Assessment of laboratory commodity supply chain practice at public health facilities of Jimma zone and Jimma town administration, South West Ethiopia

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Assessment of laboratory commodity supply chain practice at public health facilities of Jimma zone and Jimma town administration, South West Ethiopia

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Abstract

Back ground- Laboratory services play a significant role in a country's health system and in the delivery of quality health services. However managing supply chains in support of laboratory services is a formidable challenge. When diseases are diagnosed incorrectly, valuable medicines are wasted treating a disease for which they are not effective. The status of overall laboratory commodity supply chain practice in our country as well as in Jimma zone was not clearly known.

Objective- to assess the overall supply chain practice of laboratory commodity in selected public health facilities of Jimma zone and town, south west Ethiopia from March to April 2016.

Materials & Methods- A facility based cross-sectional descriptive study method was conducted. The study units have stratified in to three strata i.e. hospitals, `A` level, and `B` level health centers. The study & sample population were 122 & 34 facilities, respectively. Structured questionnaire and in-depth interview were used to collect the data. ANOVA, chi-square, linear regression and correlation analysis were conducted. SPSS version 20 was used for data analysis.

Results- almost 40% of the health facilities were found stock out on the day of visit (the overall mean days of stock out and months of stock on hand were 51 and 5.51, respectively), 19 of them had filled & send RRF, facilities maintaining acceptable storage practice were 26.5%, only 9 facilities were doing demand forecast, and only 2 of them used ABC analysis for selection of products. It was found that HCs had an average stock out days that is significantly greater than hospitals (p-value =0.003).

Conclusion- the supply chain practice towards laboratory commodity was found very poor. Availability, selection and quantification practice, quality of data, and storage practice were found significantly compromised. Mean stock out day were found different between facilities. Number of pharmacy professionals and annual budget were significantly affected availability.

Recommendation- laboratory professionals should have to participate in the procurement, inventory recording tools including RRF have to be intensively implemented, systematic selection and quantification should be followed, and storage guide line should also be strictly followed by all facilities.

Key words-supply chain practice, laboratory commodity

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Abbreviations and acronyms

ART- anti-retroviral therapy

ATLAS- assessment tool for laboratory services and supply chains

BUN-blood urea nitrogen

CD4- cluster of differentiation 4

DBS-dried blood spot

DOS-days out of stock

FEFO-first to expire first out

GOT-glutamate oxaloacetate transaminase

GPT-glutamate pyruvic transaminase

IFRR- inter-facility report and requisition form

IPLS-integrated pharmaceuticals logistics system

LIAT-logistics indicator assessment tools

LSAT-logistics system assessment tools

NEDL-national essential drug list

PFSA-pharmaceuticals fund and supply agency

RRF- report and requisition form

SCM- supply chain management

SCMS-supply chain management systems

SGOT-serum glutamate oxaloacetate transaminase

SGPT-serum glutamate pyruvic transaminase

SO-stock out

SPSS-statistical package for social sciences

STG-standard treatment guideline

TB-tuberculosis

USAID-United states agency for international development

WHO-World health organization

VEN-vital essential non-essential

1. Introduction

1.1. Back ground of the study

Medical laboratory is a place that is equipped with various biomedical instruments, equipments, materials, reagents and chemicals for performing different laboratory investigative activities by using biological specimens (1). Laboratories are an essential and fundamental part of all health systems and their goal to improve health (2).

Generally Medical laboratory science comprises different functional disciplines that are mainly used for diagnostic purposes; these are microbiology, hematology, clinical chemistry, urinalysis, immunology, serology, histopathology, immuno-hematology and molecular biology, and others (1).

When diseases are diagnosed incorrectly, not only does the patient suffer, but also valuable medicines are wasted treating a disease for which they are not effective. Therefore, clinical/medical laboratories are situated in health institutions and support the delivery of health services to patients' by screening for different conditions and providing information for differential diagnosis, allowing clinicians to choose appropriate treatment regimens and monitor treatment (3).

Laboratory commodities are products that are used to collect, prepare, test, analyze, store, and dispose of clinical specimens. For logistics purpose they are broadly classified in to three distinct categories of products such as: - reagents, consumables, and durables (4).

Supply chain management (SCM) is a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores:- so that merchandise is produced and distributed at the right quantities to the right locations and at the right time, inorder to minimize system wide costs while satisfying service level requirements (5). Pharmaceutical supply chain management shares the same goal with that of the broader SCM with specific objective of moving pharmaceuticals from the manufacturer to the end user in organized and efficient or optimized ways (6).

Although laboratory services play a significant role in a country's health system and in the delivery of quality health services, managing supply chains in support of laboratory services is a formidable challenge, especially in developing countries (7). The reason of this challenge includes the following realities; each test performed in a laboratory requires several different

commodities, laboratory commodities often come in a variety of preparations-including solid and liquid reagents, laboratory commodities can also be packaged in kits, dry laboratory chemicals and consumable liquids are often packaged in bulk, and some laboratory commodities have either short shelf lives or need special storage condition (3).

In Ethiopia, pharmaceuticals fund and supply agency (PFSA) is an agency with a prime responsibility of managing the pharmaceutical logistics system of the country. The provision of complete health care necessitates the availability of safe, effective and affordable drugs and related supplies of the required quality, in adequate quantity at all times. Despite this fact, in the past, the pharmaceutical supply chain management system of the country had several problems including non-availability, un-affordability, poor storage and stock management and irrational use (8).

As discussed above, medical laboratory has different functional disciplines in which all of them require suitable laboratory commodities in order to fully provide the required standard services at any time to patients. At the same time different challenges have been encountered to perfectly/fully supply all the necessary commodities at all time in the required quantity. Therefore, this study paper has tried to assess the supply chain practice of laboratory commodities that are used to give basic diagnostic services in public health facilities of Jimma zone and town.

1.2. Statement of the problem

Clinical laboratory services are a critical, yet often neglected component of essential health systems in resource-limited countries. However, laboratories play a central role in public health in disease control and surveillance, and in individual patient diagnosis and care inorder to forward the necessary results required for further decisions of clinicians on the choice of appropriate treatment options. Yet millions of people still do not have access to reliable and basic diagnostic laboratory services (9).

An assessment on laboratory supply chain system conducted in Angola reported its results as; critical laboratory tests are not performed in most laboratories. Sputum smear microscopy for TB is not done in most facilities; likewise, serological tests for syphilis are not done in some facilities because of lack of reagents. Moreover, due to lack of constant supply some laboratories are using expired reagents (Giemsa stain) to perform testing (10).

Other survey on integrated pharmaceuticals logistics system conducted regarding inventory control in Ethiopia revealed that the overall data accuracy of bin cards was found to be low for most of the products assessed. The result also declare that only 60% of facilities had updated their bin cards for the selected pharmaceuticals; furthermore, the exact accuracy of RRF data was between 40% and 60 % for most of the products, across products most facilities were not stocked according to the recommended 2-4 months of stock and about 45% of the facilities didn`t meet at least 80% of storage criteria (11).

To effectively and efficiently manage any required commodities which are used to run diagnostic services; logistic recording tools are not only available but also must be as accurate as possible in its recording practice, in-order to appropriately control available stock-on-hand or/and to be able to accurately plan required commodities. Failure to use and practice accurate inventory recording system may result in inability to know the exact level of stock-on-hand and its actual date of expiry, it also make unable to practice first expire first out (FEFO). Those problems, totally, might lead the facility to unavailability of essential products.

In logistics management, selection and quantification are basic functions and must need great care when conducting managing the supply system. Improper practice may produce availability of less useful products or availability of most useful products in lower quantity.

Unavailability or shortage of these reagents and chemicals at health facilities could result in incorrect diagnosis, suffering of patients due to delay or incorrect diagnosis, valuable medicines are wasted in treating a disease for which they are not effective, and wastage of money that would be used to purchase effective drugs and treat patients effectively (3).

This is further explained by the world health organization (WHO) regional office for Africa as, the diagnosis of disease based on clinical symptoms alone, without the support of diagnostic tests, leads to inappropriate treatment and increased patient morbidity and mortality, and promotes the development of drug resistance. Inaccurate clinical data lead to poor national planning and misallocation of resources (2).Therefore, consequences of varieties of those basic and significant problems due to failure to adhering on the supply management system of the needed commodities may finally result in the total lack of trust of the society on the given health care system of the country.

On the other hand, efficient laboratory and medical commodity management ensures that appropriate commodities of adequate quality are reliably available, so laboratory professionals can perform tests for individual patient care and health care staff can treat patients appropriately (9).

Researches on laboratory commodity supply chain practice at facilities level in Ethiopia are few. So this study will help to describe how well the laboratory commodity supply practice is functioning in the public health facilities found in Jimma zone including Jimma town and could also potentially identify the challenges on the existing laboratory supply chain practice.

1.3. Significance of the study

In Ethiopia, PFSA has mandated to supply and distribute quality pharmaceuticals in all public health institutions across the country. Laboratory commodities, like other pharmaceutical products, have been supplied and distributed through the agency.

Therefore, studying the overall supply chain practice of laboratory commodities in the study area could have given a potential to identify and assess the major problems and challenges in the supply management of laboratory commodities which have a significant public importance.

Hence, this study finding may help to promote evidence based health care intervention on the existing supply system of laboratory commodity through identifying problem areas and weaknesses so that it enables to know the root causes of existing problems in the supply management practice and give all the possible recommendations based on the findings of the result inorder to take corrective actions.

The study can also be considered as a baseline assessment and managers can use the findings of the study to plan interventions on the existing supply chain practice. Furthermore, this study can leave some primary data for further study to researchers who have interest on similar study area.

2. Literature review

A. Overview of clinical laboratory

An efficient laboratory system is critical for the correct diagnosis of clinical conditions and the detection and identification of the cause of disease outbreaks in the shortest possible time. These two laboratory functions - diagnostic patient services and public health surveillance & response services - are essential to provide sufficient information for treatment, prevention and health improvement (12).

The clinical laboratory's typical inventory includes a variety of items, including disposables, bulk chemicals, and individual reagents and reagent kits (13).

B. Challenges on the supply management of laboratory commodities

A report in Botswana revealed the challenges in laboratory supply system as, one of the challenges with the current laboratory system is the consistent interruption of testing services resulting from unplanned activities, reagents stock-outs and expiries because of poor quantification and inadequate logistics systems to support the flow of these commodities. Prolonged equipment down time as a result of poor service and maintenance, excessive emergency order situations that interrupts the supply plan and lack of documented procedures was also another issue identified with the current laboratory system (14).

WHO manual for procurement of diagnostics and related laboratory items states that, selection and procurement of diagnostics and laboratory technologies is often challenging given the wide choice of products and suppliers in the global market. Understanding of the needs at each level of the health system is critical and should be the first step (15).

Despite their importance, laboratories are often under-resourced, resulting in inadequate infrastructure, poorly-trained personnel and lack of standardization (16).

C. Managerial factor on the supply system of laboratory commodities

An assessment done on Angola Laboratory Supply Chain System reported that, weak management of laboratory commodities has been identified as a key gap in ensuring quality and uninterrupted laboratory testing in many developing countries. Inadequate skills, lack of proper tools, and poor infrastructure hamper effective management of commodities in laboratories

resulting into recurrent stock-outs of testing reagents, and in some instances stoppage of critical laboratory testing services (10).

