved in the assessment of the practices of LMIS on the supply of HIV/AIDS laboratory commodities in health facilities in Ethiopia, of which 9 (19.60%) were females and 37 (80.40%) were males. Regarding the age of the study population, 16 (34.80%) respondents were between the age group of 20-30 years and the rest 30 (65.20%) were from 31- 40 years age group. Concerning educational status, the majority of the respondents 27 (58.70%) have MSc degree, while 17 (37%) of them have bachelor degree and the rest 2 (4.30%) have diploma. As of the working position of the respondent, 5 (10.90%) of them were laboratory heads, 7 (15.72%) were laboratory quality officers, 4 (8.70%) were laboratory store managers, and 30 (65.20%) were laboratory technologists.

Concerning the work experience of the respondents, 29 (63%) have worked for 0-5 years, 16 (34.80%) of them have worked for 6-10 years and 1 (2.20%) respondent has worked for more than 10 years. The above information has presented in table 5 as follows:

Table 5: Socio-demographic characteristics of laboratory professionals

Variables(N=46)	Category	Frequency	Percent
Sex	Female	9	19.6
	Male	37	80.4
Age	20-30 years	16	34.8
	31-40 years	30	65.2
	41-50 years	0	0.0
	Above50 years	0	0.0
Educational Qualification	MSC & above	27	58.7
	Bachelor Degree	17	37.0
	Diploma	2	4.3
Position	Laboratory head	5	10.9
	Laboratory quality officer	7	15.2
	Laboratory store manager	4	8.7
	Laboratory technologist	30	65.2
Experience	1-5 years	29	63.0
	6-10 years	16	34.8
	Above 10 years	1	2.2

Source: Own Survey, 2018

Generally, the majority of the population included 37 (80.40%) is male and only 9 (19.60%) is female that reveals the contribution of female is still less. The result of the study also indicated that more than half of them 27 (58.70%) have MSc degree and 17 (37%) of them have bachelor degree which showed that most of them are academically fit for the intended position; however, majority of them 29 (63%) have worked for 0-5 years and only one-third of them 16 (34.80%) have worked for 6-10 years; which implies the information system on the case in point is at infant stage in the industry.

4.2. LMIS Practice With Respect to Data Synchronization

Among the 46 population of the study, 32 (69.60%) of the respondents reported that they were using stock card, while 12 (26.10%) said that they didn't use stock card at all, and the rest 2 (4.30%) said that they didn't know about it.

As of the bin card, 44 (95.70%) used bin card while the rest 2 (4.30%) didn't use it. Concerning daily register, 12 (26.10%) of them were using it, 32 (69.60%) were not, and the rest didn't know.

As regard to RRF, 43 (93.5%) of them were using RFF, while 3 (6.50%) didn't use it. But, 39 (84.80%) of them were found to use IFRR , and the rest 7 (15.20%) not.

On the other hand, majority of the respondent 44 (95.70%) were found to have the practice of compiling reports and sending to higher level, from which 22 of them used to send monthly and 19 of them used to weekly; while the rest 2 (4.30%) have no practice. In addition, 31 (67.40%) of the respondent were reporting to PFSA; 10 (21.70%) of them to RHB & PFSA, and the rest 3 (6.50%) to others.

Table6: LMIS practice with respect to data sync.

Variables (N=46)	Category	Frequency	Percent
Stock cards	Yes	32	69.6
	No	12	26.1
	I Don't Know	2	4.3
Bin cards	Yes	44	95.7
	No	2	4.3
Daily register	Yes	12	26.1
	No	32	69.6
	I Don't Know	2	4.3
RRF	Yes	43	93.5
	No	3	6.5
IFRR	Yes	39	84.8
	No	7	15.2
Data compilation & report	Yes	44	95.7
	No	2	4.3
How often reports send	Monthly	25	54.3
	Every Two Month	0	0
	Quarterly	0	0
	Bi-weekly	19	41.3
To whom reports are sent	PFSA	31	67.4
	RHB & PFSA	10	21.7
	NGO's	3	6.5
	Other	2	4.3

Source: Own Survey, 2018

The study further showed that more than half of them 32 (69.60%) were using stock card, almost all of them 44 (95.70%) were using bin card; but only one-fourth 12 (26.10%) of them were using daily register; which is lower than 100 percent usage for all the three

format reported in similar study conducted in Nigeria by Emmanuel U *et al*, 2017. Whereas, it is better than 50 percent as reported by Adino *et al*, 2013 for the study made in Ethiopia. On the other hand, as compared to another study made in Malawi by Butao *et al*, 2009 reported as 70 percent usage, the result of this study is better in case of bin card. In general, the report of this study revealed that health facilities in the case of the study focus more on the record of stock commodities by using bin card which is the minimal information of the product. On the other hand, facilities were at medium level in the utilization of stock card for keeping their transaction; while at poor level of daily registration to control their daily use of commodities. Because of which, facilities were being facing stock out and over stock.

Besides, the result of the study showed that most of them 43 (93.5%) were using RRF and majority39 (84.80%) of them were using IFRR which is nearer to 24 (92.6%) and 21 (87.50%) respectively as what is reported by Adino *et al*, 2013 for the study made in Ethiopia. However, results from interviews indicated that Sending inadequately filled and organized logistic data from the facility makes a burden for PFSA; and RRF is filled and sent to PFSA by supportive staff without physical inventory that leads to artificial stock out and facility uses emergency order which is difficult to manage distribution at PFSA level.

Majority of the respondent 44 (95.70%) were found to have the practice of compiling reports and sending to higher level, from which 22 of them were used to send monthly and 19 of them used to weekly, where majority 31 (67.40%) were reporting to PFSA and some 10 (21.70%) were reporting to RHB & PFSA which is also supported by Pharasi B, 2007 in the study conducted at Lesotho.

4.3. LMIS formats for Reporting /Ordering / Receiving

Of the total 46 respondents, only 14 (30.4%) of them were found to use Stock Ledger/registration book, but 25 (54.3%) of them were not and the rest 7(15.2%) didn't know about. Concerning the use of Receiving note model 19, most of them 39 (84.8%) were using it, 6 (13%) were not using and the rest 1 (2.20%) didn't know about it. As of the Requesting note model 20, 32 (69.6%) were using, 6 (13%) not using and the rest 8 (17.4%) didn't know it. As of the Distributing note model 22, 25 (54.3%) of them were using, while 12(26.1%) of them not and the rest 9 (19.6%) didn't know about it. In regard to the use of Laboratory logistics recording forms, 25 (54.3%) of them were using and 13 (28.3%) were not, but the rest 8 (17.4%) didn't have the information. Again as of the use of the Internal Facility Report & Requisition Forms, 38 (82.6%) were using and 7 (15.2%) were not and the rest 1 (2.2%) had no idea. In relation to the use of Report & requisition Forms, 38 (82.6%) were using it, 6 (13%) of them not using and the rest 2 (4.3%) had no idea.

