
# INVENTORY MANAGEMENT PERFORMANCE OF ANTI-TUBERCULOSIS COMMODITIES IN PUBLIC HEALTH FACILITIES IN DIRE DAWA CITY ADMINISTRATION, ETHIOPIA

**BY:**

**FASIKA BERHANU**

**A THESIS SUBMITTED TO THE SCHOOL OF PHARMACY, FACULTY OF HEALTH SCIENCES, INSTITUTE OF HEALTH, JIMMA UNIVERSITY IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR DEGREE OF MASTER OF SCIENCE IN PHARMACEUTICAL SUPPLY CHAIN MANAGEMENT**

**NOVEMBER, 2018**

**JIMMA, ETHIOPIA**

**JIMMA UNIVERSITY**

**INSTITUTE OF HEALTH SCIENCE**

**SCHOOL OF PHARMACY**

# INVENTORY MANAGEMENT PERFORMANCE OF ANTI TUBERCULOSIS COMMODITIES IN PUBLIC HEALTH FACILITIES IN DIRE DAWA CITY ADMINISTRATION, EAST ETHIOPIA

**BY:**

**FASIKA BERHANU**

**ADVISOR**

**GIZACHEW TILAHUN (MSC, ASSISTANT PROFESSOR)**

**NOVEMBER, 2018**

**JIMMA, ETHIOPIA**

## DECLARATION

I Undersigned declare that this student research paper is my original work and has not been presented for a degree in any other University, and all the materials used for this study have been duly acknowledged.

_____ _____

Name of students Signature

This student research paper has been submitted for examination with my approval as University advisor.

Name of Advisor Signature

_____ _____

Name of internal examiner Signature

_____ _____

Name of external examiner Signature

_____ _____

# ABSTRACT

## Background

Inventory management is the process to order, receive, store, issue and then reorder commodities. Poor inventory management in health facilities leads to wastage, shortage of medicines or overage resulting in expiration and decline in the quality of patient care. In addition, it results in wrong decisions, inaccurate stock records and lack of systematic performance monitoring. Different researches done in Ethiopia shows that, there was an intermittent supply and shortage of anti-tuberculosis commodities plus poor utilization of recording and reporting logistic formats. Unavailability of anti-tuberculosis commodities can lead to interruption of service and patients' treatment.

**Objective**: The objective of this study was to assess anti tuberculosis commodities inventory management performance in public health facilities of Dire Dawa city administration.

**Methods**: Facility based cross sectional study design using both quantitative and qualitative method was used. All (n=16) public health facilities found in Dire Dawa were assessed from March 22 to April 22, 2018.The quantitative data were checked for completeness and then entered into SPSS version 20 for analysis. Chi-square was used to test the presence of association and p-value < 0.05 was taken as statistically significant association.

**Results**: From the assessed 111 bincards for first line drugs sixty percent of bin cards were updated and 77.2% were accurate. Only 4(25%) of the health facilities tuberculosis clinic and 3(18.8%) of laboratory unit use bin card for stock control for drugs and supplies respectively. Average accuracy rate for report and requisition form was 57.1%. None of the health facilities had complete report and requisition form.All health facilities face stock out for at least one anti tuberculosis commodity with different duration of time.Medicines which cost 84,275.04 Ethiopian birr were lost due to expiry.Concerning storage condition only 8(50%) of health facilities have full filled good storage condition criteria.Work load, human resource inadequacy and poor adherance of dispensing unit to there schedule were identified as major inventory management challenges.

**Conclusion**: The inventory management performance of the study facilities was found to be weak which was confirmed by poor bin-card updating practice, poor stock record accuracy and poor storage condition below the standard.There were also high stock out rates and medicines wastage with loss of money.



**Key words:** Anti TB commodities, inventory management, Availability, Stock out

## ACKNOWLEDGMENT

First of all, I would like to thank Almighty God for everything I have and everything that happened in my life, and then I wish to express my deepest gratitude to my advisor Mr. Gizachew Tilahun for his unreserved guidance, support and encouragement throughout this thesis development. I am deeply indebted to Jimma University, institute of health sciences & Dire Dawa city administration health bureau for their permission & support to undertake this study.

My sincere gratitude goes to all data collectors and study participants whose contribution was vital for the data collection activity.

Finally, I would like to thank my family for their unreserved support throughout the study period. Last but not least, my special thanks go to my beloved husband Fikadu Bekele for his concern and unreserved support.