Other study in Lesotho did, however, confirm that hospital laboratories experienced frequent and occasionally prolonged stock-outs of key reagents and consumables. Reliable supply of laboratory reagents and consumables was reported at only 7 of the 19 laboratories. Laboratory demands were often not met by the local hospital procurement systems, and inadequate supply and late delivery was common. This was reported to be primarily due to inadequate local hospital funds and late payment to suppliers (17).

The same study was also reported a frequent SO of many types of commodities in government health facilities consequently due to: - extreme shortage of skilled health care workers throughout the health system, insufficiently trained and motivated staff at every level, and poor record keeping and late reporting (17).

Assessment of laboratory supply chain done in Malawi explained, some district and central hospitals were stocked-out of machine reagents on the day of the visit; 28 % of the district-level laboratories were stocked-out of CD4 reagents, but the central level had no stock-outs of CD4 reagents. Chemistry reagent for glutamate oxaloacetate transaminase (GOT) (a liver function test) was stocked out in 60 % of the district hospitals. Twenty percent of the district hospital laboratories did not have hematology reagents on the day of the visit (18).

Other study conducting on the management of laboratory reagents supply in Dominican Republic reported some causes of unavailability of stocks such as, high cost of laboratory reagents and accumulated indebtedness. Some 28 % of all reagents were out of stock at the time the study was conducted for a number of different reasons, primarily their high procurement cost. The lack of availability of these products limits timely diagnosis and treatment in public health facilities (19).

D. Prospects of availability in laboratory commodities supply management

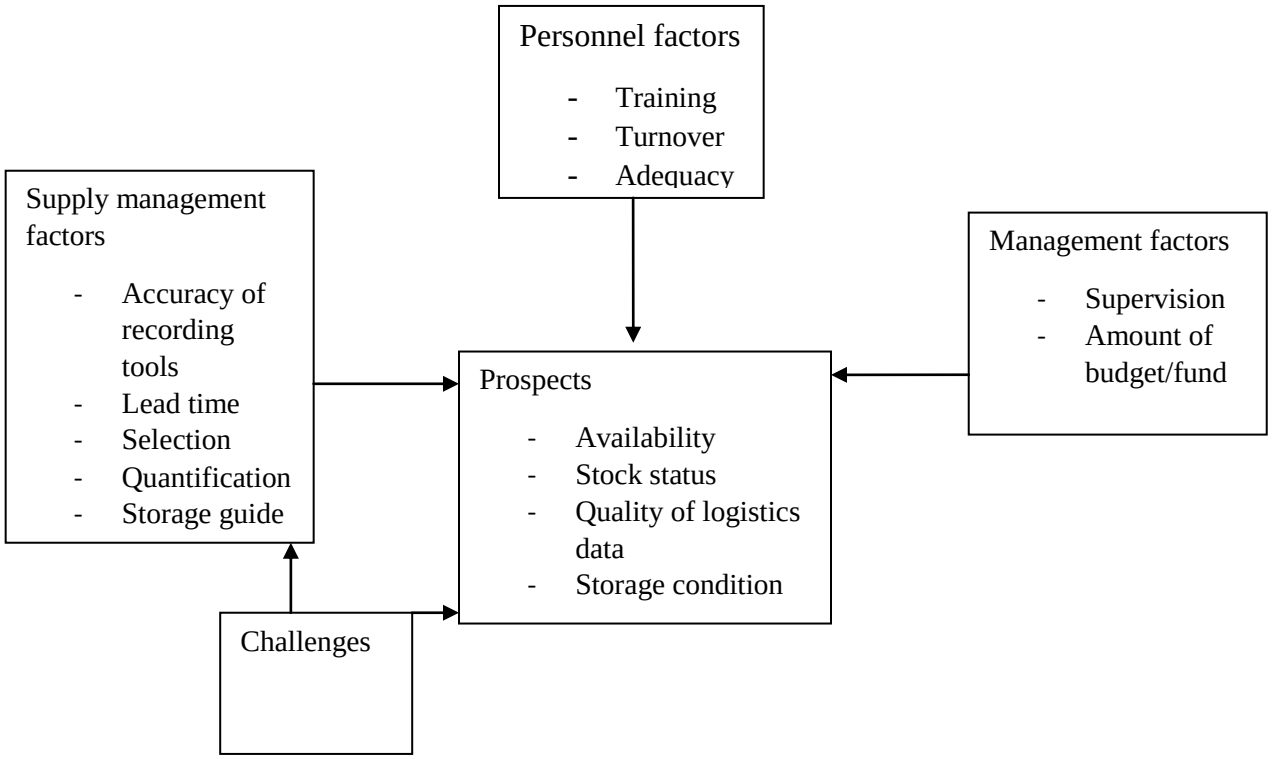
Results of the study done in Addis Ababa showed that laboratory commodities for the diagnosis of diseases which have a significant public importance such as KHB, DBS kit, acid alcohol, 1% carbol fuchsin, SGOT, SGPT, and CD4 reagents were out of the stock in significant number of facilities at the day of visit. The study also showed that 24 (96%) facilities reported one or more reagents stocked out during the last six months (20).

Besides, other study done in public health facilities of Addis Ababa also reported that 16 (37.2%) facilities 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%). The same study also revealed the status for the past 6 months as, 26 (60.5%) facilities reported that they usually run out of at least one ART monitoring and TB laboratory commodities before resupply. The most frequently stocked-out ART monitoring commodities were bilirubin reagents, BUN reagents, CD4 reagents and vacutainer tubes with stock-out rate of 75%, 50%, 50% and 52% respectively (21).

On the other hand a study conducted to assess distribution and availability of essential tuberculosis diagnostic items in health centers found in Amhara regional state reported that, 33 (40.2%) health centers were under stocked for at least one of the key items. Eleven (13.4%) health centers were under stocked for all TB diagnostic reagents. Fifteen (18.3%) health centers had a complete stock out of at least one of the key items (methylene blue 9 (11.0%), carbol fuchsin 9 (11.0%), acid alcohol 7 (8.5%) and sputum cups 3 (3.7%)). Three health centers had a complete stock out of all TB diagnostic reagents (22).

In order to manage the overall supply system of laboratory commodities more efficiently and effectively, we have to use systematic standardization of products that must be required to conduct a specific test. Standardization benefits the supply chain by streamlining the number of laboratory commodities that must be managed in the pipeline, because each test conducted using a different technique or equipment requires a unique set of products. A reduction in the number of supplies that must flow through the laboratory supply pipeline reduces congestion and complexity in the supply chain (23).

2.1. Conceptual framework



3. Objectives

3.1. General objective

The general objective of this study is to assess the overall supply chain practice of laboratory commodities in selected public health facilities of Jimma zone and Jimma town administration, south west Ethiopia, from March to April 2016.

3.2. Specific objectives

- To assess the stock status of basic laboratory commodities,
- To determine the quality of logistics data for inventory management,
- To assess the storage practice implemented for laboratory commodities,
- To assess the methods used for selection and quantification of laboratory commodities,
- To identify challenges in laboratory commodity supply chain management.

4. Methods and materials

4.1. Study settings and period

This study was conducted in health facilities found in Jimma zone and Jimma town administration, South West of Ethiopia. Jimma zone is administratively divided in to 17 woredas and Jimma town administration also administratively classified in to 17 kebeles. Both are administratively independent organs having separate health offices.

Jimma town is located at 352km to the South West from Addis Ababa. A total population of Jimma zone and Jimma town is estimated to be 3,173,545 and 189,733 respectively (based on the data of 2015, from Jimma zone health department and Jimma town administration health office).

There are 3 public hospitals, 114 health centers, and 512 health posts found in Jimma zone whereas one general public hospital, one University Specialized hospital, one army hospital, 4 health centers, 8 private whole sales, and one PFSA hub are found in Jimma town administration.

The study has been conducted from March to April 2016.

4.2. Study design

A facility based cross-sectional descriptive study design has been applied to assess the supply chain practice of laboratory commodities in selected public health facilities of the study settings. Both the qualitative and quantitative methods have also employed for data collection.

4.3. Source population

All functional public health facilities found in Jimma zone and Jimma town administration having laboratory services and all health professionals involved in laboratory commodity management were considered as a source population for the study.

4.4. Study population

Health facilities and health professionals found in the study area that fulfills the inclusion criteria have been included as the study population.

4.5. Inclusion and exclusion criteria

Public health facilities; which were giving primary health care services to the public and supporting the implementation of the health care system, were included. Laboratory head and store manager with a minimum of serving 1 year in selected facilities were considered as for the

qualitative study. However, in some facilities, store manager whose service year less than one were replaced by the former manager in the same facility.

As a result two facilities- specialized and army hospital- found in the study area was excluded from the study.

4.6. Sampling technique and sample size

4.6.1. Sample size

To calculate sample size for health facilities, primarily, we used general formula (24)

$$n = \frac{t^2 * p(1-p)}{m^2}$$

Where,

n=required sample size

t=the value of confidence level we chose (95%=1.96)

p=estimated prevalence of the indicator that is availability (we used p=0.5)

m=margin of error we wish to allow in estimating prevalence (in our case we used m=15%) (11,25)

Therefore, $n=\frac{1.96^2*0.5(1-0.5)}{(0.15)^2}$ == 42.68, approximately 43

However, where there is a predetermined population, the sample size generated from the above formula needs to be multiplied by the Finite Population Correction (FPC) factor. So that the formula can be expressed as:

$$\text{New } n = \frac{n}{1+[(n-1)/N]}$$

Where,

New n=adjusted new sample size

N=the total population size (in our case we do have 122 facilities)

n=sample size obtained from general formula (that is 43)

Therefore, new n=43 = 31.99, this is approximately 32 health facilities

1+42

122

From the total of 122 health facilities, 32 facilities have been selected as our sample size.

4.6.2. Sampling technique

Stratified random sampling technique was used to select the required sample. From each stratum sample was selected using systematic random sampling method. However, for the sought of representativeness from each stratum we also applied over-sampling technique.

A total of 122 public health facilities which are involving in supply chain of laboratory commodities used for public health care services were listed and served as a sampling frame. These facilities were classified in to three different strata- based on the functional level of facilities which have been giving primary health care services to their respective population.

The total facility of 122 includes; 3 primary hospitals under Jimma zone, one general hospital under Jimma town administration, 114 health centers under different woredas of Jimma zone, and 4 health centers under Jimma town administration. Of the total 118 health centers in Jimma zone and town; 18 were ``A`` level and the rest 100 were ``B`` level which have been stratified under different strata.

Therefore our sample has been stratified in to three strata that were; hospitals, `A` level health centers, and `B` level health centers. From each stratum, sample has been selected using systematic random sampling technique. Sampling procedure is annexed (Annex 2).

4.7. Study variables

4.7.1. Dependent variables

- Availability of laboratory commodity
- Quality of logistics data
- Storage condition for laboratory commodity

4.7.2. Independent variables

- Training of professionals on laboratory commodity management
- Health facility type
- Turnover of professionals
- Number of professionals
- Lead time
- Selection process
- Quantification process
- Amount of Budget
- Using recording tools
- Availability of storage guideline

4.8. Methods of data collection

Qualitative and quantitative methods of data collection were used.