In contrast, the contents of Reports of VL/EID commodities, majority 45 (97.80%) of the respondent said that their reporting formats included Quantities Used, Loss and Adjustment and Stock On Hand.

Table7: LMIS formats for reporting/ordering/receiving

Variables (N=46)	Category	Frequency	Percent
Stock Ledger/registration book	Yes	14	30.4
	No	25	54.3
	I Don't Know	7	15.2
Receiving note model 19	Yes	39	84.8
	No	6	13.0
	I Don't Know	1	2.2
Requesting note model 20	Yes	32	69.6
	No	6	13.0
	I Don't Know	8	17.4
Distributing note model 22	Yes	25	54.3
	No	12	26.1
	I Don't Know	9	19.6
Laboratory logistics recording forms	Yes	25	54.3
	No	13	28.3
	I Don't Know	8	17.4
Internal Facility Report & Requisition Forms	Yes	38	82.6
	No	7	15.2
	I Don't Know	1	2.2
Report & requisition Forms	Yes	38	82.6
	No	6	13.0
	I don't know	2	4.3
Quantities used	Yes	45	97.8
	No	0	0
	I don't know	1	2.2
Loss & adjustment	Yes	45	97.8
	No	0	0
	I don't know	1	2.2
Stock on hand	Yes	45	97.8
	No	0	0
	I don't know	1	2.2

Source: Own Survey, 2018

The study indicated that Stock Ledger/registration book is used by 14 (30.4%), Receiving note model 19 by 39 (84.8%), Requesting note model 20 by 32 (69.6%), Distributing note

model 22 by 25 (54.3%) and Laboratory logistics recording forms by 25 (54.3%) of the respondents. This in general showed that about half of them were using the standard formats which still need special focus on the matter. In addition, majority 45 (97.80%) of the respondent said that their reporting formats included Quantities Used, Loss and Adjustment and Stock On Hand which implies the major contents of Reports of VL/EID commodities are well stated in their format.

4.4. LMIS With Respect to Managers

To measure factors affecting the implementation of LMIS factor level of respondents, a single questionnaire having a 5 point Likert- scale was used. According to Debrah, 2012 to determine level of respondents the mean value below 3.00 low, 3.00-3.5 midpoint and above 3.5 higher level effects or roles.

Accordingly, the mean value for the question "Managers willingness & supportiveness for good implementation of LMIS in VL/EID commodities" is found to be 3.59, which is categorized as Higher; 3.41 for question "Managers special attention for application of LMIS" which is categorized as Midpoint and 2.59 for question "Managers allocate enough budgets for training to maintain up-to-date LMIS Application "which is categorized as Low. And the total mean of mean value becomes 3.20.

Table 8: LMIS with respect to Managers

Variables (n=46)	Category	Frequency	Percent	Mean	Standard deviation	Mean of mean
Managers willingness & supportiveness for good implementation of LMIS	Strongly Disagree	1	2.2	3.59	0.956	3.20
	Disagree	6	13.0			
	Neutral	10	21.7			
	Agree	23	50.0			
	Strongly Agree	6	13.0			
Managers give special attention for application of LMIS	Strongly Disagree	1	2.2	3.41	0.858	
	Disagree	4	8.7			
	Neutral	20	43.5			
	Agree	17	37.0			
	Strongly Agree	4	8.7			
Managers allocate enough budget regularly for training	Strongly Disagree	4	8.7	2.59	0.909	
	Disagree	20	43.5			
	Neutral	13	28.3			
	Agree	9	19.6			
	Strongly Agree	9	19.6			

Source: Own Survey, 2018

The study revealed that the mean values for the three factors affecting the implementation of LMIS in VL/EID commodities namely: Managers willingness & supportiveness for good implementation of LMIS in VL/EID commodities, Managers special attention for application of LMIS and Managers allocate enough budgets for training to maintain up-to-date LMIS Application" were 3.59, 3.41 and 2.59 respectively, where the total mean of mean value becomes 3.20. According to Debrah (2012), mean of 3.20 is categorized as "Midpoint", however, as managerial issues is the key element in the successful implementation of LIMS specially by making employees' technical knowledge up-to-date with trainings and other supports, it needs special attention, specially the third factors

with mean 2.95 (Low) negatively affecting the case in point. Therefore, it still needs special focus to improve the contribution of managers.

4.5. LMIS With Respect to Technology

Similarly, the mean value for question 'Enough computer & related IT equipment ' was found to be 3.67 which falls under Higher category; 2.59 for "Recording & reporting activities in the laboratory department is networked with the person in charge of the department" which falls under Low category, and 2.15 for "No power interruption in the laboratory department" which falls under Low category. That resulted the total mean of mean becomes 2.80.

Table 9: LMIS with respect to technology

Variables (N=46)	Category	Frequency	Percent	Mean	Standard deviation	Mean of Mean
Laboratory department has Enough computer & related IT equipment	Strongly Disagree	1	2.2	3.67	1.012	2.80
	Disagree	7	15.2			
	Neutral	6	13.0			
	Agree	24	52.2			
	Strongly Agree	8	17.4			
Reporting activity is networked with the person in charge of laboratory department	Strongly Disagree	11	23.9	2.59	1.292	
	Disagree	16	34.8			
	Neutral	2	4.3			
	Agree	15	32.6			
	Strongly Agree	2	4.3			
There is no power interruption in the laboratory department	Strongly Disagree	6	13.0	2.15	0.698	
	Disagree	29	63			
	Neutral	9	19.6			
	Agree	2	4.3			
	Strongly Agree	0	0			

Source: Own Survey, 2018

Again the study revealed the mean values for the three technology factors affecting the implementation of LMIS in VL/EID commodities namely: "Enough computer & related IT equipment", "Recording & reporting activities in the laboratory department is networked with the person in charge of the department" and "No power interruption in the laboratory department "were 3.67, 2.59 and 2.15 respectively, where the total mean of mean value became 2.80 considered as "Low". This implies that technology factors are affecting negatively towards the successful implementation of LMIS. Particularly, the second and third factors fall at lower mean value which implies reporting and recording activities in the laboratory departments are not well done because of poor network facility, and VL/EID machines are not working throughout the working time because of power interruption. As a result, many clients are obliged to shift to other laboratory facilities without their interest to get the services.