**Table of content**

## LIST OF TABLES

**LIST OF FIGURES**

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ART | Anti-Retroviral Therapy |
| BB | Beginning Balance |
| BC | Bin Card |
| DOTS | Directly Observed Treatment, Short-course |
| DUs | Dispensing Units |
| DST | Drug Sensitivity Test |
| FDC | Fixed Dose Combination |
| FM | Florescence Microscope |
| FMOH | Federal Ministry of Health |
| FMHACA | Food, Medicine & Health care Administration Control Authority |
| GDF | Global Drug Fund |
| GLC | Green Light Committee |
| HCMIS | Health Commodity Management Information System |
| HIV | Human Immune Deficiency Virus |
| HFs | Health Facilities |
| IFRR | Internal Facility Report and Requisition Form |
| IPLS | Integrated Pharmaceutical Logistic System |
| IPT | Isoniazid Preventive Therapy |
| INH | Isoniazid |
| LIAT | Logistic Indicator Assessment Tool |
| LMIS | Logistic Management Information System |
| MDR | Multi Drug Resistance |
| NTP | National Tuberculosis Program |
| NTLP | National Tuberculosis and Leprosy Program |
| NGO | Non-Governmental Organization |
| PAS | P-Amino salicylate |
| PFSA | Pharmaceutical Fund and Supply Agency |
| QR | Quantity Received |
| RH | Rifampicin, Isoniazid |
| RHE | Rifampicin, Isoniazid, Ethambutol |
| RHZ | Rifampicin, Isoniazid, Pyrazinamide |
| RHZE | Rifampicin, Isoniazid, Pyrazinamide, Ethambutol |
| RRF | Report and Requisition Form |

| | |
|---|---|
| RR | Resistance to Rifampicin |
| SCM | Supply Chain Management |
| SOH | Stock On hand |
| STG | Standard Treatment Guideline |
| SPSS | Statistical Package for Social Sciences |
| TB | Tuberculosis |
| WHO | World Health Organization |
| Xpert MTB/RIF | Expert Mycobacterium Tuberculosis/Rifampicin test |
| ZN | Ziehl-Neelsen |

# 1. INTRODUCTION

## 1.1 Back ground

Logistic management is the process of selection, quantification, procurement, inventory management, storage, distribution and use together with effective logistic management information system(1,2).

All TB pharmaceuticals selection, quantification and procurement are done at the central PFSA level in collaboration with the national tuberculosis program/federal ministry of health (NTP/FMOH).Health facilities are responsible for inventory management, storage and distribution of commodities from store to different dispensing units, including the TB clinics and laboratory units(3).

Inventory management is the process to order, receive, store, issue and then reorder commodities. The aim of inventory management is to secure sustainable supply of commodities. There are basic issues that must be considered in an inventory management system. These are determination of the types of stock records and inventory reports needed, determining how much to reorder and when to reorder (inventory control system) and determining when to assess stock status(4).

In Ethiopian context, bin card, internal facility report and requisition form (IFRR) and report and requisition form (RRF) are the major stock record and inventory reports used for the inventory management. Facility TB clinics and laboratory unit are required to submit internal facility report and re-supply (IFRR) form and collect the anti-TB drugs and laboratory commodities from the facility store according to their schedule. The health facility stores are required to fill the report and requisition form (RRF) every two months and submit it to their respective PFSA branches. Based on their report and request; PFSA branches will refill facilities with the required pharmaceuticals. TB pharmaceuticals are stored only at central PFSA warehouses, PFSA branch warehouses and health facilities store. Health facility stores are responsible for to develop distribution schedule for the different dispensing units, including the TB clinics and laboratory units (5).

Poor inventory management in health facilities leads to waste of financial resources, shortage of some medicines or overage of others resulting in expiration and decline in the quality of patient care. In addition, it results in wrong decisions about order frequency and quantity, inaccurate stock records and lack of systematic performance monitoring (4).

To ensure uninterrupted supply of anti TB commodities, good inventory management of anti TB commodities is mandatory. Any imperfection interrupts service provision and the patients' appropriate use of TB drugs (1).Along all these processes there are problems associated with the inventory management of anti-TB commodities such as non-availability, absence and not updated bin card for the commodities, inaccurate balance on bin cards, unsatisfactory inventory management practice and poor storage practice. In addition to this, facilities don't get the quantity ordered from PFSA (5).