4.8.1. Quantitative method

To collect a quantitative data, structured questionnaire and observational checklist were used. The questionnaires, from assessment tools for laboratory service and supply chain (ATLAS), logistics indicator assessment tool (LIAT) and logistics system assessment tool (LSAT) (26-28), which are developed by USAID/DELIVER, were customized according to our situation and level of health care and have been used to collect data from health facility store and laboratory department. In addition, physical counts of laboratory commodities have been conducted to cross check with the data filled on stock recording cards. On the other hand, to assess storage practice the guideline was taken from standard operating procedures manual for the IPLS of Ethiopia (8).

The questionnaire was designed to collect data on the variables such as commodity availability, stock status, accuracy of logistics data, and storage condition of the facility.

To assess quality of logistics data we have reviewed recorded data from bin cards and RRF. We have aimed to compute quality in-terms of accuracy and validity. A discrepancy of less than or equal to 10% was considered to be accurate as well as valid, whereas a discrepancy of more than 10% was considered in-accurate or invalid. This assumption is based on the survey of IPLS and LIAT (11) (25).

4.8.2. Qualitative method

In-depth interviews has been conducted by the principal investigator with the key informants (head of laboratory department) and store manager responsible for the management of lab commodities in the respective health facility using semi-structured interview guidelines with some probing points(Annex5). This could help us to identify challenges that facilities were facing on supply chain practice for laboratory commodities.

4.9. Data quality assurance

Before the actual data collection, the validity of the questionnaire has pre-tested on health facilities other than sampled facilities by taking 5% of the total sample size of the study and all the necessary modifications were made. One day training was given by principal investigator to data collectors regarding the objectives and significance of the study and how to collect the data. During data collection process they are being closely supervised by the principal investigator to ensure consistency and completeness of data. Finally, data have been entered in to SPSS software by giving an identification number to each facility to enable to easily identify during the process of analysis.

4.10. Data processing and analysis

Quantitative data were sorted and coded first and then analyzed by using statistical package for social sciences (SPSS) version 20. Descriptive statistics of frequencies, percentages, and averages has also calculated to describe the data and results are tabulated respectively. ANOVA and chi-square were used to compare means and test for association between different variables. Furthermore, regression and correlation analysis was carried out to determine associated factors

affecting out-come variables. Whereas the qualitative part of the study was transcribed and summarized manually and the results are presented in the form of narration.

4.11. Ethical consideration

After obtaining ethical clearance for the study by the ethics review board of college of health sciences, official letter from department of pharmacy, post graduate program coordinator, were presented to Jimma zone health department and Jimma town administration health office.

Furthermore, a letter of permission obtained from zonal health department and Jimma town administration health office has also been given to all sampled health facilities. Confidentiality of information has also maintained during data collection as well as no name of any health facility and participating subjects are disclosed in the results, instead aggregate result of all facilities and summary results of in-depth interview are going to be projected. Informed consent from key informants who were involved in the in-depth interview was taken verbally.

4.12. Dissemination of the result

The result of the study will be disseminated to whom it may be concerned, including Jimma University department of pharmacy, Oromia regional state health bureau, Jimma zone health department, and Jimma town administration health office through submission of hard copy and publications in-order to give them the general overview of supply chain practice for laboratory commodities and its practical challenges that facilities are facing.

4.13. Operational definitions

Laboratory Commodity- the term laboratory commodities refers to reagents and consumables used to collect, prepare, test, store, and dispose clinical specimens in public health facilities in Jimma zone and Jimma town administration.

Public health facilities- are health facilities giving health care services for the public and owned by the government in Jimma zone and Jimma town administration.

Accuracy- refers the degree or extent to which calculations of report and request found in each column of the RRF yields accurate result for laboratory commodities in public health facilities of Jimma zone and Jimma town administration.

Reagents- are chemicals that are used in laboratory testing or monitoring a given health condition in public health facilities of Jimma zone and Jimma town administration.

Consumables- are items that are used once while performing a test or a monitor and are not reused in public health facilities of Jimma zone and Jimma town administration.

Validity- refers the degree or extent to which amount of inventory readings on the RRF, model 19, and bin card yields the same/consistent reading in public health facilities of Jimma zone and Jimma town administration.

5. Result

A. Results for quantitative data

5.1. Characteristics of the study facilities

A total of 34 health facilities giving primary health care services were involved in the study. Among these 4 (11.8%), 12 (35.3%), and 18 (52.9%) were hospitals, A level, and B level health center respectively. A total of 42 pharmacists, 29 druggists, 40 laboratory technologists, and 35 laboratory technicians were working in those 34 selected health facilities.

The minimum and maximum number of pharmacists and druggists were found 0&8 and 0&2, respectively. On the other hand the minimum and maximum number of laboratory technologists and laboratory technician were 0&5 and 0&4, respectively. Furthermore distributions of means of each profession with respect to facility level have presented below (table 1).

Among a total of 146 pharmacy and laboratory professionals in study facilities, only two (1.3%) pharmacy professionals have taken laboratory commodity management training. A total of 30 (42.3%) pharmacy professionals and 21 (28%) lab professionals were left the facilities in the past one year.

Concerning availability of pharmacy and laboratory professionals in the studied facilities, 16 (47.1%) and 12 (35.29%) facilities have had only one pharmacy and one laboratory professional, respectively, and one of the health centers had no any pharmacy professional at all.

Table1. A cross-table that shows, types of professionals by the types of facilities in the studied area with their mean distribution, Jimma zone and town 2016.

Types of professionals	Types of facility			Mean of hospitals	Mean of HCs
	Hospitals	A-level HCs	B-level HCs		
Pharmacist	26(61.9%)	9(21.4%)	7(16.7%)	6.5	0.53
Druggist	3(10.3%)	7(24.1%)	19(65.6%)	0.75	0.87
Lab technologist	16(40%)	10(25%)	14(35%)	4	0.8
Lab technician	10(28.6%)	11(31.4%)	14(40%)	2.5	0.83

HCs= health centers, Mean of HCs=mean of A &B level HCs, No. of hospital=4, No. of HCs=30

5.2. Inventory control practice of laboratory commodities in the study facilities

From the total health facilities 31 (91.2%), 30 (88.2%), and 29 (85.3%) of them were using RRF, IFRR, and bin card, respectively, to manage pharmaceuticals. However, the physical inventory of this recording tools showed that, practically only 5 (14.7%) facilities were completely filled RRF, in 14 (41.2%) facilities complete report were not available and in the other 15 (44.1%) facilities the report were not totally filled for laboratory commodities. Among the total facilities only 3 (8.8%) facilities have been fully kept their records on bin card for laboratory commodities.

On the other hand 29 (85.3%) facilities were reported to use both IFRR and RRF to report and reorder pharmaceuticals. But only 19 (55.88%) facilities filled RRF for laboratory commodities and send to higher level and 26 (76.5%) facilities laboratory department filled and send IFRR to the main pharmacy store. From this data the inventory accuracy rate was found to be 86.3%.

During resupply from their main source (PFSA) 33 (97.1%) facilities responded they had never received all ordered quantities, besides 23 (67.6%) facilities reported that they were received products nearer to their expiry date. Among these; 9 (26.5%) of them responded that the remaining time for expiry was between 1 to 2 month at the time of arrival to their facility while others 11 (32.4%) and 3 (8.8%) replied that they were resupplied with a product remaining 2 to 3 and 3 to 6 months to expire respectively.

Regarding the lead time for resupply of order quantity, twenty eight (82.4%) facilities were received within average lead time of less than two weeks but the other 6 (17.6%) were within two weeks to one month after placing their order.

All facilities had functional refrigerator for laboratory commodities that need to be kept within specific temperature condition. Among these, only in 5 (14.7%) facilities the refrigerator were found in main pharmacy store but in others it was found in dispensary or/and other departments. From the total facilities, 32 (94.1%) of them had storage guideline for those commodities.

Majority (82.4%) of the facilities have received supervision in the last three months out of which; 16 (47.1%) of them were supervised within the last month and 12 (35.3%) of them supervised within 1-3 months. For 23 (67.6%) of facilities, the supervision does not included

laboratory commodities while 3 (8.8%) facilities have never been supervised in relation to the supply management of pharmaceuticals.

5.2.1. Quality of logistics data

Practically, it was found difficult to compute accuracy and validity because facilities were not consistently updating and recording their inventory recording tools.

When we see the accuracy of RRF in main pharmacy store of each facility; calculated consumption, maximum stock quantity, and quantity ordered of 9 (47.4%) facilities were found inaccurate. Regarding validity; 11 (57.9%), 12 (63.2%), and 16 (84.2%) facilities of beginning balance, quantity received, and ending balance, respectively, were not valid. Furthermore, loss and adjustment, calculated consumption, and days out of stock of 15 (79%) facilities were not also found to be valid; that means it has not shown consistent value between reviewed documents.

Table2. Percentage of facilities having accurate and valid inventory records on recording tools in Jimma zone and Jimma town 2016.

S.N	Description	Yes	No
1	Check the accuracy of parts within RRF, is it accurate?		
A.	Is Calculated Consumption presented on the RRF to the verified CC (recalculating the CC as beginning balance + Quantity Received – ending balance +/- Loss/Adj.) accurate?	10 (52.6%)	9 (47.4%)
B.	Is Verified Maximum stock quantity, as CC x 2, correct	10 (52.6%)	9 (47.4%)
C.	Is Verified quantity ordered, as Maximum stock quantity-Ending balance, accurate?	10 (52.6%)	9 (47.4%)
	Overall accuracy=52.6%(10)		
2	Are the data reported on the RRF valid?		
D.	Compare the "Beginning balance in the Store" to the "Ending balance in the store" of the previous report.	8 (42.1%)	11 (57.9%)
E.	Compare the "Quantity Received" on the RRF with the "Quantity Received" on PFSA STV or Facility Model 19 within the reporting period.	7 (36.8%)	12 (63.2%)
F.	Compare "Ending balance" indicated on the RRF with Quantity at the end of the reporting period as indicated on the Bin Card.	3 (15.8%)	16 (84.2%)
G.	Compare the "loss and adjustment" indicated on the bin card with RRF loss and adjustment column of the reporting period.	4 (21%)	15 (79%)
H.	Compare "CC" versus the sum of quantities issued on the "Quantity Issued" column of the bin card during the recent reporting period.	4 (21%)	15 (79%)
I.	Comparing the "DOS" on RRF versus "DOS" indicated on the bin card.	4 (21%)	15 (79%)
	Overall validity=26.31%(5)		

N=19, CC=calculated consumption, STV=stock transfer voucher, DOS=days out of stock

5.3. Selection process

Among the study facilities, 27 (79.4%) had no National Essential Drugs List while 24 (70.6%) of them did not develop their own facility drug list. In-order to select laboratory commodities 32 (94.1%) facilities used testing algorithm as well as laboratory procedures while 11 (32.4%) of them used STG as a criterion.

Table3. Percentage of level of facilities follows different type of selection method and processes for laboratory commodities in Jimma zone and town 2016.