4.6. LMIS With Respect to Personnel

Again, the mean value for question "Laboratory departments has qualified staffs" was 4.04 which fell under Higher category; 3.39 for "Laboratory departments has adequate staffs" which was considered as Midpoint; and 1.98 for "Staff members have regular training" which was considered as Low. And the total mean of mean became 3.14.

Table 10: LMIS with respect to personnel

Variables (N=46)	Category	Frequency	Percent	Mean	Standard deviation	Mean of Mean
Laboratory department has qualified staffs	Strongly Disagree	0	0	4.04	0.788	3.14
	Disagree	2	4.3			
	Neutral	7	15.2			
	Agree	24	52.2			
	Strongly Agree	13	28.3			
Laboratory department has Adequate staffs	Strongly Disagree	0	0	3.39	0.954	
	Disagree	9	19.6			
	Neutral	16	34.8			
	Agree	15	32.6			
	Strongly Agree	6	13.0			
Staff member have regular training on LMIS	Strongly Disagree	13	28.3	1.98	0.882	
	Disagree	25	54.3			
	Neutral	5	10.9			
	Agree	2	4.3			
	Strongly Agree	1	2.2			

Source: Own Survey, 2018

To this end, the mean values for the human factors affecting the implementation of LMIS in VL/EID commodities namely: Laboratory departments has qualified staffs, Laboratory departments has adequate staffs and Staff members have regular training as per the result of the study were 4.04, 3.39 and 1.98 respectively, where the total mean of mean value became 3.14 which is grouped as "Midpoint". The result showed that facilities have qualified and adequate number of staff which support the implementation of LMIS. However, staff members are not getting adequate training on LMIS an implementation VL/EID commodity, which is supported both by Desale A, 2011 and Bilal M, 2015.

4.7. LMIS with Respect to Organization

Likewise, the mean value for question "Laboratory department has a good link with the top management" was found to be 3.28 that is considered as Midpoint; 3.87 for "Assigned responsible body who cares for VL/EID Laboratory activity" that is considered as Higher; and 3.38 for "Immediate decisions made on time whenever needed" which falls under Midpoint. And the total mean of mean became 3.51.

Table 11: LMIS with respect to organization

Variables (N=46)	Category	Frequency	Percent	Mean	Standard deviation	Mean of mean
Laboratory department has a good link with Top Managers	Strongly Disagree	3	6.5	3.28	0.981	3.51
	Disagree	5	10.9			
	Neutral	17	37.0			
	Agree	18	39.1			
	Strongly Agree	3	6.5			
There is assigned body who cares for VL/EID laboratory activities	Strongly Disagree	0	0	3.87	0.859	
	Disagree	4	8.7			
	Neutral	8	17.4			
	Agree	24	52.2			
	Strongly Agree	10	21.7			
Immediate decisions regarding to VL/EID laboratory activities are made whenever needed	Strongly Disagree	2	4.3	3.38	0.96	
	Disagree	6	13.0			
	Neutral	13	28.3			
	Agree	21	45.7			
	Strongly Agree	3	6.5			

Source: Own Survey, 2018

The mean value for organization factors affecting the implementation of LMIS in VL/EID commodities namely: Laboratory department has a good link with the top management, Assigned responsible body who cares for VL/EID Laboratory activity and Immediate decisions made on time whenever needed were 3.28, 3.87 and 3.38 respectively, where the total mean of mean value became3.51 which is grouped as "Higher". Hence, the laboratory departments have a very good relationship with the

responsible person assigned who is able to take immediate decision for issues that needs action.

4.8. LMIS with Respect to Infrastructure

In the same way, mean value became 2.46 for question "The Facility has well planned & constructed laboratory room" that is Low; 2.54 for "Equipment operates throughout working hours" again Low; and 3.74 for "Laboratory department has enough furniture mean value" which is Higher. And the total mean of mean was 2.91.

Table 12: LMIS with respect to infrastructure

Variables (N=46)	Category	Frequency	Percent	Mean	Standard deviation	Mean of mean
The Facility has a well-planned & constructed laboratory room	Strongly Disagree	2	4.3	2.46	0.836	2.91
	Disagree	28	60.9			
	Neutral	10	21.7			
	Agree	5	10.9			
	Strongly Agree	1	2.2			
The VL/EID Equipment's operate throughout working hours	Strongly Disagree	0	0	2.54	0.721	
	Disagree	27	58.7			
	Neutral	13	28.3			
	Agree	6	13.0			
	Strongly Agree	0	0			
The Laboratory department has enough furniture	Strongly Disagree	0	0	3.74	0.773	
	Disagree	4	8.7			
	Neutral	9	19.6			
	Agree	28	60.9			
	Strongly Agree	5	10.9			

Source: Own Survey, 2018

In the same way, mean values for infrastructure factors affecting the implementation of LMIS in VL/EID commodities namely: The Facility has well planned & constructed

laboratory room, Equipment operates throughout working hours and Laboratory department has enough furniture mean value as per the result of the study were 2.46, 2.54 and 3.74respectively, where the total mean of mean value became2.91 which is grouped as "Low". Even though facilities are found to have enough furniture, laboratories are not well planned and constructed to meet the function intended as well as machines are not operating well because of lack of regular maintenance and spare parts.

4.9. LMIS with Respect to System Procedure Establishment

Correspondingly, mean value was 3.39 for question "Facility has standard operating procedure" that is Midpoint; 2.63 for "Facility has Guidelines for proper LMIS implementation" that is Low; and 2.57 for "Advanced computer support" again low. Then the total mean of mean yielded 3.04.

Table 13. LMIS with respect to system procedure establishment

Variables	Category	Frequency	Percent	Mean	Standard deviation	Mean of mean
The Facility has standard operating procedure	Strongly Disagree	0	0	3.93	0.742	3.04
	Disagree	2	4.3			
	Neutral	8	17.4			
	Agree	27	58.7			
	Strongly Agree	9	19.6			
The Facility has Guidelines for proper LMIS implementation	Strongly Disagree	3	6.5	2.63	0.928	
	Disagree	20	43.5			
	Neutral	16	34.8			
	Agree	5	10.9			
	Strongly Agree	2	4.3			
Advanced computer support is available at the Facility	Strongly Disagree	10	21.7	2.57	1.148	
	Disagree	13	28.3			
	Neutral	11	23.9			
	Agree	11	23.9			
	Strongly Disagree	1	2.2			

Source: Own Survey, 2018

The study further found out that the mean values for system procedure factors affecting the implementation of LMIS in VL/EID commodities namely: Facility has standard operating procedure, Facility has Guidelines for proper LMIS implementation and Advanced computer support were 3.39, 2.63 and 2.57 respectively, where the total mean of mean value became3.04 which is considered as Medium. Although facilities have adequate standard operating procedures, there is no enough guidelines and less advanced computer support which retards the implementation of LMIS at large.