This study was intended to focus in this region; because studies that have assessed the inventory management performance of anti-TB commodities in Dire Dawa city administration are limited. Therefore, the study need to assess anti-TB commodities inventory management performance and the challenges associated with it; using facility based cross sectional study in public health facilities of Dire Dawa city administration.

### 1.2. Statement of the problem

The mortality rate from TB is high if it is not treated. In the absence of treatment with anti-TB drugs about 70% of individuals with sputum smear-positive pulmonary TB and 20% of people with culture-positive (but smear-negative) pulmonary TB died within 10 years of being diagnosed(6).Even if annual TB incidence and mortality rate in Ethiopia is reducing, Ethiopia remains to be among the 30 countries reported with high burden of TB and DR-TB for 2015 to 2020.The national TB problem is worsened by the slowly but steadily rising rates of drug resistance TB (7).Common causes of MDR TB are man-made errors following an inadequate or poorly administered treatment regimen. The main causes of inadequate treatment are unavailability of certain drugs due to stock-outs, delivery disruptions, poor storage conditions, poor quality medicines and poor regulation of medicines. Poor adherence/default is the other patient related cause for inadequate treatment. In general poor inventory management practice has a great contribution for the spread of MDR TB (8).

Poor pharmaceutical inventory management is a problem associated with poor data management and improper storage. It can result in poor medicine quality, theft, expiration of medicines, losses and shortage, and such medicine shortages contribute to the spread of TB epidemic (1). In TB control, stock-outs of drugs and diagnostic laboratory commodities are unacceptable. All TB drugs and TB diagnostic laboratory commodities are essential for treatment, diagnosis and follow-up tests of TB patients respectively; therefore, they must be available at all times (9).

Even though, treatment with a six-month course of first-line TB medicines cures almost 90% of TB cases, lack of access to appropriate medicines persists; especially MDR and pediatrics TB commodity access issues are more prominent in developing countries. From 59,549 diagnosed patients for MDR TB only 55,597 were enrolled on second-line treatment. Whereas for pediatrics TB, from 327,000 pediatrics TB cases reported, only half of cases were treated in some key high-burden countries (10).

To overcome problems associated with inventory management system of the country, PFSA was established in 2007. So as to implement its mandate in the area of pharmaceuticals supply in an efficient and effective manner, integrated pharmaceuticals logistics system (IPLS) has been developed and implemented since 2010 (3).

Despite these and other ongoing efforts taken to improve the inventory management, evidences show that frequent stock depletions, shortages and unsatisfactory inventory management of such commodities at public health facilities. Different researches done in Ethiopia shows that there was an intermittent supply and shortage of anti-TB commodities plus poor utilization of recording and reporting logistic formats (11–13).Tuberculosis(TB) is expanding program which needs strong and supportive laboratory services. The capacity of laboratory depends on the availability of the required commodities to perform these tests, which require multiple commodities like supplies, reagents and equipment to be available simultaneously.However, supply chain of laboratory commodities is a great challenge, especially in developing countries including Ethiopia (9,14).

There are different factors that affect the inventory management performance at health facilities. A research done in 2014 in Ethiopia shows that data management, government support and skilled pharmacy professionals affect the supply chain management (SCM) performance (4).Another study conducted in 2016 in Ethiopia show that scarcity and lack of expertise in supply chain management, poor commitment and lack of motivation, gap in leadership, knowledge and skill, high attrition rate ,poor integration of different stake holders are human resource related factors for the inventory management performance, whereas infrastructure related factors include poor ware house design, lack of cold room, poor transport facilities(15).Assessment of IPLS in Ethiopia in 2015 also shows supportive supervision, trained personnel, coordination with stake holders, delivery(distribution) system and availability of pharmacy professionals are some of the factors contributing to inventory management performance(5).

Studies that have assessed the inventory management performance of anti TB commodities in the city administration are limited. This study is therefore, need to assess anti tuberculosis commodities inventory management performance and challenges associated with it in public health facilities in Dire Dawa city administration.

**Research questions**

- What is the performance of the logistics management information system (LMIS)?
- How is the storage condition of anti TB commodities?
- How much is the value of wasted products?
- What is the level of availability of anti TB commodities?
- What are the challenges associated with anti TB commodities inventory management practice in the health facilities?

