ADDIS ABABA UNIVERSITY FACULTY OF MEDICINE
SCHOOL OF CLINICAL LABORATORY SCIENCE

Assessment of Laboratory Logistics Management Information System Practice for HIV/AIDS and Tuberculosis (TB) Laboratory Commodities in Selected Public Health Facilities in Addis Ababa

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DECLARATION

I, the undersigned, declare that this 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 this thesis has been duly acknowledged.

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Dedication

This paper is dedicated to my most noble and beautiful girl friend Azeb Seyum; a husband could ever be blessed with. My post graduate study is made possible through her unreserved help, encouragement and ambition. God bless her once more.

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Abbreviations

AARHB	Addis Ababa Regional Health Bureau
AAU	Addis Ababa University
AAU-MF	Addis Ababa University Medical Faculty
AFB	Acid Fast Bacilli
AIDS	Acquired Immunodeficiency Syndrome
ALP	Alkaline Phosphate
ANC	Antenatal Care
ART	Antiretroviral Therapy
ARV	Antiretroviral Drug
BUN	Blood Urea Nitrogen
CD4+	T-lymphocyte Bearing CD4 Receptor
EHNRI	Ethiopian Health and Nutrition Research Institute
EOP	Emergency Order Point
et.al	And others
FCRRF	Facility combined Report and Requisition form
FGD	Focus Group Discussion
FMOH	Federal Ministry of Health
GOT	Glutamate Oxaloacetate Transaminase
GPT	Glutamate pyruvate transaminase
HIV	Human Immunodeficiency Virus
IPLS	Integrated pharmaceutical logistics system
IRB	Institutional Review Board
JSI/DELIVER	John Snow Inc. / Deliver project
KHB	Kehua Bio-engineering (KHB) HIV (1+2) rapid test kit
LIAT	Logistics Indicator Assessment Tool
LMIS	Logistics Management Information System
LSAT	Logistics System Assessment Tool
MOH	Ministry of Health
MSH	Management Sciences for Health
NGO	Non-Governmental Organization
PFSA	Pharmaceuticals Fund and Supply Agency
PMTCT	Prevention Mother to Child Transmission
RHB	Regional Health Bureau
RL	Regional Laboratory
SCMS	Supply Chain Management System
SDP	Service Delivery Points
SPSS	Statistical package for social sciences
STI	Sexually transmitted infection
STK	Sample Transfer Kits
TB	Tuberculosis
USAID	United States Agency for International Development
VCT	Voluntary Counselling and Testing

Abstract

Background: - Logistics management information system for health commodities remained poorly implemented in most of developing countries. These days; however since poor commodity management for HIV/AIDS and TB laboratory commodities is leading to stock outs and overstocks of these commodities, the need of robust logistics system have gained attention.

Objectives: **-** To assess the status of laboratory logistics management information system for HIV/AIDS and tuberculosis laboratory commodities in selected public health facilities in Addis Ababa.

Methods: **-** A cross-sectional descriptive study was conducted to assess the status of laboratory LMIS used for managing HIV/AIDS and TB laboratory commodities at selected public health facilities run by the Addis Ababa Regional Health Bureau (AARHB) and Federal Ministry of Health (FMOH) which either distribute HIV/AIDS and TB laboratory commodities to other facilities or provide services such as ART, VCT, PMTCT or TB laboratory services. A stratified random sampling method was used to include a total 43 facilities which, were investigated through quantitative methods using structured questionnaires interviews. The principal person responsible for managing laboratory commodities was interviewed by well trained interviewers using pre-tested questionaries in each facility. Focus group discussion with the designated supply chain managers and key informant interviews, using questions adapted from logistics system assessment tool (LSAT), were conducted with central level staff from PFSA, EHNRI and RHB for the qualitative method

Results: **-** There exists a well-designed logistics system for laboratory commodities with trained pharmacy personnel, distributed standard LMIS formats and established inventory control procedures. However, majority of laboratory professionals were not trained in LMIS. Majority of the facilities (60.5%) were stocked out for at least one ART monitoring and TB laboratory reagents and the highest stock out rate was for chemistry reagents (direct and total bilirubin reagents). Sixteen facilities (37.2%) had stock outs at the time of visit for at least one ART monitoring and TB laboratory commodity. Expired ART monitoring laboratory commodities were found in 25 (73.5%) of facilities. Fifty percent (50%) of the assessed hospitals and 54% of health centers were currently using stock/bin cards for all HIV/AIDS

and TB laboratory commodities in main pharmacy store, among these only 25% and 20.8% of them were updated with accurate information matching with the physical count done at the time of visit for hospitals and health centers respectively. In hospitals laboratory mini-stores 37.5% of them uses stock/bin cards for HIV/AIDS and TB laboratory commodities and 25% of health centers laboratories starts to use bin cards that were not updated.

Conclusion: **-** Even though there exists a well designed laboratory LMIS, keeping quality stock/bin cards and LMIS reports were very low. Key ART monitoring laboratory commodities were stock out at many facilities at the day of visit and during the past six months. Based on findings, training of laboratory personnels managing laboratory commodities and keeping accurate inventory control procedures were recommended.

Key words: Logistics management information system, stock outs, laboratory commodities

1. INTRODUCTION

1.1 Background

Logistics is a branch of management that studies the process of planning, implementing and controlling the efficient, cost 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 in the least possible time (1). Laboratory logistics management information system is the management of laboratory commodities (reagents, consumables, supplies and equipment) in a systematic and standardized way by collecting, processing and utilizing timely logistics data to inform quantification, procurement, storage and distribution of laboratory commodities (2).

Logistics Management Information System (LMIS) is important for all public health commodity distribution systems. It is especially critical for *Human Immunodeficiency Virus*/*Acquired Immunodeficiency Syndrome* (HIV/AIDS) commodities that have high value and requires special handling procedures (3). Without LMIS implementation, programs will inevitably waste valuable resources through prolonged and frequent stock outs, overstocks and losses (4). A well implemented LMIS reduces the likely hood of stock outs and overstocks that can waste scarce resources and lead to product expiration, especially given the short shelf life of HIV test kits (5).

Laboratory logistics data are collected, processed, and reported through a LMIS which increases the likelihood of an adequate supply of all HIV/AIDS and tuberculosis (TB) laboratory commodities for all facilities (2). LMIS is an essential tool for supply chain managers and policy makers to make sound decisions, ranging from routine resupply decisions at the local level to long-term forecasting and procurement decisions at the national level (3).

Managing supply chains in support of laboratory services is a formidable challenge, especially in developing countries (2). Expanding programs for HIV/AIDS, TB and malaria require strong and supportive laboratory services that depend on the availability of the required commodities to perform critical tests, with most tests requiring multiple commodities to be available simultaneously (6).

The Ethiopian laboratory LMIS was weak, consistently being hampered by several systemic challenges that caused frequent stock outs of critical commodities, thus impeding continuous and quality testing for patients (7). Currently, the country has designed integrated pharmaceutical logistics systems (IPLS) for all public health commodities including essential drugs, family planning, malaria, laboratory services, nutrition, TB-leprosy and HIV/AIDS commodities (8).

Laboratory logistics management information system that manages test kits, reagents and other supplies in any setting (public or private sector) and at any level (local, regional or national) follows a well-recognized system that can be viewed as a cycle of selection, quantification and procurement, distribution and use. At the centre of the cycle is management support that includes financing, information management, staffing, monitoring and evaluation (9).

Logisticians have developed a systemic approach (logistics cycle) to describe the activities of a logistics system (10). A good supply chain is customer driven and all logistics functions within the supply chain must work effectively to ensure commodity availability. Logistics information available through the LMIS drives all decisions in the supply chain, and enables managers to operate supply chain functions including forecasting, quantification, and inventory management (11).

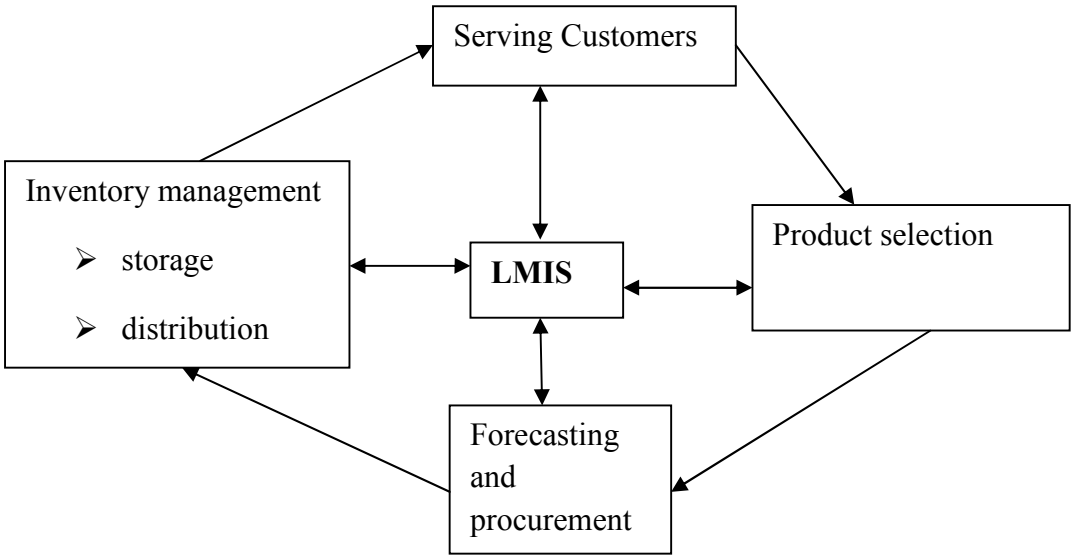

Figure 2: The Logistics Cycle (From Logistics Hand Book: JSI/DELIVER, 2004 page 5)

Logistics information is the motor that drives the logistics cycle. Information has to be gathered and analysed about each activity in the system to coordinate subsequent actions. Thus there is a need to manage the information system for other activities of the logistics cycle to function properly. Logistics management information system is the collection, processing and utilization of logistics information for decision-making (8).

A logistics system provides quality customer service by fulfilling six rights: ensuring that the right information on the right laboratory commodity in the right quantities at the right time and right place for making the right decisions on what, when and how much to order (12). If the laboratory LMIS is not functioning well, service delivery points (SDPs) will be forced to experience either stock outs or excess stocks finally leading to dissatisfaction of clients or wastage of commodities (10, 13).

The essential logistics data to be collected, processed and utilized for decision making are stock on hand, consumption, losses and adjustments (14). These data need to be collected, processed and analysed at all levels of service delivery points (hospitals, regional laboratory and health centres) and warehouses at different levels (PFSA, RHBs, Sub city pharmaceutical supply assuring sustainability case team) for decision making.

This study focuses only on the facilities that are owned by Ministry of Health or Addis Ababa Health Bureau. This is because the public sector is the major provider of HIV related and tuberculosis laboratory diagnosis and monitoring services (15, 16) and the staffing pattern and administrative structures are similar since their major HIV/AIDS and TB laboratory commodity supplier being the Ministry of Health/Pharmaceutical Fund and Supply Agency (MOH/PFSA).

1.2 Statement of the problem

Supply Chain Management of HIV/AIDS and tuberculosis commodities in resource-limited countries is challenging, that requires innovative approaches which are built on sound logistics principles (17). Strong laboratory LMIS accompanied by coordination and harmonization of quantification, procurement, inventory control, distribution and reporting are necessary to ensure continuity of care for the patient and to guarantee efficient use of limited resources (18).

The successful provision of voluntary counselling and testing (VCT), prevention of mother to child transmission (PMTCT) and antiretroviral therapy (ART) service depends on the continuous availability of HIV/AIDS supplies and commodities (13). Without adequate supplies of HIV/AIDS laboratory commodities or an effective supply chain to deliver the laboratory commodities to SDPs on a continuous basis, investments in provision of ART will not be maximized (19). In addition, as ART services expand, laboratory services must expand to meet the growing demand of laboratory tests required for initiation, monitoring and changing anti-retroviral therapy. A key element to support these expanded laboratory services is a well-designed laboratory logistics management system that ensures the availability of essential laboratory supplies and test kits (20).

Poor laboratory LMIS for laboratory commodities used for TB diagnosis and monitoring purpose hinders the availability of TB laboratory commodities and high-quality services to all people presenting with symptoms of tuberculosis and minimizes TB detection rates (21). A well implemented laboratory LMIS for TB programs ensures reliable, valid and timely laboratory results that supports the tuberculosis package of care and treatment including diagnosing new patients and monitoring treatment response (22).

Unlike pharmaceuticals, little attention has been given to the particular need for a laboratory commodity management system. In most cases, poor laboratory LMIS has created many problems at SDPs such as the shortage of reagents to conduct the most critical tests (23).

The design and implementation of a LMIS is the most important technical intervention in supply chain management systems. Without accurate and timely logistics data, HIV/AIDS and tuberculosis program managers will not have sufficient information to make key resupply decisions or to efficiently and effectively operate the logistics system (2, 24).

1.3 Ethiopian National HIV/AIDS Laboratory Logistics Management Information System Situation

National laboratory logistics system was designed in 2007 to support HIV/AIDS prevention, treatment and support programs in Ethiopia (25). The designed logistics system was integrated in to the national ARV logistics system to make patients receive comprehensive package of care (25).

Laboratory commodities are used in the provision of HIV/AIDS and TB prevention, care and treatment services in Ethiopia (26). These services are provided through a variety of public health facilities offering antiretroviral therapy (ART), care and support services, sexually transmitted infection (STI) diagnosis and treatment, voluntary counselling and testing (VCT), tuberculosis diagnosis and prevention services including federal and specialized hospitals, uniformed services and prison hospitals, selected regional laboratories and health center sites that provide the service (27).

Health facilities order laboratory commodities using standard inventory control procedures, receive commodities from Pharmaceuticals Fund and Supply Agency (PFSA), and store, use, and account for laboratory commodities using recording and reporting forms (27, 28). PFSA is responsible for quantification, procurement, storage and distribution of laboratory commodities to public health facilities or service delivery points (SDPs) (8, 28). Ethiopian Health and Nutrition Research Institute (EHNRI) provide technical support to laboratory regents and supplies in the logistics system, including equipment maintenance, external and internal quality assurance schemes (5).

Laboratory commodities flow down from PFSA to PFSA hubs, hospitals and health centre stores. The information collected on facility combined report and requisition form (FCRRF) of the logistics management information system is used for decision making on inventory level flows from the health facility stores (SDPs) up to PFSA (25).

The inventory control system is a forced ordering maximum/minimum inventory control system. Every SDP in the system is required to report at the end of every other month and order all laboratory commodities back up to the maximum level. If stock on hand for any commodity falls below 2 weeks (0.5 months) of stock before the end of the reporting period, an emergency order should be placed. To maintain adequate stock levels, the maximum

months of stock, minimum months of stock and an emergency order point have been established as 4, 2 and 0.5 months respectively for SDPs (25).

The designed laboratory LMIS brings a sound improvement on distribution of laboratory commodities, decrease emergency orders, decreases stock out rates and expired commodities (7). However, there are still many challenges such as; an inadequate availability of needed laboratory reagents and supplies, lack of information for procurement and re-supply decision, limited capacity of the SDPs in the implementation of laboratory LMIS that lead to long patient waiting-times for tests at some health facilities (29).