Generally, the results of the study revealed that there is a big gap of technology and infrastructure below the basic requirements needed to proceed the existing implementation programs of LMIS. Therefore special attention is required to improve technology and infrastructure at health facilities.

4.10. Stock Management Practice

Among the total population, 41 (89.10%) of lab technologists and 5 (10.90%) of pharmacists were being involved in the management of VL/EID commodities. 21(45.7%) the respondents said that Inventory count is done annually, while 6(13%) said twice a year, and 12(26.1%) said quarterly; but the rest 7(15.2%) mentioned other. Required Quantities of VL/EID commodities are found to be determined 11(23.9%) by PFSA, 4(8.7%) by RHB,27(58.7%) by the facilities themselves, and the rest 4(8.7%) by others.

Regarding the Maximum stock level of the facility, 14(30.4%) hold two months stock, 23(50%) four months stock and the rest 9(19.6%) have no standard stock level..

As of the Minimum stock level of the facility, 13(28.3%) have 15 days stock,6(13%) have one month stock,15(32.6%) have two months stock and the rest 12(26%) have no minimum stock level. Concerning the period between sending an order & receiving the product, 10(21.7%) of them said less than one week, 23(50%) said between two week to one month, 9(19.6%) said between one month to two month, and the other 4(8.7%) said other. Finally, only 11(23.9%) of the respondent said their facilities get the ordered quantity.

Table14: Stock Management practice of VL/EID Commodities

Variables (n=46)	Category	Frequency	Percent
Who is responsible for managing VL/EID commodities	Laboratory technologist	41	89.1
	Pharmacist	5	10.9
How frequent is an inventory count conducted?	Annually	21	45.7
	Twice a year	6	13.0
	Quarterly	12	26.1
	Other	7	15.2
Who determine the required quantity of VL/EID?	PFSA	11	23.9
	RHB	4	8.7
	Facility itself	27	58.7
	Other	4	8.7
Maximum stock level	Two months	14	30.4
	Four months	23	50.0
	Didn't use	9	19.6
	Total	46	100.0
Minimum stock level	15 days	13	28.3
	One month	6	13.0
	Two months	15	32.6
	Didn't use	12	26.1
Reporting & ordering schedule	Yes	25	54.3
	No	20	43.5
	I don't know	1	2.2
Period between sending an order & receiving the product	< 1 week	10	21.7
	Between 2 week to 1 month	23	50.0
	Between1 to 2 month	9	19.6
	Other	4	8.7
Usually get the ordered quantity	Yes	11	23.9
	No	34	73.9
	I don't know	1	2.2

Source: Own Survey, 2018

As per the result of the study, majority 41 (89.10%) the total population who is in charge of managing VL/EID commodities were laboratory technologists, which is quite different from the result reported by Desale A, 2011 that stated that 25(73.5%) of them were non-laboratory professionals. On the other hand, 21(45.7%) the respondents said that Inventory count is done Annually, while 6(13%) said twice a year, and 12(26.1%) said quarterly.

In addition, a little more than half of the facilities 27(58.7%) were determining Required Quantities of VL/EID commodities by themselves while 11(23.9%) of them need quantity to be determined by PFSA and 4(8.7%) by RHB. This showed how non uniform ordering procedures facilities are being followed that will result in incompatibility with their consumption.

Regarding the stock level,, most of them 37(80.40%) had Maximum stock level and 33(71.70%) of them had Minimum stock level, which is better than (17% and 33% respectively) the study conducted in Lesotho by Pharasi B, 2007. However, facilities were not applying standard minimum and maximum stock level.

The result also showed that the period between sending an order & receiving the product was between two week to one month for half of the facilities. This duration was not short period as for the case of facilities applying modern information system. In addition, only 11(23.9%) of the respondent got the ordered quantity.

4.11. Expected Causes of Stock Out for Key VL/EID Commodities

Out of the 10 most expected causes of stock out, the respondents' rank was computed to yield the following mean ranks.

Table 15: Rank of Stock Out

Variables	Mean Rank
Getting less quantity than requested	1.59
Lack of consistency in reporting & data comp	2.28
Less safety stock & long lead time	3.52
Late delivery of the VL/EID Commodities	4.05
Receiving with near expiry	5.28
Shortage of vehicles	5.57
Increased consumption of VL/EID	6.88
Underestimate the demand	7.80
Late request for the required VL/EID	8.96
Wastage of VL/EID commodities	9.07
Test Statistics	
N	46
Kendall's W[a]	.771
Chi-Square	319.160
Df	9
Asymp. Sig.	.000

Source: Primary data collected from Facility Laboratory Professionals

N.B. a. Kendall's Coefficient of Concordance

As proposed by Maurice G. Kendall and Bernard Babington Smith, Kendall's coefficient of concordance (W) is a measure of the agreement among several (m) quantitative or semi-quantitative variables that are assessing a set of n objects of interest. In the social sciences, the variables are often people, called judges, assessing different subjects or situations.

The Kendall coefficient of concordance can be used to assess the degree to which a group of variables provides a common ranking for a set of objects. It should be used only to obtain a statement about variables that are all meant to measure the same general property of the objects. It should not be used to analyze sets of variables in which the negative and positive correlations have equal importance for interpretation. When the null hypothesis

is rejected, one cannot conclude that all variables are concordant with one another, only that at least one variable is concordant with one or some of the others. When the Kendall's coefficient of concordance W approaches to value 1, it implies that there is a high agreement among the raters; whereas when the W approaches to value 0, it means that there no agreement among the raters. Accordingly, the Kendall's coefficient of concordance was analyzed for the two variables, the expected causes for stock out and expected causes for overstock.

From the 10 most expected causes of stock out, the result of the study showed that, getting less quantity than requested ranked high (1.59) followed by Lack of consistency in reporting & data comp (2.28), Less safety stock & long lead time (3.52) and Late delivery of the VL/EID Commodities (4.05); which were found to be the major causes for the occurrence of stock out. While receiving with near expiry, Shortage of vehicles and increased consumption of VL/EID ranked 5.28, 5.57 and 6.88 respectively were found to be the moderate causes for stock out. And the rest Underestimate the demand (7.80), late request for the required VL/EID (8.96) and Wastage of VL/EID commodities (9.07) ranked less and considered as the minor causes for stock out. In support of this, the Kendall's coefficient of concordance W=0.771 which is nearer to 1; which implies that there is a good agreement among the 46 respondents as shown the in the table below.