### 1.3. Significance of the study

The main aim of this study is to assess the inventory management performance of anti TB commodities in public health facilities of Dire Dawa city administration, East Ethiopia. Therefore, a need arises to conduct this research in order to determine the extent of the problem of inventory management of anti TB commodities in public health facilities. Findings from this study will help program managers, supply chain officers, donors, stake holders and policy makers to know the problem and develop strategic plan to solve the problems and bridge the gaps that will minimize these problems so as to ensure sustainable and uninterrupted supply of anti TB commodities in public health facilities. In addition to this it will be useful to health facility managers, to strengthen their management support and follow up by planning different activities. Moreover, this study can be used as a background literature for further studies in the area.

# 2. LITRATURE REVIEW

## 2.1Logistic management information system (LMIS)

The function of a logistics management information system (LMIS) is to collect, organize, and report information to other levels in the system in order to make decisions that govern the logistics system and ensure that all six rights are fulfilled for each client. There are different forms used in the LMIS. This includes Bin card, RRF, IFRR, receiving and issuing voucher and the like. For efficient inventory management practice recording tools should be available and should be used. In addition to this, accurate reports of logistics information should be submitted to relevant management units on a specific schedule (3).

Even if this is the case, assessment done on IPLS for the management of HIV/AIDS and tuberculosis laboratory diagnostic commodities in public health facilities in Addis Ababa, Ethiopia shows; bin card uses for TB reagents (1%carbol fuchsine and acid alcohol) was reported among 13(39.4%) health facilities, 24(92.6%) and 21 (87.5%) of facilities had completed data items on RRF and IFRR respectively. Discrepancy between bin card and RRF data was seen in 15(60%) of the health facilities. Discrepancy between RRF and proofs of delivery (Model 19) was seen among 13(52%) facilities(16).

Assessment done on LMIS for HIV/AIDS and TB laboratory commodities in Addis Ababa, Ethiopia shows, four (50%) of the assessed hospitals and 13(54%) of health centres were using stock/bin cards for all TB laboratory commodities in main pharmacy store. Majority of bin cards were not updated with accurate information matching with the physical count done at the time of visit. The total accuracy of stock/bin cards were 38.9 %(13).

### 2.2 Availability and storage condition

Inventory management practices have to be smart enough for constant assessment of imbalances. Stock status assessment done on health commodities used in the management of HIV/AIDS and tuberculosis in Kano state, Nigeria shows that out of 299 health facilities ,59 health facilities reported stock out of Adult category I(2RHZE+4RH) commodities,22 health facilities were at emergency point of stock on hand(SOH) of Adult category I commodities,38 health facilities reported stock out of adult category II(3RHZE and 2Streptomycin+4RHE) commodities and 8 health facilities had adult category II commodities above the maximum stock level. These results are a reflection of poor inventory or commodities management practices (17).

Another assessment done in Tanzania on TB commodities shows that 60% of the store were stock out of streptomycin on the day of visit and in the last six month for 65 days .In addition 9% and 21% of HF was stocked of RHZE on the day of visit and in the last 6 month respectively (18).

Shortage and intermittent supply of anti TB drugs is not tolerable in TB program control, however a qualitative study done in Uganda on barriers to delivery of routine tuberculosis diagnostic evaluation services from health worker perspectives shows that there was shortages in drugs and supplies for TB diagnosis (19).

Finding from an assessment done on LMIS practice for HIV/AIDS and TB laboratory commodities in Addis Ababa in 2013 showed that, twenty six (60.5%) of facilities reported that they usually run out of at least one TB laboratory commodities before resupply during the last 6 months. Sixteen facilities (37.2%) had stock outs at the time of visit for at least one laboratory commodity (13).

A qualitative assessment done in 2015 on challenges of tuberculosis control in west Gojjam zone shows that; there was an intermittent supply of anti-TB drugs; specifically, paediatric fixed drug dose combinations. Delay by PFSA to deliver supplies to health facilities and late report by health facilities was stated as a reason for that. In addition to this intermittent supply of laboratory reagents used for performing Ziehl-Neelsen staining for acid-fast bacilli (AFB) were reported by majority of the respondents (12).

