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Evaluation of Logistic System on Hematology commodities in Nifas Silk Lafto Sub City Public Health Centers, Addis Ababa, Ethiopia

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This is to certify that the thesis prepared by GetayeNigussie, entitled:

Evaluation of Logistic System on Hematology commodities in Nifas Silk Lafto Sub City Public Health Center, Addis Ababa, Ethiopia and submitted in partial fulfillment of the requirements for Master of Science degree in Clinical Laboratory Sciences (Hematology and Immunohematology) complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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Acronyms and abbreviation

AAHB	Addis Ababa Health Bureau
AAU	Addis Ababa University
AIDS	Acquired Immunodeficiency Syndrome
ART	Antiretroviral Therapy
ARV	Antiretroviral Drug
CD	Cluster of Differentiation
CHS	College of Health Sciences
DM	Department of Medical Laboratory
EDTA	EthyleneDiamine Tetra Acetic Acid
EPHI	Ethiopian Public Health Institute
EPSA	Ethiopian pharmaceutical Supply Agency
FPC	Finite Population Correction
HIV	Human Immunodeficiency Virus
IFRR	Internal Facility Report & Resupply
IPLS	Integrated pharmaceutical logistics system
JSI/DELIVER	John Snow Inc. / Deliver project
KAP	Knowledge Attitude and practice
LIAT	Logistics Indicator Assessment Tool
LLMIS	Laboratory Logistics Management Information System
LMIS	Logistics Management Information System
LSAT	Logistics System Assessment Tool
PI	Principal Investigator
QC	Quality Control
RRF	Report and Requisition form
SCMS	Supply Chain Management System
SPMMCH	St. Paul Hospital Millennium medical College
SPSS	Statistical package for social sciences
TB	Tuberculosis

Abstract

Background: Laboratory logistics management information system (LLMIS) is the management of laboratory commodities, such as reagents, consumables, chemicals, equipment and other durables in a systematic and standardized way. Its purpose is to obtain and move commodities in a timely fashion to the places where they are needed at a reasonable cost with acceptable quality

Objective: To assess Logistic system on Hematology commodities in Nifas Silk Lafto sub city Public health centers, Addis Ababa

Methods: A facility based cross-sectional descriptive study was conducted on 10 health facilities from Jan – Feb, 2020 on the logistics management information system of hematology analyzer reagents in Nifas Silk Lafto sub city Addis Ababa. Quantitative and qualitative data collection methods were employed. The quantitative data were entered and analyzed using the Statistical Package for the Social Sciences version 20 (SPSS). Descriptive statistics computed and results presented using tables and graphs. Chi-square test was used to see the association between selected indicators with reported management supports.

Results:A total of 20 pharmacy and 44 Laboratory professionals participated in the study from the ten health centers. 3(15%) and 11(55%) of the facilities had 1-5 IPLS and Lab commodity management trained pharmacy staffs respectively. A significant association observed in management enforcement on use of IFRR for reporting & resupply with calculated consumption equal in RRF and CC at all periods*(p=0.032)*. From laboratory participants 17(38.6%) use all IPLS formats with regard to stock out status it was stated by 12(27.3%) of the participants. Most frequent stock out Hematology reagents were control, cell pack, diluent and detergent with 20(45.5%), 7(15.9%), 7(15.9%) and 5(11.4%) respectively. 37(84.1%) laboratory participants had got IPLS training through formal training 17(38.6%), colleague 25(56.8%) and 2(4.5%) from workshop on LMIS respectively. 27(61.4%) were agree that, developing system management will improve LMIS. Causes of successful implementation of LMIS were, 30(68.1%) staff interest, 6(13.6%) of them knowledge of the project, and team work and 2(4.5%) of them managerial support.

Conclusion and recommendation: Management enforcement on use of IFRR for reporting & resupply is important for IPLS implementation. Integrated management support and supervision is recommended for proper implementation of IPLS.

Key words: Hematological reagents, Commodities, LMIS, IPLS

1. Introduction

1.1 Background

Blood inspection was a basic principle of diagnosis from ancient times till the 16th century. Quantitative determination of the individual cellular components was first enabled in 1852. In 1924, Neubauer led to the manual cell counts, which are still taken as gold standards. The first step towards automation was made in 1934 with the Moldavan capillary method. The actual breakthrough in the development of hematological instruments suitable for routine work was achieved by Wallace Coulter in 1956. Blood count parameters have been measured automatically for more than 40 years. A variety of fully automated instruments are now commercially available. The instruments are based on various measurement technologies used in different ways [1]. The instrument utilizes different types of reagents which need to be managed by Logistic Management Information System (LMIS).

Logistics is the process of planning, implementing and controlling the efficient, effective flow and storage of goods, services and related information from point of origin to point of consumption for the purpose of conforming to customer requirements [2 – 4].

Logistics management activities typically include inbound and out bound 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 [4]. In addition to these logistics activities, it includes quantification, procurement, and data collection and reporting. These components are in a continuous cycle, so decisions made at a single point directly impact other parts of the cycle [4].

A LMIS is a system of records and reports whether paper based or electronic used to aggregate, analyze, validate, and display data (from all levels of the logistics system) that can be used to make logistics decisions and manage the supply chain. A well-functioning LMIS provides decision makers throughout a supply chain with accurate, timely, and appropriate data, such as stock on hand, lossesand adjustments, consumption, demand, issues, shipment status, and information about the cost of commodities managed in the system [5]. Thus, supply chain

management includes the logistics activities plus the coordination and collaboration of staff, levels, and related functions [4].

LMIS is the system that helps personnel involved in the management of a programme commodities in the timely collection and management of the information necessary, provides mechanism through which personnel collect, manage, and report such information, which is necessary to support sound and objective decision making in managing the supply chain of the commodities, so as to ensure an uninterrupted supply of commodities and to identify any problems in the supply pipeline [6 & 7]. It also collect three essential data items to make decisions: stock on hand, quantities dispensed or used in a given period (consumption), and losses and adjustments to stock for purposes other than use (expiry, damage, theft, etc.). Those data are recorded on stock-keeping records, transaction records, and consumption records. The data are then used at the facility and are reported to higher levels for resupply and management purposes. Information provided to higher levels is processed and reported back to lower-level facilities in feedback reports to encourage and improve the performance of the logistics system [6]

Personnel's involved in LMIS determine how much of each commodity to order or resupply. They forecast future demand for commodities and plan procurement and shipments. They identify potential supply problems and handle other issues related to commodity management.

The general purpose LMIS is to fulfill the rights of a supply system by delivering the right products the right quantities, in right time, in the right condition, for the right cost and to the right place [8] Moreover, Health logistics system is responsible to ensure every customer able to obtain and use quality health supplies [4]

A logistics system that manages health commodities should have established infrastructure which supports the supply chain as a whole in order to manage and move the commodities [2]. The required infrastructures are a commodity resupply pipeline, an information system for gathering and using commodity data, storage facilities, including cool storage facilities a distribution system (pickup or delivery), based on the availability of reliable transportation Staff/human resources to implement the system [2].

Laboratory logistics management information system (LLMIS) is the management of laboratory commodities. Commodities are broadly classified into three distinct categories of products: reagents, consumables, and durable [9]. The LLMIS manages reagents, consumables, chemicals and equipment and other durables in a systematic and standardized way [7, 10]. The characteristics of laboratory commodities affect the design and management of the logistics system. The physical presentation of a commodity has implications for how data are collected and reported, storage and distribution, and quantification [11]. Its purpose is to obtain and move commodities in a timely fashion to the places where they are needed at a reasonable cost with acceptable quality [4].Reagents are chemicals and biological agents that are used in laboratory testing to detect or measure an analyte, the substance for which you are testing. Reagents vary widely in cost, stability, cold chain requirements, availability, and associated hazards [12].

In 2007, a Logistics Management Information System (LMIS) was introduced by the Ethiopian Federal Ministry of Health to manage the distribution and stock control of laboratory reagents and consumables in the country. The Integrated Pharmaceutical Logistics System (IPLS) was established in 2011byFederal Ministry of Health. It is meant to strengthen institutional capacity to store and distribute commodities using a single system under the management of one entity: the Ethiopian Pharmaceutical Supply Agency (EPSA) [13].

1.2 Statement of the Problem

Ethiopian laboratory LMIS was weak, and consistently being hampered by several systemic challenges that caused frequent stock outs of critical commodities, thus impeding continuous and quality testing for patients. Even though currently, the country has designed integrated pharmaceutical logistics systems (IPLS) for all public health commodities [10], there were no standardized LMIS forms and many staff members had not been trained in LMIS [2]. Laboratory diagnostic service is a dynamic process for new tests to be introduced with new technology which requires new and variable commodities. The extensive number of commodities used by laboratories and the technological advancement makes logistics management of laboratory commodities more complex [14].

Many laboratory commodities are liquids or powders that are difficult to count. Only a few drops or a weighed measure of a laboratory commodity may be used at a time. The same commodity may be used for a variety of different tests and by a number of different people in a single laboratory, thereby making actual consumption of the commodity either as its actual use or as a function of the number of tests performed difficult to track and measure. In addition to this challenge the number of commodities used in a laboratory, and the task of tracking consumption becomes unmanageable. Moreover, a percentage of laboratory commodities are used for quality control (QC) purposes. Distinguishing the use of commodities for QC from the use of commodities for testing is difficult and time-consuming. Because of the short shelf life of reconstituted reagents, they may be discarded before being completely consumed, and therefore are wasted. Wastage is the quantity of a commodity that is lost during the performance of a test, and is associated with the technique and equipment used [4].

Shortages of supplies result in a delay of treatment or diagnostics, availability and the quality of laboratory services, [2] increases costs and may produce life-threatening outcomes [15]. Stock outs of reagents cause delays in testing, longer hospitalization, and missed opportunities for outpatient testing [6].

Whereas a well implemented LMIS reduces the likelihood of stock outs and overstocks that can waste scarce resources and lead to product expiration, especially given the short shelf life of some commodities [7].

Ethiopian laboratory logistics system was weak, consistently being hampered by several systemic challenges that caused frequent stock outs of critical items, thus impeding continuous and quality testing for patients. The laboratory logistics system was characterized by an inadequate supply of required reagents and supplies, which in turn was affected by the lack of information on these commodities for procurement and resupply decisions. In addition, distribution systems for laboratory commodities were not systematically designed, strengthened or supported. Patients were requested to wait 2-3 months or longer to receive results from hospitals for critical commodities such as CD4 reagents [16].

Though several studies have been conducted to see the status of logistics management information system and supply chain systems for HIV/AIDS and TB laboratory, there is limited information in Ethiopia in general and particularly in Automated hematology reagent logistics management information system. In recent years, several automated hematology analyzers are widely available in health centers, though their logistic management system is less investigated. Therefore, this study is designed to assess the status of hematology commodities logistics management information system at selected public health facilities in Nifas Silk Lafto Sub City Public Health Centers, Addis Ababa, Ethiopia.