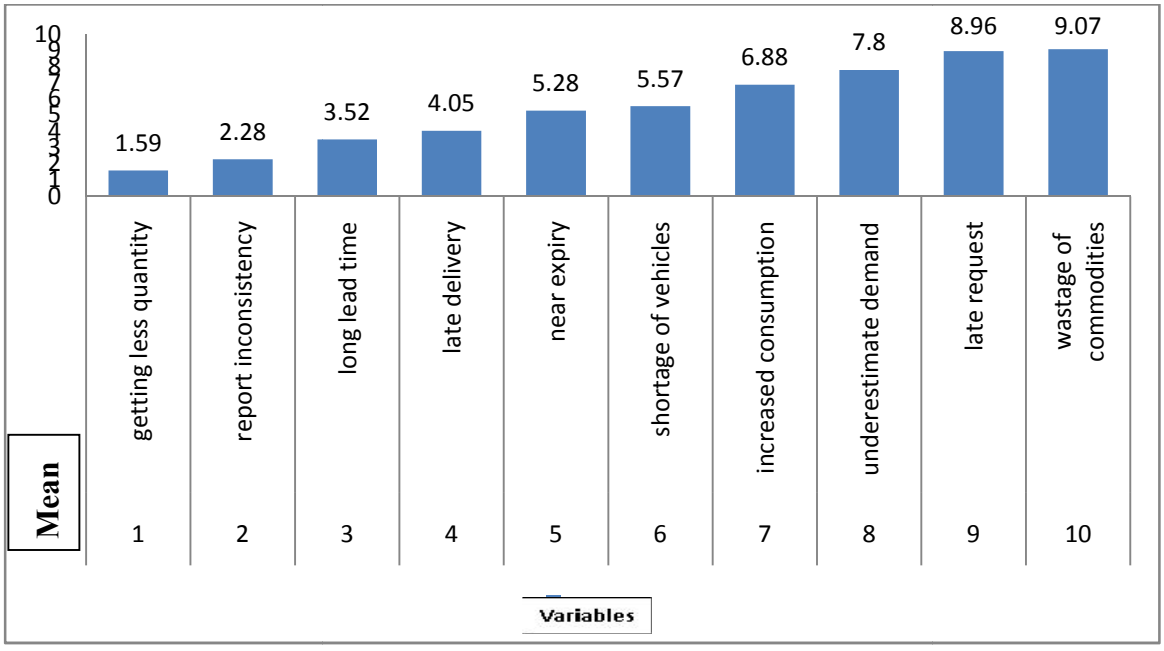

Fig 4.1: Expected Causes of Stock Out (Source: Own Survey, 2018)

4.12. Expected Causes of Overstock

From the seven most expected causes of overstock, the rank given by the respondents was summarized to yield the following mean rank.

Table 16: Rank of Overstock

Variables	Mean Rank
Excessive safety stocks	2.89
Error in inventory records	3.33
Over ordering	3.65
using Inappropriate lead time	3.83
Lack of consistency in reporting	4.07
Overestimate the demand	5.10
Product quality issue	5.14
Test Statistics	
N	46
Kendall's W[a]	.172
Chi-Square	47.451
df	6
Asymp. Sig.	.000

Source: Primary data collected from Facility Laboratory Professionals

N.B. a. Kendall's Coefficient of Concordance

Out of the seven most expected causes of overstock, the study indicated that Excessive safety stocks ranked 2.89 followed by Error in inventory records with 3.33, Over ordering with 3.65 and using Inappropriate lead time with 3.83 were the major causes. Whereas, Lack of consistency in reporting was the moderate cause with a rank of 4.07; and Overestimate the demand with rank of 5.10 and Product quality issue with rank of 5.14 were the minor causes. However, the Kendall's coefficient of concordance W=0.172 which is nearer to 0; which implies that there is a less agreement among the 46 respondents as shown the in the figure below.

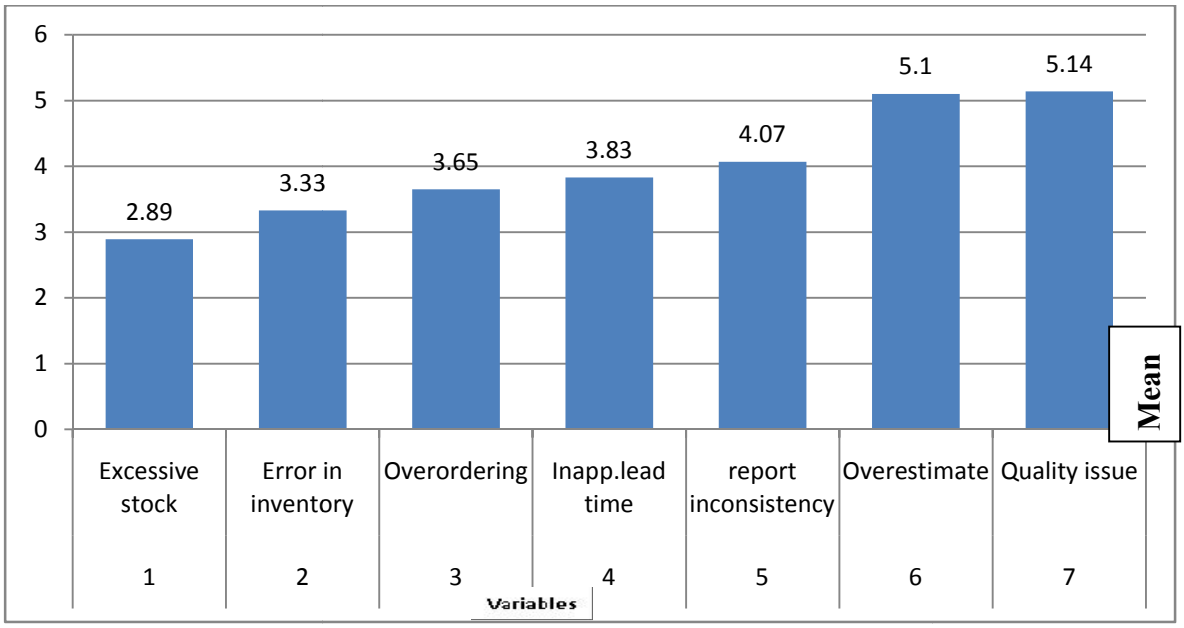

Fig 4.2: Expected Causes of Overstock (Source: Own Survey, 2018)