Another assessment done in 2014 in Amhara region, Ethiopia shows that: -thirty-three (40.2%) health centres were under stocked for at least one of the key items. Eleven (13.4%) health centres were under stocked for all TB diagnostic reagents. Fifteen (18.3%) health centres had a complete stock out of at least one of the key items (methylene blue 9 (11.0%), carbol fuchsine 9 (11.0%), acid alcohol 7 (8.5%) and sputum cups 3 (3. 7%).Three health centres had a complete stock out of all TB diagnostic reagents. In this study, 77(93.9%) health centres did not fulfil the criteria for effective distribution of TB laboratory reagents and consumables. Seventy-six (92.7%) health centres sent reports or orders for TB laboratory reagents and consumables to the higher level every 2 months that meets the standard. Of these, thirty six (47.4%) health centres obtained the requested quantity (11).

Assessment of IPLS for the management of HIV/AIDS and tuberculosis laboratory diagnostic commodities in public health facilities of Addis Ababa, Ethiopia shows that-a total of 24

(92.6%) facilities reported stock out for one or more of these reagents during the last six months. Twenty two (84.6%) facilities reported that HIV/AIDS and TB laboratory commodities were not refilled as per their request (16).

Pilot assessment of supply chain for pharmaceuticals and medical commodities for malaria, TB and HIV infection in Ethiopia was done in October 2008.The result show that among the surveyed 48 hospitals and health centres 19% didn't have TB drug even if these facilities provide service to manage such patients (20).

According to qualitative assessment done on challenges of tuberculosis management and prevention in west Gojjam zone, northern Ethiopia shows, there was shortage of first-line anti- tuberculosis medications (12).According to study done in west Amhara region, Ethiopia, shows there was shortage of acid fast bacilli(AFB) reagents in 83 (41.3%) laboratories (12).

Storing is keeping of pharmaceuticals safely to avoid damage, expiry, and theft. Proper storage procedures help to ensure that storage facilities protect the shelf life of products, that only high quality products are issued, and that there is little or no waste due to damaged or expired products. Storage conditions will affect the quality of the pharmaceuticals being stored (3).But there are different challenges associated with storage practice. A research done in sub Saharan Africa shows that, inadequate warehouse infrastructure (storage capacity)and inadequate warehouse management( lack of expertise of human resources and insufficient operational processes) are some of the challenges in good storage practice(21).

## Conceptual framework of the study

This conceptual framework is developed by reviewing different literature which is related to inventory management. The box at the centre shows the dependent variables (inventory management) and the rest others are independent variables affecting the dependent variable.