Several studies have been conducted to see the status of logistics management information system and supply chain systems for HIV/AIDS and TB laboratory commodities specially for ART drugs and HIV test kits elsewhere, (30-40) however, there is limited information in Ethiopia in general and particularly in laboratory logistics management information system. Therefore, this study is designed to assess the status of laboratory logistics management information system for HIV/AIDS and TB laboratory commodities at selected public health facilities in Addis Ababa and identify the strengths and weaknesses of the LMIS in order to improve the design and operation of the logistics data collection, analysis and utilization of data for decision of key logistics functions.

2. Literature Review

A number of studies conducted to assess the status of logistics management information system and supply chain systems for the implementation of HIV/AIDS and tuberculosis programmes, majority of them showed, logistics management tools didn't capture the three essential logistics data items (stock on hand, consumption and losses and adjustments) and implementation of logistics management information system is still a serious problem in many areas as shown by presence of inaccurate logistics data and frequent stock outs of key commodities (30-40).

In 2005, an assessment was conducted in Lesotho to see the status of laboratory capacity to support the scale-up of ART. The result showed that laboratories experience frequent and prolonged stock-outs of key reagents. Haematology reagents were stock out for three months. Thirteen (67%) and 16 (83%) of laboratories didn't set minimum and maximum stock levels respectively. Thirteen (67%) of laboratories had no stock/bin cards to track laboratory commodities. There were no developed LMIS guide lines on how to determine orders and few laboratory staffs were trained in LMIS. Storage spaces were inadequate and poorly ventilated. Thirty three percent of laboratories reported that, reagents were not stored according to the first expiring first out (FEFO) practice. None of the laboratories practiced the separation of damaged/or expired supplies from usable products and storage spaces were small.The author concluded the placing of orders was erratic and inconsistent and Data collected in the LMIS wasn't reliable due to poor record keeping (30).

A cross-sectional facility based-survey was conducted in Zimbabwe. The result showed that, Forty seven (34.4%), 46 (31.95) and 23 (28.9%) of facilities reported that, they were stock out for uni-gold, determine and oraquick test kits respectively during six months before the assessment. Two (3.2%), 2 (3.2%) and 16 (38.6%) of facilities were stock out for uni-gold, determine and oraquick test kits respectively on the day of visit. Average duration of stock outs were 24, 21 and 108 days for uni-gold, determine and oraquick test kits respectively. Fifteen (25.9%), 11 (19.7%) and 5 (28.7%) of facilities had less than the minimum stock levels for uni-gold, determine and oraquick test kits respectively. Twenty three (38.9%), 18 (30.6%) and 10 (58%) of facilities had higher than the maximum stock levels for uni-gold, determine and oraquick test kits respectively. Seventy five percent of facilities maintained stock/bin cards for rapid test kits from which 80% of them were updated. Sixty percent of

facilities recorded stock on hand that differed from the physical inventory on the day of visit. None of the facilities had expired determine and uni-gold test kits. Eighty percent of facilities maintained the ideal storage conditions. Six (9%), 25 (39.5%) and 7 (12%) of facilities had received less, equal and higher quantity than ordered respectively for rapid test kits. Majority of laboratory staffs were not trained in LMIS except PMTCT staffs (31).

A study done in Tanzania showed that, 14 % of hospitals and 75% of warehouses were stock out for rapid test kits on the day visit. Nineteen percent of hospitals and 75% of warehouses were stock out for rapid test kits during six months before the assessment. Highest duration of stock outs were for determine test kits which were 184 days. Seventy-eight percent of facilities had received supervision for LMIS. Sixty-eighty percent storage areas were in compliance with storage guidelines. The overall condition of the storerooms and their inadequate size were the two weakest areas noted in the storage conditions of the survey (32).

Another study done in Tanzania by Allers *et al.* showed that, there was no logistics data (consumption, stock on hand, losses and adjustments), no standardized inventory control systems, physical inventory and monitoring expiration dates weren't carried out. The authors conclude that logistics information for laboratory commodities were unavailable, outdated or underestimates demand because of underreporting and inaccurate logistics data (33).

A study in Ghana showed that, there was no minimum /maximum stock levels for laboratory supplies, LMIS was limited to HIV test kits, laboratories didn't maintain stock cards, laboratory staffs weren't regularly aware of the stock status in the stores due to minimal communication between the storekeeper and the laboratory staff. Moreover, there was no standard ordering schedule and procedures in the system. Storage facilities had adequate space, 25 (83.3%) of facilities followed FEFO guidelines. Expired laboratory commodities weren't removed on time (34).

A health facility survey conducted in Uganda showed that, many laboratories experienced frequent stock outs and delay of key commodities, such as HIV rapid test kits, chemistry reagent and chase buffer. There were no standardized LMIS forms and many staff members hadn't been trained in LMIS. The author concludes, supply chain deficiencies affected the availability and the quality of laboratory services in the country (35).

A study done in Malawi showed that, minimum/maximum stock level and EOP weren't set for laboratory commodities, 70% and 40% of hospitals and health centers respectively had stock/bin cards for laboratory commodities in pharmacy store however, majority of them were not kept up-to-date. No stock/bin cards were used in the laboratory store and VCT room, all hospitals and 30% of health centers used standardized LMIS format. Twenty-eight percent and 60% of facilities were stocked out for CD4 and glutamate oxaloacetate transaminase (GOT) reagents respectively. Twenty-two percent and 18% of health centers were stock out for determine and uni-gold test kits respectively on the day of visit. Similarly, 8% and 25% of facilities were stock out for determine and uni-gold test kits respectively. 15%, 8%, 18% and 8% of hospitals and 5% of health centers were stock out for carbon fuchsin, methylene blue, acid alcohol and oil immersion on the day of visit respectively. Fifty percent of facilities had functioning vehicle, the rest 50% didn't had vehicle for commodity distribution and pick up. Half (50%) of the storage facilities were in compliance with proper storage guide lines, separate storage of hazardous reagents and absence of written storage guide lines were the two weakest storage conditions found (36).

A study conducted in Tanah Papua region in Indonesia showed that, supply chains of HIV/AIDS laboratory commodities were well maintained. However, the author claimed there were challenges such as poor inventory management with stock holdings out of balance, poor logistics data and record keeping, poor management of expiry dates due to the "push" logistics management information system (37).

A cross-sectional descriptive and qualitative assessment of supply chains for HIV test kits in Sierra Leone showed that, there were no standardized LMIS for collection and reporting of essential logistics data on consumption, losses and adjustments, stock balances of HIV tests weren't accurate, stock cards were in use at some of the facilities but they had not been updated in one or two years, the data on stock cards weren't match the physical count. There were no standardized inventory control systems with procedures for monitoring and managing stock levels of HIV test kits at all levels of the logistics system. As a result, national HIV/AIDS Secretariat was unable to detect and address stock imbalances in a timely fashion to avoid stock outs and overstocking throughout the country supply pipeline (38).

An assessment of health commodity supply in Rwanda showed that, 42% of facilities had expired HIV related laboratory commodities, 59 (69%), 45 (53%), 59 (69%), 19 (22%) and 4 (11%) of facilities had adequate stocks for determine, uni-gold, Capillus kits, creatinine and

bilirubin reagents respectively. Six (17%) of facilities had vacutainer tubes, GPT, GOT and glucose reagents. About 34 (39%) of facilities had stock outs of rapid test kits. Three (3.4%) of facilities had stock outs for glutamate pyruvate transaminase (GPT), glutamate oxaloacetate transaminase (GOT) and alkaline phosphates (ALP) reagents. Inventory control procedures were poor and most proper storage conditions were not met by stores (39).

Assessment of integrated logistics system performance in Tanzania showed that, 35% of laboratories were stock out. Of these, 10% were stock out for rapid HIV test kits. Order fill rate was accurate in which laboratories receive equal amount of quantities ordered. Thirty-seven percent of facilities had stock ledger of which 69% were updated. Fifty-eight percent of facilities had stock ledger forms for rapid test kits of which 91% were updated. 16% of facilities had reported stock outs (40).

An assessment of impact of the national HIV/AIDS laboratory logistics management information system on the harmonization of laboratory commodities in Ethiopia by EHNRI through technical support of SCMS claimed that, after implementation of the national HIV/AIDS laboratory logistics management information system; stock outs, number and frequency of emergency orders and commodity wastage were decreased dramatically. In addition, laboratory reagents and related supplies were arriving on time in quantities needed. As a result, patients waiting time for tests have been reduced significantly (7).

2.1 Significance of the study

Public health laboratory systems and programs in developing countries struggle to make important laboratory commodities available to those who need them. A strong laboratory logistics management information system is critical for successful supply chain management implementation and laboratory commodity security, especially to ensure consistent commodity availability for HIV/AIDS and tuberculosis testing and monitoring service (41). To our information an assessment of laboratory LMIS at facility level in Ethiopia was not done until to date. Therefore, this assessment will help to describe how well the laboratory logistics management information system is functioning in the public health facilities of Addis Ababa and identify the strengths and weaknesses of the existing laboratory LMIS.

3. Objective

3.1 General objective

- To assess the status of the laboratory Logistics Management Information System for HIV/AIDS and tuberculosis laboratory commodities in selected public health facilities in Addis Ababa.

3.2 Specific objectives

- To describe how the designed laboratory LMIS operates for HIV/AIDS and TB laboratory commodities
- To assess the availability of ART monitoring and AFB testing laboratory commodities
- To evaluate the utilization of logistics data for decision making

4. Materials and methods

4.1 Study area

The study was conducted in Addis Ababa which is the capital city of Ethiopia, seat of African Union and Economic Commission. It is located in the geographic centre of the country and covers a landmass of 540 sq. km. It is administratively sub-divided into 10 sub cities and 116 weredas. According to central statistical agency 2008 report the city has an estimated population of 2.98 million (42). The city has 45 hospitals, 31 health centers and 551 clinics (43). From 45 hospitals 10 are public, 5 are under Addis Ababa Regional Health Bureau, 5 are specialized referral hospitals, 3 are uniformed forces (military), 4 are NGOs and the rest 28 are private hospitals. The study area was chosen because it is the most accessible area for better implementation of the laboratory logistics system compared to other parts of the country and poor functioning of the system in such area will enable us to see how severe the problem will be in the rural areas of the country.

4.2 Study design and period

A facility based cross-sectional descriptive study was conducted from September 2010-January 2011 on laboratory LMIS practice. Both quantitative and qualitative data collection methods were employed. Interviewing persons responsible for managing laboratory commodities at all levels of the supply chain using structured questionnaire and physical inventory of HIV/AIDS and TB laboratory commodities available at the time of visit was assessed in quantitative part of the study. Focus group discussion with the designated supply chain managers and key informant interviews, using questions adapted from logistics system assessment tool (LSAT), were conducted with central level staff from PFSA, EHNRI and RHB to understand the challenges facing the logistics systems and to obtain a description of the supply chain system for HIV/AIDS and TB laboratory commodities were done for the qualitative method.

4.3 Source population

The source population were all the facilities involved in the supply chain of HIV/AIDS and TB laboratory commodities from PFSA and Regional Health Bureau (RHB) to the SDPs. This includes all public health facilities providing laboratory services for HIV and TB

diagnosis, monitoring and treatment services. These facilities are five federal specialized hospitals, five hospitals under AARHB, ten sub-city pharmaceutical supply assuring sustainability case teams, 26 health centers, Addis Ababa Regional Health Bureau (AARHB) and Addis Ababa Regional Laboratory (AARL).

4.3.1 Study population

A total of 43 health facilities comprising 4 federal specialized hospitals, 4 hospitals under AARHB, 23 health centers, 9 sub-city pharmaceutical supply sustainability case teams, one regional laboratory and AARHB were included in this study using a stratified random sampling method.

4.3.2 Sampling procedures

A total of 48 public facilities involving in supply chain of HIV/AIDS and TB laboratory commodities were listed and can serve as a sampling frame. A stratified random sampling method was used to create different strata according to their type. These includes five federal hospitals, five hospitals under AARHB, one regional laboratory and regional health bureau, 10 sub-city pharmaceutical supply assuring sustainability case teams and 26 health centers. A separate sample unit was selected from each stratum using proportionate to their size. Thus, 4 federal hospitals, 4 hospitals under AARHB, 23 health centers, 9 sub-city pharmaceutical supply assuring sustainability case teams, one RHB and one regional laboratory were the sample population. Individual units were selected by simple random sampling method from the study populations.

4. 4 Sample Size Estimation

Sample size was calculated using the minimum sample size calculation formula for cross-sectional study for estimating single proportion assuming 50% prevalence of poorly functioning laboratory LMIS, 5% margin of error and 95% CI due to lack of similar prevalence study in Ethiopia.

P=0.5 $\quad n = \frac{(Za/2)^2 * P\,(1-P)}{d^2} = \frac{(1.96)^2 * (0.5) * (0.5)}{(0.05)^2} = 384$

D= 0.05

N=48

Finally the correction factor for finite population was applied to include a total of 43 facilities. Corrected sample size

n= N*n/N+n 48*384/48+384= 42.66≈ 43

4.5 Inclusion and Exclusion criteria

All public health facilities that provide ART monitoring service, perform rapid HIV testing, perform AFB testing, refer samples for CD4 testing and monitoring, store and distribute HIV/AIDS and TB laboratory commodities to other health facilities was included in the study. Those facilities that don't provide ART monitoring service, HIV testing, AFB testing and don't refer samples for CD4 were excluded from the study.

4.6 Stock availability and stock outs by commodity type

4.6.1 Stock availability

Stock availability was defined as, if the facility had within the established minimum/maximum stock levels. The established minimum and maximum stock level was 2 and 4 months respectively. The current stock on hand was divided by average monthly consumption to determine how many months of stock on hand was available. Months of stock on hand were compared with established minimum and maximum stock levels.

4.6.2 Stock outs

Stock outs were defined as, a situation when the commodity is temporary unavailable on the shelf of the laboratory or in the warehouse, due to extremely prolonged supply lead time or over consumption of commodities.

4.7 Expired ART monitoring and TB laboratory commodities

Expired laboratory commodities were defined as, a commodity that was stored beyond the manufacturers expired date, at which the manufacturer cannot guarantee the full potency and safety of the commodity (44). The quantity of expired laboratory commodities that were stored in main pharmacy and mini-laboratory store were captured from bin cards, stock cards and physical inventory were done to count the actual quantities.

4.8 Storage conditions

To provide clients with high-quality services, each facility must have safe, protected storage areas to help prevent damage and ensure efficient handling of commodities (45). In assessing storage areas, the assessment examined the level of compliance with 14 guidelines for proper storage. Storage areas' adherences to storage conditions were assessed through direct observation and interviewing the principal person in the unit.

4.9 Data collection techniques: Two data collection methods were used for the assessment:

4.9.1 Quantitative method: A structured questionnaire which is originally developed by DELIVER (46) and locally adapted was used to collect quantitative information from the RHB warehouse and SDPs. Since logistics records are made only available in English, the data were collected in the same language as recorded but interviewers were all health professionals who had experience on laboratory logistics system and interview was done in Amharic. The data collectors were trained for 3 days on the questionnaire and other ethical issues. On top of the information collected through interview using the structured questionnaire, physical counts of HIV/AIDS and TB laboratory commodities was done in order to assess data quality by comparing the actual counts with the available records.

The instrument was then pretested on three facilities which were not selected by the sampling procedure applied. These were one sub-city pharmaceutical supply assuring sustainability case team, one health center and one hospital. It was used to assess utilization of LMIS formats and laboratory commodity availability at SDPs and stores.