4. 13. Stock status of VL/EID commodities of the selected facilities

A. Stock Out Items of VL/EID Commodities Of Abbot Machine

Table 17: Abbot's stock outs VL/EID commodities Stock out commodities

SN	ITEM DETAILS	Frequency & percentage
1	Glove Examination Nitrile Non-Sterile Powder Free Large	19(41.3%)
2	Glove Examination Nitrile Non-Sterile Powder Free Small	19(41.3%)
3	Abbott VL m2000 - Real Time HIV-1 Quan Calibration, 2 Levels (12cal A; 12 cal B)	17(37%)
4	Abbott EID m2000 - Real Time HIV-1 Qual Amplification Reagent	14(30.4%)
5	Glove Examination Nitrile Non-Sterile Powder Free Medium	11(23.9%)
6	Biohazard Bag	10(21.7%)
7	Abbott VL/EID m2000 - Halogen Lamp 12V/100W	10(21.7%)
8	Abbott EID m2000 - Sample, Preparation System (DNA) Reagent	10(21.7%)
9	Abbott VL/ EID m2000 - Absolute Ethanol, Non denatured	10(21.7%)
10	Absorbent Undepad	9(19.6%)

(Source: Own Survey, 2018)

As can be seen from the above table, out of the total of 34 items used in Abbot Machine, 10 items were stock out during the assessment period of July to September 2018. The table above lists the stock out list of commodities 1 to 10 based on their frequencies weight as replied by the respondents. Accordingly, the first two commodities namely, Glove Examination Nitrile Non-Sterile Powder Free Large and Glove Examination Nitrile Non-Sterile Powder Free Small were the primary frequently stock out commodities followed by Abbott VL m2000 - Real Time HIV-1 Quan Calibration, 2 Levels (12cal A; 12 cal B), Abbott EID m2000 - Real Time HIV-1 Qual Amplification Reagent and Glove Examination Nitrile Non-Sterile Powder Free Medium respectively. Whereas, Biohazard Bag, Abbott VL/EID m2000 - Halogen Lamp 12V/100W, Abbott EID m2000 - Sample, Preparation System (DNA) Reagent, Abbott VL/ EID m2000 - Absolute Ethanol, Non denatured and Absorbant Undepad were the next frequently stock out commodities.

Based on the result found from interviews, as the machines are closed system, they can only use those commodities from that manufacturer. This forced the entire commodity purchase to be from one supplier. In addition, one machine (Abbot) required too much commodities about 34 which made the coordination necktie and the supplier of this machine was less responsive for the orders it is requested for. Moreover, most of the time procurement at National level is done for a maximum of five months stock which resulted for the delivery of near expiry commodities. Many purchasing were done for small quantities of commodities which spent longer time in managing too much but smaller quantity orders. Both cases would lead to supply interruption at the end of the day. At last, as quantification was being made based on consumption data, this leads to stock out.

B. Over Stock items of VL/EID commodities of Abbot Machine

Table 18: Over Stock items of VL/EID commodities of Abbot Machine

SN	ITEM DETAILS	Frequency &percentage
1	Abbott VL/EID m2000 - Falcon tube, 50ml	10(21.7%)
2	Abbott VL/EID m2000 - Master Mix Tubes/Caps, Plastic, 10ml	7(21.7%)
3	Laboratory Coat Disposable Blue	7(21.7%)
4	Laboratory Coat Disposable White	7(21.7%)
5	Abbott VL/EID m2000 - 96 Well Optical Reaction Plate	6(13%)
6	Abbott VL/EID m2000 - Disposable (DiTis) tips, 200µl	5(10.9%)
7	Abbott VL/EID m2000 - Optical Adhesive Cover	5(10.9%)

(Source: Own Survey, 2018)

The above table shows the list of Abbot Overstock commodities based on the frequencies weights as given by the respondents. Thus, Abbott VL/EID m2000 - Falcon tube, 50ml was the first commodity found over stocked followed by other three commodities (Abbott VL/EID m2000 - Master Mix Tubes/Caps, Plastic, 10ml, Laboratory Coat Disposable Blue and Laboratory Coat Disposable White). Then after, Abbott VL/EID m2000 - 96 Well Optical Reaction Plate, Abbott VL/EID m2000 - Disposable (DiTis) tips, 200µl and Abbott VL/EID m2000 - Optical Adhesive Cover were the next over stocked commodities found in the study.

As per the qualitative data, the major reasons were because of sending inadequately filled and organized logistic data from the facilities that are managed by supportive staff without physical inventory.

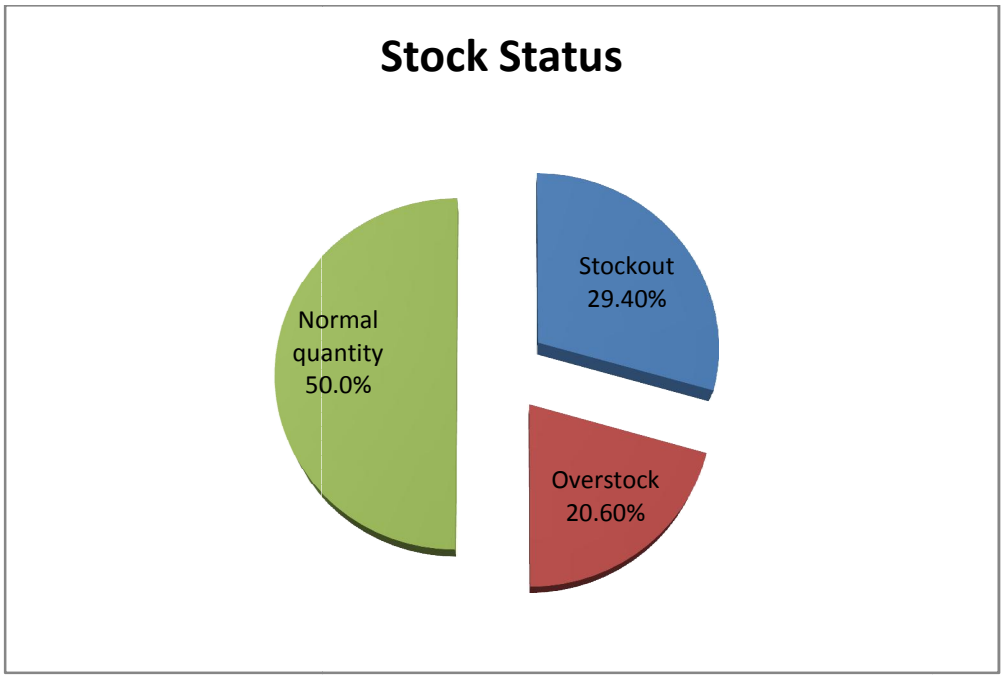

Fig 4.3: Stock Status of Commodities for Abbot Machine (Source: Own Survey, 2018)

The above figure shows the current stock status of commodities for Abbot Machine during the study period. Accordingly, half of the commodities were found at normal quantities and about one-third (29.40%) of the commodities were stock out and the rest were over stock. However, as the procedure cannot be operated without a complete set of commodities, a single commodity stock out will hinder the operation.