1.3 Significance of the study

There is no properly managed inventory and supply chain system available in Ethiopia, which will considerably improve the performance of the organization by reducing the costs and improving the efficiency of inventory management activities within the firm.

Reliability of supply of the appropriate laboratory reagents and consumables are still major problems as a result it is impossible to offer quality treatment to patients. Moreover, the distribution and stock levels of hematology commodities in health centers were not well managed, management related problems also exist and the behavior of users towards hematology commodities LMIS is poor. Therefore, this study aim to provide reliable, accurate and manageable information that helps for decision making, improve management of hematology commodity logistics system. Consequently, customers can have uninterrupted services regards to hematology commodity. Furthermore, it aspires to avert resource wastage and reduce supply chain of commodities inconsistency in Nifas Silk Lafto Sub City Public Health Centers, Addis Ababa, Ethiopia.

2. Literature review

The health laboratory plays a pivotal role in the health care delivery system. The complete blood count is one of the most frequently requested tests. In recent years automated hematology analyzers are widely available in our country. A reliable supply of appropriate laboratory reagents and consumables are crucial to offer quality laboratory service and hence treatment to patients [13]. However, several studies particularly from developing countries are demonstrating the inefficiency of the system. For example, a health facility survey conducted in Uganda showed that many laboratories experienced frequent stock outs and delay in receipt of key commodities [2].

A study conducted to Evaluate Laboratory Logistics Management Information System in HIV/AIDS Comprehensive Health Facilities in Bayelsa State, Nigeria indicated that resupply of hematology and CD4 reagent is 100% while commodities received is more than the required quantity. Stock level of hematology reagents were within the maximum and minimum level during the study period. In the same study training level of professionals for LIMS shows that 34.6%, 57.7% and 7.7% for laboratory scientists, technicians and assistants respectively [7].

In a study conducted in Addis Ababa Ethiopia, among the facilities performing CD4 and hematology tests, 46.7% facilities were stock out for EDTA test tube; however, only 1 (33.3%) facility for CD4 reagent and another 1 (25%) for detergent. The average duration of stock outs (in days) within six months was found to be highest for EDTA test tube while the lowest average stock out duration was observed for CD4 reagents and detergents respectively. The mean stock out frequency within the last six months was 1.5 times higher for detergent and EDTA tube. Findings suggest that bin cards, IFRRs and RRFs were available among 25 (96.2%) of the health facilities. Among these facilities, 16 (61.5%) health facilities update bin cards regularly, and 22 (84.6%) of them complete and send IFRR to their respective facility stores, while 24 (92.6%) of the facilities were completing and sending RRF to supplying EPSA every two months [14].

In a study conducted in SPMMCH among 18 professionals handling stocks, only 3 of them had got in-service training, but 15 (83.3%) of respondents did not have training on the LMIS and have no knowledge about the consumption and inventory system of medical laboratory LMIS.

Among those who took training, 2(11.1%) of them know about the consumption and inventory system of laboratory commodities, but 1 respondent did not know about inventory mechanism (17). The majority 12(66.7%) of respondents strongly agreed that developing a system management will improve LMIS while 6(33.3%) of them agreed that, developing system management will improve LMIS. When participants were requested about their preference regarding team work, 16(88.9%) of the study participants responded that they prefer to work as a team while 2(11.1%) preferred to work individually if LMIS implemented. With regard to causes of successful implementation of LMIS, 5(27.8%) of them responded that staff interest, 4(22.2%) of them knowledge of the project, again 4 (22.2%) of them claimed that team work, 2(11.1%) of them managerial support and 3(16.7%) of them responded that all the above are causes for successful implementation. Regarding the importance of LMIS for decision making and controlling of stock status, 10(55.6%) of them replied as moderate and 7(38.9%) of them said most important and 1 study participant replied least helpful. All study participants believed that improvement of LMIS will improve the quality of laboratory services and they were also interested to take training on medical laboratory LMIS [17].

Related to stock balance problem of the study commodities, Hematology complained by 2(11.1%) participants. Concerning laboratory machines, 6(33.3%) of respondents states that Hematology machines as source of complaint were claimed by respondents [17].

Among 7 items of Hematology commodities all of them have 100% stock bin/cards and the items were CELDYN diluents solution, CELDYN detergent solution, CELDYN lyze, Anti-A, Anti-B, Anti-AB and lastly anti-D or Rh-factor. All reagents were not stock out during the study period but 2(28.6%) out of 7 were under stock for CELLDYN diluents and detergents but no over stock expired status identified [17].

In a study conducted Addis Ababa, Ethiopia a total of 114 professionals involved in laboratory commodity management, 71 (62.3%) were trained in logistics management information system (integrated pharmaceutical logistics system or Ethiopian laboratory logistics system). of these, 67 (58.8%) were pharmacy professions and 4 (3.5%) were laboratory professionals. In the same study six (75%), 5(62.5%) and 5(62.5%) of facilities had within the established minimum-maximum (min-max) stock levels for cell dyne diluents, lyze and detergent respectively. Six

(75%) and 3(37.5%) of facilities had less stock levels than the minimum stock levels for CD4, cell dyne lyze detergent reagents respectively [10].

The available studies in Ethiopia were related to HIV services and little is investigated regarding the whole hematology service and hence this study tries to address this gap.

3. Objectives

3.1 General objective

To assess Logistic system on Hematology commodities in Nifas Silk Lafto sub city Public health centers, Addis Ababa, Ethiopia.

3.2 Specific objective

To assess the distribution and stock levels of hematology commodities in health centers

To identify management related factors affecting hematology commodities in health centers

To assess the knowledge, attitude and practice (KAP) of users towards hematology commodities LMIS

4. Materials and Methods

4.1 Study area

The study was conducted in Nifas silk Lafto sub city public health centers. The sub city is one of the ten sub cities found in Addis Ababa which covers 68.3 sq.km area and a population of 335,740, Population density per sq. m: 4,915.7 and No. of Woreda : 12. [18] The sub city currently has ten health centers (information from sub city administration). The study area was chosen as it is the most accessible area and facilities are nearby to Addis Ababa EPSA hub, this will help for better implementation of IPLS compared to other parts of the country and poor functioning of the system in such area will enable to see how severe the problem will be in relatively far areas of the country.

4.2 Study design and period

A facility based cross-sectional descriptive study was conducted from Jan – Feb, 2020 on the logistics management information system of hematology commodities. Quantitative and qualitative data collection methods was employed. Interviews for persons responsible for managing laboratory commodities at the study facilities using structured questionnaire was conducted. Review of stock keeping records (documentation) and observation of physical inventory (participant observation) of Hematology reagents and commodities available at the time of visit to the facilities.

4.3 Source of population

The source population were all health professionals which are working in Public health center found in Nifas Silk Lafto Sub City.

4.4 Study population

A total of 60 laboratory professionals (Medical Laboratory Technicians and Medical Laboratory Technologists) and 20 pharmacy heads and pharmacy store from 10 public health centers providing laboratory services by automated hematology analyzer were constitute the population of study in this study.

4.5 Sampling method and sample size determination

4.5.1 Sample size determination

Sample size is calculated according to the guide to conducting Supply Chain Assessments Using the Logistic System Assessment Tool [19] and Logistic Indicators Assessment Tool [20]; a

margin of error at or below 10% and a confidence level at or above 95% and assuming that 50% of the professionals are poorly functioning due to lack of similar study in the study area. This will give the maximum possible sample size.

The general formula for calculating a sample size is:

$$n = z^2 * p\ (1-p)/m2$$

Where:

n = required sample size

z = the value of the confidence level of 95% = 1.96

p = 0.5. Therefore, when implementation status is unknown, 0.5 will be used

m = margin of error (at 10% m = 0.1)

Therefore: - n = 1.962 * 0.5(1- 0.5)/0.12

n = 3.842 *0.25/0.01

n = 96

Where there is a predetermined population (e.g., total number of facilities in the area), the sample size generated from the above equation needs to be multiplied by the Finite Population Correction (FPC) factor. For this purposes, the formula can be expressed as:

New n = n/1+ [(n-1)/N]

Where: New n = the adjusted new sample size

N = the population size (80)

n = the sample size obtained from the general formula (96)

New n = 96/1 + [(96 – 1)/80

New n = 96/2.19

New n = 44 professionals

4.5.2. Sampling procedures

Census sampling technique was practiced for collecting the Automated Hematology reagents and commodities in the laboratory and Pharmacy stores and purposive sampling technique was conducted for laboratory and Pharmacy professionals during the assessment.

4.6 Eligibility criteria

4.6.1 Inclusion criteria

All health facilities having functional automated hematology commodities

4.7. Data collection techniques

Quantitative and qualitative data collection methods was used for this study.

4.7.1. Quantitative method

A structured questionnaire (annex III) which was originally developed by USAID/DELIVER (and customized to our context to collect quantitative information from health facility's store and laboratory department was implemented. The data was collected in the same language by trained professionals who have experience on laboratory LMIS and interview was conducted in Amharic. Furthermore physical counts of hematological reagents and commodities were conducted in order to check data quality by comparing the actual counts with the available records.

The sources of data for the assessment were physical counts of hematological reagent and commodities, bin cards, IFRR (internal facility report & resupply form), RRF(report requisition form). Interviews were held with store managers of facility pharmacy store, laboratory managers at health centers and pharmaceutical heads. Indicators to be measured and data sources are summarized in the following table.