Selection requirements	Yes		No	
	Hospitals	HCs	Hospitals	HCs
Standard drug list				
Facility has NEDL	3 (75%)	4(13.3%)	1 (25%)	26(86.7%)
NEDL used for selection	3 (75%)	2(6.7%)	1 (25%)	28(93.3%)
All products are available in the NEDL	0	0	4(100%)	30(100%)
Facility has its own list	3 (75%)	7(23.3%)	1 (25%)	23(76.7%)
Selection method to adjust budget				
Facility used ABC analysis to select products	0	2(6.7%)	4 (100%)	28(93.3%)
Facility used VEN analysis to select products	3 (75%)	8(26.7%)	1 (25%)	22(73.3%)
Facility has no resource problem for selection	1 (25%)	20(66.7%)	3 (75%)	10(33.3%)
Selection process				
STG used for selection	0	11(36.7%)	4 (100%)	19(63.3%)
Testing algorithm used for selection	4 (100%)	28(93.3%)	0	2(6.7%)
Lab procedure used for selection	4 (100%)	28(93.3%)	0	2(6.7%)

HCs=health centers, number of HCs=30, number of hospitals=4

On the other hand only 2 (5.9%) facilities used ABC analysis to adjust their budget whereas others, 21 (61.8%) facilities responded they have not used either ABC or VEN analysis to adjust their budget since they had no resource problem to procure products.

A linear by linear association showed that, developing facility`s drug list was found to be associated with the number of available pharmacy professionals (p-value= 0.023).

5.4. Steps and processes of quantification

Regarding the forecasting of laboratory commodity in the study facilities, only 9 (26.5%) of them were actually doing demand forecast. But the other 25 (73.5%) were not undertook demand forecast annually. Nine facilities have accomplished forecasting initiated by PFSA and seven by head of pharmacy of the facility.

While conducting demand forecast only one facility reviewed its goals, strategies, and priorities of forecasting. In the same fashion it also defined its scope and purpose. On the other hand 30 (88.2%) facilities have not adjusted for stock out while calculating quantification. Besides, 24 (70.6%) facilities were not reporting their actual consumption of those commodities to higher level and only 12 (35.29%) facilities did reconciliation of their demand with the available budget.

Almost all, 33, facilities didn`t have dedicated or/and separate budget for laboratory commodities; even though 26 (76.5%) of them responded they had sufficient fund to purchase all needed pharmaceuticals. Eventually all facilities did have functional power to decide on the already allocated budget.

Table4. Percentage of level of studied facilities follows different forecasting methods and processes for the quantification of laboratory commodity, Jimma zone and town 2016.

Forecasting requirements	**Yes**		**No**	
	Hospitals	**HCs**	**Hospitals**	**HCs**
Actual forecasting undertaken	1 (25%)	8(26.7%)	3 (75%)	22(73.3%)
Goals, strategies, and priorities reviewed	1 (25%)	0	3 (75%)	30(100%)
Scope and purpose defined	1 (25%)	0	3 (75%)	30(100%)
Facility used consumption data	4 (100%)	26(86.7%)	0	4(13.3%)
Facility used morbidity data	0	6(20%)	4(100%)	24(80%)
Facility used service data	0	0	4 (100%)	30(100%)

Facility report consumption	2 (50%)	8(26.7%)	2 (50%)	22(73.3%)
Facility adjust for SO	1(25%)	3(10%)	3 (75%)	27(90%)
Facility used STG as conversion factor	0	6(20%)	4(100%)	24(80%)
Facility used testing algorithm as conversion factor	0	6(20%)	4(100%)	24(80%)
Facility used lab procedure as conversion factor	0	6(20%)	4(100%)	24(80%)
Reconciliation of costs of demand with budget	3 (75%)	9(30%)	1 (25%)	21(70%)

HCs=health centers, number of HCs=30, number of hospitals=4

5.5. Availability of products and storage condition

Percentage facilities with available & updated bin cards, stock out on the day of visit and in the last 6 months are presented in the table 5; additionally their respective overall averages are also presented.

Among those 40 laboratory commodities included in this study seven were not totally found in any of the studied health facilities; these were Field stain reagents(A and B), Xylene, Glacial acetic acid, Formalin solution, Ether, Indian ink, and Potassium hydroxide reagents so that are going to be omitted from statistical analysis.

Sodium hypochlorite had no bin card at all facilities, alcohol 70% was recorded on bin card in 8 (23.5%) facilities, and only 6 (17.6%) facilities updated their bin card for immersion oil.

Sodium chloride reagent and weil-felix were stocked out both on day of visit and in the last 6 months from 33 (97.1%) and 27 (79.4%) facilities respectively. Furthermore, during both periods crystals violate, acetone alcohol, and glucose test strip were also stocked out from 25 (73.5%) facilities. Microscope slide and disposable examination glove were stocked out only from 1 (2.9%) facility both on the day of visit and in the previous 6 months from the day of visit; while immersion oil, and blood group reagent and sputum cup were out of stock from 4 (11.8%) and 6 (17.6%) facilities in both periods respectively.

When we see the overall averages for each variable, the finding showed that 39.87% and 39.97% of the facilities were stocked out on the day of visit and in the last 6 months, respectively.

Using linear regression method, as number of pharmacy professionals increases by one the number of available items on average also increases by around 1.2 (p-value=0.001), whereas, as turn over increases by one unit the number of available items on average decreases by around 3 (p-value=0.008). On the other hand as annual budget increases by one thousand the number of available items on average also increases by 0.003 (p-value=0.011).

Table5. Percentage distribution with respect to availability by commodity type and bin cards at facilities in Jimma zone and town, 2016.

Types of commodities	% of facilities with available bin card	% of facilities with updated bin card	% of facilities SO on day of visit	% of facilities SO in the last 6 months	Mean SD for facilities SO on day of visit
Diagnostic reagents					
Grams iodine	3(8.8%)	3(8.8%)	17(50%)	17(50%)	0.50
Crystal violate	2(5.9%)	1(2.9%)	25(73.5%)	25(73.5%)	0.447
Acetone alcohol	4(11.8%)	2(5.9%)	25(73.5%)	25(73.5%)	0.447
Safranin	3(8.8%)	3(8.8%)	14(41.2%)	14(41.2%)	0.499
Carbol fuchsine	4(11.7%)	4(11.8%)	12(35.3%)	12(35.3%)	0.495
Acid alcohol	5(14.7%)	4(11.8%)	13(38.2%)	13(38.2%)	0.493
Methylene blue	4(11.8%)	4(11.8%)	10(29.4%)	10(29.4%)	0.462
Sodium chloride reagent	1(2.9%)	1(2.9%)	33(97.1%)	33(97.1%)	0.171
RPR antigen	3(8.8%)	2(5.9%)	12(35.3%)	12(35.3%)	0.485
Immersion oil	6(17.6%)	6(17.6%)	4(11.8%)	4(11.8%)	0.327
Urine dipstick	5(14.7%)	5(14.7%)	9(26.5%)	9(26.5%)	0.447
Methanol	3(8.8%)	2(5.9%)	14(41.2%)	14(41.2%)	0.499
HIV screening test kit	6(17.6%)	5(14.7%)	17(50%)	17(50%)	0.507
HIV confirmatory test kit	5(14.7%)	3(8.8%)	18(52.9%)	18(52.9%)	0.506
HIV tie-breaker test kit	4(11.8%)	3(8.8%)	25(73.5%)	25(73.5%)	0.447
Blood group anti-A,B,D	3(8.8%)	3(8.8%)	6(17.6%)	6(17.6%)	0.386
Widal O and H	3(8.8%)	3(8.8%)	21(61.8%)	21(61.8%)	0.493
Weil-felix	1(2.9%)	1(2.9%)	27(79.4%)	27(79.4%)	0.410
RF	1(2.9%)	1(2.9%)	21(61.8%)	21(61.8%)	0.493
H.pylori	3(8.8%)	3(8.8%)	20(58.8%)	20(58.8%)	0.499
Pregnancy test kit	5(14.7%)	4(11.8%)	14(41.2%)	14(41.2%)	0.499
Giemsa stain	5(14.7%)	4(11.8%)	9(26.5%)	9(26.5%)	0.447
Glucose test strip	2(5.9%)	2(5.9%)	25(73.5%)	25(73.5%)	0.447
Consumables					
Sputum cup	4(11.8%)	4(11.8%)	6(17.6%)	6(17.6%)	0.386
Microscope slide	6(17.6%)	5(14.7%)	1(2.9%)	1(2.9%)	0.171
Gloves latex disposable	7(20.6%)	6(17.6%)	1(2.9%)	1(2.9%)	0.71
Goggles	2(5.9%)	2(5.9%)	12(35.3%)	12(35.3%)	0.485
Masks	3(8.8%)	3(8.8%)	11(32.4%)	11(32.4%)	0.474

IP materials					
Biohazard bags	2(5.9%)	2(5.9%)	20(58.8%)	20(58.8%)	0.499
Alcohol 70%	8(23.5%)	5(14.7%)	7(20.6%)	8(23.5%)	0.410
Sodium hypochlorite	0(0%)	0(0%)	2(5.9%)	2(5.9%)	0.238
Sharps boxes	3(8.8%)	2(5.9%)	10(29.4%)	10(29.8%)	0.462
Overall average	**4(12.96%)**	**3(9.94%)**	**14(39.87%)**	**14(39.97%)**	**0.418**

Where, N=34, SO= stock out, SD=standard deviation, IP=infection prevention

Mean frequency of SO, number of days products were out of stock and the other computed mean frequencies are going to be presented in the table below (table 6). At the last row of the table overall averages of each column has also presented.

As depicted on the table, the overall averages mean number of days in which the commodities were out of the stock was 50.82 days. The smallest mean number of days in which the product was out of stock was observed for disposable examination glove, microscope slide and sodium hypochlorite which were 0.2, 0.23 and 1.08 days, respectively. On the other hand the longest mean number of days (171.1 and 129.7 days) for which the products were out of stock were seen for sodium chloride reagent and weil-felix, respectively. Glucose test strip, crystals violate and acetone alcohols were also stocked out for a mean of 109.6, 108.7 and 107.8 days, respectively.

The result of ANOVA shows that mean stock out day were found to be different among hospital, A-level and B-level health centers (p-value=0.003). Using the Bonferroni test for multiple comparisons it was also found that the mean stock out day of the hospitals were the one which was significantly shorter compared to health centers of any level (p-value < 0.05). For example, the average stock out day of hospitals was 35.2 days shorter compared to B-level health centers with p-value =0.002.

The Pearson correlation was done for mean stock out days of health facilities Vs number of pharmacy professionals and the result showed very weak linear relation (correlation coefficient= -0.117).

A correlation analysis was also computed to evaluate the relation between mean stock out days and annual budget (funding) for pharmaceuticals. And the result showed that there was a large correlation between the two variables (correlation coefficient= -0.513).

When we see mean months of stock (MOS) on hand between facility levels it was not normally distributed, therefore, it is better to compute and measure MOS on hand in-terms of median for

each level of facility so that median MOS on hand for hospitals, A-level health centers, and B-level health centers were found to be 2.5, 1.5, and 1.1, respectively. But these results are somewhat smaller in its value, because a number of variables with zero median MOS on hand were included. By controlling zero values we could get better median MOS on hand for hospitals, A-level health centers, and B-level health centers 4.2, 6, and 5.9, respectively. But the overall average mean of month in which stock on hand can possibly be used is 5.51 months.

Table6. Mean distributions of stock quantity, frequency and days of stock-out within certain period of time, computed by product type, Jimma zone and town 2016.