Five data collectors with BSc. in medical laboratory science who have experience in laboratory commodity management were provided intensive training for three days. Data collection was completed over a three-week period, well supervised. The laboratory commodities covered in the assessment were ART monitoring chemistry, hematology and CD4 reagents. In addition RTKs, sample transfer kits (STKs) and AFB testing laboratory reagents were assessed.

The sources of data for the assessment were physical counts of HIV/AIDS and AFB testing laboratory commodities, stock cards/bin cards, and LMIS reports. The source of information,

including position of person interviewed, was standardized across all facility types. Interviews was held with store managers at warehouses and main pharmacy store at hospitals and health centers, pharmaceutical supply assuring sustainability sub process in RHB, pharmaceutical supply assuring sustainability case team at sub-cities, and laboratory managers and laboratory mini-store keepers in hospitals and health centers.

The instrument was used to provide information on the indicators like the availability of laboratory commodities for HIV/AIDS and TB diagnostics service on day of visit, stock out frequency and average duration of stock outs, percentage of facilities with personnel trained in logistics, percentage of facilities that had expired commodities, percentage of facilities with stock /bin cards available and accuracy of stock keeping records.

The above indicators were measured as follows: (1) commodity availability by conducting a physical inventory, (2) duration of stock outs by collecting information from both bin cards and interviewees, (3) percentage of facilities with adequate stock levels by calculating months of stock on hand and comparing to minimum and maximum stock levels, (4) percentage of facilities with inadequate and over stock levels by calculating months of stock on hand and comparing to minimum and maximum stock levels, (5) stock data quality by comparing stock/bin cards to physical inventory and reports to LMIS and (6) storage conditions by visually inspecting facilities.

The indicators that were measured were quantities of expired stock, percentage of facilities stocked out of one or more HIV/AIDS and TB laboratory commodities on day of visit, percentage of facilities where HIV/AIDS and TB laboratory commodities physical inventory count matches balance on at least one stock/bin card, percentage of facilities with staff trained in laboratory logistics system, percentage of facilities recording essential logistics data properly, percentage of facilities sending logistics data to the next higher level of the system, percentage of facilities compliance with each proper storage guidelines.

4.9.2 Qualitative method: The quantitative method has provided what information was available regarding the design and operation of the logistics management information system but does not provide how the logistics system functions (47). The Focus group guide originally developed by DELIVER (48) was locally adapted to be used for this study. Two Focus Group Discussions (FGD) with participants responsible for logistics activities in all the facilities was conducted. The FGDs was conducted one with participants from the hospital

level and the other at the sub-cities and health center level. The principal investigator facilitated the discussion and take notes on top of the tape cassette recorder. The topics that were discussed to identify strengths and weaknesses in the system were flow of HIV/AIDS and TB laboratory commodities in the supply chain, existence and functioning of laboratory LMIS, description of the information flow and how logistics information is used for decision making and capacity of logistics personnel, including training and supervision.

4.10 Data quality

Before embarking upon data collection, pre-test of the prepared questionnaires was performed in three non-sampled facilities in Addis Ababa to ensure the validity of the survey tool. After the data collection tools were pretested, appropriate modification were made to standardize the questionnaire. Data collectors were trained and provided written interpretation for logistics variables. Supervisor and the principal investigator made frequent checks on the data collection process to ensure the completeness and consistency of the gathered information; data were double entered to enable cross-checking during analysis as well.

4.11 Data analysis procedures: The quantitative data were entered and analyzed using the Statistical Package for the Social Sciences version 16 (SPSS). Descriptive statistics were computed and result was presented using tables and graphs. The qualitative portions of the study (FGD) were analysed using qualitative analysis technique (relistening to the tape recorders several times, transcribing data, categorizing, reducing and finally writing the report by narrating the finding).

4.12 Ethical consideration

The study was first approved by Addis Ababa University (AAU) Institutional Review Board of the Faculty of Medicine (IRB) and research and ethical committee of Addis Ababa Health Bureau before the study was commenced, then a letter informing the facility administrators were written from the school of clinical laboratory science and AARHB. There were a high degree of confidentiality during data collection and no name of any health facility and participating subjects were put in the result instead the aggregate result of the facilities and summary results of focus group discussants were projected.

5. Operational definitions

I. ***Adjustments*:** Changes to inventory records to reflect losses or transfers of commodities, or to correct record keeping errors.

II. ***Distribution:*** Logistics management function that includes inventory control, storage, and transporting products.

III. ***Inventory management*:** Procedures that govern how supplies are received, stored, handled, and issued.

IV. ***Logistics management information system (LMIS)*:** a manual or computerized system that collects, processes, and reports logistics data.

V. ***Logistics***: the set of activities that control how materials and products move from the initial source to the end user. It is the branch of management that ensures resources needed (or products required) by clients reach their destination in the required amount in the least possible time.

VI. ***Maximum/minimum (max/min):*** An inventory control method that requires each facility to set maximum and minimum desired stock levels for each item to ensure that quantities fall within an established range.

VII. ***On-the-job training*:** Pairing a trainee with an experienced colleague or supervisor to help the trainee acquire a set of specific skills.

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

IX. ***Reports***: forms on which all essential data items for a specific facility and for a specific time are moved from one level in a logistics system to another.

X. ***Service delivery point (SDP)*:** any facility that serves clients directly and where clients (users) receive their supplies.

XI. ***Stock card***: a generic name for an inventory control card.

XII. ***Stock on hand*:** The quantity of usable stock in inventory at a particular point in time. (Unusable items are not part of stock on hand)

XIII. ***Stock out*:** Depleted supply of a given product or products; a zero stock balance.

XIV. ***Understock*:** A supply imbalance that occurs when stocks fall below the established minimum. May result in unserved customers.

6. Results

6.1 characteristics of study facilities and study participants

A total of 43 public health facilities which are involved in HIV/AIDS and TB laboratory commodity management were investigated in this study, of which 8 (18.6%) were hospitals, 24 (55.8%) health centers, 9 (20.9%) sub-city pharmaceutical supply assuring sustainability case team, 1 (2.3%) Regional Laboratory (RL) and 1 (2.3%) RHB.

A total of 75 (65.8%) pharmacy professionals and 39 (34.2%) laboratory professionals were interviewed. (Table 1)

Table 1: Characteristics of study participants involved in the assessment of laboratory LMIS for ART monitoring and TB laboratory commodities in Addis Ababa, 2010

Variable	No	%
Facility		
Hospital	8	18.6
Health center	24	55.8
Regional Laboratory	1	2.3
Regional Health Bureau	1	2.3
Sub-city[1]	9	20.9
Total	**43**	**100**
Professionals		
Pharmacy co-ordinators	33	28.9
Pharmacy store managers	33	28.9
Sub-city[2]	9	7.9
Laboratory managers	33	28.9
Laboratory mini-store managers	6	5.4
Total	**114**	**100**

Sub-city[1] = sub-city pharmaceutical supply assuring sustainability case team

Sub-city[2] = sub-city pharmaceutical supply assuring sustainability case team leader

6.2 Organizational Structure and Supply Chain Description of HIV/AIDS and TB laboratory commodities

The laboratory logistics system for antiretroviral therapy (ART) monitoring service is totally managed by pharmaceutical fund and supply agency (PFSA) in collaboration with Supply Chain Management System/Management Sciences for Health (SCMS/MSH) and Ethiopian

Health and Nutrition Research Institute (EHNRI). Laboratory logistics system for ART monitoring service is an integrated system with other public health commodities.

PFSA distributes all the ART monitoring laboratory commodities to the service delivery points. Such as, public hospital laboratories and regional laboratory by its vehicle every 2 months period, according to their LMIS report.

Laboratory logistics system for HIV rapid test kits, sample transfer kits, and TB reagents is a vertical system managed at the RHB level by pharmaceutical supply assuring sustainability sub process and HIV/AIDS prevention and control office as well as TB/leprosy prevention and control office. These three units in the RHB work in coordination for collection of test kits and TB laboratory reagents from MOH/PFSA and distribute to the sub city pharmaceutical supply assuring sustainability case teams.

Laboratory commodities are flow from PFSA to PFSA hubs and then to the SDPs nationally. PFSA is responsible for the quantification, procurement, storage, and distribution of laboratory commodities. EHNRI is responsible for equipment maintenance duties.

Figure 2 illustrates the actual flow of laboratory commodities and information in the system in Addis Ababa.

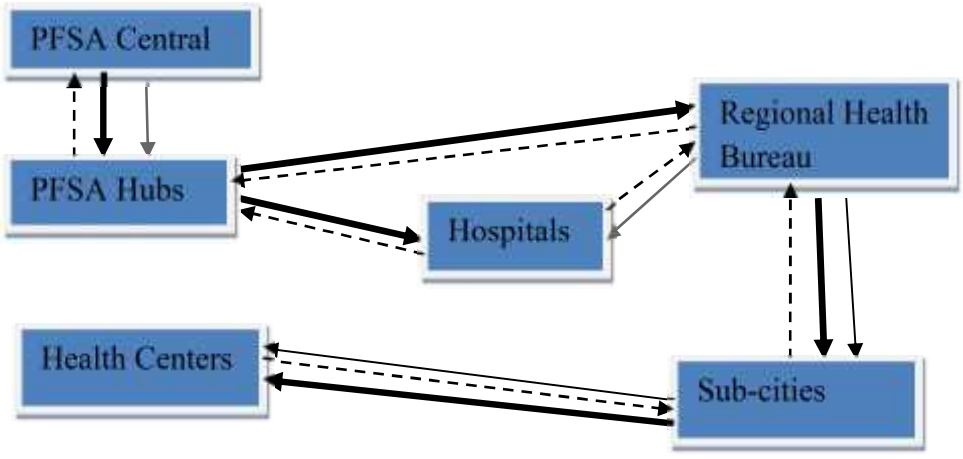

Fig 2: Flow of laboratory commodities and Information in Addis Ababa, 2010

Flow of laboratory commodities
Flow of LMIS
Feedback

Similarly, PFSA delivers ART monitoring laboratory commodities to public hospitals in Addis Ababa and to Addis Ababa regional laboratory (AARL) by its vehicle every 2 months according to their LMIS and consumption report. Figure 3 illustrates the flow of ART monitoring laboratory commodities in Addis Ababa.

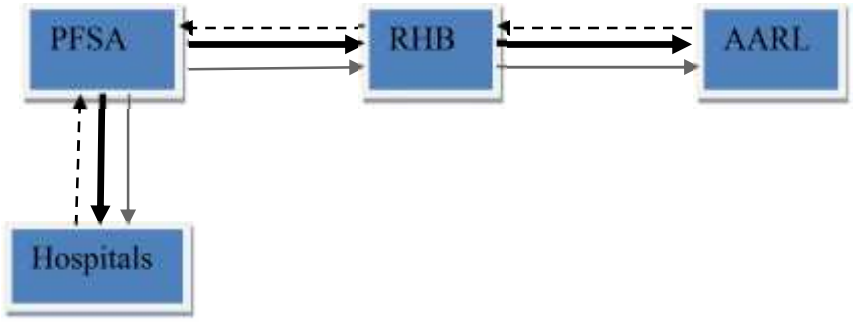

Figure 3: Flow of ART laboratory commodities and Information in Addis Ababa, 2010
AARL- Addis Ababa regional laboratory

As shown in the figure 4, RHB collects TB laboratory reagents, sample transfer kits and rapid test kits based on its quota allocation from PFSA and distributes to sub cites. Since sub cities don't have their own stores they distribute the laboratory commodities to the health centers within the day they bring from RHB.

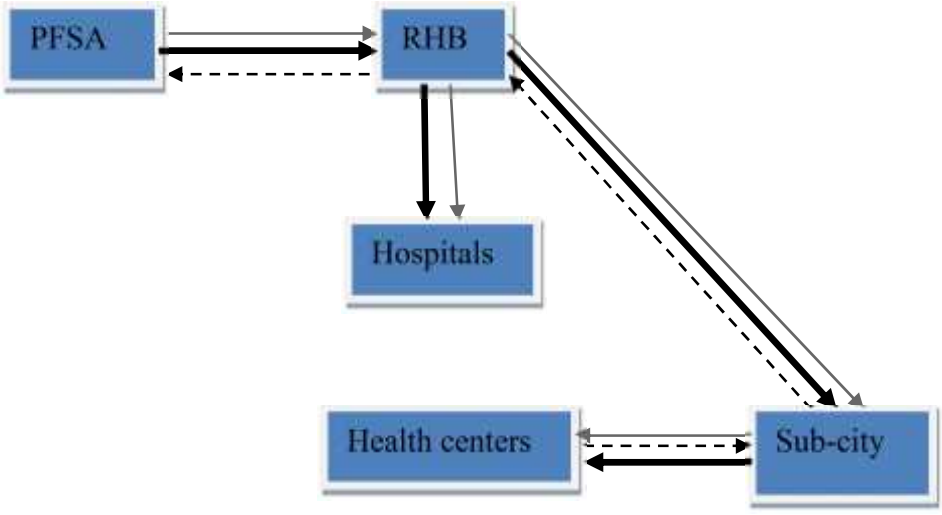

Figure 4: Flow of TB, STK, RTK and Information in Addis Ababa, 2010

Flow of laboratory commodities
Flow of information
Feedback

6.2.1 Principal person responsible for managing laboratory commodities

The principal persons responsible for managing laboratory commodities were found to be different from facility to facility. From the total 42 facilities visited in the main pharmacy store and sub-city pharmaceutical supply assuring sustainability case team visited 31 (73.8%) were pharmacists and 11 (26.2%) were druggists. In six hospitals and one regional laboratory that had laboratory mini-stores the principal person responsible for managing laboratory commodities were laboratory professionals. Our result also showed that, No laboratory professionals were assigned to mange laboratory commodities in health centers due to the absence of laboratory mini-stores in health centers.

Eighteen (41.9%) of facilities had functional vehicle, the rest 25(58.1%) of facilities did not have functional vehicle to transport laboratory and other medical supplies.

6.3 Training of professionals in LMIS

From 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. Among 67 pharmacy professionals and 4 laboratory professionals trained, 14 (12.3%), 42 (36.8%), 9 (7.9%) and 2 (1.8) pharmacy professionals were trained from hospitals, health centers, sub-cities and RHB respectively. Similarly, from 4 laboratory professionals trained, 3 (2.6%), 1(0.9%) and 0 (0%) laboratory professionals were from hospitals, AARL and health centers respectively.