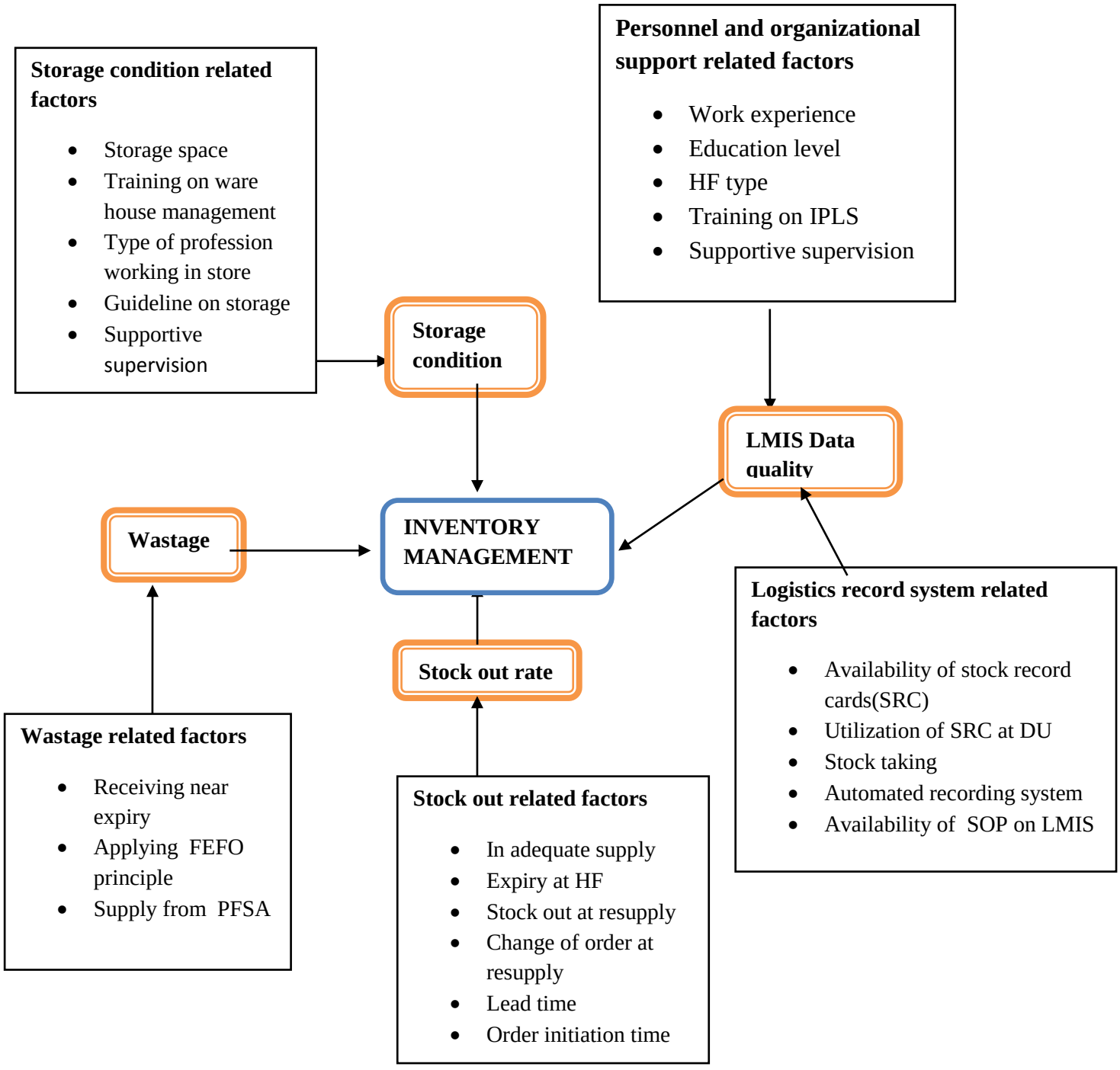


**Figure1:**Conceptual framework of the study developed by reviewing different literatures, 2018

# 3. OBJECTIVE

## 3.1. General Objective

To assess the inventory management practice of anti TB commodities in public health facilities found in Dire Dawa city administration from March 22-April 22, 2018.

## 3.2. Specific Objectives

- To assess the logistics management information system (LMIS) practice
- To assess the storage condition of anti TB commodities
- To assess the value of wasted products due to expiry/damage
- To assess the availability of anti TB commodities
- To explore challenges associated with anti TB commodities inventory management practice in the health facilities

# 4. METHODS AND MATERIALS

## 4.1. Study area and period

Dire Dawa city administration is located in the Eastern part of Ethiopia. It is 515 km far from Addis Ababa and covers an area of 1,547 $km^2$ with a total population of 427,000.It is administratively sub-divided into 9 kebeles. Currently there are 15 health centers, 1 general hospital and 1 primary hospital which are owned by government and 4 private hospitals. In addition, there are 6 primary clinics,24 medium clinics,1 higher clinic,9 medium dental clinics,1 specialized pediatrics clinic,1 public diagnostic laboratory and 1 international basic diagnostic laboratory. This study was conducted from March 22 to April 22, 2018 in 16 public health facilities found in Dire Dawa (22).

## 4.2. Study Design

Facility based cross sectional study design was conducted by using quantitative and qualitative method. For the quantitative part indicators were used to measure the inventory management performance.

## 4.3 population

### 4.3.1 Source population

- All public health facilities found in Dire Dawa city administration
- All anti TB commodities
- All LMIS records that were used to manage the inventory management of anti TB commodities were sources of information.
- All health care professionals

### 4.3.2 Study population

- All public health facilities in Dire Dawa city administration that provides TB diagnosis and treatment service.
- All anti TB commodities
- Selected logistic data records
- Key informants from health facilities; supply chain officers (pharmacy coordinators), store manager, laboratory unit coordinators were included.

## 4.4 Inclusion and exclusion criteria

### 4.4.1 Inclusion criteria

- All public health facilities that were providing TB diagnosis and treatment.

- Health professionals with work experience of greater than six month.