Types of commodities	Mean balance on bin card	Mean freq. of SO	Mean No. of days SO	Mean Issued in 6 month	Mean Inv. On hand	Mean MOS on hand	Mean No. of exp.	Mean SD for stock out day
Diagnostic reagents								
Grams iodine	2333.3	0.5	67.1	676.4	1264.7	7.03	588.2	79.9,
Crystal violate	1750	0.73	108.7	680.8	573.5	1.5	455.8	81.6
Acetone alcohol	125	0.73	107.8	691.1	911.7	1.5	279.4	79.13
Safranin	1500	0.41	69.7	338.2	955.8	2.3	382.3	86.3
Carbol fuchsine	1500	0.35	17.7	2294.1	1205.8	3.1	250	28.5
Acid alcohol	400	0.38	17.7	2632.3	970	2	529.4	29.36
Methylene blue	2375	0.29	21.6	2176.4	1294.1	4.4	117.6	46.01
Sodium chloride reagent	500	0.97	171.1	176.4	147	0.87	0	36.57
RPR antigen	166.7	0.35	35.6	261.7	172	3.46	73.5	61.6
Immersion oil	308.3	0.11	11.4	125	400	20.2	0	36.19
Urine dipstick	570	0.26	16.4	1060.2	569.1	4.4	191.1	38.4
Methanol	4666.7	0.41	51.2	1102	3161.7	8.4	147	74.33
HIV screening test kit	158.3	0.55	31.9	580.8	116.2	2.2	30.8	47.2
HIV confirmatory test kit	16	0.58	44.1	52.3	24.11	4.3	22.3	56.36
HIV tie-breaker test kit	5	0.73	108	12.3	5.8	1.2	2.3	79.8
Blood group anti-A,B,D	16.7	0.17	13.6	44.1	27.9	5.7	3.8	40.55
Widal O and H	133.3	0.61	101.4	186.7	105.8	2.4	20.5	85.81
Weil-felix	400	0.79	129.7	76.4	44.1	1.2	5.8	76.53
RF	0	0.61	100.7	138.2	167.6	4.9	5.8	85.70
H.pylori	266.7	0.61	96.4	151.4	141.1	5.6	4.4	87.76
Pregnancy test kit	150	0.41	16.3	658.8	125	1.4	54.4	25.94
Giemsa stain	1800	0.26	17.6	1455.8	1250	7.1	441.1	35.51
Glucose test strip	1075	0.73	109.6	226.4	97.7	2	3.7	81.90
Consumables								
Sputum cup	2125	0.17	8.5	909.7	1691.1	10.9		23.75
Microscope slide	4891.6	0.02	0.23	2886.7	3938.2	10.87	0	1.37
Gloves latex disposable	6142.8	0.02	0.20	9494.1	7414.7	6.8	0	1.20
Goggles	3	0.35	50.5	2.02	2.14	4.9		74.69
Masks	2683.3	0.32	54.7	323.8	527	9.7		82.72

IP materials								
Biohazard bags	274	0.58	101.4	135.2	654.6	30.9		89.85
Alcohol 70%	16000	0.23	12.5	13000	10897	5.5	88.2	32.06
Sodium hypochlorite		0.05	1.08	97279.4	24644.1	3.1		5.24
Sharps boxes	191.6	0.29	33.7	52.5	58	7.7		63.00
Overall average		**0.399**	**50.82**			**5.51**		**51.61**

Where, N=34, SO=stock-out, MOS=months of stock, IP=infection prevention

Storage practice with in our study facilities has been assessed against standard storage guidelines at the day of visit and results has presented in tabular form below (table 7).

In 3 (8.8%) facilities fire safety equipment was available and ready for use and diagnostic products were separated from chemicals. On the other hand, the storage area was secured with limited access and products were protected from water and humidity in 33 (97.1%) health facilities stores.

In general, percentage of facilities that maintain acceptable storage condition was computed and found to be 26.5%; that means only 9 facilities full filled acceptable storage condition.

Table7. Percentage of facilities that full fills specific storage practice, Jimma zone and town 2016.

S.N	Storage practice	%Complied	%Not complied
1	Products arranged with clear identification	23(67.6%)	11(32.4%)
2	Products are arranged accessible for FEFO	19(55.9%)	15(44.1%)
3	Cartons and products in good condition	30(88.2%)	4(11.8%)
4	Facility separate unusable from usable	22(64.7%)	12(35.3%)
5	Products protected from direct sunlight	31(91.2%)	3(8.8%)
6	Cartons and products protected from water and humidity	33(97.1%)	1(2.9%)
7	Products protected from harmful animals	27(79.4%)	7(20.6%)
8	Storage area secured and access limited	33(97.1%)	1(2.9%)
9	Products stored at appropriate temperature	30(88.2%)	4(11.8%)
10	Roof maintained in good condition	32(94.1%)	2(5.9%)
11	Storeroom maintained in good condition	18(52.9%)	16(47.1%)
12	Current space sufficient	21(61.8%)	13(38.2%)
13	Fire safety equipment available and accessible	3(8.8%)	31(91.2%)
14	Diagnostic products stored separately from chemicals	3(8.8%)	31(91.2%)
	Overall average	**23(68.3%)**	**11(31.7%)**

N=34

B. Qualitative study result

For qualitative study in-depth interview was made with facility`s laboratory department heads and store managers by the principal investigator. Twelve facilities were selected for the qualitative study. The findings of the study has been categorized in to four themes; problems encountered, competency of professionals, comparison of quality and availability at the two sources (PFSA or private suppliers), and possible solutions for improvement of the supply chain management of those commodities so that our interviewees opinions are going to be discussed below.

Problems encountered

Our interviewee raised different types and sources of problems they have encountered while obtaining and managing lab commodities for their facility.

Frequent SO of products while purchasing from PFSA and difficulty of obtaining commodities and spare parts especially for closed system equipment in the market were the main problem raised by all of the participants. Some of them were also complaining that PFSA was not willing to give SO form to facilities for those products which were not available at the time of procurement and this was mentioned as one of the main factors that results in frequent stock out of most laboratory commodities at facility level. The argument was exemplified by one of our key informant

…… `` *when we went to PFSA to procure products it is difficult to get majority of products which are essential to give basic services, for example now a day we can`t get EDTA tube. In addition to this there were also a supply of near expired lab commodities from PFSA, especially for those products supplied by a special agreement between PFSA and Oromia region health bureau..*``

On the other hand few informants were also revealed their failures of doing demand forecast and RRF periodically as one of the contributor for poor supply chain management of those commodities. Lack of adequate storage space for those commodities was also mentioned by some of the key informants as it affects the quality of inventory management. This was exemplified by one of the key informants as;

……. ``*we are not consistently doing demand forecast for our facility*``.

Competency of professionals

In managing allocated budget most facilities had already knowledge gap and long bureaucracy on the aspects of financial management, though some have had budget shortage problem. This may be due to lack of communication among professionals on how to manage their allocated resources wisely. This was exemplified by one of our key informant;

..…"*good communication and commitment should be created among professionals and health professionals should request the necessary products at the appropriate time*``.

This could be one factor that results in failure to properly manage available resources. On the other hand majority of informant raised, the pharmacy professionals, managers, and the management of the facility itself didn't give attention for lab commodity. They only pay attention on the availability of medicines rather than lab commodity. This can be exemplified by the expression of one of our interviewee;

……..``*the pharmacists are not providing lab commodities, even sometimes they replied `we don`t know` so that it is better to be purchased by lab personnel*``. So that this can also be one factor results in frequent SO of those laboratory commodities.

Comparison of quality and availability between the two sources

We have also asked our key informants their opinion about the quality and availability of products with regard to their supplying sources that are PFSA or private suppliers. Some of them have said availability is batter at PFSA but the other said so at private supplier, at the same time regarding quality most said it is better at PFSA but the other said at private supplier, this is exemplified by the response of one interviewee;

``…….*PFSA has supplied good quality products because the agency supplied and managed products according to SOP*``.

On the other hand some other interviewee said both availability and quality are the same at both separate organizations since they have got products from similar manufacturing companies.

Possible solutions

Our informants have also raised different types of solutions that could help to alleviate the burden of facilities on managing lab commodities; during supply of near expiry and SO they raised applying FEFO and borrowing products from nearby facilities as a possible solution. On the other hand in order to fill knowledge gap; provision of capacity building trainings or assigning logistician having good knowledge and experience have believed to provide better solution. Besides, some interviewee said that; intensive supportive supervision should also be undertaken consistently. This was exemplified by one of our key informant;

``……..*knowledge gap of pharmacy professionals about laboratory commodities should be filled with continuous capacity building trainings*``.

Despite the fact that majority responded; strengthening PFSA should be given priority attention to enable the agency capable enough to fully supply vital commodities, based on facility request, others also raised purchasing from private suppliers should be facilitated inorder to maintain their stock within allowable level. Meanwhile others raised their opinion regarding options on sustainable availability of stock provided that in order to maintain stock within acceptable level, lab commodities should have to be purchased by lab professionals. The central theme and essence of these responses can be exemplified by the opinion of one of our key informant;

``…….*in order to get variety of products in bulk, PFSA should have to be strengthened since the price in PFSA is very competitive*``.

Finally our interviewee has also raised their opinions that could bring actual solutions for those problems at facility level. These are; request and demand forecast should be done frequently in appropriate time and good communication and commitment among professionals should also be created and maintained.

6. Discussion

The ultimate objective of studying or managing the overall supply chain system is all about availability of products at service delivery point consistently in required quantity and quality with affordable price. Therefore, the major aim of this study paper is to show the level of availability of products of selected laboratory commodities within our respective study facility.

Primarily we are going to discuss about stock status of laboratory commodities in the study facilities, here we do have the following variables; availability on the day of visit, stock out in the last 6 months, and months of usable stock on hand in the facility.

When we see the availability of laboratory commodities during the day of visit it was found that and explained as; the overall percentage of facility that was stocked out during the day of visit was 39.87%, which means its availability was 60.13%. When we compare this result with other survey conducted on IPLS implementation in Ethiopia (that is, its average availability of products on day of visit was 89%), it has a very wide difference, this may be due to the fact that the survey was conducted only on selected vital medicines across the country (11). Other study conducted on distribution and availability of TB diagnostic items in Amhara regional state reveled its findings as; carbol fuchsin, methylene blue and acid alcohol were out of stock from 11%, 11%, and 8.5% of health centers, respectively, on the day of visit (22), whereas our study found that acid alcohol, carbol fuchsine, and methylene blue were stocked out from 38.2%, 35.3%, and 29.4% of facilities, respectively, during the specified time. These distinct findings may come from that of; the reference study was conducted specifically on laboratory commodity for TB diagnosis.

Other study conducted in Malawi reported its findings in terms of availability of each product in health centers and hospitals separately (18). According to the study, availability of AFB and Malaria reagents was in stock at all health centers on the day of visit. But Methanol was stocked out from 60% of hospitals. In our study, however, Acid alcohol, Carbol fuchsine, and Methylene blue was stocked out from 38.2%, 35.3%, and 29.4% facilities, respectively, on the day of visit. Besides these Giemsa stain was also stocked out from 26.5% of our facility. This shows the supply system in our study area was found ineffective and poor, because even program products like AFB reagents were not supplied in well manner. This may probably due to; lack of reliable

supplier, poor quantification practice, lack of consistent integrated supportive supervision or trainings especially on the management of laboratory commodities. This opinion is also supported by the finding from the qualitative study, because our key-informants were raised frequent SO from PFSA and fail to undertake demand forecast and RRF as main problems in their facility that results for poor availability of products. On the other hand the same study reported 17% of health centers had no disinfectants but a situation was better in hospitals (8% were stocked out) similarly in our study a comparable results have seen; Alcohol and Sodium hypochlorite were out of stock from 20.6% and 5.9% of facilities, respectively. This similar study result may come from their comparable sample size (that is 40 and 34 facilities) or similarity of the study area that were on laboratory commodity.