Table 1: List of Indicators and data sources

Indicators Data Source(s)	Indicators Data Source(s)
I. Logistics Management Practices	
1.Percentage of facilities which have bin cards	availability of bin cards in facilities and stores

2.Percentage of facilities using bin cards	Usage of bin cards in facilities and stores
3. Percentage of facilities store with bin cards updated	Presence of updated bin cards and evidence of some updated bin card in facilities stores
4. percentage of facilities available of IFRR	Availability of IFRR at facility store/laboratory
5. Percentage of facility completed and submitted IFRR to facility store with regular schedule	Presence of IFRR reports and evidence of utilization in facilities stores
6. Percentage of facilities available RRF	Availability of RRF at facility store
7. Percentage of facility complete an d s end report to EPSA hub every two months	RRF complete and send to EPSA hub
8. percentage of facility with IPLS SOP manual	IPLS SOP manual at facility store
II. Personnel	
1. Percentage of facility with number of pharmacy professionals	Respondent
2. Percentage of facility with work experience of facility store person	Respondent
3. Percentage of facility with Trained professional in LMIS	Respondent
4. Percentage of facilities with staff trained in IPLS	Respondent
5. Percentage of facilities with staff trained in laboratory commodity management training	Respondent
6. Percentage of facility laboratory commodity managed by trained professionals in LMIS	Respondent
7. Percentage of facilities with laboratory staff	Respondent

in IPLS orientation	
III. Supportive supervision on HIV/AIDS laboratory commodities	
1. Percentage of facilities store managers receiving supportive supervision within a reasonable amount of time	Respondent and IPLS supervisor's action plan developed
2. Percentage of facilities laboratory department receiving IPLS supportive supervision within a reasonable amount of time	Respondent and IPLS supervisor's action plan developed
IV. Storage practice	
1. Percentage of facilities adhering to storage Guidelines	Visual observation
2. Percentage of facility store with functional and reasonable No of refrigerator	Observation from facility store
V. Data quality of RRF	
1. Percentage of facility with valid R RF report	i. Check ending balance of the previous report become beginning balance of the next report ii. Quantity received column concede with Model 19 or EPSA STV iii. Loss and adjustment concede with bin card of tracer products iv. Ending balance of RRF with bin card balance of tracer products
2. Percentage of facility with accurate report of at least two reporting period of RRF	i. Verified Calculated Consumption" indicated on the RRF to the verified CC (BB + QR - EB +/- Loss/Adj.) ii. Verified Maximum stock =CCX2

	iii. Qty Ord. = Max Stock – EB
3. Percentage of facilities with complete beginning balance, Quantity received. Ending balance and Loss/Adjustment	Observe at least two reports
VI. Product Availability	
1. Percentage of facilities stocked out of tracer product at time of visit	respondent, and bin card balance, physical inventory of the tracer products
2. Percentage of facilities stocked out within six months of before the assessment the tracer product	Respondent, bin card records of the tracer products
3. percentage of facilities with frequency of stock outs with in the last six months of the tracer product	Respondent, bin card records of the tracer products
4. percentage of facilities with days of stock out of the tracer product	Bin card records of the tracer products

Questionnaire were used to provided information on the indicators like the availability of laboratory reagents and commodities for Hematology analysis service on day of visit, stock out frequency and average duration of stock outs (days of stock out) , percentage of facilities with personnel trained and oriented on IPLS , percentage of facilities that have expired commodities, percentage of facilities with bin cards, IFRR, & RRF availability, percentage of facilities with IFRR & RRF reporting rate, percentage of facilities with acceptable data quality of RRF & IFRR, percentage of facilities with completeness of bin cards, percentage of facilities resupplied ordered quantities at lab and facility stores.

The above indicators were measured as follows: (1) commodity availability (2) duration of stock outs by collecting information from bin cards, from RRF of days of stock out (3) stock data quality by comparing bin cards to physical inventory and reports to IFRR & RRF this tool also annexed (annex- IV) and (4) storage conditions by visually inspecting facilities with bench mark of standard storage guideline and check temperature recordings log.

The indicators used to measure the percentage of facilities stocked out of one or more Hematology reagent or commodities on day of visit, percentage of facilities where hematology reagents and commodities physical inventory count matches balance on bin card, percentage of facilities with staff trained or oriented on IPLS, percentage of facility laboratories that has provided IPLS orientation, percentage of facilities recording essential logistics data properly, percentage of facilities sending RRF to directly EPSA hub or sub cities logistic officers for data aggregation and percentage of facilities compliance with each proper storage guidelines.

4.7.2. Qualitative method

Key informant interviews were conducted with the key designated supply chain managers using standard point of discussion (annex-IV) adapted from logistics system assessment tool (LSAT). This tool is designed to facilitate a comprehensive quality assessment of the separate components that make up a logistics system and it was developed by USAID DELIVER project (19). The key informant interviews were conducted with Nifas silk lafto sub city pharmaceutical and supplies logistics officers and health center Pharmacy head to understand the challenges facing the logistics systems and to obtain a description of the supply chain management system for hematology reagent and commodities.

The interviewer was conducted by principal investigator. The in-depth interview was focused on how to identify strengths and weaknesses in the LIMS with regard to the management of hematology reagent and commodities and also associated factors like training and supervision.

In-depth interview participant were

Nifas Silk Lafto sub city pharmacy unit = 1

Each health center pharmacy heads = 10

Each health center Laboratory heads = 10

Total interviewed = 21

4.8. Variables of the Study

4. 8. 1. Dependent Variable

• Availability of Hematology commodities

• Accuracy/validity of logistic data for inventory management

• Frequency of stock outs

• Duration of stock out

4.8.2. Independent Variables

• Demographic characteristics

• IPLS training

• Management supports

4.9. Data quality assurance

The data collection tool was pre tested in three non-sampled professionals in the sub city to ensure the validity of the survey tool. After the data collection tools pretested, appropriate modification was taken to standardize the questionnaire. Data collectors were trained and provide written interpretation for logistics variables. The principal investigator performed frequent checks on the data collection process to ensure the completeness and consistency of the gathered information; data was double entered to enable cross-checking during analysis as well.

4.10. Data analysis procedures

The quantitative data was entered and analyzed using the Statistical Package for the Social Sciences version 20 (SPSS). Descriptive statistics was computed (mean, median and percentage) and results was presented using tables and graphs. Chi-square was used to see the association between selected indicators with reported management supports. The qualitative portions of the study (interview) was transcribed and summarized in narrative format.

4.11. Operational Definitions

RRF data validation:- means checking the correctness data by Comparing the “Ending Balance” indicated on the bin card to physical count at the time of visit, Comparing the “Beginning Balance in the Store” to the “Ending Balance in the Store” of the previous report (which should be equal), Comparing “Loss and Adjustment” indicated on the RRF to the

quantity in the Bin Card, Comparing the "Quantity Received" on the RRF with the "Quantity Received" on EPSA STV/DIC or Facility Model 19 within the reporting period, Comparing "Ending balance" indicated on the RRF versus Quantity at the end of the reporting period as indicated on the Bin Card, Comparing "Calculated Consumption" versus the sum of quantities issued on the "Quantity Issued" column of the bin card during the recent reporting period. **Accuracy of RRF data**: - means Comparing "Calculated Consumption" indicated on the RRF to the verified CC (recalculating the CC as "SOH at the start of the period + Quantity Received – SOH at the end of the period +/- Loss/Adj.). Comparing "Maximum Stock Quantity" indicated on the RRF to the verified "Maximum Stock Quantity" (recalculating the "Maximum Stock Quantity" as CC X 2).

Acceptable storage practice: - the facility should fulfill at least greater than 80 % of the storage guideline

Bin card: is IPLS/LMIS format which records received or issued data

Commodities: - include reagents and test kits, laboratory equipment and supplies, condoms, and other medical supplies and equipment such as specimen collection tools

Facility Maximum/minimum (max/min) ICS: means each facility to set and hold maximum stock level for four months and minimum stock level for two months of consumption

Facility Report and Requisition System:- the facility should continuous RRF reporting to EPSA branch, timely Reporting (within 10 days from the last date of the previous reporting interval) and timely resupply (Duration of time for EPSA to deliver supplies after receiving RRF from health facilities.

IPLS Implementation means :- if the facility availed and used all recording and reporting tools, products that required, established Man/Min inventory control system, acceptable storage practice, established internal reporting and resupplying system, facility report, requisition and re supply System and management ownership (Institutionalization of the system)

Internal Facility Report Resupplied Form: - is IPLS format that is used for reporting and resupplying laboratory commodities from the facility store to the laboratory

Internal Report and Re Supply System: - measured through IFRR reporting rate of the laboratory, average IFRR reporting rate of the laboratories, data Quality (% of facilities with

acceptable quality IFRR that is accurate and valid), Percentage of facilities with timely IFRR reporting, that is according to the calendar and schedule developed, Percentage of facilities with timely internal re supply, that is according to the calendar and schedule developed

Maximum Stock level: - In IPLS the maximum stock level designed and holds to facilities is four months of stock

Minimum stock level: - In IPLS the minimum stock level designed and holds to facilities is two months of stock

Overstock: A supply imbalance that occurs when stocks exceed the established maximum level may result in losses due to expiry.

Product Availability: - the amount of stock on hand at the time of visit

Reporting period: - the reporting interval of the facilities to the respective hub is every two months

Stock out on the day of the visit: - was defined as not having any available stock on the day that the data collector arrived

Tracer products: - includes RRF, IFRR, Bin card, Stock card and stock transfer voucher

4.12 Ethical considerations

Approval from Research and Ethical Committee of Addis Ababa University College of Health Science Department of Medical Laboratory and Addis Ababa Health Bureau obtained. There was a high degree of confidentiality during data collection and no name of any health facility and participating individuals were put in the result instead the aggregate result of the facilities and summary results of in-depth interview projected.

5. Results

5.1 Background characteristics

This study was under taken in ten health centers and one sub city health office which were found in Nifas Silk Lafto Sub City. The sub city has one pharmacist which will supervise each health centers every two weeks. Supervision was carried on for both pharmacy and laboratory stores which considers hematological reagents too.

A total of 20 pharmacy professionals participated in the study from the ten health centers of which 10(50%) were pharmacy heads while 10(50%) were pharmacy store workers. Experience of pharmacy professionals were 3years minimum and 34 maximum with mean 9.6(7.28).

A total of 44Laboratory professionals participated in the study from the ten health centers of which 29(65.9%) of the participant said Laboratory heads monitor the overall laboratory commodity while 15(34.1%) were said laboratoryinventory officers manage the overall laboratory commodity. Experienceof laboratory professionals were 1 year minimum and 34 maximum with mean±8.43 (6.99).

Table 2: Depicts the background characteristics of the study institutes and study participants.

Variables	Number(n)	Percent (%)
Health Facility		
Sub city	1	9.09%
Health Center	10	90.91%
Professionals Involved		
Pharmacists	14	21.54%
Druggists	7	10.77%
Technologists	28	43.08%
Technicians	16	24.62%

Experience of health center	pharmacy professionals	
0-5	5	25%
6-10	10	50%
11-15	2	10%
16-20	2	10%
>20	1	5%
Total	20	100%
Experience of health center	Laboratory professionals	
0-5	15	34.1%
6-10	21	47.7%
11-15	3	6.8%
16-20	3	6.8%
>20	2	4.5%
Total	44	100%

5.2 IPLS Implementation related to hematology commodities

Each health centers was staffed either with seven or eight pharmacy professionals in which 15(75%) of them the participants replied as they have 7 staffs while 5(25%) of theparticipants replied as they have 8 staffs. To trace the laboratory personnel staff level of the health centers 25(56.8%) responded as staffed with eight and 19(43.2%) with seven. In the ten health centers IPLS implementation and stock keeping records were exist. 15(75%) of interviewed pharmacy professionals responded that both RRF and IFRR were used for managing hematological commodities while 5(25%) of them states that they use only IFRR. All health centers report RRF to higher level every two months.