Table 2: Training of pharmacy and laboratory professionals in LMIS by facility type

Facility type	Pharmacy professionals trained	Laboratory professionals trained
Hospitals	14(12.3%)	3 (2.6%)
Health centers	42 (36.8%)	0 (0%)
Sub-cities*	9 (7.9%)	___
AARL	____	1(0.9%)
AARHB	2 (1.8)	____
Total	67 (58.8%)	4 (3.5%)

Sub-cities* sub-city pharmaceutical supply assuring sustainability case team

__ Respective personnel not available in those facilities

6.4 Stock Availability by Commodity Type

6.4.1 Availability of ART monitoring and TB laboratory commodities

6.4.1.1 Facilities that had stock on hand within the minimum-maximum stock levels

As illustrate in the table 3 below, Six (75%) of facilities had within the established minimum-maximum (min-max) stock levels for creatinine, glucose and cell dyne diluent. Five (62.5%) of facilities had stock on hand within the min-max levels for cell dyne lyze and cell dyne detergents. Two (25%) of facilities had stock status within the min-max stock level for CD4 and bilirubin reagents. sixteen (47%) of facilities had stock on hand within the min-max stock levels for carbon fucshin and methyelene blue reagents. (Table 3)

6.4.1.2 Facilities that had stock on hand less than the minimum stock level

Six (75%) of facilities had less stock levels than the minimum stock levels for CD4 and bilirubin reagents. Three (37.5%) of facilities had less stock levels than the minimum stock levels for ALP, GPT, BUN, cell dyne lyze and cell dyne detergent reagents. (Table 3)

6.4.1.2 Facilities that had stock levels higher than the maximum stock levels

Two (25%) of facilities had higher stock levels for GPT, GOT and ALP reagents. Two (6%), 5 (15%) and 12 (36.4%) of facilities had higher stock levels for KHB, stat-pack and uni-gold test kits respectively. Eight (23.5%), 8 (23.5%), 6 (24%) and 5 (20%) of facilities had higher stock levels for Carbon fuchsin and Methylene blue, vacutainer tube and vacutainer needle commodities respectively. No health facilities had higher stock levels for CD4, bilirubin, creatinine and cell dyne reagents. (Table 3)

Table: 3 Percentage of facilities that had stock on hand below, above and within the minimum/maximum stock levels on the day of visit on Addis Ababa, 2010

Commodities	Facilities with less than the minimum stock level n (%)	Facilities with higher than the maximum stock level n (%)	Facilities within the minimum-maximum stock level n (%)	Median months of stock on hand (25^{th}-75^{th} percentile)
CD4 Reagent	6 (75)	0 (0%)	2 (25%)	1.0 (1.0-1.75)
FACS flow	4 (50)	0 (0%)	4 (50%)	1.0 (0.625-1.75)
ALP	3 (37.5%)	2 (25%)	3 (37.5%)	1.5 (1.0-4.25)
GPT	3 (37.5%)	2 (25%)	3 (37.5%)	2.0 (1.0-4.25)
GOT	2 (25%)	2(25%)	4 (50%)	1.5 (1.0-4.5)
Bilirubin (Direct)	6 (75%)	0 (0%)	2 (25%)	0.75 (0.5-1.75)
Bilirubin (Total)	6 (75%)	0 (0%)	2 (25%)	0.75 (0.5-1.00)
BUN	3 (37.5%)	1 (12.5%)	4 (50%)	1.0 (0.625-1.75)
Creatinine	2 (25%)	0 (0%)	6 (75%)	2.0 (1.00-2.00)
Glucose	1 (12.5%)	1 (12.5%)	6 (75%)	1.0 (0.625-2.0)
Cell Dyne Lyze	3 37.5%)	0 (0%)	5 (62.5%)	1.0 (0.625-1.75)
Cell Dyne Detergent	3 37.5%)	0 (0%)	5 (62.5%)	1.0 (0.625-1.75)
Cell Dyne Diluent	2 (25%)	0 (0%)	6 (75%)	1.0 (0.5-1.75)
KHB	15 (45.5%)	2 (6%)	16 (48.5%)	2.0 (1.0-2.0)
Stat-pack	10 (30.3%)	5 (15%)	18 (54.5%)	1.0 (1.0-2.0)
Uni-gold	7 (21.2%)	12 (36.4%)	14 (42.4%)	1.0 (1.0-2.5)
Vacutainer Tube[1]	15 (60%)	6 (24%)	4 (16%)	2.0 (1.0-2.0)
Vacutainer Tube[2]	12 (48%)	5 (20%)	8 (32%)	2.0 (1.0-2.0)
Vacutainer N	15 (60%)	5 (20%)	5 (20%)	1.0 (1.0-2.0)
Carbon fuchsin	10 (29.4%)	8 (23.5%)	16 (47%)	1.0 (1.0-2.0)
Methylene blue	10 (29.4%)	8 (23.5%)	16 (47%)	1.0 (1.0-2.0)
Acid alcohol	15 (44.1%)	6 (17.6%)	13 (338%)	1.0 (0.5-2.0)

1- vacutainer tube (4ml), 2- vacutainer tube (10ml), vacutainer N- vacutainer needle

*For CD4, Hematology and Chemistry reagents number of facilities that manage them (n=8)

*For Rapid test kits (n= 33), for sample transfer kits (n=25), for TB reagent (n=34)

6.4.2 Stock outs

6.4.2.1 Reportecd stock outs during the last 6 months

Twenty six (60.5%) of facilities reported that they usually run out of at least one ART monitoring and TB laboratory commodities before resupply. The most frequently stock out ART monitoring commodities were bilirubin reagents, BUN reagents, CD4 reagents and vacutainer tubes with stock out rate 75%, 50%, 50% and 52% respectively. The lowest stock out were uni-gold test kits, stat-pack test kits, carbon fuchsin and Methylene blue reagents with stock out rate 3%, 9%, 11.8% and 11.8% respectively.

6.4.2.2 Stock outs at the time of visit

Sixteen facilities (37.2%) had stock outs at the time of visit for at least one laboratory commodity. The highest stock out rate was for bilirubin reagents 4 (50%) followed by vacutainer tubes 10 (40%) and FACS flow reagents 2 (25%).

6.4.4 Average number of stock outs

As shown in table 4 below cell dyne reagents, vacutainer tubes and KHB had the highest average number of stock outs 3 times in the last six months. FACS flow, BUN, stat-pack, glucose, carbon fuchsin and methylene blue reagents had the lowest average number of stock outs one times in the last six months.

6.4.5 Average duration of stock outs

As shown in table 4 below from the facilities that had stock cards/bin cards the average duration of stock outs in days was found to be lowest for stat-pack, sample transfer kits (vacutainer tube and needle), FACS flow and TB laboratory reagents 3, 5 and 6 days respectively. The highest average duration of stock outs were for bilirubin reagents (73) days followed by ALP, GPT and GOT (40) days.

Table 4: Percentage of facilities stock out for laboratory commodities on the day of visit, reported stock outs during the last 6 months, average duration of stock outs and mean number of stock outs in the last 6 months, March-September/2010, Addis Ababa

Commodities	No of Facilities	Facilities stock Out on the day of visit n (%)	Facilities stock out any time in the past months % (n)	Mean # of days (range) of stock outs in the past 6 months	Mean # of times stock outs in the past 6 months
CD4 reagents	8	1 (12.5%)	4 (50%)	6 (1-10)	3
FACS flow	8	2 (25%)	2 (25%)	5 (1-7)	1
ALP	8	1 (12.5%)	3 (37.5%)	40 (10-60)	2
GPT	8	1 (12.5%)	3 (37.5%)	40 (7-60)	2
GOT	8	1 (12.5%)	3 (37.5%)	40 (7-60)	2
Bilirubin (Direct)	8	4 (50%)	75 (6)	73 (15-90)	2
Bilirubin (Total)	8	4 (50%)	75 (6)	73 (15-90)	2
BUN	8	2 (25%)	50 (4)	30 (7-45)	1
Creatinine	8	2 (25%)	25 (2)	21 (5-30)	2
Glucose	8	2 (25%)	25 (2)	15 (5-30)	1
Cell Dyne lyze	8	2 (25%)	37.5 (3)	15 (7-21)	3
CellDyne detergent	8	2 (25%)	25 (2)	15(7-30)	3
Cell Dyne diluent	8	1 (12.5%)	37.5 (3)	15 (3-21)	3
KHB	33	4 (12%)	27.3 (9)	13 (5-20)	3
Stat-pack	33	0 (0%)	9 (3)	3 (5-20)	1
Uni-gold	33	1 (3%)	21 (7)	7 (5-12)	2
Vacutainer tube (4 ml)	25	10 (40%)	52 (13)	5 (3-10)	3
Vacutainer tube (10 ml)	25	10 (40%)	52 (13)	5 (2-7)	3
Vacutainer tube needle	25	12 (48%)	40 (10)	6 (5-10)	3
Carbon fuchsin	34	0 (0%)	11.8 (4)	7 (5-15)	1
Methylene blue	34	0 (0%)	11.8 (4)	7 (5-15)	1
Acid alcohol	34	1 (3%)	17.8 (6)	7 (3-10)	2

6.4.6 Reasons for stock outs

As illustrated in the figure 6 below 18 (42%), 5 (12%) and 4 (9%) of facilities claimed delivery of near expiry laboratory commodities, unable to bring laboratory commodities on time and did not receive enough laboratory commodities were reasons for stock outs respectively. The rest 16 (37%) did not know the reasons for stock outs.

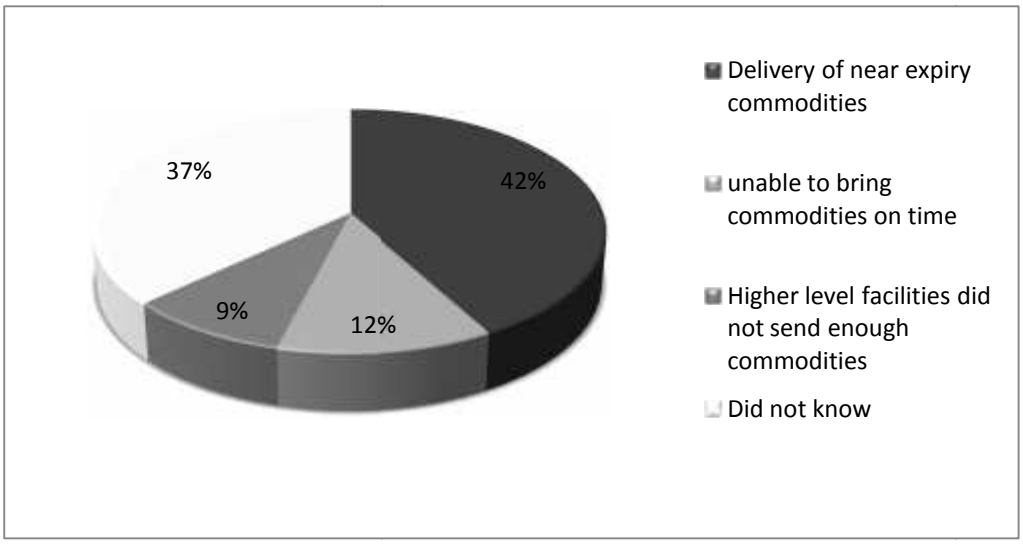

Figure 5: Percent of facilities that reported reasons for stock outs

6.4.7 Actions Taken during stock outs

In our study, stock out were handled by the participating facilities by going to higher level facilities for re-supply in 19 (44%) facilities, by referring clients to other private or public facilities in 3 (6.9%) facilities, borrowed commodities from other facilities in 12 (27.9%) and make positive adjustment (distributing commodities from facilities that had higher stock to that report stock out) in 9 (20.9%) facilities.

6.4.8 Surplus commodities

Ten (23.2%) of facilities reported to have a surplus of some HIV/AIDS and TB laboratory commodities before re-supply the most common types they usually had surplus uni-gold and sample transfer kits (vacutainer tube, vacutainer needle) in health centers and chemistry reagents (GPT, GOT, ALP) in hospitals and regional laboratories.

6.4.9 Number of emergency orders

Twenty (46.5%) and 33(76.7%) of the assessed facilities don't place emergency orders for ART monitoring and TB laboratory commodities respectively in the last six months. The rest 23 (53.5%) and 10 (23.3 %) places emergency order for ART monitoring and TB laboratory commodities respectively ranging from one to three times in the last six months.

6.5 Logistics Reporting and Ordering of ART monitoring and TB laboratory commodities

All sub city pharmaceutical supply assuring sustainability case team and SDPs reported passing stock information to their next higher levels using FCRRF, LMIS and supplies report and request forms during the most recent reporting period (last month).

All the sub-cities pharmaceutical supply assuring sustainability case teams reported lead-time of one day between ordering and receiving laboratory commodities from RHB. Sixteen (37.2%) facilities reported that the period to be in a week's time, 13(30.2%) reported the time in two weeks period the rest 5(11.6%) took three weeks to one month.

6.5.1 Order fill rate

As shown in table 5 below, facilities were received the ordered quantities of CD4 reagents. For other commodities facilities were received either less or higher quantity than their order.

Table 5: Percentage of facilities that received the quantity ordered by type of laboratory commodities (in the last order they received), Addis Ababa, 2010

HIV/AIDS and TB diagnostics Laboratory reagents	Number of facilities that ordered the commodity (n)	% of Facilities that received lesser quantity of commodities ordered n (%)	% of Facilities that received quantity of commodities ordered n (%)	% of Facilities that received more quantity of products ordered n (%)
Rapid test kits	42	21 (50%)	21(50%)	0
TB lab reagents	42	4(9.5%)	34(81%)	4(9.5%)
CD4 reagents	8	0	8(100%)	0
Chemistry R	9	3(33.3)	5(55.6%)	1(11.1%)
Haematology R	8	3(37.5)	5(62.5%)	0

STK	34	21(61.7%)	4 (11.7%)	10(26.6%)

%-percent, R- Reagent, STK-Sample transfer kits, lab- laboratory

6.6 Expired laboratory commodities

Expired HIV/AIDS laboratory commodities were found in 25 (73.5%) of facilities. sub-cities were excluded since they did not capture expired laboratory commodities. As shown in the table 6 below expired stocks of ALP, GPT and GOT were found at all facilities that mange these commodities, while none of the facilities had expired TB laboratory reagents. Two (25%) of facilities were found to have expired CD4 reagents FACS flow, and cell Dyne diluents on the day of the assessment. Similarly 10 (30.3%), 5 (15.2%) and 25 (75.5%) of facilities were found to have expired KHB, stat-pack and uni-gold test kits respectively on the day of the assessment. The quantities of expired commodities were highest for chemistry reagents (GPT, GOT, ALP), chemistry test tubes, sample transfer kits (vacutainer tube both 10 and 5ml) and vacutainer needle (Table 6).