Moreover, the overall percentage facilities stocked out during the last 6 months were 39.97%, which means its availability was 60.03%. When we compared this result with similar study of the survey of IPLS (its average percent of stock out in last 6 months was 78.1%), it has showed a wider difference (11). The difference could be resulting from that of; the survey was conducted country wide in all regions, however, as we know there are remarkable or visible and tremendous differences in performance, other managerial and geographical aspects among regions, therefore, those differences could potentially compromise similar availability across facilities, there by the findings of the survey about overall availability could show comparable lower value. This quantitative result can also be supported by our findings from qualitative assessment. Some relative finding from qualitative analysis showed; there was a frequent SO of laboratory commodities from their main source (PFSA) and simultaneously the agency has attributed by its lack of willingness to give SO form, based on which, facilities enable to undertake procurement of those non-available products from private suppliers, thereby it was difficult to undertake procurement from these optional competitive sources. Furthermore, interviewee also rose about lack of knowledge on the management and utilization of financial resources and the longer financial bureaucracy that discourage them to take possible options. Therefore, facilities could become stocked out because of these reasons.

Other study conducted on assessment of Laboratory logistics management information system in Addis Ababa reported its findings as; uni-gold test kit, stat-pack test kit, carbol fuchsine and methylene blue were stocked out from 3%, 9%, 11%, and 11% of facilities, respectively, during

the last 6 months (21). But our study result showed SO of the same products from 73.5%, 52.9%, 35.3%, and 29.4% of facilities, respectively, during the same specific period. This huge difference may because of a plan to change testing algorithm for HIV/AIDS by Ministry of health throughout the country so that in most health facilities these testing kits have not been supplying. But concerning TB reagents it may because of the proximity of facilities (in Addis Ababa) to potential supplying sources.

This current study, however, also found that mean number of days the products were out of the stock are almost 51 days. A correlation analysis was computed for mean number of days the product was out of the stock versus number of pharmacy professionals given that very weak correlation was seen between the two variables (correlation coefficient= -0.117). The negative value showed it has inverse relation so that with more number of pharmacy professionals mean number of SO day would not be minimized. This assumption can also be supported by qualitative finding, which is, majority of interviewee replied pharmacy professionals didn`t give attention for laboratory commodities during the time of procurement. Therefore, the actual available number of pharmacy professionals might not influence the number of days in which products were out of the stock.

A minimum and maximum month of stock has already established by PFSA so that both hospitals and health centers should have a minimum of 2 months and a maximum of 4 months of stock on hand (8). In this current study, while computing mean months of stock (MOS) on hand for each facility we found a significant number of outliers in the box plot so that it was difficult to obtain a mean that may approximately represent MOS on hand to each facility. Therefore, in such a case it is preferred to compute MOS on hand in-terms of median for each level of health facility. As a result we found that hospitals have median MOS on hand for 2.5 months, A-level health centers have 1.5 months and B-level health centers have 1.1 months. Furthermore, the overall median MOS on hand was 1.5 months.

When we see the median MOS on hand for each level of facility, it was somewhat lower than expected standard duration of MOS. This may probably be due to the presence of zero MOS on hand or stock out of products on day of visit so that in-order to provide and show the most likely value of MOS for the actual available commodities, we have to compute our data based on what we have or stock availability at the day of visit, that means zero values or zero MOS on hand

should be omitted and the rest values are going to be computed to get the most likely median MOS on hand. At this time we have got 4.2 median MOS on hand for hospitals and 6.0 median MOS on hand for A-level health centers whereas 5.9 median MOS on hand for B-level health centers provided that the overall median MOS on hand about 5.9.

A similar of 582 laboratory commodities was computed to analyze percentage composition of MOS on hand whether it is below, above, or within the allowable set MOS. Therefore, 12.9% of commodities were below 2 MOS, 61.5% were above 4 MOS and 25.6% were within 2 and 4 MOS. Result of survey on IPLS of Ethiopia reveled a comparable result with our study. It stated that across products, most facilities were not stocked according to the recommended 2-4 months of stock. For most of assessed products overstocking was more common than under stocking (11).

These results might because of; facilities were not conducting demand forecast properly periodically thereby at a time of procurement they were going to purchase any quantity of available commodity arbitrarily. This opinion can also be supported by the finding from qualitative study because similar opinion was raised during in-depth interview; while facilities went to PFSA to procure commodities, because of frequent SO from PFSA, they would procure as much as possible any available products.

To compute accuracy and validity of inventory recording data we have reviewed RRF and bin card that were recorded within the period of September to February 2016. From all facilities we found out that only 19(55.9%) filled RRF and only 4(12.96%) had a bin card for the majority of laboratory commodities.

Among these facilities, accuracy of calculated consumption (CC) (beginning balance + quantity received – ending balance ± loss & adjustment) were 10 (52.6%), again accuracy of quantity ordered (maximum stock quantity – ending balance) and maximum stock quantity (CC *2) were also 52.6%. Only 10 facilities were trying to record laboratory commodities on bin cards, among these only 4 practically recorded majorities (but not all) of our commodity of interest against their bin cards. Among those 10 facilities, one facility recorded only one commodity and another one facility recorded two commodities.

The validity of beginning balance (ending balance of previous Vs beginning balance of the next), quantity received (quantity received on RRF Vs on model 19), and CC (calculated consumption Vs sum of quantity issued in quantity issue column) were 8(42.1%), 7(36.8%), and 3(15.8%), respectively.

A study conducted in Addis on the assessment of IPLS for HIV/AIDS and TB laboratory commodity reported that facilities had discrepancy on CC of RRF Vs quantity issued column of bin cards were 68%, ending balance column of RRF Vs ending balance column of bin card at day of report were 60%, and quantity received column of RRF Vs quantity received on STV were 52% (20) so that these findings showed a comparable result with our study finding. On the other hand a survey of IPLS reported that the exact accuracy of RRF data was between 40% and 50% for most of the products (11).

Moreover, the storage practice followed by the facilities was somewhat weaker. The overall average percentage of facilities that could be able to comply the specific storage guideline was 68.3%. A survey conducted on IPLS implementation reported that on average, slightly more than half (55%) of facilities met acceptable storage condition, that is greater than or equal to 80% of storage guideline (11). Based on our study finding percentage of facilities that maintain acceptable storage condition was computed and found to be 26.5%. That means, only 9 (26.5%) facilities full filled acceptable condition (that is >=80% of standard storage guide). This could because of; lack of adequate storage space, most stores in study facilities were managing by nurses, even some facilities didn`t employ pharmacy professionals. On the other hand pharmacy professionals, themselves, were not committed to strictly follow and apply the standard available storage guideline. This opinion can also be supported by the qualitative findings. Because our key-informants have raised lack of attention & commitment, adequate storage space among problems in their facilities that may lead to a poor storage practice.

Regarding selection process, in this current study, we found that only 20.6% of facilities had the national essential drug list (NEDL). Though it was only available in some facilities, all were reported that the list didn`t include all crucial products (especially laboratory commodities) which are assumed to be vital to give the required health care services. On the other hand only ten facilities have developed their own facility list. To select products, may be in resource constraint setting, 5.9% and 32.4% of facilities were using ABC and VEN analysis respectively

but the other significant proportion of facilities,61.8%, responded they didn`t use either ABC or VEN analysis because they had no actual resource problem(financial resource) that could force them to undertake selection of products for their facility. Whereas, as we all know, resources are always scarce and that is why products were being stocked out, therefore, such kind of responses will never be acceptable especially in health care service delivery setting.

The need of developing and applying different methods of selection, however, is indeed used to efficiently and effectively manage all the available scarce resources. Even-though, more than half of facilities responded as they had no resource problem, our finding showed that almost 40% of facilities were stocked out during the day of visit and products were also experienced being stocked out for overall mean of 51days.

Actually in our view, the Ministry of health as well as Food, Medicine, and Health care administration and control Authority also didn`t give attention for laboratory commodities. This is said so, because laboratory commodities were not included in the national essential medicine list (26).

Besides these, when we see the processes of demand forecast almost all facilities (97.1%) have never had reviewed its goals, strategies, and priorities as well as never defined scope and purpose of forecasting prior to undertake the actual demand forecast. Actually 73.53% of facilities didn`t undertake forecasting. And the other 88.2% of facilities didn`t adjust stock out while performing demand forecast.

On the other hand 70.6% of facilities were not reporting their actual consumption of laboratory commodities to higher level. A study conducted in Addis Ababa reported, 24 (92.6%) facilities were completing and sending RRF to supplying PFSA every two months (27). This huge difference may probably due to a wide gap between sampled facilities- the reference study included specialized hospitals, regional hospitals, national referral laboratory- and it also assess only HIV and TB diagnostics commodities.

Therefore we assumed that, because of all the above reasons forecasting process were not following the right procedure so that procurement was undertaking arbitrarily; that is why stock status of facilities couldn`t show stable, consistent and acceptable value.

Finally, facilities were facing different kinds of challenges up on managing its supply chain system. During our in-depth interview key informants have raised their respective challenges they were facing on the process of obtaining and managing laboratory commodities.

The major challenges almost raised by all interviewee was frequent stock out of products from their primary source (that is PFSA), fail to perform forecasting periodically, fail to fill and send RRF periodically, difficulty to get SO form from PFSA (PFSA is attributed by its unwillingness to give SO form), lack of management for available budget, and long bureaucracy in financial process to purchase products from private suppliers. These are the most existing and unsolved challenges that health facilities have been facing inorder-to obtain and manage laboratory commodities.

A study conducted in Addis Ababa reported, on its qualitative part, the following findings as a problem encountered on the implementation of IPLS; frequent stock outs caused by long distribution channel and lack of standard inventory control practice for reagents remain the main cause of poor product availability, failure of some high volume health facilities to make timely report of complete and accurate RRFs, weak stock keeping practice, weak level of motivation and commitment to properly and timely conduct operations (27). Therefore, the findings are showing almost a comparative result.

Eventually most facility key informants have also raised procurement of laboratory commodities by Pharmacy professionals as a major challenge in their facility because they thought Pharmacy professionals have not been giving attention to laboratory commodities at a time of procurement, similarly some informants said that their own facility management didn`t give attention for the supply of laboratory commodities, as a result, SO or delay of initiation of purchase request would be consequently occurred in the facility.

7. Strength and limitation of the study

7.1. Strengths of the study

- The study could provide baseline information to plan intervention inorder to improve laboratory commodity supply chain system across the study area.
- The qualitative findings may help to strengthen the quantitative finding of the study therefore both results can supplement each other.

7.2. Limitation of the study

- The focus of the study was only on the supply chain practice of selected laboratory commodities but it didn`t assess the practice of specialty commodities.
- It was difficult to find adequate number of similar studies to compare results.
- Since the study was conducted in Jimma zone and town with limited sample size it may not be representative of the country.