C. Stock out items of VL/EID commodities of Roche Machine

Table19: Roche's stock out VL/EID commodities

SN	ITEM DETAILS	Frequency & percentage
1	Glove Examination Nitrile Non-Sterile Powder Free Small	18(39.1%)
2	Glove Examination Nitrile Non-Sterile Powder Free Medium	14(30.4%)
3	Glove Examination Nitrile Non-Sterile Powder Free Large	11(23.9%)
4	COBAS - Pipette 5.8ml Transfer Sterile	9(19.6%)
5	COBAS TaqMan VL-Buffer in a box premixed PBS Solution (10x)	7(15.2%)
6	COBAS TaqMan VL/EID- Wash Reagent 5.1L IVD	7(15.2%)

(Source: Own Survey, 2018)

As can be seen from the above table, out of the total of 23 items used in Roche Machine, 6 items were stocked out during the assessment period (June to September 2018). Similarly, Glove Examination Nitrile Non-Sterile Powder Free Small was found to be the first stocked out item followed by Glove Examination Nitrile Non-Sterile Powder Free Medium. Then after, Glove Examination Nitrile Non-Sterile Powder Free Large and COBAS - Pipette 5.8ml Transfer Sterile came next. Finally, COBAS TaqMan VL-Buffer in a box premixed PBS Solution (10x) and COBAS TaqMan VL/EID- Wash Reagent 5.1L IVD followed respectively.

As per the result found from interviews, machines are also closed system and need 23 commodities which can only found from that manufacturer. This forced the entire commodity purchase to be from one supplier. Moreover, most of the time procurement at National level is done for a maximum of five months stock which resulted for the delivery of near expiry commodities. Many purchasing were done for small quantities of commodities which spent longer time in managing too much but smaller quantity orders. Both cases would lead to supply interruption at the end of the day. At last, as quantification was being made based on consumption data, this leads to stock out.

Table 20: Overstock items of VL/EID commodities of Roche Machine

SN	ITEM DETAILS	Frequency & percentage
1	COBAS - Absorbent Underpad	11(23.9%)
2	COBAS - Pipette 5.8ml Transfer Sterile	7(15.2%)
3	COBAS - Lint Free Clothe	6(13%)
4	COBAS TaqMan VL/EID-AmpliPrep K-tips	5(10.9%)

(Source: Own Survey, 2018)

D. Overstock items of VL/EID commodities of Roche Machine

Out of the total of 23 items used in Roche Machine, 4 items were over stocked during the assessment period. Thus, COBAS - Absorbent Underpad was the first item found overstocked followed by COBAS - Pipette 5.8ml Transfer Sterile, COBAS - Lint Free Clothe and COBAS TaqMan VL/EID-AmpliPrep K-tips.

The major reasons as per the qualitative data for the over stock were because of sending inadequately filled and organized logistic data from the facilities that are managed by supportive staff without physical inventory.

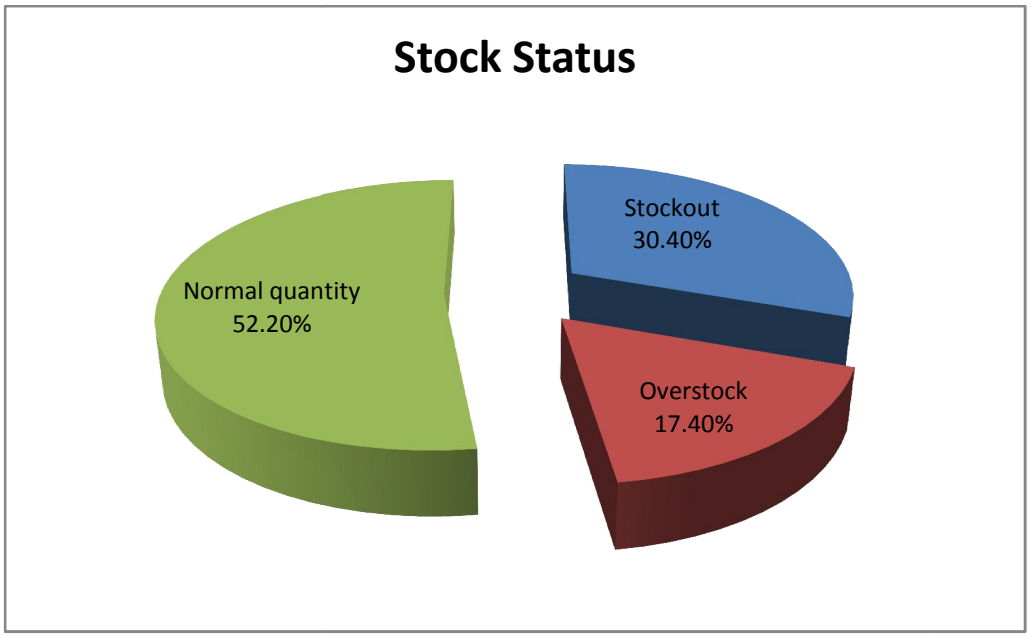

Fig 4.4: Stock status of commodities for Roche Machine (Source: Own Survey, 2018)

In general, most of the VL/EID commodities need cold chain storage and transport where there exists a big shortage at PFSA. However, there are only three cold room store and one deep freezer at central PFSA which is insufficient as a National Agency. Laboratory reagents are stored with pharmaceuticals FEFO method and standard labeling is not applicable. Besides, PFSA, having one head office and 19 branches (hubs), there are total of 21 cold vans, where 4 of them were found at head office from which 2 of them were not functional and the rest 17 vans were assigned for 19 branches which is lower than the number of branches. As a result, laboratory reagents were being transported with normal vans using ice packs together with pharmaceutical products.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATION

5.1. Summary of Findings

After a thorough analysis of the overall data obtained both from the primary and secondary sources, the study divulges the following findings:

The utilization of logistics formats in the health facilities is not adequate which leads facilities to face in artificial stock out, stock out and over stock problems. Even though the contribution of managerial support for the successful implementation of LMIS in VL/EID commodities is vital, there is a big gap in the employee skill because of lack of continuous and up-to-date training which has be arranged by managers. This is mainly because of poor allocation of budget.