Table 6: Percentage of facilities that had expired ART monitoring and TB laboratory commodities and their quantities on the day of visit in SDPs and AARHB warehouse in Addis Ababa, 2010

ART monitoring and TB laboratory reagents	Facilities that had expired reagents	Quantities of expired commodities in different SDPs and RHB warehouse				
	n (%)	Hospitals (n=8)	RL(n=1)	RHB (n=1)	Health centers (n=24)	Total quantity
ALP (kit)	9 (100%)	31 kit (8×50 ml)	0	-	-	31 kits
GPT (kit)	9 (100%)	41 kit (8×50 ml)	9 kit	-	-	50 kits
GOT (kit)	9 (100%)	37 kit (8×50 ml)	9 kit	-	-	46 kits
Creatinine (kit)	2 (22%)	10 kit (250ml)	0	-	-	10 kits
BUN (kit)	2 (22%)	4 kit ((8×50 ml)	0	-	-	4 kits
Bilirubin (direct)	4 (44.4%)	13 kits	0	-	-	13 kits
Bilirubin (total)	3 (33.3%)	16 kits	0	-	-	16 kits
Cell Dyne detergent	3 (37.5%)	10 kit (1×20L)	0	-	-	10 kits
Cell Dyne diluents	2 (25%)	11 kit (1×20L)	0	-	-	11 kits
Cell Dyne lyse	5 (62.5%)	21 kit (1×3.8L)	1 kit	-	-	22 kits
Glucose (kit)	5 (55.5%)	28 kit (1×1000ml)	0	-	-	28 kits
CD4 Reagent (kit)	2 (25%)	27 kit (1×50 tests)	0	-	-	27 kits

FACS flow (kit)	2 (25%)	9 kit (1×20L)	0	-	-	9 kits
FACS cleaner (kit)	2 (25%)	9 kit (1×5L	0	-	-	9 kits
CD4 control	2 (25%)	4 kit (1×25 tests)	0	-	-	4 kits
Cell Dyne calibrator	2 (25%)	6 kit (2×2.5ml)	0	-	-	6 kits
KHB (1×50 tests)	10 (30.3%)	18	-	0	12	30
Stat-pack (1×25tests)	5 (15.2%)	9	-	0	5	14 kits
Uni-gold (1×25tests)	25 (75.7%)	15	-	30	8	53
Vacutainer tube (5ml)	13 (52%)	-	-	0	82	82 boxes
Vacutainer tube (10ml)	9 (36%)	-	-	0	97	97 boxes
Vacutainer needle 21G)	9 (36%)	-	-	0	125	125 boxes
CD4 tube (box) (1×100)	2 (25%)	-	-	0	110	110 boxes
Chemistry tube (box)	3 (37.5%)	-	-	0	43	43 boxes
Carbon fuchsin	0 (0%)	0	0	0	0	0
Methylene blue	0 (0%)	0	0	0	0	0
Acid alcohol	0 (0%)	0	0	0	0	0
Oil immersion	0 (0%)	0	0	0	0	0

**For CD4 and Haematology (n=8), for chemistry reagents number of facilities (n=9)*
**For Rapid test kits (n=33), for sample transfer kits (n=25), for TB reagents (n=34)*

From 50 kits of GPT and 46 kits of GOT expired, 21 and 17 kits were from two hospitals respectively. Similarly from 97 boxes of vacutainer tube (5ml) and 110 boxes of CD4 tubes expired, 22 and 100 boxes were from one health center and one hospital respectively. Even though these laboratory commodities have expired years back they are still kept in stores without being disposed. There are commodities expired two years ago but kept in stores.

6.7 Logistics Management Information System

Four (50%) of the assessed hospitals and 13(54%) of health centers were currently using stock/bin cards for all HIV/AIDS and TB laboratory commodities in main pharmacy store. RHB uses both stock cards and bin cards. Similarly regional laboratory starts using bin cards. In hospitals laboratory mini-store 3(37.5%) of them uses stock/bin cards for HIV/AIDS and TB laboratory commodities and 8(37.5%) of health center laboratories starts to use bin cards.

All the assessed hospitals pharmacy departments, RHB and RL were currently using standardized logistics management information system (LMIS) forms for ordering commodities from PFSA. No laboratory mini-stores were using standardized LMIS forms.

Table 7: utilization of LMIS forms and bin cards for ART monitoring and TB laboratory reagents by type of facility in Addis Ababa, 2010

Type of facility	using stock cards	using bin cards	using LMIS forms
Hospitals (pharmacy) (n=8)	3(37.5%)	4 (50%)	8(100%)
Hospitals (Laboratory) (n=8)	2(25%)	3(37.5%)	0
Health centers (pharmacy) (n=24)	4(16.7%)	13(54%)	-
Health centers (laboratory) (n=24)	0	9 (37.5%)	0
Sub-cities (n=9)	-	-	-
RHB (warehouse) (n=1)	1 (100%)	1(100%)	1 (100%)
Regional Laboratory (n=1)	0	1(100%)	1(100%)
Total	10(23.3%)	31(72.1%)	10(23.3%)

Majority of stock/bin cards were not updated with accurate information matching with the physical count done at the time of visit. The total accuracy of stock/bin cards were less than 50% (Table 8). LMIS data accuracy is crucial to a quality logistics system, and this begins with the stock/bin card accuracy.

Table 8: Stock/bin card availability and information accuracy on stock/bin cards for laboratory commodities by type of facility in Addis Ababa, 2010

Health facility type	Number of Facility	with bin card for at least one commodity		With accurate information on bin card for all commodities among facilities that had bin card	
		n	%	n	%
RHB (warehouse)	1	1	100	1	100
Hospitals	8	4	50	2	25
Health centers	24	13	54	5	20.8
Regional Laboratory	1	1	100	0	0
Total SDPs	33	18	54.5	**7**	38.9

Accuracy was defined- *The matching of inventories on stock/bin cards with physical count*

6.7.1 Availability of stock/bin cards for selected laboratory commodities

In this study, availability of stock/bin cards were assessed for selected laboratory commodities. The result showed, 4(50%), 4 (50%), 3 (42.8%), 3 (42.8%) and 2(25%) of hospitals were using stock /bin cards for rapid test kits, chemistry reagents, haematology reagents, CD4 reagents and TB laboratory reagents respectively. 13(54%), 13 (54%) and 3 (12.5%) of health centers were using stock/bin cards for rapid test kits, sample transfer kits and TB laboratory reagents respectively. Regional laboratory was using bin cards for chemistry, haematology and CD4 reagents. RHB was using stock/bin cards for rapid test kits, sample transfer kits and TB laboratory reagents.

Table 9: Percentage of facilities with stock card/ bin card available for selected laboratory commodities in Addis Ababa, 2010

Health facility type	Rapid test kits		Chemistry reagent		Haematology reagent		CD4 reagent		Sample transfer kits		TB reagent	
	n	%	n	%	n	%	n	%	n	%	n	%
Hospital	4	50%	4	50%	3	42.8%	3	42.8%	-	-	2	25%
Health center	13	54%	-	-	-	-	-	-	13	54 %	3	12.5 %
RL	-	-	1	100%	1	100%	1	100%	-	-	0	0
RHB	1	100%	-	-	-	-	-	-	1	100	1	100
Total	18	52.9	5	55.5	4	44.4	5	55.5	14	56	6	17.6

6.8 Inventory control for laboratory commodities

The inventory control system enables staff at warehouses and stores to know when to order, how much to order, and how to maintain an appropriate stock level (between established minimum and maximum levels) to avoid shortages and oversupply. Inventory control procedure was established at all ART monitoring laboratories and actually existed in the national standard operating procedure manual for national laboratory logistics system. In actual practice all hospitals main pharmacy stores, regional laboratory and RHB were using

maximum/minimum stock levels and emergency order points. Majority of hospitals mini-laboratory store keepers, laboratory managers and all health centers did not know the established maximum/minimum and emergency stock levels. Which were well elaborated and established as 4, 2 and 0.5 months for maximum, minimum and emergency order points respectively for service delivery points.

Table 10: Percentage of facilities using max/min and emergency order points by facility type

Type of facility	using Max stock level	using Min stock level	using EOP
Hospitals (pharmacy)	8(100%)	8(100%)	8(100%)
Hospitals (Laboratory)	2(25%)	2(25%)	3(37.5%)
Health centers (pharmacy)	0	0	0
Health centers (laboratory)	0	0	0
Sub-cities	-	-	-
RHB (warehouse)	1 (100%)	1(100%)	1 (100%)
Regional Laboratory	1(100%)	1(100%)	1(100%)
Total	12(27.9%)	12(27.9%)	13(30.2%)

6.9 Storage condition

RHB warehouse was in compliance with almost all of individual proper storage conditions. Majority of hospitals main pharmacy stores were in compliance with individual proper storage conditions. However, majority of hospitals mini-laboratory stores weren't in compliance with proper storage conditions. As shown in the table 11 below inadequate space, unable to separate expired and damaged commodities and absence of fire safety equipment were the three weakest areas found in hospitals mini-laboratory stores, hospitals main pharmacy stores and health centers pharmacy stores.

Table 11: Percentage of facilities that adhere to each storage guidelines

Storage conditions	Facilities adhere to storage conditions			
	Hospitals main pharmacy store n (%)	Health centers pharmacy store n (%)	RHB warehouse n (%)	Hospitals mini-laboratory store n (%)
Labels and expiry dates visible	6 (75%)	17 (70.8%)	1(100%)	3 (42.8%)
Products organized for FEFO	5 (62.5%)	18(75%)	1(100%)	3 (42.8%)
Cartons and products in good condition Not crushed due to mishandling	6 (75%)	20 (83.3%)	1(100%)	5(71.4%)
Damaged and expired products separated	3 (37.5%)	8 (33.3%)	0 (0%)	1(14.3%)
Products protected from direct sunlight	8 (100%)	23 (95.8%)	1(100%)	7 (100%)
Products protected from water and humidity	8 (100%)	23 (95.8%)	1(100%)	7 (100%)
Free from harmful insects and rodents	7 (87.5%)	20 (83.3%)	1 (100)	6 (85.7%)
Storage area secured with a lock and key	8 (100%)	24 (100%)	1(100%)	7 (100%)
Stored at the appropriate temperature	6 (75%)	16 (66.7%)	1(100%)	2 (28.5%)
Roof in good condition to avoid sun light and water penetration	7 (87.5%)	17 (70.8%)	1(100%)	6 (85.7%)
Storeroom maintained in good condition (clean, all trashed removed, etc.)	4 (50%)	10 (41.7%)	1(100%)	1(14.3%)
Sufficient space for existing products and expansion	4 (50%)	6 (25%)	1(100%)	1 (14.3%)
Fire safety equipment available and accessible	3 (37.5%)	4 (16.7%)	1(100%)	0 (0%)
Products stored separately from insecticides and chemicals	8 (100%)	24 (100%)	1(100%)	7 (100%)

*FEFO-First expiry first out *for hospitals main pharmacy store (n=8), health centers pharmacy store (n=24), hospitals mini-laboratory store (n=7) and for RHB warehouse (n=1)*

6.10 Supervision

Fourteen (32.6%) of the facilities did not receive supervision from higher facility for logistics management information system, while only 5(11.6%) received supervision in the last 6 months that included commodity management where bin cards, LMIS reports and IFRR were checked. In the rest 24(55.8%) of facilities supervision was reported to be more than 6 months ago.

7. Results of Qualitative data

7.1 Summary result of focus group discussions

Two FGD disaggregated by profession (laboratory and pharmacy) of participants were conducted at governmental health facilities. One with hospitals, the other with health centers and sub cities participants. Eight participants were included in each group.

7.1.1 Training of pharmacy and laboratory professionals on LMIS

The focus group discussion members have raised the following issues during their discussion time regarding training about LMIS. Health centers laboratory professionals were not included in the training of the laboratory logistics system and since there were high turnover of trained staff at the higher facilities (hospitals), those that replaced them were neither trained nor obtained proper orientation in running the designed logistics system. It was also pointed that those designated as a mini-store keeper in hospitals were not received appropriate training and orientation about laboratory logistics management information system. One of the laboratory discussant shares his opinion by saying "*In our hospital mini-laboratory store, three persons were designated periodically as a store manager within one year period, without receiving appropriate training*."

In addition the FGD points out stock keeping were not their primary responsibility for designated laboratory persons that makes gaps in the implementation of laboratory LMIS.

The FGD revealed that the major problem encountered in the implementation of the laboratory LMIS were providing stock keeping responsibility periodically without training the staff and lack of communication between laboratory head and pharmacy case team coordinator to list and track essential laboratory commodities. In case of machine failures

large amount of laboratory commodities were ordered and expired without providing their appropriate purposes due to poor communication between designated persons.

One of the laboratory discussant shares his opinion by saying "*In our hospital large amount of chemistry and hematology reagents, especially cell dyne reagents were ordered on the behalf of the failed machine and wasted without providing appropriate services."*

7.1.2 Availability of vehicles to deliver commodities to the service delivery point

The absence of functional vehicle in healthy facilities were raised and discussed in the FDG. It was discussed in focus group discussion (FGD) that in the absence of the SCMS/MSH donated car majority of sub-cities spent longer times (stock out) due to absence of functional vehicles to bring commodities in their facility. One of the sub-cities discussant shares her idea by saying "*In the absence of the SCMS/MSH donated car we spent 3-5 days due to the absence of vehicle in our facility*." the other discussant added her opinion by saying "*It will be better if PFSA distributes all commodities to the service delivery points and we only supervise and control the LMIS reports."*

7.1.3 Stock outs

All discussant agreed on stock outs and revealed that the chemistry reagent (total and direct bilirubin) and haematology reagent (Cell Dyne lyze and Cell Dyne diluents) shortage was due to poor estimation of this commodities in health facilities. While for rapid test kits and sample transfer kits were due to increased consumption and delivery of near expired commodities respectively. It was discussed that direct and total bilirubin was continuously available in adequate amounts at the PFSA for the last 2 year while the cell dyne lzye was not available adequately as a result less amount of commodities was delivered. Sample transfer kits were delivered within 3- 6 month remaining expiration date that causes large amount of sample transfer kits expired as discussed in the FGD. One discussant from health centers shares his experience by saying "*Majority of sample transfer kits delivered in our health facility were 3-4 months remaining expiration date."* The other ideas agreed upon by discussants were the absence of clear control system in pharmacies and laboratories during commodity exchange that leads commodity wastage in most health facilities that leads stock outs for key ART monitoring laboratory commodities.

7.1.4 Expired laboratory commodities

The majority of the discussants have agreed the reasons for the expiration of high quantities of laboratory commodities were due to push system from higher levels when they were near expiry and poor estimation of commodity requirement in most facilities. "*Health centers request large quantities of commodities to avoid future stock out treats that causes expiry of commodities"* according to one sub-city discussant. In hospitals, laboratory commodities are expired even without the laboratory department knows the delivery and availability of that commodity in the main store. One laboratory manager discussant shares his experience by saying "*Our laboratory was stock out for cell dyne reagents and bilirubin reagents for more than 15 days. As a result patients were referred to other private and public facilities. Suddenly when we collect expired laboratory commodities in pharmacy store we got these commodities available in the store"*

But all the discussants agreed upon reduction of quantities of expired laboratory commodities after the implementation of the new laboratory logistics system and integrated pharmaceutical logistics system.

7.1.5 Logistics Management Information System (LMIS)

As it was clearly indicated in the FGD sessions, guidelines for recording and reporting consumption, for recording transactions, calculating months of stock on hand and requesting ART monitoring laboratory supplies were provided to all individuals (pharmacy and laboratory personnel) responsible for managing laboratory commodities at all hospitals during the training. Forms and reports that should be in use to the minimum are the daily registers, internal facility report and resupply (IFRR), facility combined report and requisition form (FCRRF) at health centers, sub-cities and hospitals, LMIS forms and stock records at hospitals and regional laboratory. LMIS forms were distributed throughout the system that have ART monitoring laboratories, but it was found that different version and types of logistics report (LR) forms were being used by lower level facilities (health centers) that lack inventory control procedures of minimum and maximum stock levels . From the FGD, it was discussed that the revised IFRR were not distributed for health centers in adequate amounts.

7.1.5.1 Accuracy of stock/cards and logistics reports

All the discussants agreed that there was high reporting rate of logistics management information system data from lower level facilities to higher level facilities during the recent months. Though there was high reporting rate, the quality of the data on the reports was still questionable in the majority of facilities since most did not have accurate information on bin cards which will create further difficulty for higher levels to calculate stock needs and to order and deliver correct amounts for SDPs. Focus group discussants identified high turnover of trained staff, lack of supervision from higher levels and work overload as major reasons for the low utilization of stock records and their inaccuracies.