As shown in table 3, 3(15%) and 11(55%) of the facilities had 1-5 IPLS and Lab commodity management trained pharmacy staffs respectively.

Table 3: Training profile of participants on IPLS and Lab commodity management for Hematological reagents and commodities

Variables	Number(n)	Percent (%)
IPLS trained pharmacy staffs	per health center	
1-5	3	15
6-10	17	85
LMIS trained pharmacy staffs	Per health center	
0-5	11	55
6-10	9	45
Responsible person for managing laboratory commodities according to pharmacy professionals response		
Pharmacy expertise	13	65
Laboratory expertise	7	35
Reporting of RRF to higher	Level	
EPSA	18	90
EPSA and RHB	2	10

5.3 Quality of records of IPLS documents

Out of a total of 20 pharmacy professionals 11(55%) ofthem reported the completeness of RRF. Of these, 13(65%) acquire the knowledge through formal training. In addition 11(55%) the participant responded they get the quantity requested while 10(50%) of the participants said that they get all the items required. All the commodities for hematological analyzers were obtained from EPSA Hanamariam hub.

Table 4: Describes the record quality of IPLS documents based on the questionnaires administered to 20 pharmacy professionals.

Variables	Number(n)	Percent (%)
Completeness of RRF		
Yes	11	55
No	9	45
Ways of acquiring knowledge	On how to record different	Forms
Formal training	13	65
On job training	7	35
Number of emergency order	Within the reporting period	
None	11	55
1-2	6	30
> 2	3	15
Doyougetthequantity	You requested	
Yes	11	55
No	9	45
Doyougetalltheitems	You requested	
Yes	10	50
No	10	50
Lead time of supply		
2 weeks - a month	16	80.0
1 month – 2 month	4	20.0
Responsible organization	For transportation of items	

Sub city	5	25
Health center	15	75
Time of last supervision		
<2 months	13	65
2-3 months	6	30
3-6 months	1	5
Supervision carried by		
EPSA	2	10
RHB	4	20
Sub city	14	70
Isthe recorded	temperature up-to-date	
Yes	18	90
No	2	10

5.4 Accurate/valid RRF report by comparing RRF document data completeness

Table 5: showed review of20 RRF records based on that15 (75%) balanced value on the calculated consumption and maximum quantity in the RRF and the verified one. In addition 16(80%) showed agreement by comparing "Quantity Ordered" indicated on the RRF to the verified "Quantity Ordered".

Table 5: Accurate/valid RRF report by comparing RRF document data completeness

Accuracy of RRF	Yes	No
Comparing "Calculated Consumption" indicated on the RRF to the verified CC	15(75%)	5(25%)
(CC=beg. Bal. +QR-SOH+/- Loss/Adj.		
Comparing "Maximum Stock Quantity" indicated on the RRF to the verified	15(75%)	5(25%)

Maximum Stock Quantity" as CC X 2		
Comparing "Quantity Ordered" indicated on the RRF to the verified "Quantity Ordered"	16(80%)	4(20%)
Recalculating the "Quantity Ordered" as "Maximum Stock Quantity" – "Ending Balance" in the Store		
Validity of RRF report	Yes	No
Comparing the "Beginning balance in the Store" to the "Ending balance in the store" of the previous reports	16(80%)	4(20%)
Comparing "Quantity Received" on RRF with "Quantity Received" on EPSA STV/DIC or Facility Model 19 within the reporting period.	18(90%)	2(10%)
Comparing "Ending balance" indicated on RRF versus Quantity at the end of the reporting period as indicated on Bin Card	16(80%)	4(20%)
Comparing "loss and adjustment" indicated on the bin card with RRF of the reporting period	14(70%)	6(30%)
Comparing "Calculated Consumption" versus the sum of quantities issued on the "Quantity Issued" column of the bin card during the recent reporting period	16(80%)	4(20%)
Comparing the "DOS" on RRF versus "DOS" indicated on the bin card	15(75%)	5(25%)

5.5 Association of IFRR utilization with management support

For the observation of the association between IFRR utilization and management support a significant association observed in management enforcement on use of IFRR for reporting & resupply were associated with Calculated consumption equal in RRF and CC at all periods*(p=0.032)*. Significance value of less than 0.05.

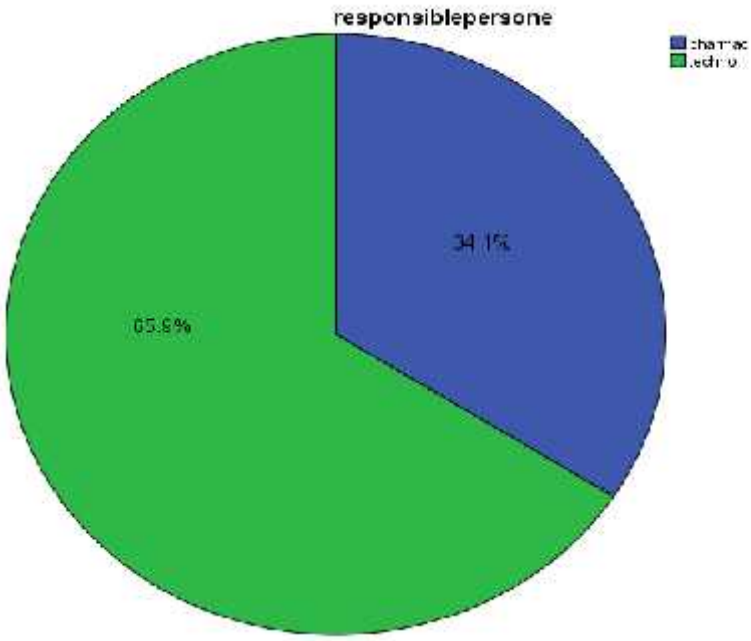
Table 6, Association of IFRR utilization with management support based on reviewed questioners

IPLS format availability	Management Support on IPLS implementation		P. Value	Management enforcement on use of IFRR for reporting & resupply		P. Value
Calculated consumption equal in RRF and CC at all periods	Yes	No	0.249	Yes	No	0.032
Yes	13	2		14	1	
No	3	2		2	3	
Maximum stock equal on RRF and verified						
Yes	13	2	0.249	13	2	0.249
No	3	2		3	2	
Quantity ordered and verified RRF equal						
Yes	13	3	0.624	14	2	0.162
No	3	1		2	2	
Ending balance of previous equal with current						
Yes	12	4	0.376	14	2	0.162
No	4	0		2	2	
Quantity received on RRF equal with STV						

Yes	15	3	0.368	14	4	0.632
No	1	1		2	0	
Ending balance equal on RRF and bin card						
Yes	13	3	0.624	14	2	0.162
No	3	1		2	2	
Loss/adjustment equal on bin card and RRF						
Yes	11	3	0.657	10	4	0.207
No	5	1		6	0	
Quantity issued and calculated consumption on RRF						
Yes	12	4	0.376	13	3	0.624
No	4	0		3	1	
Comparison between bin card and RRF						
Yes	13	2	0.249	12	3	0.751
No	3	2		4	1	

5.6Responsibility of professionals According to the management of hematology commodities

Figure 1: Depicts proportion of professionals managing hematology reagents and consumables. Responsible person for managing laboratory commodities in accordance with questionnaires administered to 44 laboratory professionals.



5.7 Utilization of stock keeping records like bin card, stock cards and IFRR for hematology commodities

Table 7: Shows usage of stock keeping records like bin card, stock cards and IFRR for hematology commodities. Of these 44 participants 17(38.6%) replied as they are using all the formats, 26(59.1%) of them replied as they are using some of it and 1(2.3%) participant replied as he has never used. In addition it was indicated Hematology reagents and its supply stock out status was indicated by 12(27.3%) of the participants. Most frequent stock out Hematology reagents were control, cell pack, diluents and detergent with20(45.5%), 7(15.9%), 7(15.9%) and 5(11.4%)respectively. Although there were stock out status again there were still surplus reagents according to some respondents 3(6.8%), frequently surplusHematology reagents were detergent and diluent 1(2.3%) and 2(4.6%).

Table 7: Utilization of stock keeping records like bin card, stock cards and IFRR for hematology commodities.

Variables	Number(n)	Percent (%)
Usage of stock keeping records like bin card, stock cards and IFRR for hematology commodities		
Yes	17	38.6

No	1	2.3
Some	26	59.1
Do IFRR of Hematology reagents and its supply include stock on hand, quantities used and loss/adjustment		
Yes	40	90
No	1	2.3
Some	3	6.8
How did you learn to complete different formats		
Formal training	7	15.9
On job training	35	79.5
Colleagues	1	2.3
Never learned	1	2.3
Last supervision for hematological commodities		
Ever	2	4.5
Last month	40	90.9
Within three month ago	2	4.5
Are there any Hematology reagents and its supply you usually run out of before resupply?		
Yes	12	27.3
No	32	72.7
Most frequent stock out Hematology reagents		
Detergent	5	11.4
Diluent	7	15.9

Cell pack	7	15.9
Control	20	45.5
Are there any Hematology reagents and its supply you usually have surplus before resupply		
Yes	3	6.8
No	41	93.2
Most frequent Hematology reagents that become surplus		
None	41	93.2
Detergent	1	2.3
Diluent	2	4.5
Do you have reporting & resupplied schedule		
Yes	42	95.5
No	2	4.5
Is the temperature chart up-to-date?		
Yes	37	84.1
No	7	15.9
Do you report hematological machine failure		
Yes	35	79.5
No	9	20.5

5.8 Data quality

Comparing of “Loss and Adjustment” on IFRR to the actual physical count of damaged/expired items or transferred to dispensary units has no variation in 37 (84.1%), discrepancy on “Loss and Adjustment” on IFRR to the actual physical count of damaged/expired found in 7 (15.9%),

Table 8:To show relationship of document to what actually exist for quality of data

Variables	Number(n)	Percent (%)
Do you use IFRR for hematological reagents in the laboratory		
Yes	39	88.6
No	5	22.4
Are stock on hand equal at the start of the period and previous on IFRR		
Yes	40	90.9
No	4	9.1
Comparing “Loss and Adjustment” on IFRR to the actual physical count of damaged/expired items or transferred to dispensary units has no variation.		
Yes	37	84.1
No	7	15.9
Comparing “Calculated Consumption” indicated on the IFRR to the verified CC		
Yes	39	88.9
No	5	11.4

5.9 Knowledge of laboratory professionals towards LMIS

All 44 study populationknows what LMIS mean, how to monitor consumption and how to complete stock keeping records. From these participants 37(84.1%) of them had got training the training could be through formal training 17(38.6%), from colleague 25(56.8%) and 2(4.5%) from workshopon LIMS, the in service training was organized by HC for 28(63.6%).

Most or 37(84.1%) respondents have knowledge about stock consumption of medical laboratory LMIS. Among those 41(93.2%) monitor per test while 3(6.8%) per patient.