8. Conclusion

Our study result showed that availability or/and stock status in Jimma zone was very low; this might be because of frequent stock out of products at their main source or failure to re-supply based on quantity request. In addition to this inappropriate selection process and/or quantification of lab commodities may also be a reason. However months of stock on hand showed a better result, though, it may not be an indication of good practice; therefore, it might be due to inappropriate quantification of products or failure of using inventory control tools adequately as required, as a result it may provide an input that fail to obtain an accurate inventory control tools.

Unfortunately our study finding showed that; health centers were stocked out for an average of more than thirty days than hospitals. This could be due to the presence of inadequate number of pharmacy and laboratory professionals at the health centers or, on the other hand, could be from lack of commitment or attention towards lab commodity both by professionals and the management of the study facilities.

Selection and quantification process and performance of study facilities were also poor so that majority of facilities procure arbitrarily; therefore, this may lead to availability of products more than expected maximum stock level or in the other side unavailability of vital products in the facility. On the other hand storage practice followed by majority of facilities was less than the minimum acceptable value.

9. Recommendation

From our study findings most health facilities were not compliance with the necessary and acceptable requirements concerning; human power, inventory control tools, accuracy and validity of RRF, selection and quantification of laboratory commodities. Based on these findings we would like to recommend zonal health department and regional health bureau as follows;

- Inventory recording tools have to be intensively implemented in all health facilities in order to effectively manage laboratory commodities across the supply system.
- All health facilities have to use and fill all columns of RRF consistently inorder to correctly report and resupplied from the main source.
- All health facilities have to use acceptable selection and quantification process to efficiently use available resources as well as to minimize wastage.
- All facilities should at least full-fill the minimum acceptable percentage of the standards of storage practice guideline for laboratory commodities.
- Since most of laboratory professionals (our key informants) raised overlook questions about procurement of laboratory commodities; therefore, we strongly recommend that should be obligatory to include laboratory professionals in selection, quantification, and procurement of laboratory commodities.
- Most facilities were not compliance with adequate number of man power with respect to the allowable human resource structure set by the regional health bureau so that we strongly recommend health facilities need have to employ at least the minimum required number of health professionals in order to provide quality service effectively.

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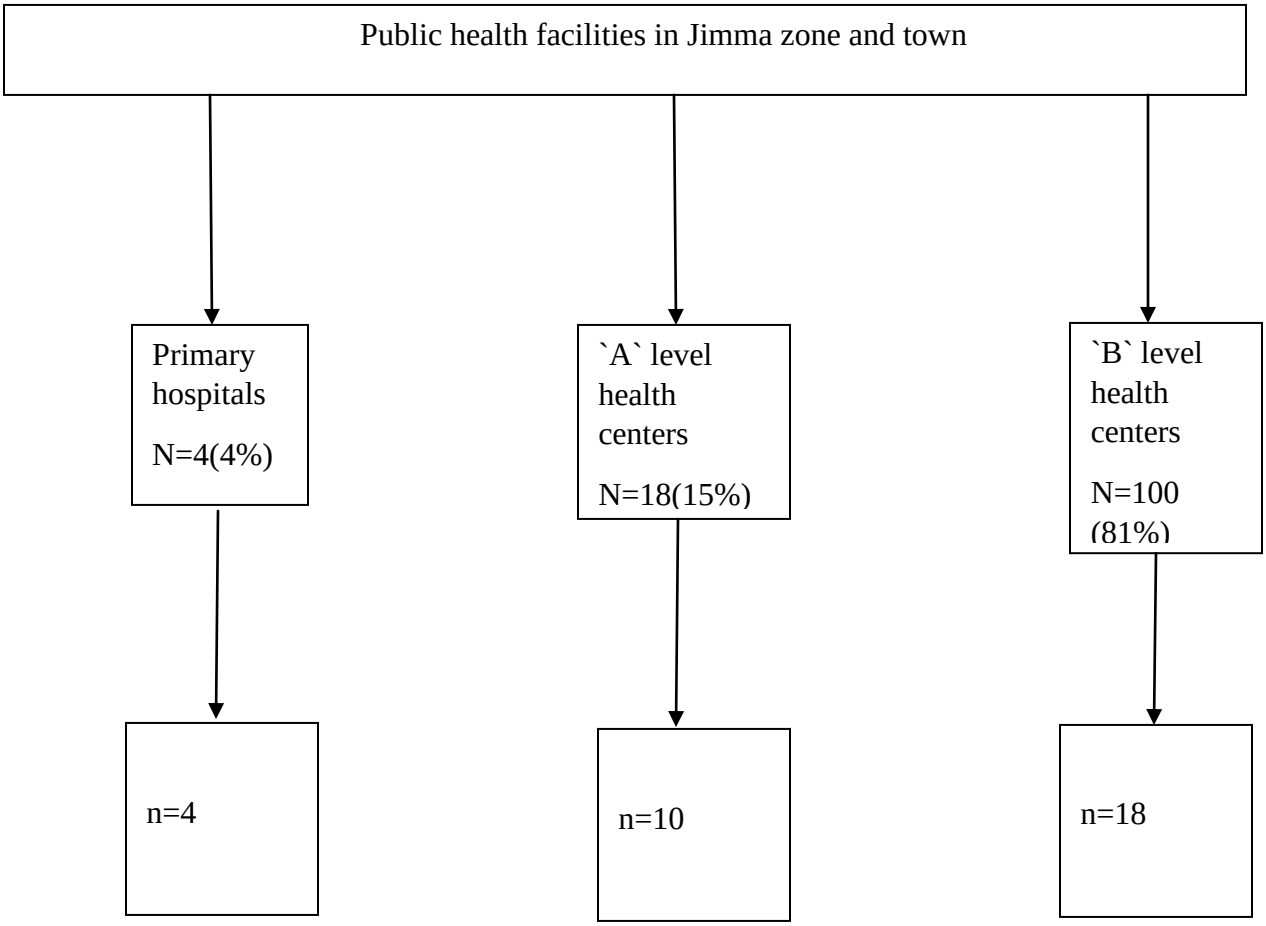
Annex 2. Sampling procedure



In situation when we have smaller number of sample within each stratum it is desirable to use a different sampling fraction for each stratum. In our situation we do have only 4 hospitals as a single stratum; if the same sampling fraction is used as for other strata, the number of hospitals included in the sample would be small so that any estimates based on such a small sample would be too unreliable to report.

Therefore, to avoid such problem WHO recommended that all hospitals in our sampling frame could be included as our sample (28). In the same fashion, it is better to over sample the A level health center so that we have taken half of them as our sample and the remaining number of sample had been for B type health center.

Annex 3. Indicator and its data sources

S.N	Indicators	Data source
A	Personnel	
1.	Percentage of personnel who trained logistics management	Respondent
2.	Percentage of facility with number of pharmacy professionals	Respondents
3.	Percentage of facility with number of laboratory professionals	Respondents
B	Accuracy of Logistics data	
4.	Percentage of facilities with bin cards available and updated by product.	Bin cards
5.	Percentage of facilities with accurate stock balances.	Bin card & physical count
6.	Percentage of facilities that keep accurate logistics data for inventory management.	Recording tools
7.	Percentage of facilities using recording formats for reporting and ordering	Respondents and observations
8.	Inventory accuracy rate	Bin card & physical count
C	Inventory Control	
9.	Percentage of facilities that is under stocked, adequately stocked, and overstocked.	Recording tools
10.	Average duration of time between the date an order was placed and when it was received	Respondents and observation (if possible)
D	Storage	
11.	Percentage of facilities that maintain acceptable storage conditions	Visual observation
E	Stock status/availability	
12.	Percentage of facilities that are within maximum & minimum stock levels	Recording tools
12.	Percentage of facilities experiencing stock out of commodities on the day of visit	Bin card & physical count

13.	Percentage of facilities experiencing stock out of commodities in the previous six months	Recording tools
14.	Average duration of stock outs for commodities in the previous six months	Recording tools
15.	Average months of stock on hand for all products	Recording tools & physical count

Annex 4. Questionnaires

Section I: Facility Services and Infrastructure

General information			
Interviewer/s Name:		DAY MONTH YEAR	
Checked by: supervisors name		Signature	
No	Details	Possible answers	Comments
1	Name of the facility		
2	Region		
3	Zone		
4	Woreda		
5	City/town		
6	Supplying hub		
7	Type of facility	General hospital Health center `A` type Health center `B` type Other(Specify) _____	
Section II: Background of personnel			
8	Name, position and mobile phone number of person interviewed for this survey	Name: Position: Mobile number:	
9	Number of years and months you have worked at this facility?	Years: _____ Months: _____	
10	Are you the primary person responsible for managing drugs and medicine products at this facility?	Yes No	
11	How many staff the facility has under the pharmacy and laboratory unit?	Pharmacists/degree-------- Druggists/diploma-------- Lab technologist-----	

		Lab technician-------	
12	How many of them are trained in laboratory commodity management?		
13	Who is the principal person responsible for managing laboratory commodities that are used for diagnosis and monitoring at this facility? Multiple responses are possible.	Pharmacist Pharmacy Technician Laboratory technologist Lab technician Druggist Other (specify)	
14	Is supplies/stock management the primary role of this person at this facility?	Yes No	
15	Are professionals frequently left the facility in the past 12 months?	Yes No	
	If yes, how many laboratory personnel are left the facility in the past 12 months?	Lab technologist------ Lab technician-------- Others ------	
	How many pharmacy personnel are left the facility in the past 12 months?	Pharmacist --------- Druggist ---------- Others ----------	

Ask the following questions of someone in charge of controlling laboratory commodities. After asking the questions in this section, visit the facility`s storage area where the laboratory commodities that are used for diagnosis and monitoring products listed are managed.

Section III. Inventory control for laboratory commodities at the facility.