7.1.6 Inventory control for laboratory commodities

The established maximum/minimum stock levels and emergency order points (EOP) were not known and used by majority of facilities. This point was raised in the FGD and participants discussed that in the situation where storage space is limited, lack of vehicles for the transport of laboratory commodities, high turnover of trained staff and lack of laboratory logistics manuals; implementation of the established inventory control procedures were said to be unlikely. In addition, the FGD revealed that the implementation of inventory procedures will be unlikely if it continues without the participation of the laboratory staffs. Furthermore, the FGD pointed out that most of the facilities (SDPs) didn't use the minimum-maximum system and orders were usually made when they stock out (zero stock on hand) and orders were made in larger quantities to avoid threats of stock outs for the future that causes imbalances in smooth implementation of logistics systems.

7.1.7 Supervision

The absence of timely supervision was raised and discussed in the FGD that supervision checklists were not available in order to perform effective and timely supervision to enhance the proper functioning of the laboratory logistics system. In addition, majority of discussants reported, supervision was not done for proper storage, availability of IFRR, accuracy of bin cards and LMIS reports.

7.1.8 Suggested interventions for effective LMIS for laboratory commodities

It was pointed that laboratory professionals should be trained in LMIS and commodity management. Majority of group's discussants demanded on better accessibility and availability of key ART laboratory commodities on time to satisfy their clients. Discussant also suggested that it was important to provide pre-service training about LMIS for laboratory professionals.

7.2 Findings from Key Informant Interviews

Key informant interviews conducted with logistics program managers and officers of EHNRI, PFSA and AARHB identified the following challenges in laboratory LMIS implementation.

- Lack of tools and transport for logistics supervisory visits
- Lack of computers and software for logistics management at SDPs. Even though, some health facilities had practiced computerized LMIS
- Inadequate logistics training for facility-level staff and lack of inventory control system
- Low commitment of staffs at the lower level facilities to implement the designed laboratory LMIS
- Lack of manpower to supervise all facilities
- Delivery of incorrect logistics data from lower level facilities. Especially for ART monitoring laboratory reagents
- Inadequate funds for monitoring, supervision and training.

Besides the above challenges there were reported strengths in Laboratory LMIS implementation

- Increasing government commitment to implement Laboratory LMIS
- Increasing donor participation and coordination
- Integration of the laboratory LMIS to other HIV/AIDS commodities. such as, ARV drugs that improves the system performance and enables clients to receive a comprehensive package of care

8. Discussion

The ultimate goal of the laboratory logistics system is to ensure laboratory commodity availability at the service delivery points so that clients will receive the necessary laboratory tests. Individuals responsible for managing laboratory commodities need to be trained in timely keeping of records on essential logistics data, analyzing the collected information to make the right decisions and submission of reports to the next higher level.

In this study, it was found that 67 (58.8%) of pharmacy professionals and only 4 (3.5%) laboratory professionals were trained in LMIS. which was comparable with study done by Jabulani N *et al*. in Zimbabwe (31). where few number of laboratory professionals were trained in LMIS.

The results of the present study showed that, majority of facilities were found under stock for vacutainer tubes, CD4 and bilirubin reagents. In contrast to our finding a study done in Ghana (34) revealed that facilities had adequately stock for CD4 and chemistry reagents. The difference might be due to the fact that the assessment was done in Ghana at the start of ART programme where consumption of these reagents was lower. Our study also showed that, majority of facilities had adequate stock levels for creatinine, glucose, cell dyne diluent, cell dyne lyze and cell dyne detergent reagents, Which was in agreement with study done in Ghana (34).

Our data showed that, 12 (36.3%) of facilities had higher stock levels for uni-gold test kits that was less than Jabulani N *et al*. findings which was 59 (39%). The difference might be due to the fact that uni-gold is used as a tie-breaker kit in our case, which was not ordered frequently.

In the present study, it was found that majority of facilities 26 (60.5%) were stocked out at least one HIV/AIDS and TB laboratory commodities in the past six months. which was comparable with the study done in Tanzania (32).

Our result showed that, most frequent stock out reagents were chemistry reagents (bilirubin and BUN), CD4 reagents in hospitals and vacutainer tubes in health centers, which was comparable with the study done in Rwanda (39). More over our study showed that from eight facilities that manage haematology reagents, 3 (37.5%) of facilities were stock out for cell

dyne reagents in the past 6 months. In contrast to our finding all facilities were stock out for haematology reagents as shown by Pharasi B in Lesotho (30). The difference might be due to the absence of functional procurement unit for ART monitoring laboratory commodities in Lesotho at that time and our assessment includes only cell dyne haematology reagents.

Our study showed that from 33 facilities, 9 (27.3%), 3 (9%) and 7 (21%) of facilities were stock out for KHB, stat-pack and uni-gold test kits respectively. A study done in Zimbabwe by Jabulani *et al*. showed 46 (31%), 47 (34.4%) and 23 (28.9%) of facilities were stock out for determine, uni-gold and oraquick test kits respectively much higher stock out rates than our finding due to the fact that they assessed many facilities and include district facilities far from the central warehouse (31).

In the present study, it was found that only 1 (2.9%) of facilities were stock out for acid alcohol reagents on the day visit. however, we could not found health facilities stock out for Carbon fuchsin, Methylene blue and oil immersion reagents on the day of visit. Similar study conducted in Malawi (36) reported 50% of all central hospitals, 15%, 8%, and 18% of district hospitals were stock out for carbon fuchsin, Methylene blue and acid alcohol reagents on the day of visit higher than our finding. This might be due to the fact that absences of standardized inventory control procedures for laboratory commodities in Malawi.

Our study showed that from 33 facilities, 4 (12%) and 1 (3%) of facilities were stock out for KHB and uni-gold test kits respectively on the day of visit. Similar study in Zimbabwe (31) reported 2 (3.2%) of facilities were stock out for uni-gold test kits that was in agreement with our finding.

In this study, it was found majority of facilities received the quantities they order for TB laboratory reagents and CD4 reagents which were in agreement with Amenyah et al. findings in Tanzania. However, 21(50%) of facilities received less quantity than ordered quantity for rapid test kits, which was higher than Jabulani *et al*. finding 6 (9%). The difference may be due to the fact that the existence of many suppliers for HIV tests kits in Zimbabwe at the study time.

The present study showed that 25 (75.5%) of facilities had expired stock for uni-gold test kits which was higher than Jabulani *et al*. finding 2 (0.3%). This may be due to the fact that uni-gold was used as a confirmatory test kit that could be consumed frequently in Zimbabwe than

in our case which is used as a tie-breaker test kit and delivery of near expiry uni-gold test kits in our case as confirmed in the FDG.

The present study showed that, higher quantities of expired GPT (31 kits), GOT (50 kits), ALP (46 kits) and sample transfer kits (>90 kits) were found. The reason for expiration was receiving the commodities near expiry due to push from higher facility as confirmed by the focus group discussion.

In this study it was found that, 4 (50%) hospitals and 13 (54%) of health centers were currently using stock/bin cards to track all HIV/AIDS and TB laboratory commodities in their main pharmacy store. Similar study conducted in Malawi (36) showed, 70% and 40% of hospitals and health centers respectively were using stock/bin cards for laboratory commodities in pharmacy store, which were better and higher than our finding in case of hospitals and lower than in case of health centers. The difference was due to the fact that stock/bin cards were distributed adequately in hospitals, in case of Malawi. Similarly our study showed that, 3 (33.3%) of hospital and regional laboratory mini-laboratory store, 9 (37.5%) of health center laboratories were using stock/bin cards to track HIV/AIDS and TB laboratory commodities.

Our study also showed that, from 9 laboratory mini-stores 6 (66.7%) of laboratory mini-stores were not using stock/bin cards. which was in agreement with study conducted in Lesotho (30).

In the present study, it was found that 18 (52.9%), 14 (56%), 5 (55.5%), 4 (44.4%), 5 (55.5%) and 6 (17.6%) of facilities were using stock/bin cards for rapid test kits, sample transfer kits, chemistry, haematology, CD4 and TB laboratory reagents respectively. Similar study conducted in Zimbabwe (31) showed 50 (80%) of facilities were using stock/bin cards for rapid test kits higher and better than our finding. This might be due to the fact that majority of the assessed facilities were PMTCT sites which had enough stock/bin cards and well trained staffs.

This study showed that, majority of stock/bin cards were not updated with accurate information matching with the physical count done at the time of visit. The overall accuracy (matching with physical count) of stock/bin cards in all facilities was 38.9%. Similar study in Zimbabwe (31) showed, from 50 (80%) of facilities using stock/bin cards 40 (60%) were

updated with accurate information which were much better than our finding. This may be due to the presence of programmed supervision and trained staffs that improved stock/bin card accuracy in Zimbabwe, whereas absence of supportive, programmed supervision and work load as confirmed in FGD were the reasons for low accuracy of stock/bin cards in our case.

In a well designed laboratory logistics system, lower facilities request laboratory commodities based on the established inventory control procedures and supposed to receive the quantity requested (49). Facilities use an inventory control system with established maximum-minimum stock levels to determine quantity of laboratory commodities they order and receive. But in this study it was found that, the established inventory control procedures were known and utilized by only 2 (25%) out of eight hospital laboratories. The rest 75% of hospital laboratories did not know and utilized the established maximum-minimum stock levels. This result was in agreement with the study done in Lesotho (30), Rwanda (39), Uganda (35) and Malawi (36).

Our study showed that, while some facilities were under stocked for some laboratory commodities others were observed with excess stocks of similar laboratory commodities. It was also found that some health centers were stock out for sample transfer kits others had over stock for similar commodities. This may be due to min-max inventory procedures were not implemented in health centers. In contrast to this all pharmacy main store, RHB and regional laboratory were using the established minimum-maximum stock levels.

The present study showed that, RHB warehouse was relatively in compliance with almost all of the 14 proper storage conditions. Nearly 70% of storage areas practiced first expiring, first out (FEFO) procedures better than the study done in Lesotho in which only 33% of facilities practiced (30). This study also shown that inadequate size and unable to separate expired and damaged commodities were the two weakest areas found in all facilities except RHB warehouse, which was in agreement with the study done in Tanzania (32), Lesotho (30) and Malawi (36).

9. Strengths and limitations of the study

9.1 Strengths of the study

- The study has provided baseline information for interventions aiming to identify the weakness and improve the laboratory LMIS
- Combination of both qualitative and quantitative method helps to supplement the findings each other
- The first to be conducted with high number of facilities

9.2 Limitation of the study

- Lack of similar studies especially in Ethiopia made difficult for comparing results.
- The sample size was not large enough for some specific indicators
- the study was done only in Addis Ababa where distribution of commodities is relatively easy and good

Conclusions

- There is a well-designed logistics system for laboratory commodities and majority of persons responsible in managing commodities in main store (pharmacy store) were trained in LMIS
- Majority of laboratory mini-store managers and laboratory managers didn't get LMIS training
- A significant number of facilities were stock out for key ART monitoring and TB laboratory commodities at the day of the assessment and during six months before the assessment.
- Utilization of the logistics recording and stock/bin cards usage were limited to the higher level facilities (RHB and hospitals).
- High amount of laboratory commodities were expired due to poor implementation of LMIS
- In general, managers do not follow the established inventory control procedures of minimum-maximum, EOP, stock records, and order forms that resulted many facilities stock out and expiry of commodities.

Recommendations

- Provision of training on logistics management information system to health professionals who are managing laboratory supplies
- Regular supervision and follow up on proper implementation of the logistic system should be done with a well designed supervision checklists
- Distribute standard logistics report and record forms especially at lower facilities (health centers)
- It is highly recommended that laboratory managers and pharmacy store manager should communicate frequently to track and monitor laboratory commodities
- PFSA and RHB should designed effective mechanisms to redistribute surplus commodities from facilities that have large quantities to those under stocked or out of stock
- Further detailed and large scale studies should be done to see the status of logistics management information system practice for laboratory commodities nationally.

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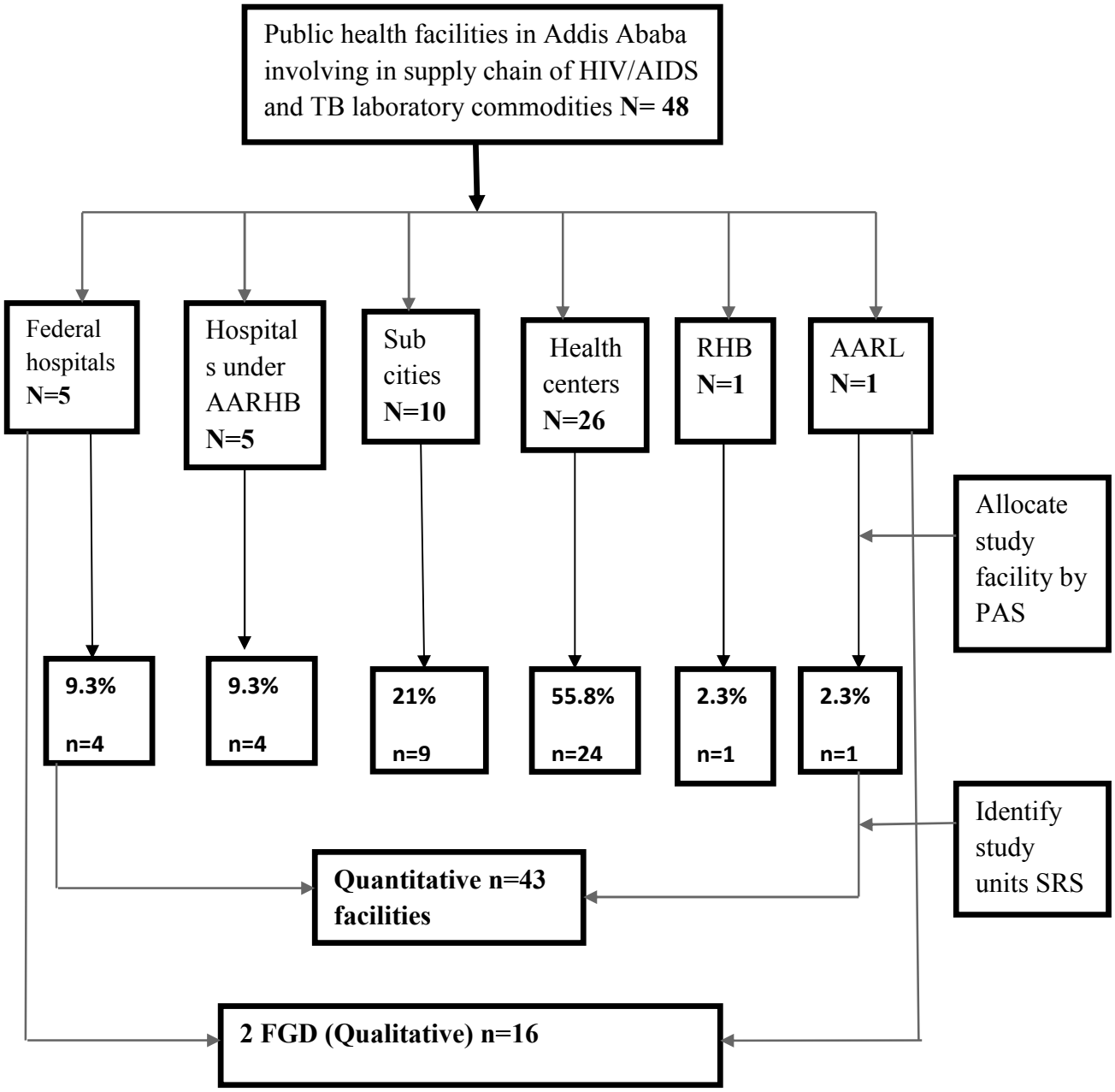
Annexes

Annex 1: Sampling Procedure



NB: a) PAS- proportional allocate to size

b) SRS- Simple Random Sampling

Figure 6: Schematic Presentation of sampling Procedure in Addis Ababa, Ethiopia, February 2011.