On the other hand, poor network access (technology) and frequent power interruption are another major obstacles that hinder communication of report and underrate the productivity of the machines respectively. Most of the facilities have enough qualified and adequate number of staff; however, staff members are not getting adequate training on LMIS implementation VL/EID commodities. It is good practice that the laboratory departments have a very good relationship with the responsible person assigned who is able to take immediate decision for issues that needs action.

Even though facilities are found to have enough furniture, laboratories are not well planned and constructed to meet the function intended as well as machines are not operating well because of lack of regular maintenance and spare parts. Although facilities have adequate standard operating procedures, there is no enough guidelines and less advanced computer support which retards the implementation of LMIS at large. It is also a good practice that VL/EID commodities are being managed by more of by laboratory professionals at facilities; however VL/EID commodities are being managed by pharmacists at PFSA. In addition, the order quantity of VL/EID commodities is decided non-uniformly by different bodies at each health facilities which lead PFSA to face big

problem to manage the distribution practices. However, facilities are not applying standard minimum and maximum stock level.

The period between sending an order & receiving the product at facilities is late and non-uniform and facilities are not getting the required order quantity. This is because of report inconsistency and lack of stock and transport at PFSA. The major causes for the occurrence of stock out are found to be: Getting less quantity than requested, Lack of consistency in reporting & data comp, less safety stock & long lead time and late delivery of the VL/EID Commodities. And the major causes for overstock at health facilities are Excessive safety stocks, Error in inventory records, over ordering and using Inappropriate lead time.

From the total of 34 items used by Abbot Machine, 10 items are stock out and 7 items are overstock during the study period. While from the total of 23 items used by Roche machine, 6 items are stock out and 4 items are overstock. As the machines are closed system, they can only use those commodities from that manufacturer. This will force the entire commodity purchase to be only from one supplier. One machine (Abbot) requires too much commodities about 34 which makes the coordination becomes necktie. Moreover, the supplier of this machine is less responsive for the orders it is requested. Most of the VL/EID commodities need cold chain storage and transport where there exists a big shortage at PFSA.

5.2. Conclusions

Based on the data analysis made on the measuring parameters, the following conclusions are drawn in order to forward the possible managerial implications.

Logistics formats in the health facilities are found to be used inadequately which causes facilities to come up with false reports like artificial stock out, stock out and over stock problems. This is totally against the essence of LMIS application in the industry to improve service quality at health facilities.

Even though health facilities are equipped with relatively adequate number of qualified staff, there is a big gap in the employees' skill because of lack of continuous and up-to-date training as a result of inadequate planning and budget management at different levels of the top management. Besides, poor network access (technology) and frequent power interruption are another major obstacles that hinder communication of report and underrate the productivity of the machines and negatively affect application of LMIS at the health facilities.

On the other hand, the order quantity of VL/EID commodities is decided non-uniformly by different bodies at each health facilities which lead PFSA to face big problem to manage the distribution practices. In addition, facilities are not applying standard minimum and maximum stock level at all.

Finally, during the study period, it found out that of 34 items used by Abbot Machine, 10 of them were stock out and 7 of them were overstock. While from the total of 23 items used by Roche machine, 6 of them were stock out and the other 4 items were overstock. As a result, missing a single commodity will result in total interruption of the overall operation of the VL/EID testing machine in both Abbot and Roche machines. In other words, machines are not operating at their full capacities because of some of the commodities are not available at facilities and customers services are inadequate as well.

5.3. Recommendations

Finally, based on the research findings and investigated drawbacks, the researcher forwards the following recommendations as a possible decision implications for concerned bodies.

The results of the study reveal that there is a gap of technology and infrastructure provisions to run the existing LMIS implementation programs at facilities level. Thus, laboratory facilities are in need of internal redesign and technology improvement to perform better and share their activities and stock status for their stalk holders. Therefore, the Ethiopian Federal Ministry of Health (FMOH) should redesign laboratory

infrastructures to run the laboratory activities suitably with the existing machines. Besides, FMOH should deploy improved technology at laboratory facilities to link them with a network so that they can share their activities and stock status for stakeholders.

Add to this, it is found out that continuous power interruption is the other problem that hinder the implementation of LMIS. Even though, facilities are equipped with generators, they can't solve the problem yet because of lack of regular maintenance and fuel. Therefore, each facility together with Addis Ababa Regional Health Bureau (AARHB) should focus special attention in applying continuous and regular maintenance and fuel management.

On the other hand, the Ethiopian Public Health Institute (EPHI) with help of NGOs should arrange regular and sustainable training concerning on LMIS, logistic formats, the max-min stock standard, and reporting, ordering & recording schedule for facility managers & laboratory professional in order to attain a better implementation of LMIS. And FMOH should prepare standardized laboratory guidelines and should be available for each professional at facility level. Moreover, bio-medical engineers both from PFSA and EPHI should be trained well about VL/EID machines to perform maintenance of machines by themselves rather than waiting for suppliers' engineers.

The purchaser (PFSA) & donors (Global Fund) should have a clear agreement on spare parts management & maintenance with the supplier so that too long time should not be spent to get a single part when a machinery is failed. Besides, PFSA should have a good stock of at least the main spare parts of the machines.

During procurement process of closed system machines, PFSA should use two steps tender method in order to have a better information about the machines before performing the purchase. Besides, PFSA should evaluate the profile of the supplier and its agent and make the contract agreement special for HIV/AIDS commodities to avoid commodity supply interruption.

PFSA should have separated cold chain storage place for HIV laboratory commodities and should add cold chain vans so that laboratory reagents & pharmaceuticals should be stored and transported separately according to their temperature requirements.

PFSA together with NGOs should offer continuous and regular training about how to manage commodities, FEFO method & labeling to trace commodities for warehouse managers and laboratory commodities should be managed by laboratory professionals.

The contract management department of PFSA should manage the shelf life of the commodity before products are imported from the supplier & near expiry products should not be imported.

FMOH should apply an improved mechanism to trace the real consumption data directly from facilities so as to make relatively accurate quantification of annual VL/EID commodities purchase.

In general, FMOH should develop a policy that encourages the integration of professionals at FMOH, PFSA, EPHI, facilities and other supporting stalk holders so as to get satisfactory result of LMIS implementation.

5.4. Future Research Direction

Even though there are 18 health facilities in Ethiopia working on VL/EID testing, the investigation of this research is conducted only on 11 facilities because of some limitations. Thus, the researcher would like to recommend the next researches to include the rest 7 sites to get more accurate feedbacks throughout the country. In addition, it is also the researcher's recommendation to include the customer perspective in the upcoming studies to get more precise results about the case in point.

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Annex