Table 9: knowledge status of laboratory participants towards LMIS

Variables	Category	Frequency	Percent
Trained on LIMS	Yes	37	84.1
	No	7	15.9
Way of knowledge acquired	Training	17	38.6
	Colleague	25	56.8
	Workshop	2	4.5
Training provider	HC	28	63.6
	Sub CITY	9	20.5
	RHB	5	11.4
	NGO	2	4.5
Knowledge about stock consumption	Yes	37	84.1
	No	7	15.9
Ways of monitoring consumption	Per patient	3	6.8
	Per test	41	93.2
How often inventory monitored	Every two weeks	40	90.9
	Monthly	1	2.30
	Every two month	3	6.8

Knowledge about how to complete stock keeping records	Yes	37	84.1
	No	7	15.9
What formats do you use to monitor consumption	IFRR	24	54.5
	IFRR and RRF	20	45.5

5.10 Attitude of laboratory professionals towards quality improvement of LMIS

The following table depicts that response of study participants towards LMIS attitude. Among 44 study population majority of them 27(61.4%) were agree that, developing system management will improve LMIS. The 17(38.6%) of respondents said that strongly agree, developing system management will improve LMIS.

Response of the study participants for the causes of successful implementation of LMIS were, 30(68.1%) of them responded that staff interest, 6(13.6%) of them knowledge of the project, again 6(13.6%) of them claimed that team work and 2(4.5%) of them managerial support.

Table 10: Attitude of respondents about quality improvement of medical laboratory LMIS

Variables	Category	Frequency	Percent
Contribution of developing system management for improvement of LMIS	Strongly agree	17	38.6
	Agree	27	61.4
	Disagree	0	0
	Strongly disagree	0	0
	Total	44	100
How did you prefer to work if LMIS implemented	As individual	18	40.9
	As team	26	59.1
	Other	0	0
	Total	44	100
Causes for successful implementation of LMIS	Staff interest	30	68.2
	Knowledge of LMIS	6	13.6

	Management support	2	4.5
	Team work	6	13.6
	Other	0	0
	Total	44	100
Importance of quality improvement of LMIS for decision making & controlling	Most	34	77.3
	Moderate	7	15.9
	Faire	3	6.8
	Total	44	100
Do you agree improving LMIS will improve service quality	Strongly agree	19	43.2
	Agree	25	56.8
	Disagree	0	0
	Total	44	100
Do you agree staff interest will improve LMIS	Strongly agree	6	13.6
	Agree	38	86.6
	Disagree	0	0
	Strongly disagree	0	0
	Total	44	100
Do you agree staff knowledge will improve LMIS	Strongly agree	6	13.6
	Agree	38	86.6
	Disagree	0	0
	Strongly disagree	0	0
	Total	44	100
Do you agree managerial support will improve LMIS	Strongly agree	6	13.6
	Agree	38	86.6
	Disagree	0	0
	Strongly disagree	0	0
	Total	44	100

Do you agree improving LMIS will help decision making	Strongly agree	15	34.1
	Agree	29	65.9
	Disagree	0	0
	Strongly disagree	0	0
	Total	44	100
Do you agree training on LMIS will improve quality of service	Strongly agree	25	56.8
	Agree	19	43.2
	Disagree	0	0
	Strongly disagree	0	0
	Total	44	100

5.11 Practice of laboratory professionals towards quality improvement of LMIS

The following table illustrates various practices of laboratory professionals. Among 44 study Populationall of them were participating on quality improvement of LMIS. Among 44 participated 40(90.9%) of them participated as team, while 4(9.1%) of them as individual. Those participatedeither as team or individual evaluated their participation and 41(93.2%) of them said as average, 2(4.5%) highest while 1(2.3%) individual rate it as lowest.

One of important issue is that stock status of hematological laboratory commodities, based on the respondentstock out of hematology laboratory commodities is occurs monthly 26(59.1), quarterly10(22.7%) , and 8(18.2%) biannually. Control and detergents are commodity mostly encounter stock in balance.

Table 11: Practice of respondents about quality improvement of medical laboratory LMIS

Variables	Category	Frequency	Percent
Have you participate in LMIS work	Yes	44	100
	No	0	0
	Total	44	100
How do you participate	As individual	4	9.1

	As team	40	90.9
	Other	0	0
	Total	42	100
How did you evaluate your participation	Highest	2	4.5
	Average	41	93.2
	Lowest	1	2.3
	Total	44	100
Integration of LMIS with LIS	Yes	40	90.9
	No	4	9.1
	Total	44	100
Stock out of laboratory commodities	Monthly	26	59.1
	Quarterly	10	22.7
	Biannual	8	18.2
	Other	0	0
	Total	44	100
Under stock of laboratory commodities	Monthly	23	52.3
	Quarterly	11	25.00
	Biannually	8	18.2
	Other	2	4.5
	Total	44	100
Over stock of laboratory commodities	Monthly	17	38.6
	Quarterly	8	18.2
	Biannually	8	18.2
	Other	11	25.00

	Total	44	100
Which commodity mostly encounter stock in balance	Detergent	5	11.4
	Diluents	0	0
	Cell pack	0	0
	Cell clean	0	0
	Control	31	70.5
	None	8	18.2
	Total	44	100
Is hematology machine functional most of the time	Yes	26	59.1
	No	18	40.9
	Total	44	100
Method of laboratory commodities recorded	Paper	7	15.9
	Electronic	0	0
	Both	37	84.1
	Total	44	100

5.12 Qualitative finding through in depth Interview

Result of In-depth interview Logistics program managers and officers who are involved in logistic activities were interviewed about IPLS implementation status and identified strength and challenges.

Key area of Strength

Improved laboratory quality management system

Presence of trained professionals

Staff collaboration

Availability of SOP and other RRF and IFRR formats

Integration of management

IPLS integrate the fragmented distribution of products and minimized the cost for transportation, expiry, over stock and frequent stock out

All most all facilities have adequate amount of recording and reporting formats

Building capacity of facilities through IPLS training and supportive supervision

Creating management ownership of the system through IPLS orientation

Supported facilities to implement IPLS

Key area of weakness

Lack of institutional ownership

Lack of strong supportive supervision

Lack of coordination among stakeholders

High turnover of trained man power

No accountability at facility, and poor enforcement by facility manager

Shortage of cold chain at AA hub to store cold temperature lab items

No monitoring and evaluation of the system established

High volume facilities were not sending RRF with completed, valid and accurate report

Most facilities do not calculate their consumption accurately and requested huge amount of laboratory reagents

Standard reagent inventory control practice were not followed

Transportation of laboratory reagent is poor

Hematological reagent supply chain is not organized

No functional regulatory system

6. Discussion

This study was under taken in ten health centers and one sub city. The health centers have 20 pharmacist and 44 laboratory professionals which participate in this study. Only one pharmacist from sub city was participated.

According to the majority of the respondents most health centers in the sub city are staffed with seven professionals for pharmacy and eight for laboratory. 3(15%) and 11(55%) of the facilities had at least 1-5 IPLS and LMIS trained pharmacy staffs respectively. 13(65%) of participated laboratory professionals acquire the knowledge through formal training. 37(84.1%) of them had got the training through formal training 17(38.6%), 25(56.8%) from colleague and 2(4.5%) from workshop on LIMS. Among 44 study population majority of them 27(61.4%) were agree that, developing system management will improve LMIS. 17(38.6%) of respondents said that strongly agree, developing system management will improve LMIS. In relation to practice of 44 participated 40(90.9%) of them participated as team, while 4(9.1%) of them as individual.

6.1 IPLS Implementation related to hematology commodities

IPLS implementation and stock keeping records were exist in all health centers this is line with the finding in Malawi [2],while my finding is contradictory to the finding of studies conducted in Uganda and Sierra Leone that showed there were no standardized LMIS forms [2], this difference could be because of study period.

In this study 15(75%) of interviewed pharmacy professionals responded that both RRF and IFRR were used for managing hematological commodities. While 5(25%) of them states that they use only IFRR,but a study conducted in Addis Ababa Ethiopia suggest that bin cards, IFRRs and RRFs were available among 25 (96.2%) of the health facilities this is a little bit more than this study finding. Among these facilities, 16 (61.5%) health facilities update bin cards regularly, and 22 (84.6%) of them complete and send IFRR to their respective facility stores, while 24 (92.6%) of the facilities were completing and sending RRF to supplying EPSA every two months [14] this is almost similar to this study finding.

In this study 3(15%) and 11(55%) of the facilities had 1-5 IPLS and Lab commodity management trained staffs respectively. A relatively similar finding was found in study conducted in Bayelsa State, Nigeria indicate training level of 34.6%, 57.7% and 7.7% for

laboratory scientists, technicians and assistants respectively [7]. A more or less similarity was also found in a study conducted in MAUL where less than 50% of the facilities had staff that had not been trained on logistics management system of health commodities. In a study conducted in Addis Ababa, Ethiopia a total of 114 professionals involved in laboratory commodity management, 71 (62.3%) were trained in logistics management information system (integrated pharmaceutical logistics system or Ethiopian laboratory logistics system). of these, 67 (58.8%) were pharmacy professions and 4 (3.5%) were laboratory professionals. In contradiction to these studies were found in SPMMCH among 18 professionals, only 3 of them had got in-service training, but 15 (83.3%) of respondents did not have training on the LMIS[17]similarly studies which were conducted in Zimbabwe and Uganda reported that majority of laboratory staff were not trained on LMIS[2] this difference may be because of the number of participant, study period and study place.

6.2Utilization Recording and Reporting Formats For IPLS

The reports used in IPLS (IFRR and RRF) have multiple portions arranged as columns requiring various data sets (beginning balance, quantity received, loss and adjustments, and ending balances) and requires additional computations (consumption, quantity needed to reach maximum stock level, etc). In this study it is found that review of comparison between "Quantity Received" on RRF with "Quantity Received" on EPSA STV/DIC or Facility Model 19 within twenty consecutive period in the ten health centers indicated that 18(90%) had perfect match while 2(10%) had discrepancies though in a study conducted in Addis Ababa Ethiopian, discrepancy in quantity received was seen among 13 (52%) facilities [4]. This Difference may be because of sample size variation.

6.3Association of IFRR utilization with management support

For the observation of the association between IFRR utilization and management support a significant association observed in management enforcement on use of IFRR for reporting & resupply were associated with Calculated consumption equal in RRF and CC at all periods*(p=0.032).* While in a study 2(11.1%) of participants responded managerial support as a cause for successful implementation of LMIS [4].