A. Inventory management practice

No	Questions	Possible answers	Comments
1.	Do you have the following inventory recording tools that are used to manage laboratory commodities, in the facility?		
	Bin cards Stock cards IFRR RRF Others	Yes No Yes No Yes No Yes No	
2.	Do you use the following inventory recording forms to manage laboratory commodities in the facility? (Must be physically verified)		
	Government receiving note (Model 19) Government requesting note (Model 20) Government approval note (Model 21) Government distributed note (Model 22)	Yes No Yes No Yes No Yes No	

	RRF IFRR Other (specify)	Yes No Yes No	
3.	What inventory control forms do you use for reporting/ordering?		
	RRF IFRR Others(specify)	Yes No Yes No	
4.	Does the facility fills and sends RRF for laboratory commodities to higher level?	Yes No	
5.	If yes, for no. 4, to who:	PFSA RHB Town health office ZHD WoHO Other(specify)__	
6.	If yes, for no. 4, how often are these RRF reports sent to the higher level?	Monthly Bimonthly Quarterly Semi-annually Annually	
7.	Does all the columns in RRF are completed for all laboratory commodities? (Must be verified with last completed report).	Yes No Completed report not available	
8.	Does the facility laboratory use IFRR for regular reporting on laboratory commodities? (Must be verified with completed report)	Yes No	
9.	How many emergency orders have you placed in the last 12 months? (If available, ask for documents to verify using RRF)	None ------- times	
10.	On average, for a normal order approximately how long it takes between order initiation and receiving product from your main source?	Less than 2wks 2 wks to 1 month B/n1&2months Morethan2months	
11.	Have the facility usually get the quantities of all laboratory commodities ordered?	Yes No	
12.	Have you ever resupplied the product with short shelf life?	Yes No	
13.	If 'Yes, how many months were left to complete its shelf life?	1-2 months	

		2-3 months 3-6 months More than 6 months	
14.	Have you received training on Ethiopian laboratory Logistics System before?	Yes No	
15.	When did the facility receive the most recent supervision visit?	Never received Within the last month 1 - 3 months ago 3 - 6 months ago More than 6 months ago Other (specify)	
16.	Did the recent supervision include laboratory commodities management/logistics (e.g., bin cards checked, logistics reports checked, storage conditions checked etc)?	Yes No Don't know	
17.	The recent supervision that included laboratory commodities management was done by:	PFSA RHB Town health office ZHD WoHO Other (specify)	
18.	Does the facility have a functioning refrigerator(s) to store cold chain lab reagents and chemicals?	Yes No	Specify the quantity
19.	Has the refrigerator functional temperature regulation thermometer?	Yes No	
20.	Is the temperature chart updated?	Yes No	
21.	Does the facility have functional refrigerator in pharmacy store?	Yes No	
22.	Does the facility have storage guideline?	Yes No	

B. Accuracy of inventory recordings

S.N	Details	Possible answers	Comments
1	Check the accuracy of parts within RRF, is it accurate?		
	Scrutinize Calculated Consumption presented on the RRF to the verified CC (recalculating the CC as beginning balance + Quantity Received – ending balance +/- Loss/Adj.).	Yes No	
	Verified Maximum stock quantity, as CC x 2	Yes No	

	Verified quantity ordered, as Maximum stock quantity-Ending balance	Yes No	
2	Are the data reported on the RRF valid?		
	Compare the "Beginning balance in the Store" to the "Ending balance in the store" of the previous report.	Yes No	
	Compare the "Quantity Received" on the RRF with the "Quantity Received" on PFSA STV or Facility Model 19 within the reporting period.	Yes No	
	Compare "Ending balance" indicated on the RRF with Quantity at the end of the reporting period as indicated on the Bin Card.	Yes No	
	Compare the "loss and adjustment" indicated on the bin card with RRF loss and adjustment column of the reporting period.	Yes No	
	Compare "Calculated Consumption" versus the sum of quantities issued on the "Quantity Issued" column of the bin card during the recent reporting period.	Yes No	
	Comparing the "DOS" on RRF versus "DOS" indicated on the bin card.	Yes No	

Section IV Product Availability

S.N	Product	Units of count	Managed in the facility? (Y/N)	Bin card available? (Y/N)	Bin card updated? (Y/N)	Balance on bin card	Stock out today? (Y/N)	Stock out last 6 months (Y/N)	Number (frequency) of stock outs	Total no. of days stocked out	Total issued (most recent 6 months)	Physical inventory in store room	No. of Expired product available
	Commodities and tests												
1.	Field stain A												
2.	Field stain B												
3.	Grams iodine												
4.	Crystal violate												
5.	Acetone alcohol												
6.	Safranin												
7.	Carbol fuschin												
8.	Acid alcohol												
9.	Methylene blue												
10.	Sodium chloride reagent												
11.	RPR antigen												
12.	Immersion oil												
13.	Urine dipstick												
14.	Methanol												
15.	Xylene												
16.	HIV screening test kit												
17.	HIV confirmatory test kit												
18.	HIV tie-breaker test kit												
19.	Blood group anti-A,B,D												
20.	Acetic acid,												

	glacial												
21.	Widal O and H												
22.	Weil-felix												
23.	RF												
24.	H.pylori												
25.	Formalin, solution												
26.	Ether												
27.	India ink												
28.	Potassium hydroxide, reagent												
29.	Pregnancy test kit												
30.	Giemsa stain												
31.	Glucose test strip												
32.	Sputum cup												
33.	Microscope slide												
	Infection control												
34.	Gloves latex disposable												
35.	Goggles												
36.	Masks												
37.	Biohazard bags												
38.	Alcohol 70%												
39.	Sodium hypochlorite												
40.	Sharps boxes												

Section V. Usable stock data quality

Usable stock on hand at the time of visit of the facility

S.N	Reagents and chemicals	Physical inventory	Inventory from bin card	Percentage difference (C-B/C)100	Reason of difference
	A	B	C	D	E
1.	Field stain A				
2.	Field stain B				
3.	Grams iodine				
4.	Crystal violate				
5.	Acetone alcohol				
6.	Safranin				
7.	Carbol fuchsin				
8.	Acid alcohol				
9.	Methylene blue				
10.	Sodium chloride reagent				
11.	RPR antigen				
12.	Immersion oil				
13.	Urine dipstick				
14.	Methanol				
15.	Xylene				
16.	HIV screening test kit				
17.	HIV confirmatory test kit				
18.	HIV tie-breaker test kit				
19.	Blood group anti-A,B,D				
20.	Acetic acid, glacial				
21.	Widal O and H				
22.	Weil-felix				
23.	RF				
24.	H.pylori				
25.	Formalin, solution				
26.	Ether				
27.	India ink				
28.	Potassium hydroxide, reagent				
29.	Pregnancy test kit				
30.	Giemsa stain				
31.	Glucose test strip				
32.	Sputum cup				
33.	Microscope slide				
	Infection control				
34.	Gloves latex disposable				
35.	Goggles				
36.	Masks				

37.	Biohazard bags				
38.	Alcohol 70%				
39.	Sodium hypochlorite				
40.	Sharps boxes				

Section VI Storage condition assessment

S.N	Activities	Comply(Y)	Not comply(N)	Comments
1	Do lab products stored are arranged, so that identification labels and expiry dates and/or manufacturing dates are clearly visible?			
2	Do lab products are stored and organized in a manner that is accessible for FEFO counting and general management?			
3	Are cartons and products in good condition, not crushed due to miss handling? or cracked due to heat/radiation or wet?			
4	Does the facility practice to separate damaged and expired products from usable products and removes them from inventory?			
5	Are products protected from direct sunlight?			
6	Do cartons and products protected from water and humidity?			
7	Does storage area visually free from harmful insects and rodents (Check the storage area for traces of bats and/or rodents)?			
8	Does storage area secured with a lock and key, access is limited to authorized personnel?			
9	Are products stored at the appropriate temperature according to product temperature specifications?			
10	Is roof maintained in good condition to avoid sunlight and water penetration?			
11	Is storeroom maintained in good condition (clean, all trash removed, sturdy shelves, organized boxes)?			
12	Is the current space and organization sufficient for accommodating existing products?			
13	Is fire safety equipment available and accessible?			
14	Are diagnostic products stored separately from chemicals?			

Section VII Questions regarding process and steps of quantification

S.N	Steps of quantification	Possible answer	Comments
A	Preparation		
1.	Describe the forecasting process a. Who initiates it? b. When does it take place?		
2.	Do goals, strategies, and priorities of quantification reviewed prior to every forecast process?	Yes No	
3.	Have your facility define the scope and purpose of quantification during forecasting process?	Yes No	
4.	Which forecasting data your facility used?		
	Consumption data? Morbidity data? Service data? Others (specify)	Yes No Yes No Yes No	
B	Forecasting		
5.	Have you frequently report consumption/service data of the facility to higher level?	Yes No	
6.	If yes, how frequently?	Every month Every other month Quarterly Every 6 month Annually	
7.	Do forecasts take into account programmatic plans (e.g., expansion of service outlets, training, other organization's activities, etc.)? Describe	Yes No	
8.	Do you adjust consumption for stock out while conducting forecasting?	Yes No	

9.	Have you use conversion factor while forecast consumption?	Yes No	
10.	Which guide you use as a conversion factor during forecast consumption?	STGs Testing algorithm Lab procedure Others (specify)	
	Supply planning		
11.	Does maximum and minimum stock levels established within the facility?	Yes No	
12.	How close have most forecasts been to actual consumption?	□ less than 0–10% □between 10– 25% □ between 25–50% □ more than 50% discrepancy	
13.	Have you made reconciliation of costs of forecast demand against available fund?	Yes No	
14.	If yes, does the need closely match with fund?	Yes No	
15.	If no, does discrepancy between needs and available fund vast? (percentage discrepancy)	Less than 10% B/n 10&20% B/n 20&30% More than 30%	
16.	What other partners procure laboratory commodities for your facility (describe if available)?		

Section VIII Questions regarding selection

S.N	Selection question	Possible answers	comments
1.	Is there a national essential drug list in the facility?	□Yes ‰ □ No	
2.	Are all the commodities used in this health facility on the essential drug list?	□Yes ‰ □ No	
3.	Is the national drug list used for product selection and ordering commodities?	□Yes ‰ □ No	
4.	Does the facility have developed its own drug list?	□Yes ‰ □ No	
5.	If yes for Q 4, what criteria are used to select a product for the list?	-STGs -Testing algorithm -Lab procedure -NDL -Others (specify)	
6.	What criteria are used to select commodities?	-STGs -Testing algorithm -Lab procedure -Others (specify)	
7.	During resource constraint which method you use to select products?	ABC analysis VEN analysis Others (specify)	

Section IX Financing

S.N	Financial questions	Possible answers	Comments
1.	Does your facility establish a Laboratory Commodity Committee?	□Yes □ No	
2.	What are the sources of existing funding for laboratory commodities?		
	a. Government? b. User's fees/cost recovery? c. Donors (list by donor)? Donor 1:_____ Donor 2:_____ Donor 3:_____ d.Other? (specify):_____	□Yes □ No □Yes □ No □Yes □ No	
3.	Does the facility have separate/specific budget for laboratory commodities?	□Yes □ No	
4.	What is the Pharmaceuticals/laboratory commodity's annual budget from all sources?		
5.	Are funds sufficient to cover the needed commodities?	□Yes ‰□ No	
6.	Does the facility have functional power to decide on its operational budget?	□Yes ‰□ No	

Annex 5. Questionnaire for qualitative study

Name of the interviewer_____

1. What are the challenges you face in the supply chain management of laboratory commodities?

Probe: on selection, forecasting, procurement, storage, order, resupply, budget, etc.

2. How the handling practice of these products does looks like in your facility?

Probe: on storage conditions that need improvement, if any (e.g., cleanliness, organization, temperature, building structure, etc.).

3. Have you encountered any notable problems in the past year associated to this products?
   - If any, please note product, location, approximate amount of goods, and actions taken.

Probe: on expired products, resupply of near expiry products, stock outs, delay of order (lead time)

4. How do you evaluate/see products your facility obtaining from supply source?
   - From where did you get these commodities?

Probe: on products from PFSA - their availability and quality; products from private wholesalers – their availability and quality

5. How do you rate the availability of these products in your facility?
   - What are the major factors affecting availability of these products?

6. Capacity building activities on laboratory commodities

A. Training/important areas to bring changes

I. Was there any training for professionals involved in the management of these products? If any, please specify.

II. On what aspects of these products do you want to get (or as additional) training?

B. Supportive supervision

- What do you think is the impact of supportive supervision and close government follow up on improving the supply chain management as well as the availability of the commodities?

7. Do you think availability of staff with good logistics management knowledge and experience will improve the availability of the commodities?

8. What do you think as the possible solutions to improve the availability of the commodities?

Probe: on efforts to be made by health facilities, the role of government, the role of health professionals, etc.