Annex-II Consent form in English

I_____ here by giving my consent for giving accurate information about the status of HIV/AIDS and TB laboratory commodity in this 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 understand this study will be used not only for my health facility but also for other health facilities that provide HIV/AIDS and TB related laboratory services. I believe that at the end of study the result will not refer individual facilities but rather will describe the overall picture of all facilities.

Participants Name _____ *Signature*_____ *Date*_____

Researcher's Name_____ *Signature* _____*Date*_____

Thank you in helping with this important study

N.B*: If you want to request additional information about the study, you will call by those phone numbers*

Contact address of Principal investigator, 0913165557, IRB address: 251-115- 538734

ANNEX III Information Sheet (English Version)

Addis Ababa University Medical Faculty, School of Medical Laboratory Sciences

Dear Participant, How are you? My name …….....I am a post graduate student of Addis Ababa University, School of Medical Laboratory Sciences; going to conduct study and collect data on Laboratory Logistics Management Information System for selected HIV/AIDs and TB laboratory commodities and the overall laboratory commodity management practices in public health facilities in Addis Ababa. The objective of the study is to collect current information on laboratory logistics system performance and stock status of key HIV/AIDS and TB laboratory commodities. This is not a supervisory visit and the performance of individual staff members is not being evaluated. The information you provide will be used to improve laboratory logistics system performances and to design appropriate logistics interventions for the future.

If you decide to participate, we will guarantee that there is no any influence related to study but only request you that to provide all relevant information regarding the study. We cannot guarantee, however, that you will receive any benefits from this study.

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 penalty. 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.

You are making a decision whether or not to participate in this study. Your signature below indicates that you have read the information above and have decided to participate in the study.

Thank you for your participation

Contact address of PI, 0913 16 55 57, IRB address: 251-115- 53873

Annex IV QUESTIONNAIRE

HIV and TB laboratory commodities logistics management information system assessment

Questionnaire for service delivery points, sub city pharmaceutical supply sustainability assuring case team and regional warehouses

April 2010

Federal Democratic Republic of Ethiopia

Addis Ababa

Interviewer's Guide

*Facility Identification***:** Ask to speak to the person in-charge of the facility.

Record the name of the facility. Using the codes provided for each question, place all other responses in the boxes on the right.

*Information about Interview***:** Record the date the interviews took place and list the names of the interviewers.

Introduction: Use the text here to guide your introduction of the survey to facility staff.

Questions 01 to 7: Receive permission to conduct the interview and record information regarding the interviewee.

Questions 01 to 6: Record information regarding the interviewee

*Questions101 to 127***:** Record responses clearly by circling either the number or letter that corresponds to the interviewee's response. Questions with letters may have multiple responses; questions with numbers have only a single response.

Table 1: Ordered/Received. Record the quantity ordered and received from the Logistics Recording Form.

Table 2: Stock Status Record the maximum months of stock, minimum months of stock, and order interval above the table. If the interviewee does not know these, mark DK as the response. To fill in the cells, follow the instructions above the table.

*Table 3: Stock data quality tables***.** Record each HIV and TB laboratory commodity available and compare the records with the actual counts.

Table 4: Storage Conditions. Record observations on the main storage area by responding to storage conditions, check questions 1 to 14 for every facility visited.

*End Interview***:** Ask the interviewee/s if they want to ask you any questions. Thank them for their time and cooperation.

Acronyms

ALT Alanine Aminotransferase

CD4 T lymphocyte CD4+

DK Don't Know

FEFO First Expire First Out

LIAT Logistics Indicators Assessment Tool

LMIS Logistics Management Information System

LSAT Logistics system Assessment Tool

MOH Ministry of Health

NA Not Applicable/Not Available

NGO Non-Governmental Organization

RHB Regional Health Bureau

SDP Service Delivery Point

TB Tuberculosis

Facility Services

Facility Identification

Region: _____

Sub-city:_____

Name of the facility _____

Type of facility: 1 = Hospital; 2=Health Center; 3=Regional laboratory

4=Regional Health Bureau and Warehouse;

5=Sub-city Warehouse; 6=other (specify) _____

Interviewer/s: _____ signature. _____

Date of Interview_____

Checked by: supervisors name _____ signature _____

"Good day. My name is _____.My colleague and I are representatives of this research team. We are conducting a survey of facility warehouses and service delivery points to determine the availability of laboratory commodities for HIV and TB diagnosis and monitoring and general characteristics of the laboratory logistics management information system. Your facility was selected by chance to be included in the study. The assessment will provide information enabling the MOH and RHB to implement appropriate interventions to improve laboratory logistics system 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?

No.	Introduction	Code Classification	Go To
01.	Can we continue?	Yes …… 1 No ……0	➔STOP
02.	Position of person interviewed for this section		
03.	Number of years and months you have worked at this facility?	Years: _____ Months: _____	
04.	Number of years and months you have worked in this facility in this unit?	Years: _____ Months: _____	
05.	Received training in logistics?	Yes …… 1 No ……. 0	
06.	Who is the principal person responsible for managin laboratory commodities that are used for HIV and TB diagnosis and monitoring at this facility?	Pharmacist …….. 1 Pharmacy Technician……..2 Laboratory technologist..…3 Lab technician …….4 Druggist …….5 Nurse ……..6 Other (Specify) ————	
07.	Is supplies/stock management the primary role of this person at this facility?	Yes ..... 1 No 0	

Ask the following questions of someone in charge of managing/overseeing HIV/AIDS and TB laboratory commodities. After asking the questions in this section, visit the warehouse, storeroom, or storage area where the laboratory commodities that are used for HIV and TB diagnosis and monitoring products listed are managed.

No	Questions	Code classification	Go to/comments
HIV/AIDS and TB laboratory commodities			
101	Do you use and fill out the following logistics forms to manage HIV and TB laboratory commodity products?		
	A. stock cards B. daily register C. bin cards D. reporting and requisition E. others ----------	Yes1.....No.....0 Yes 1.....No.....0 Yes 1.....No.....0 Yes 1.....No.....0	
102	What forms do you use for reporting/ordering HIV and TB laboratory commodities?		
	A. Stock ledger/registration book/notebook B. Government receiving note (Model 19) C. Government requesting note (Model 20) D. Government approval note (Model 21) E. Government distributed note (Model 22) F. Laboratory Logistics Recording forms G. Facility supplies report and request format H. Internal Facility Report and Resupply(IFRR) I. Other----------	Yes 1.....No.....0 Yes 1.....No.....0 Yes 1.....No.....0 Yes 1.....No.....0 Yes 1.....No.....0 Yes 1.....No.....0 Yes 1.....No.....0 Yes 1.....No.....0	
103	Do reports of HIV/AIDS and TB laboratory commodities include the following?		
	A. Stock on hand B. Quantities used C. Losses and adjustments	Yes 1.....No.....0 Yes 1.....No.....0 Yes 1.....No.....0	
104	How often are these reports or orders for HIV and TB laboratory commodities sent to the higher level? *Circle all if they are applied in your facility*	Monthly.....A Every two month.....B Quarterly.....C	

		Semi-annually.....d Annually .....E Other (specify)---------
105	When was the last time you sent an order/report for HIV/AIDS and TB laboratory commodity at this facility?	Never .....1 Within the last month…...2 Two months ago.....3 Three months ago.....4 Four months ago.....5 more than 3 months ago….6
106	How often are you supposed to send these reports for HIV/AIDS and TB laboratory commodities to the higher level? *Circle all if they are applied in your facility*	Monthly.....A Every two month .....B Quarterly.....C Semi annually.....D Annually.....E Other(specify)----------
107	How did you learn to complete the forms/records for HIV/AIDS and TB laboratory commodities used at this facility?	Never learned.....A During the logistics work shop.....B On the- job- training.....C On the –job (self learning)….D Other (specify) _____
108	Have you ever received training in calculating the HIV/AIDS and TB laboratory commodity needs for your facility?	Yes .....1 No 0

109	Have you ever received training in the proper storage of HIV/AIDS and TB laboratory commodities?	Yes.....1 No 0	
110	Have you ever received training in Ethiopian laboratory Logistics System?	Yes.....1 No 0	
111	Have you ever receiving training in Ethiopian integrated pharmaceutical logistics system (IPLS)?	Yes.....1 No 0	
111	Does this facility use a maximum stock level for HIV/AIDS and TB laboratory commodities?	Yes.....1 No 0	
112	Does this facility use a minimum stock level for HIV/AIDS and TB laboratory commodities?	Yes.....1 No 0	
113	What (in months) is the minimum stock level for HIV/AIDS and TB laboratory commodities?	One month.....0 Two months.....1 Three months.....2 Four months.....3 More than 4 months.....4 NA/DK.....9	
114	What (in months) is the maximum stock level for HIV/AIDS and TB laboratory commodities?	1 month.....0 2 months.....1 3 months.....2 4 months.....3 more than 4 months.....4 NA/DK.....9	
115	Does this facility use an emergency order point for HIV/AIDS and TB laboratory commodities? If No, skip to question 17	Yes .....1 No 0	
116	What (in months) is the emergency order point for HIV/AIDS and TB laboratory commodities?	Two weeks .....1 One month.....2	

		Two months.....3 Three months.....5 Four months.....6 More than 4 months.....7 NA/DK.....9
117	Who determines how much of HIV/AIDS and TB laboratory commodities this facility should order?	The staff here at the facility itself.....A Higher level facility.....B Other (specify) _____
118	Who determines how much of HIV/AIDS and TB laboratory commodities this facility should receive?	The staff here at the facility itself.....A Higher level facility.....B Other (specify) _____
119	How does your facility determine how much of a HIV/AIDS and TB laboratory commodities to order?	Formula.....1 Don't know.....2 Other means (specify) _____
120	Who is responsible for transporting HIV/AIDS and TB laboratory commodities to your facility?	Higher level drivers.....A This facility collectors.....B Local supplier drivers.....C Others (specify) _____
121	What type of transportation for HIV/AIDS and TB laboratory commodities are most often used?	Facility vehicle.....1 Public transportation.....2 Private vehicle.....3 Animal.....4 Motorcycle.....5

		Bicycle.....6 On foot.....7 Other (specify) _____
122	Does your facility have functioning vehicles for the transport of HIV/AIDS and TB laboratory commodities? If No skip to Q24	Yes.....1 No 0
123	Does your facility typically have any problems with the use of facility vehicles?	Yes .....1 No.....0
124	What types of problems do you typically encounter with the use of facility vehicles? *Circle all if they are applied in your facility*	Lack of vehicle maintenance.....A Not often available for the transport of HIV/AIDS and TB commodities.....B Lack of availability of drivers due to lack of per diems or Salaries.....C Other (specify _____
125	On average, approximately how long does it take between ordering and receiving HIV/AIDS and TB laboratory commodities?	One day.....1 Less than one week.....2 2 weeks to 1 month .....3 Between 1 and 2 months...4 More than 2 months 5
126	When did you receive your most recent supervision visit?	Never 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) _____
127	When did you receive your last supervision visit that	Never received.....1

	included laboratory commodity management (e.g. stock cards checked, reports checked, expired stock removed, supplies checked)?	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) _____

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.

When in the Store Room (if with a different person): Introduce all team members and ask facility representatives to introduce themselves. Explain the objectives of this survey:

No	Question	Code classification	Go to
1	Position of person interviewed for this section		
2	Number of years and months you have worked at this facility?	Year - month--	
3	Who is the principal person responsible for managing HIV/AIDS and TB laboratory commodities at this facility?	Pharmacist ……..….1 Lab technologies……..2 Lab technician……..3 Other (specify) _____	
4	Are stock cards recorded using the Smallest unit of count (for example vials for CD4 reagents and pieces for KHB, STAT PACK and uni-Gold)?	Yes (always).....1 No(not always).....0	
5	Are there any HIV/AIDS and TB laboratory commodities you usually run out of before resupply?	Yes.....1 No 0	If NO go to Q8
6	If yes, list the four most frequent HIV/AIDS and TB laboratory	_____ _____	

	commodities.		
7	If you run out of HIV/AIDS and TB laboratory commodities, what do you do?	Go to the next higher level for resupply .....A Buy from the open market/NGO.....B Refer clients to other facilities .....C Borrowed from other health facilities.....D Positive adjustment.....E Other (specify).....	
8	Are there any HIV/AIDS and TB laboratory commodities you usually have a surplus of before resupply?	Yes .....1 No 0	
9	If yes, list the four most frequent?	_____ _____	

T ABLE 1: Quantity Ordered and Quantity Received

EOP (months) ------- maximum stock (months) ----------order interval (months) -----

HIV/AIDS and TB laboratory commodities	Quantity Ordered for the Last Order that has been delivered	Date Order Placed	Quantity Received in Last Order	Date Order Received
1	2	3	4	5
Rapid test kits				

KHB(kit)		---/ ----/---- DD MM YYYY		-----/-----/------- DD MM YYYY
Stat-pack(kit)				
Uni-gold(kit)				
Chemistry reagents				
ALP (kit)				
GPT (kit)				
GOT (kit)				
Urea (kit)				
Creatinine (kit)				
Glucose (kit)				
Direct bilirubin (B12)				
Total bilirubin (B12)				
Haematology reagents				
Cell dyne lyze(bag)				
Celldyne diluents(bag)				
Celldynedetergent(bag)				
CD4 reagents				
CD4 reagent(kit)				
BDFACS flow(bag)				
Sample transfer kits				
BD vacutainer needle 21G				
BD vacutainer tube 10ml				
BD vacutainer tube 4ml				
DBS test kits				
Consumables				
Test tube				
EDTA tube				
Chemistry tube				
TB reagents				

Methylene blue of 300 ml				
Cabonfucshin of 300 ml				
Acid alcohol of 300 ml				

Ask the person/people you interviewed if they want to ask you any questions. Comments or general observations on products management:

Thank the person/people who talked with you. Reiterate how they have helped the program achieve its objectives, and assure them that the results will be used to develop improvements in logistics system performance.

Notes/Comments:

TABLE 2: Stock Status (March – August 2010 and the day of visit)

Column:

1. Number of row
2. Name of all authorized HIV and TB laboratory commodities that will be counted
3. Unit of count for the HIV and TB laboratory commodities
4. Whether or not the HIV and TB laboratory commodities is managed at this facility, answer Y for yes or N if no. Note that for some HIV and TB laboratory commodities, at certain levels all facilities should manage them. In such cases, this column should be marked Y.
5. Check if the stock card is available, answer Y for yes or N for no. If column 5 is No, then column 6 and column 7 will be N/A.
6. Check if the stock card had been updated within the last 30 days, answer Y for yes or N for no. Note: If the stock card was last updated with the balance of 0 and the facility has not received any re-supply, consider the stock card up-to-date.
7. Record the balance on the stock card.
8. Record if the facility has had any stock-out of the HIV and TB laboratory commodities during the most recent 6 full months before the survey, answer Y for yes or N for no.
9. Record how many times the HIV and TB laboratory commodities stocked out during the most recent full 6 months before the survey according to stock cards, if available, or to a key informant if not. Note source information.