6.4Utilization of stock keeping records like bin card, stock cards and IFRR for hematology commodities

Some of the stock keeping records that are used for hematology commodities are bin card, stock cards and IFRR. In this study from 44 participants 17(38.6%) replied as they are using all the formats, 26(59.1%) of them replied as they are using some of it and 1(2.3%) participant replied as he has never used. What found in this study is in parallel to the finding in Tanzania where 35% of facilities had stock/bin cards [2] and Ethiopia were available among 25 (96.2%) of the health facilities, but contradictory to evidence that had no stock/bin cards to track laboratory commodities [2] while there were also situations in which 70% of health facilities had stock/bin cards for laboratory commodities in the store. [2] Moreover, evidence showed that 100% availability of bin/stock card for 7 hematological reagents [17] this is in line with my finding.

In addition it was indicated that Hematology reagents and its supply stock out status was stated by 12(27.3%) of the participants before resupply occurs this almost similar to a study conducted in Tanzania [2] where 35% of laboratories were stock out and contradictory to the finding of a health facility survey conducted in Uganda that showed many laboratories experienced frequent stock outs and delay in receipt of key Hematology reagents and commodities that happens for months [2] this difference could be because of study area difference. Furthermore most frequently happening stock out for Hematological reagents were control, cell pack, diluents and detergent with 20(45.5%), 7(15.9%), 7(15.9%) and 5(11.4%) respectively. While in a study conducted in Addis Ababa 46.7% facilities were stock out for EDTA test tube; however, only 1 (33.3%) facility for CD4 reagent and another 1 (25%) for detergent [14]. Another evidence indicated that Six (75%) and 3(37.5%) of facilities had less stock levels than the minimum stock levels for CD4, cell dyne lyze detergent reagents respectively [10].

Although there was stock out status again there were still surplus reagents according to some respondents 3(6.8%), frequently happening surplus Hematology reagents were detergent and diluents 1(2.3%) and 2(4.6%) respectively but in a study conducted in SPMHMC Addis Ababa Ethiopia among 7 items of Hematology commodities no over stock observed[17] this difference could be because of study area and study item.

6.5Knowledge of laboratory professionals towards LMIS

All 44 study population knows what LMIS mean, how to monitor consumption and how to complete stock keeping records. From these participants 37(84.1%) of them had got training in contrary to this finding a study conducted in SPHMMC only 3(16.67%) of them had got in-service training this variation may be because of study time and, sample size. The training provided according to this finding could be through formal training 17(38.6%), from colleague 25(56.8%) and 2(4.5%) from workshop on LIMS. In my finding all participants know about the consumption and inventory system of laboratory commodities but in this evidence only 2(11.1%) of them know about it, but 1 respondent did not know about inventory mechanism (17).

Among 44 study population majority of them 27(61.4%) were agree that, developing system management will improve LMIS. The 17(38.6%) of respondents said that strongly agree, developing system management will improve LMIS.This finding is a little bit different from an evidence in which the majority 12(66.7%) of respondents strongly agreed that developing a system management will improve LMIS while 6(33.3%) of them agreed that, developing system management will improve LMIS[17] this slit difference might be because of study area.

When participants were requested about their preference regarding team work 26(59.1%) prefer to work as team while 18(40.9%) prefer to work as individual on LMIS, this is different from the finding in which 16(88.9%) of the study participants responded that they prefer to work as a team while 2(11.1%) preferred to work individually[17] this slit difference might be because of study area.

Response of the study participants for the question causes of successful implementation of LMIS were, 30(68.1%) of them responded that staff interest, 6(13.6%) of them knowledge of the project, again 6(13.6%) of them claimed that team work and 2(4.5%) of them managerial support. But in a study conducted in Addis Ababa Ethiopia they found that 5(27.8%) of them responded that staff interest, 4(22.2%) of them knowledge of the project, again 4 (22.2%) of them claimed that team work, 2(11.1%) of them managerial support and 3(16.7%) of them responded that all the above are causes for successful implementation. This finding is totally different from my finding specially with regard to staff interest this difference could be because of study time, sample size and study area differences[17].

Importance of quality improvement of LMIS for decision making & controlling hematology commoditiesbased on participants response 35(77.3%) said it most important, 7(15.9%) moderately important and 3(6.8%) said fairly important. In previous study in Addis Ababa 10(55.6%) of them replied as moderate and 7(38.9%) of them said most important and 1 study participant replied least helpful [17]. Again this finding is contradictory to my finding this may be because of study time, sample size and study area differences.

19(43.2%) of respondent strongly agree improving LMIS will improve service quality, while 25(56.8%) of them agree improving LMIS will improve service quality. This evidence if also somewhat different to my finding as all participants believed that improvement of LMIS will improve the quality of laboratory services[17]. This difference most probably because of difference in the institutional level, management level, and study area.

7. Conclusion and recommendation:

7.1 Conclusion: Management enforcement on use of IFRR for reporting & resupply significantly associated with calculated consumption at all periods.

Most frequent stock out Hematology reagents were correspondingly control, cell pack, diluent and detergent with their magnitude.

All 44 study population knows what LMIS mean, how to monitor consumption and how to complete stock keeping records.

Majority of the participants either agreed or strongly agreed, developing system management will improve LMIS.

All of participants were participating on quality improvement of LMIS of which the majority of them participated as team

7.2 Recommendation: Management enforcement on use of IFRR for reporting & resupply is important for IPLS implementation. Integrated management support and supervision is recommended for proper implementation of IPLS.

7.3 **Strength**: Improved laboratory hematology commodities in quality management system.

Integration of management with staff trained professional in logistic management information system.

7.4 **Weakness**: lack of coordination among stakeholders and institutional ownership.
High turn over of trained manpower and poor enforcement by facility manager.

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9. Annexes

Annex I. Information Sheet (English Version)

Addis Ababa University Medical Faculty, School of Medical Laboratory Sciences

Dear Participant,

My name is GetayeNigussie, Post graduate student of Addis Ababa University, College of Health Sciences Department of Medical Laboratory Sciences; I am going to conduct study and collect data on LMIS status for public health facilities found in Nifas silk lafto sub city that perform Automated Hematology tests. The objective of the study is to collect current information on LMIS of Automated Hematology analyzer commodities and associated factors at governmental health institutions. The information you provided improves the logistics management information system in the management of laboratory commodities and better quality service provision to the clients. The study identified gaps and challenges and provide recommendations for proper interventions of government and logistic interventions for the future. If you decide to participate, I will guarantee that there is no any influence related to study but only request you that to provide all relevant information regarding the study. I cannot guarantee, however, that you will receive any direct benefits from this study. However this information will be useful to manage hematology reagents logistic system and quality of service provided to the public. Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Your name will not be written on the questionnaire or be kept in any other records. Your participation is voluntary and you are free to withdraw your consent and to discontinue participation at any time without consequence. Your participation or not, do not have any influence for your position or responsibilities in your health facility. The interview may take about 45- 60 minutes. For the successes of our study, you are kindly requested to respond genuinely and voluntary with patience. Your signature below indicates that you have read the information above and have decided to participate in the study.

Thank you for your participation;

GetayeNigussie

Contact address of PI, 0937671265

Annex II. Consent form in English

I_____ here by giving my consent to provide accurate

Information about LMIS in the management of Automated Hematology Reagents in health facility as recommended by the researcher/data collector and to answer those logistics questions. I understand there is no problem within my position in the health facility by participating in this assessment at the beginning as well as at the end of the study. I believe that the result of the study will help EPSA and health facilities Management to improve the overall logistic system and provision of quality service to the public as a whole

Participants Name _____ Signature_____ Date_____

.

Researcher's Name_____ Signature _____Date_____

Annex III. Questionnaire

Assessment of logistics management information System in Public Health Center of Nifas Silk Lafto Sub city

“Good day. My name is _____.My colleague and I am representatives of this research team. We are conducting a survey to check status of LMIS in public health facility laboratory professionals’, pharmacy head and stores availability of reagents in store and dispensing unit (facility laboratory) your facility will be selected by chance to be included in the study. The assessment will provide information for respective stakeholders and give chance to appropriate interventions to improve LMIS performance. All of the information collected is strictly confidential. We will not refer to individual facilities in the report, but rather will describe the overall picture of all facilities. Do you have any questions? May we proceed?

First, ask the following questions of the person in-charge or pharmacy head/store manager. After asking questions 01 -07 under section I, visit the storeroom, or storage area where the automated hematology reagents are managed. If you are referred to another staff member for the stocktaking exercise, introduce the survey goals and objectives as you did during the introduction. Hand the respondent the list of products that are included in the survey, and explain that we will refer to the list for some of the following questions.

Section I: Facility Services and Infrastructure

Information about Interview	
Date: Interviewer/s Name: signature	DAY MONTH YEAR
Checked by: supervisors name _____	Signature----------

No .	Question	Code Classification	Go To/ Comments
1	Name of the facility		
2	Region		
3	Sub city		
4	Woreda		
5	City/Town		
6	Supply Hub		
7	Facility code		
8	Type of Facility	Health center ---1 Sub City store ---2	

Section II: Background Characteristics of the Respondent and health center

No	Question	Code Classification	Go to/Comment
1	Name, title and mobile phone number of person interviewed for this survey	Name: _____ Title: _____ Mobile number: _____	
2	Number of years and months you have worked at this facility?	Years: _____ Months: _____	
3	Are you the primary person responsible f or managing drugs and medicine products at this facility?	Yes --- 1 No --- 0	
4	How many staff the facility has under the pharmacy unit?	Number of pharmacy unit staff /_____/	
5	How many of them are trained in IPLS?	Number trained /_____/	
6	How many of them are trained in laboratory commodity management?	Number trained /_____/	
7	Educational qualification of pharmacy unit staff	# of staff with Degree /_____/ # of staff with Diploma /_____/ Other # /_____/	
8	Who is /are the principal person responsible for managing laboratory commodities that are used for automated hematology analysis at this facility? Multiple responses are possible	Pharmacist …….. 1 Pharmacy Technician……..2 Laboratory technologist..…3 Lab technician …….4 Druggist …….5 Nurse ……...6	

Ask the following questions of someone in charge of managing/overseeing Hematology reagents. After asking the questions in this section, visit the warehouse, storeroom, or storage area where the laboratory commodities that are used for hematology consumables are managed.

Section III. IPLS Implementation related to hematology commodities

No	Questions	Code classification	Go to Comments
1	Are the following LMIS Formats, Job Aides and SOPs are available at the facility? (Ask for documents to verify)		
	Bin Cards	Yes 1 No 0	
	Internal Facility Report and Requisition Voucher (IFRR)	Yes 1 No 0	
	Facility Report and Requisition Form (RRF)	Yes 1 No 0	
	Standard Operation Procedure (SOP) for IPLS	Yes 1 No 0	
2	Do you use the following stock keeping logistics forms to manage hematology consumables in this facility? Must be verified by checking sample(3-5 product bin cards) complete		
	A. Bin Cards	Yes 1 No 0	
	B. Other (specify)_____	Yes 1(specific)---------- No 0	
3	What LMIS forms do you use for reporting/ordering? Multiple responses are possible. Must be verified with completed report		
	A. IFRR	Yes 1 No 0	
	B. RRF	Yes 1 No 0	
	C. Other	Yes 1(specific)--------- No 0	
4	The health facility compiles and sends RRF for Hematology reagent reports to higher level?	Yes 1 No 0	
5	If yes, to who: Multiple responses are possible.	EPSA……1 RHB……..2	

		Sub-city /ZHD Health Office……..…..3 Wereda.……4 Don't Know…….5 Other (specify)_____6	
6	If yes, how often are these LMIS (RRF) reports sent to the higher level (PFSA/sub city/zone)? Multiple responses are possible.	Monthly 1 Bimonthly (every two months)…...……2 Quarterly…….……..3 Semi-annually…… 4 Annually 5	
7	When was the last time this facility sent RRF? Must be verified with completed report	Never 1 Within the last month……..2 2 months ago 3 3 months ago 4 More than 3 months ago…… 5	
8	Does all the columns in RRF are completed for all hematology reagents? Must be verified with last completed report.	Yes 1 No 0 Completed report not available 3	
9	Does the facility laboratory use IFRR for regular reporting on hematology reagents? Must be verified with completed report	Yes----- 1 No----- 0	
10	How did you learn to complete the forms/records used at this facility? Multiple responses are possible	Formal Trainings IPLS……1 Pre service Trainings……..2 Other informal trainings (Specify)_____3 On-the-job training (other staff from facility)…….4 On-the-job training (someone outside facility).....5 Never been trained……..6	

		Other (specify) 7	
11	How many emergency orders have you placed in the last 3 months? If available, ask for documents to verify using RRF	Actual number	
12	What are the direct sources of supply for hematology reagents at this facility? Multiple responses are possible		
	For hematology, CD4 reagents & their supplies	EPSA……1 RHB……..2 Sub-city ZHD…….……..3 Woreda……4 Health Center…….5 Other (specify)_____9	
13	On average, for a normal order approximately how long it does takes between sending an order and receiving product from EPSA or RHB or other source. (Main resupply point)?	actual weeks	
14	Does the facility usually get the quantities of all Hematology reagents that orders?	Yes 1 No 0 Don't know 9	
15	Does this facility normally collect all hematology reagents and its supply?	Yes 1 No 0 Don't know 9	
16	Who is responsible for transporting all Hematology reagents and its supply to your facility?	EPSA……1 RHB……..2 Sub-city /ZHD……..…..…..3 Woreda……4 Hospital…….5	

		Health Center……...……6 Other (specify)_____9	
17	When did you receive your most recent supervision visit? Check visitors book, if necessary	Never received 1 Within the last month 2 1 - 3 months ago 3 3 - 6 months ago 4 More than 6 months ago 5 Other (specify) 9	
18	The last supervision visit that hematology reagents and its supply management was by: Multiple responses are possible.	EPSA……1 RHB……..2 Sub-city/Zone ……3 Health Office……..…..4 Woreda……5 Health Center…….6 Partner(specify)_____ 7 Other (specify)_____9	
19	Did your last supervision visit include that hematology reagents and its supplymanagement/logistics (e.g., bin cards checked, logistics reports checked, storage conditions checked etc)?	Yes 1 No 0 Don't know 9	
20	Do you have a functioning refrigerator(s) to s tore cold chain lab reagents?	Yes (specify number ____) 1 No--- 0 Not applicable---9	
21	To record the actual temperature, look at the internal thermometer inside the refrigerator—ideal temperature is between 0 and +8 degrees centigrade. (Note if thermometer is broken or missing.)	Temperature (in centigrade) _____	

22	Is the temperature chart up-to-date? (To be up-to-date, there must be an entry for the day before the visit).	Yes -----1 No------0	
	Data quality		
23	Are the calculations on the RRF accurate? (check to see if they are accurate and tick into the boxes below)		
	a. Comparing "Calculated Consumption" indicated on the RRF to the verified CC (recalculating the CC as "SOH at the start of the period + Quantity Received – SOH at the end of the period +/- Loss/Adj.).	Yes-----1 No---------0	
	b. Comparing "Maximum Stock Quantity" indicated on the RRF to the verified "Maximum S tock Quantity" (recalculating the "Maximum Stock Quantity" as CC X 2).	Yes-----1 No---------0	
	c. Comparing "Quantity Ordered" indicated on the RRF to the verified "Quantity Ordered" (recalculating the "Quantity Ordered" as "Maximum S tock Quantity" – "Ending Balance in the Store").	Yes-----1 No---------0	
24	Are the data reported on the RRF valid? (check to see if they are valid and tick into the boxes below)		
	a. Comparing the "Beginning balance in the Store" to the "Ending balance in the store" of the previous report.	Yes-----1 No---------0	
	b. Comparing the "Quantity Received" on the RRF with the "Quantity Received" on PFSA STV/DIC or Facility Model 19 within the reporting period.	Yes-----1 No---------0	
	c. Comparing "Ending balance" indicated on t he RRF versus Quantity at the end of the reporting period as indicated on the Bin Card.	Yes-----1 No---------0	
	d. Comparing the "loss and adjustment" indicated on the bin card with RRF loss and	Yes-----1	

	adjustment column of t he reporting period.	No---------0	
	e. Comparing "Calculated Consumption" versus the sum of quantities issued on the "Quantity Issued" column of the bin card during the recent reporting period.	Yes-----1 No---------0	
	f. Comparing the "DOS" on RRF versus "DOS" indicated on the bin card	Yes-----1 No---------0	
25	Does management (Head of the health facility, CEO, Medical Director, and DTC) take supportive actions for the implementation / improvement of the IPLS		
	a) Has management enforced the use of a regular schedule for internal reporting and resupply?	Yes-----1 No---------0	
	b) Has it enforced use of IFRR for reporting & resupply?	Yes-----1 No---------0	

Thank you for your time and information. You have been very helpful. Our remaining question will require looking at products in the storeroom and speaking with the person who oversees the store.

Questioner's for laboratory personnel: Introduce all team members and ask facility representatives to introduce themselves. Explain the objectives of this survey:

No	Questions	Code classification	Go to
1	Name, title and mobile phone number of person interviewed for this survey	Name: _____ Title: _____ Mobile number: _____	
2	Number of years and months you have worked at this facility?	Year----- months-----	
3	Who is the principal person responsible for managing Hematology reagents and its supplyat this facility	Pharmacist ……..….1 Lab technologies……..2 Lab technician……..3 Other (specify) -----9	
4	Do you use the following stock keeping recording & reporting IPLS forms to manage Hematology reagents		

	and its supply in this facility		
	A. bin card B. stock cards C. IFRR D. others ----------	Yes ------1 No----------0 Yes -------1 No----------0 Yes ------1 No----------0 Yes ------1 No----------	
5	Do IFRR of Hematology reagents and its supply include the following		
	A. Stock on hand B. Quantities used C. Losses and adjustment	Yes -----1 No---------0 Yes -----1 No---------0 Yes ---1 No---------0	
6	How did you learn to complete the bin card & IFRR used at this facility laboratory? (Circle all that apply.)	During IPLS DU orientation-----1 On-the-job training ---------2 Never been trained-------3 Other (specify)---------9	
7	When did you receive your last supervision vi sit or O JT that how to manage laboratory commodity (e.g. bin cards checked, IFRR, and expired stock removed, supplies checked)	ever received.....1 Within the last month.....2 Within the last 3 months.....3 Within the last 6 months.....4 More than 6 months ago.....5 Other (specify) ----------9	
8	Are there any Hematology reagents and its supply you usually run out of before resupply?	Yes.....1 No 0	If NO go to Q11
9	If yes, list the four most frequent Hematology reagents and its supply.	…….	
10	Do you have reporting & resupplied schedule	Yes .....1 No 0	
11	Are there any Hematology reagents and its supply you usually have a surplus of before resupply? At the time of visit	Yes .....1 No 0	If N O go to Q14

12	If yes, list the four most frequent?	List four most frequent items ---------- ------ ------	
13	Do you have a functioning refrigerator(s) to store cold chain lab reagents?	Yes (specify number ____) 1 No--- 0 Not applicable---9	
14	To record the actual temperature, look at the internal thermometer inside the refrigerator—ideal temperature is between 0 and +8 degrees centigrade. (Note if thermometer is broken or missing.)	Temperature (in centigrade) ____	
15	Is the temperature chart up-to-date? (To be up-to-date, there must be an entry for the day before the visit).	Yes -----1 No------0	
16	Do you inform machine functionality status to the facility store mam	Yes -----1 No------0	
	Data quality of IFRR		
17	Do you use IFRR in the laboratory	Yes -----1 No----------0	if No, skip
18	Are data of IFRR at laboratory unit valid and accurate? Check a few sample copies of the IFRR	Yes -----1 No----------0	
	a. Comparing the “SOH at the start of the period” to “ SOH at the end of period” of the previous report	Yes ----1 No-------0	
	b. Comparing “Loss and Adjustment” indicated on the IFRR to the actual physical count of damaged/expired items or transferred to or from other dispensary units (whenever possible).	Yes ----1 No-------0	
	c. Comparing “Calculated Consumption” indicated on the IFRR to the verified CC (recalculating the CC as “SOH at the start of the period + Quantity Received – SOH at the end of the period +/- Loss/Adj.)	Yes ----1 No-------0	

Questioners for sub city pharmaceutical and medical supplies logistic officer

No	Question	Code classification	Go to
1	Name, title and mobile phone number of person interviewed for this survey	Title/position : _____ Mobile number: _____	
2	Number of years and months you have worked at the sub city?	Years: 1_____ Months: __9_____	
3	Are you rained on IPLS Supportive supervision skill training	Yes 1 No 0	
4	Are you trained on laboratory commodity management training	Yes 1 No 0	
5	Have you provided SS on IPLS implementation to your respective facilities	Yes 1 No 0	
6	If yes for Q 5 how frequent	Bimonthly 1 Quarterly 2 Bi annually 3 Annually 4	
7	Do you included in your SS Hematology reagents and its supply management in IPLS implementation	Yes 1 No 0	
8	Have you develop action point on provided OJT to laboratory dispensing units in regarding to IPLS implementation	Yes 1 No 0	
9	Are your respective facilities send to you copy of HIV/AIDS laboratory commodities RRF	Yes 1 No 0	
10	If yes for Q 9 do you aggregate and send to higher level for monitoring and evaluation	Yes 1 No 0	
11	Do you think RRF data of your respective facilities are valid and accurate	Yes 1 No 0	
12	If yes for Q 10 how frequent	Bimonthly 1 Quarterly 2 Bi annually 3 Annually 4	
13	Are your respective facilities sending their consumption report of hematology reagent and its supply?	Yes 1 No 0	