10. Record the total number of days the HIV and TB laboratory commodities was stocked out during the most recent full 6 months before the survey.
11. Record the quantity of HIV and TB laboratory commodities used for diagnosis and monitoring of HIV and tuberculosis patients (from register/reports) or issued from the storeroom (from stock card or bin card) during the most recent 6 months before the survey. Note: If the answer to column 5 is N, record NA in this column.
12. Record the number of months the issued data represents (may be less than 6); record the months for which there is any data recorded, including 0. Note: If column 5 is N, record NA in this column.
13. Record the quantity of HIV and TB laboratory commodities in the storeroom.
14. Record if the facility is experiencing a stock-out of the HIV and TB laboratory commodities on the day of the visit, *according to the physical inventory*, answer Y for yes or N for no.
15. Record the quantity of expired products. Count all expired HIV and TB laboratory commodities on the day of the visit. If there are HIV and TB laboratory commodities that are near expiry (within one week), note in the comments section.

TABLE 2: Stock Status and stock out assessment table

No	HIV/AIDS and TB commodities	Unit of count	Managed at this facilities ?(Y/N)	Stock card/bin card available?(Y/N)	Stock card/ bin card updated?(Y/N)	Balance on stock card/ bin card (#)	Stock-out most recent 6 months? (Y/N)	Number of stock-outs (most recent 6months) (#)	Total number of days of stock-out(s) (#)	Total units used/issued (most recent 6months) (#)	Number of months of data available (#)	Physical inventory (in store room) (#)	Stock-out today? (Y/N)	Quantity of expired products(#)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Rapid test kit														

1	*KHB*	kit												
2	*Stat-pack*	kit												
3	*Uni-gold*	kit												
Chemistry reagent														
1	ALP	kit												
2	GPT	kit												
3	GOT	kit												
4	urea	kit												
5	Creatinine (kit)	kit												
6	Glucose (kit)	kit												
7	Direct bilirubin (B12)	kit												
8	Total bilirubin (B12)	kit												
Haematology reagents														

1	Celldyne lyze	bag												
2	Celldyne diluent	bag												
3	Celldyne detergent	bag												
CD4 reagent														
1	CD4 reagent(kit)	kit												
2	BDFACS flow(bag	bag												
Sample transfer kits														
1	*BDvacutainernee dle 21G*													
2	*BDvacutainertube 10ml*													
3	*BDvacutainer tube 4ml*													
4	*DBS test kits*													
Consumables														

1	*Test tube*	box												
2	*EDTA tube*	box												
3	*Chemistry tube*	kit												
TB reagents														
1	*Methylene blue of*	ml												
2	*Cabonfuchsin of 300 ml*	ml												
3	*Acid alcohol of 300 ml*	ml												
4	*Frostedslide(box)*	box												

Reasons for stock outs: 1= could not go to pick up the products due to vehicle problem 2= Higher level facility did not send enough products 3= Increase in consumption 4= did not request the right amount at the right time 5= flow of near expiry commodities from higher facilities to the lower facilities 6= Do not know 7=in consistent logistics reporting and data

Table 3: Stock data quality tables

A. Usable stock on hand on the day of the visit:-

1. List all types of HIV/AIDS and TB laboratory commodities available in the facility by brand
2. Copy from stock status table (table 2-col.7)
3. Record stock on hand from physical inventory on the day of the visit.

4. Calculate the percentage of the discrepancy.
5. Note the reasons for the discrepancy**.**

Usable stock on hand (day of visit)				
HIV and TB laboratory commodities	From physical inventory	From stock cards	% Discrepancy (col.3 col.2/col.2)*100	Reasons for discrepancy
1	**2**	**3**	**4**	**5**
Rapid test kits				
KHB(kit)				
Stat-pack(kit)				
Uni-gold(kit)				
Chemistry reagents				
ALP (kit)				
GPT (kit)				
GOT (kit)				
Urea (kit)				
Creatinine (kit)				
Glucose (kit)				
Direct bilirubin (B12)				
Total bilirubin (B12)				
Haematology reagents				
Cell dyne lyze(bag)				
Celldyne diluents(bag)				
Celldynedetergent(bag)				
CD4 reagents				
CD4 reagent(kit)				
BDFACS flow(bag)				
Sample transfer kits				
BD vacutainer needle 21G				
BD vacutainer tube				

10ml				
BD vacutainer tube 4ml				
DBS test kits				
Consumables				
Test tube				
EDTA tube				
Chemistry tube				
TB reagents				
Methylene blue of 300 ml				
Cabonfucshin of 300 ml				
Acid alcohol of 300 ml				

B. Usable stock on hand at time of most recent laboratory LMIS report:-

1. List the same products as in table 3A in column 1.
2. Get the most recent laboratory LMIS report showing the selected products and write in the stock on hand from the laboratory LMIS report in col.2.
3. In column 3, write the quantity of usable stock on hand from the stock records from the time of the selected laboratory LMIS report.
4. Calculate the percentage of discrepancy.
5. Note the reasons for the discrepancy

	Usable stock on hand (at time of most recent Laboratory LMIS)			
HIV and TB lab oratory diagnosis commodities	According to most recent LMIS report	From stock cards from time of LMIS report	% Discrepancy (col.3-col.2/col.2)*100	Reasons for Discrepancy
1	2	3	4	5

Rapid test kits				
KHB(kit)				
Stat-pack(kit)				
Uni-gold(kit)				
Chemistry reagents				
ALP (kit)				
GPT (kit)				
GOT (kit)				
Urea (kit)				
Creatinine (kit)				
Glucose (kit)				
Direct bilirubin (B12)				
Total bilirubin (B12)				
Haematology reagents				
Cell dyne lyze(bag)				
Celldyne diluents(bag)				
Celldynedetergent(bag)				
CD4 reagents				
CD4 reagent(kit)				
BDFACS flow(bag)				
Sample transfer kits				
BD vacutainer needle 21G				
BD vacutainer tube 10ml				
BD vacutainer tube 4ml				
DBS test kits				
Consumables				
Test tube				

EDTA tube				
Chemistry tube				
TB reagents				
Methylene blue of 300 ml				
Cabonfucshin of 300 ml				
Acid alcohol of 300 ml				

Table 4. Storage Conditions

Items 1–14 should be assessed for all facilities for products that are ready to be issued or distributed to SDPs and for store rooms in all SDPs. Place a check mark in the 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	No	Yes	Comments
01.	Products that are ready for distribution are arranged so that identification labels and expiry dates and/or manufacturing dates are visible.			
02.	Products are stored and organized in a manner accessible for first-to-expire, first-out (FEFO) counting and general management.			
03.	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/radiation (fluorescent lights in the case of BD FACS flow).			
04.	The facility makes it a practice to separate damaged and/or expired products from usable products and removes them from inventory.			
05.	Products are protected from direct sunlight.			
06.	Cartons and products are protected from water and humidity.			

07.	Storage area is visually free from harmful insects and rodents. (Check the storage area for traces of bats and/or rodents [droppings or insects].)			
08.	Storage area is secured with a lock and key, but is accessible during normal working hours; access is limited to authorized personnel.			
09.	Products are stored at the appropriate temperature according to product temperature specifications.			
10.	Roof is 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.	The current space and organization is sufficient for existing products and reasonable expansion (i.e., receipt of expected product deliveries for foreseeable future).			
13.	Fire safety equipment is available and accessible (any item identified as being used to promote fire safety should be considered).			
14.	Products are stored separately from insecticides and chemicals.			

Annex V: Focus group discussion guide

Q1. What is your opinion on the laboratory LMIS in your health facility?

- Groups understanding on the meaning of laboratory LMIS
- Discuss the laboratory supply chain in the region
- Existence of more than one LMIS design in the region
- Existence of guidelines and system manuals for laboratory logistics management system

How are they tracking logistics information?

How do you feel the importance of tracking logistics information?

Table 1: strength and weaknesses on laboratory LMIS

Strength	Weaknesses

Q2. How are the inventory control procedures in your health facility?

- Established policies for Max – Min stocks at all levels
- Existence of established procedures for placing emergency orders
- How do you determine when and how much to order?
- Existence of procedures for redistribution of over stocked supplies
- Existence of FEFO systems at all levels
- How are you preventing stock outs and wastages of HIV/AIDS and TB laboratory commodities?

Table 2: Strengths and weaknesses on inventory control procedures

Strength	Weaknesses

Q3. What is your opinion regarding the organizational support for the laboratory logistics system?

- Discuss how often different levels communicate. How often do store keeper and HIV and TB co-ordinator (laboratory manager) meet in the facility?
- Existence of procedures and guidelines to help staff carry out laboratory logistics responsibilities
- Discuss the importance of supervision for improving the laboratory logistics system
- Discuss how to apply the training knowledge?

Table 3: Strengths and weaknesses on organizational support for the laboratory logistics system

Strengths	Weaknesses

Q4. Is there anything you would like to add?

Annex VI: Logistics System Assessment Interview Guide

1. Who are the main suppliers of HIV/AIDS and TB laboratory commodities?
2. Describe the procedures for:
    - Managing and using the logistics management information system?
    - Forecasting quantities needed?
    - Inventory management, storage, and distribution?
    - Staffing of logistics positions?
    - Supervision and staff development?
3. Are there documented guidelines for the above activities?
4. Do LMIS or other information system reports received at the central level provide information on stock status at the SDP level (i.e., do central level staff have accurate routine information on which SDPs are stocked out, understocked, adequately stocked, or overstocked)? Explain
5. What is the approximate percentage of information system reports received in time to be used for logistics decisions at each level of the system?
6. Is pipeline status regularly monitored so that procurement decisions can be made and actions can be initiated in time to avoid stock outs?
7. Describe the challenges that the program is currently facing in logistics management of the selected HIV and AIDS commodities.

Annex VII Amharic version consent form

ለጥናቱ ተሳታፊወች የተዘጋጀ የፈቃደኝነት መግለጫ ቅጽ (ኮንሰት)

እኔ ..... የኤች አይቪ ኤድስና የሳንባ ነቀርሳን የላቦራቶሪ ግብአቶችን በተመለከተ ለምጠየቀው ጥያቄ ትክክለኛ መረጃ ለመስጠት ፍቃደኝነቴን እገልጻለሁ፡ ፡ በጥናቱ ወቅትም ከመጀመሪያ እስከ መጨረሻ ምንም አይነት እኔን የሚጎዳ ሁኔታ እንደለለ ተረድቻለሁ፡ ፡ ጥናቱም እኔ ለምሳራበት ጤና ድርጅት ብቻ ሳይሆን ለሌሎች ተመሳሳይ ድርጅቶች በተለይም የኤች አይቪ ኤድስና የሳንባ ነቀርሳ ምርመራና ከትትል ለሚያደርጉ ድርጅቶችሁሉ እንደሚጠቅም እወቂያለሁ፡ ፡ ጥናቱ በሚጠናቀቅበት ጊዜም የሁሉንም የጤና ድርጅቶች ጥንቅር መረጃ እንጅ የአንድ ጤና ድርጅት መረጃ ብቻ እንደሚይቀርብ ተረድቻለሁ፡ ፡

የ ተሳታፊ ስም .....ፊርማ .....ቀን .....

የ ተመራማሪ ስም ..... ፊርማ .....ቀን .....

ለዚህ ጠቃሚ ጥናት ስለተባበራችሁኝ አመሰግናለሁ፡ ፡

<u>ማሳሰቢያ፣</u> ስለጥናቱ ተጨማሪ መረጃ ከፈለጉ በነዚህ ስልክ ቁጥሮች ይደውሉ

PI ስልክ ቁጥር 251 913 16 55 57/ 913 79 59 95

IRB ስልክ ቁጥር 251 115 53 87 34

Annex VII Amharic version (የቃል ስምምነት ቅጽ)

በአድስ አበባ ዩኒቨርስቲ

በህክምና ክፍል

የህክምና ላቦራቶሪ ማስልተኛ ተቁም

የተከበርክ/ሽ እንደምን አረፈድክ/ሽ ፡፡ ስሜ ..... ይባላል፡፡ እኔ በአድስ አበባ ዩኒቨርስቲ በህክምና ላብራቶሪ ትምህርት ቤት የክሊኒካል ላብራቶሪ ሳይንስ የድህረ ምረቃ ተማሪ ነኝ፡፡ በዚህ ጥናት ለመስራት ያቀድኩት በአዲስ አበባ ጤና ቢሮ እና በጤና ጥበቃ ስር ባሉ የጤና ድርጅቶች ማለትም የክልል ጤና ቢሮ የመድሃኒትና የህክምና መጋዘኖችንና የአገልግሎት ሰጪ ተቋማትን የኤች ኣይቪ እና የሳንባ ነቀርሳ የላቦራቶሪ ግብአቶች ፍስት፤ አወቃቀርና ሰንሰለት ምን እንደሚመስል ለማየት ነው። ይሄ ጥናት የእያንዳንዱ ጤና ድርጅት ብቃት የሚዳሰስበት የጉብኝት ዳሰሳ ሳይሆን የላቦራቶሪ ግብአቶችን ፍስት፤ አወቃቀርና ሰንሰለት ለማጥናት የተዘጋጀ ጥናት ነው፡፡

በመሆኑም እርስወ በጥናቱ ለመሳተፍ ከወሰኑ በቆይታወ ምንም አይነት ተጽእኖ እንደማይደርስብወት እያሳወቅነወት፤ነገር ግን ጥናቱ የሚጠይቆትን ማንኛውንም መረጃ ትክክለኛነቱን ባመኑበት መልኩ ብቻ እንድሰጡን በአክብሮት እንጠይቀወታለን፡፡ ርስወ በጥናቱ ላይ በመሳተፍወት የተለየ ጥቅም እንደሌለው መረዳት ይኖርበወታል፡፡

ማንኛውም ከዚህ ጥናት ጋር የተያያዘ የርስወን መረጃ በተመለከተ ከርስወ ፈቃድ ውጭ በምንም ሁኔታ መረጃ ለማንም አካል አይሰጥም ወይም አይተላለፍም፡፡ የርስወ ስም በቃለ መጠይቁ ላይ አይጻፍም ፡፡

ስለሆነም ጥናቱ ላይ መሳተፍ ከጀመሩም በኃላም ቢሆን ጥናቱን ማቆም ከፈለጉ ያለምንም ቅጣት በማንኛውም ጊዜና ሰአት ማቆም ይችላሉ፡፡ የርስወ ተሳትፎም በፈቃደኝነት ላይ የተመሰረተ ሲሆን ቃለ መጠይቁን ለማቆም ከፈለጉ ከሀላፊነትወና ከስራው ጋር ምንም አይነት ግንኙነት አይኖረውም፡፡ እያንዳንዱ ቃለመጠይቅ ከ45-60 ደቂቃ ሊወስድ ይችላል፡፡ በመጨረሻም የዚህን ጥናት ውጤት እንደመነሻ በመጠቀም በጤና ጥበቃ ሚኒስተርና በክልል ጤና ቢሮ በኩል የሚወጡ የጤና ደንቦች የሚሻሻሉበትን መንገድና የላቦራቶሪ ግብአቶች በጥራትና በሰአቱ የሚሰራጩበትን መንገድ ለመፍጠር ነው፡፡

ስለትብብርወት አመሰግናለሁ፡፡ ቃለ መጠይቁን ይቀጥሉ

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