14	If yes for Q13 how frequent	Bimonthly 1 Quarterly 2 Bi annually 3 Annually 4 No regular schedule 5	
15	Do you think needs special training for management of hematology reagents and its supply	Yes 1 No 0	
16	What is your comment on IPLS implementation status on regarding hematology reagents and its supply		

IV Knowledge, attitude and practice about hematology commodities laboratory logistics management information systems (LMIS)

Knowledge of professionals on hematology commodities laboratory logistics management information systems (LMIS)

No	Questions	Code classification	Go to
1.	Do you know how hematological commodities laboratory management information system LMIS is monitored? (If No, skip)	1.yes 2.No	
2.	If yes for Q1, how did you get it?	a. Through training b. Through workshop c. Discussion with colleagues d. Other (specify)……	
3.	If yes for Q1, which organization did provide you acquisition of yourknowledge?	a. The health center itself b. Sub city c. The regional health bureau d. NGO's e. Other (specify)……	
4.	Do you know how the laboratory commodity stock status consumption monitored? (If No, skip Q5)	a. Yes b. No c. Do not know	
5.	If yes for Q4, how did you monitor?	a. Per patient	

		b. Per test performance c. Other (specify)……..	
6.	Do you know how the laboratory commodity inventory system conducted?	a. Yes b. No c. Do not know	
7	If yes for Q6, how often did you perform inventory?	a. Every two weeks b. Every month c. Every two month d. Other (specify) …….	
8	Do you know stock keeping logistics forms to manage hematology consumables in this facility?	a. Yes b. No c. Do not know	
9	If yes for Q7, with what did you manage?	a. IFRR b. RRF c. Other (specify)……	

Attitude of professionals on hematology commodities laboratory logistics management information systems (LMIS)

No	Questions	Code classification	Go to
10.	Do you agree that, developing the system management for hematological laboratory commodity will contribute to the improvement of quality of LMIS?	a. Strongly agree b. Agree c. Disagree d. Strongly disagree	
11.	Working as team is preferable to implement LMIS?	a. Strongly agree b. Agree c. Disagree d. Strongly disagree	

12.	All staff interest, managerial support and knowledge about successful implementation of LMIS is important.	a. Strongly agree b. Agree c. Disagree d. Strongly disagree	
13.	Do you agree, improving the quality of hematological consumables LMIS will help for decision making and controlling of stock status?	a. Strongly agree b. Agree c. Disagree d. Strongly disagree	
14.	Do you agree, improving the quality of hematological consumables LMIS will improve the quality of laboratory services in the health center?	a. Strongly agree b. Agree c. Disagree d. Strongly disagree	
15.	Do you agree providing training will improve quality of hematological consumables LMIS?	a. Strongly agree b. Agree c. Disagree d. Strongly disagree	

Practice of professionals on hematology commodities laboratory logistics management information systems (LMIS)

No	Questions	Code classification	Go to
16.	Have you ever got the opportunity to participate in quality improvement of hematological consumables LMIS? (If No, skip Q17&18)	a. Yes b. No	
17.	If yes for Q1, how did you participate?	a. As individual b. As a team c. Other (specify)……	

18.	If yes for Q16, how did you evaluate your participation in quality improvement project activities?	a. Highest b. Average c. Lowest	
19.	Is the laboratory LMIS integrated with laboratory information system?	a. Yes b. No c. Don't know	
20.	How often do you face hematology consumable stock out?	a. Monthly b. Quarterly c. Annually d. Other (specify)….....	
21.	How often do you encounter hematology consumable under stock?	a. Monthly b. Quarterly c. Annually d. Other (specify)….....	
22.	How often do you face hematology consumable over stock?	a. Monthly b. Quarterly c. Annually d. Other (specify)….....	
23.	Which laboratory commodity mostly encounters a problem of stock balance status?	a. cell pack b. Detergent c. Other (specify)….....	
24.	Is hematology equipment/machine is mostly out of functioning?	a. Yes b. No	
25.	How are the commodities of laboratory being recorded?	a. Electronic based b. Paper based c. Other (specify)……	

Section V Product Availability

Table1. Stock Status (Specify a full six month period prior to the survey; and the day of visit)

Column:

1. Name of all tracer products that will be counted
2. Unit of count for the product

Note: Columns 1 and 2 will be filled out before questionnaires are printed for the survey.

3. Record whether or not the product is available at this facility, answer Y for yes or N if no.
4. Check if the bin card is available, answer Y for yes or N for no.
5. Check if the bin card has been updated within the last 30 days, answer Y for yes or N for no. Note: If the bin card was last updated with the balance of 0 and the facility has not received any resupply, consider the bin card up-to-date.
6. Record the balance on the bin card.
7. Record if the facility has had any stock out of the product during the 6 month period from --/--/ -- /--/ 2019, answer Y for yes or N for no.
8. Record how many times the product stocked out during the 6 month period from --/--/ -- /--/ 2019 according to bin cards, if available.
9. Record the total number of days the product was stocked out between --/--/ -- /--/ 2019, only.
10. Record the quantity of product issued from the storeroom between --/--/ -- /--/ 2019, only.
11. Record the physical count in the storeroom.
12. Record if the facility experiencing a stock out of the product on the day of the visit, answer Y for yes or N f or no. If products are available outside the storeroom there is no stock out. Visually verify that usable products are in stock.
13. Record if the facility has expired products. If there are products that are near expiry (within one month), note the product and quantity in the comments section

SN	Product	Unit of count	Managed at this facility(Y/N)	Bin card available(Y/N)	Bin card updated(Y/N)	Balance on Bin card	Stock out most recent 6 months(Y/N)	No of stock outs	Total NO of days stock out	Total issued(most recent 6 months)	Physical inventory-store room	Stock out today(Y/N)	Availability of expired products(Y/N)
1	Deterg ent	20lit											
2	Diluent	20 lit											
3	Cell pack	20 lit											
4	Cell Clean	50 lit											
5	BD vacutainer tube 4ml												
6	BD vacutainer needle												

Section VI. Storage Conditions

Items 1–17 should be assessed for all facilities for products that are ready to be issued or distributed to SDPs an d for store rooms in all S DPs. P lace a c heck mark i n t he appropriate column based on visual inspection of the storage facility; note any relevant observations in the comments column. To qualify as "yes," all products and cartons must meet the criteria for each item

No	Description	Yes	No	Comment
1	Products that are ready for distribution are arranged so that identification labels and expiry dates and/or manufacturing dates are visible.			
2	Products are stored and organized in a manner accessible for first-to-expire, first-out (FEFO) counting and general			

	management.			
3	Cartons and products are in good condition, not crushed due to mishandling. If cartons are open, determine if products are wet or cracked due to heat			
4	The facility makes it a practice to separate damaged and/or expired products from usable products and removes them from inventory.			
5	Products are protected from direct sunlight at all times of the day and during all seasons			
6	Cartons and products are protected from water and humidity during all seasons			
7	Storage area is visually free from harmful insects and rodents			
8	Storage area is secured with a lock and key, but is accessible during normal working hours; access is limited to authorized personnel.			
9	Products are stored at the appropriate temperature during all seasons according to product temperature specifications.			
10	Roof is always maintained in good condition to avoid sunlight and water penetration.			
11	Storeroom is maintained in good condition (clean, all trash removed, sturdy shelves, organized boxes)			
12	he current space and organization is sufficient for existing products and reasonable expansion (i.e., receipt of expected product deliveries for foreseeable future)			
13	Products are stacked at least 10 cm off the floor			
14	Products are stacked at least 30 cm away from the walls and other stacks			
15	Products are stacked no more than 2.5 meters high			
16	Fire safety equipment is available and accessible (any item identified as being used to promote fire safety should be considered)			

Annex IV. Key Informant interview guide

List of questions interviewed the respective respondent

1. What is y our opinion on the IPLS implementation in regarding hematological reagents and their supply in your respective health facility?

The informant person describe on IPLS implementation status

Discuss the laboratory supply chain (flow of information and product) in the region/sub city/facility

Existence of Bincard, IFRR, RRF, SOP and Job aid for IPLS implementation

Practice of using IPLS recording and reporting formats

How are they tracking and reporting of logistics information to higher body

How do you feel the importance of tracking logistics information?

What is your opinion regarding the organizational support for the IPLS implementation in regarding to hematological reagents and their supply management with in the IPLS?

Discuss management ownership on IPLS implementation

Discuss the importance of supervision for improving IPLS implementation

Describe the challenges that the program is currently facing in implementing IPLS in the management of hematological reagents and their supply.

What is your opinion to implement IPLS in the management of hematological reagents and their supply

Collect their ideas and opinions of the informant interviewed and arranged in table of the strength and weakness of facilities to implement IPLS specifically for hematological reagents and its supply. Analyze and discuss the results.

Annex V. Amharic version consent form

ለጥናቱተሳታፊወችየተዘጋጀየፈቃደኝነትመግለጫቅጽ (ኮንሰት)

እኔ…… የhematologyየላቦራቶሪግብአቶችንበተመለከተለምጠየቀውጥያቄ ትክክለኛመረጃለመስጠትፍቃደኝነቴንእገልጻለሁ፡፡በጥናቱወቅትምከመጀመሪያእስከመጨረሻምንምአይነትእኔንየ ሚነዳሁኔታእንደለለተረድቻለሁ፡፡ጥናቱምእኔለምሰራበትጤናድርጅትብቻሳይሆንለሌሎችተመሳሳይድርጅቶችበተለይም የhematologyምርመራናከትትልለሚያደርጉድርጅቶችሁሉእንደሚጠቅምእውቄያለሁ፡፡ጥናቱበሚጠና ቀቅበትጊዜምየሁሉንምየጤናድርጅቶችጥንቅርመረጃእንጅየአንድጤናድርጅትመረጃብቻእንደማይቀርብተረድቻለሁ፡፡

የተሳታፊስም……ፊርማ……ቀን……

የተመራማሪስም…… ፊርማ……ቀን……

ለዚህጠቃሚጥናትስለተባበራችሁኝአመሰግናለሁ፡፡

ማሳሰቢያ፣ስለጥናቱተጨማሪመረጃከፈለጉበነዚህስልክቁጥሮችይደውሉ

PI 0937671265

Declaration

I, the undersigned, declare that this M.Sc. thesis is my original work, has not been presented for a degree in this or any other university and that all sources of materials used for the thesis have been duly acknowledged.

M.Sc. candidate: GetayeNigussie (B.Sc.)

Signature:_____

Date of submission:_____

This thesis has been submitted with our approval as advisors.

Advisor:Dr. Aster Tsegaye(MSc, PhD)

Signature: _____

Date: _____

Place: Addis Ababa, Ethiopia.

Advisor: AdinewDesale (MSc)

Signature: _____

Date: _____

Place: Addis Ababa, Ethiopia.