#### 4.4.2 Exclusion criteria

- Health posts

## 4.5. Sample Size determination and Sampling technique

- For the health facilities: -because the total health facilities in the region were too small, the study censuses all facilities thus no need of sample size determination and use of sampling technique.
- For documents
    - ✓ Logistics indicators assessment tool (LIAT), a quantitative data collection instrument developed by DELIVER recommend to use the most recent RRF report to check LMIS data quality (23).Thus the most recent RRF report was used from the day of data collection thus a total of 16 RRF(one from each HF)
    - ✓ A total of 125 bin cards from all HF were assessed (those commodities which had bin card i.e 111 bincards from medicines and 14 from supplies)
    - ✓ The most recent IFRR reports were used from September 2017 to February 2018(six months back from day of data collection).
- For products
    - ✓ 7 first line drugs which were used to prevent and cure TB(census)
    - ✓ 8 second line drugs which were used to cure MDR-TB(census)
    - ✓ 14 laboratory reagents and consumables which were delivered by regional laboratory and PFSA for TB program which were used to diagnose TB
- For personnel: -key informants were selected from facilities purposively which includes pharmacy coordinator, laboratory unit coordinator and pharmacy store manager.

## 4.6. Study variables

#### *4.6.1 Dependent variables*

- LMIS performance
- Storage condition
- Wastage
- Availability

#### *4.6.2 Independent variables*

**Pesrsonal and organizational support related factors**

- Work experience
- Education level
- Health facility type
- Training on IPLS
- Supportive supervision

**Logistic record system related**

- Availability of bin card
- Utilization of stock record card
- Automated recording system
- Availability of standard operating procedure on LMIS
- Stock taking practice

**Wastage related factors**

- Receiving near expiry
- Not to apply FEFO
- Over supply from PFSA
- Change of order at resupply point
- Regimen change by program

**Stock out related factors**

- In adequate supply from supplier
- Expiry at health facility
- Stock out at resupply point
- Change of order at resupply point
- Lead time
- Regimen change by program
- Order initiation time

**Storage condition related factors**

- Storage space
- Type of profession working in store
- Guideline on storage

- Training on ware house management
- Supportive supervision

### 4.7. Data Collection Procedures

The logistics indicators assessment tool (LIAT), a quantitative data collection instrument developed by DELIVER, was used to collect data on the inventory management of anti TB commodities (23).These tool was used to collect data on availability, LMIS and inventory control system of anti TB commodities. Store keepers and pharmacy unit head in each HFs was selected to participate in the quantitative survey made using structured questionnaire. In addition, review of relevant documents with a maximum of six-month duration, structured observation using check lists and physical counts of the products were done. The data was collected by trained pharmacy professionals with close supervision by the principal investigator.

To assess the challenges associated with inventory management, in depth face to face interview with key informants (pharmacy heads, store managers, laboratory coordinators) was done using semi-structured questionnaire by principal investigator. All of the interviews were conducted in the respondents' office/work place lasted for about 20-30 minutes.

### 4.8. Data Processing and Analysis

The quantitative data was entered and analysed using Excel sheet and statistical package for social sciences (SPSS) version 20 computer software. Descriptive statistics such as frequencies, mean and percentage were used to represent data. Inferential statistics such as chi-square tests was used to determine the association between the variables. *p-value* ($P<0.05$) was considered as there is association between variables. The qualitative data was analysed thematically and was narrated; in addition, some of the responses were quoted. Finally, the qualitative findings were triangulated with quantitative results.

### 4.9. Data quality assurance

To assess clarity and consistency of the data collection tool, pre-test was carried out prior to data collection. In addition, training was given to data collectors by principal investigator (PI). Data completeness and consistency was checked by the principal investigator. The PI discussed with the data collectors on regular basis and reviews the collected data for completeness. The collected data was summarized on the same day of the data collection.

### 4.10. Ethical considerations

Ethical approval was obtained from the institutional review board of Jimma University, institute of health. In addition, permission to conduct the research was obtained from the city administration health bureau and the health facilities. Participants of the study were asked for verbal consent before participating in the study and enough information was given about the purpose of the study.

### 4.11. Plan for dissemination of the result

The result will be presented to Jimma University, institute of health science and the document will be disseminated to Dire Dawa city administration health bureau, PFSA central and Dire Dawa hub, Federal ministry of health (FMOH), Food, medicine and health care administration control authority (FMHACA) and different organizations working in the area of TB prevention and control. The result will be disseminated through presenting the finding at different meetings, workshops and publishing in scientific journals.

### 4.12 Operational definition and definition of terms

- **Operational definition**

**Overstock**: -a supply imbalance that occurs when stocks exceed the established maximum stock level which may result in losses due to expiry.

**Under stock**: -a supply imbalance that occurs when stocks is under the established minimum stock level may result in stock out.

**Reporting period**: - the reporting interval of the facilities to the respective hub is every two months and also the reporting interval of DUs to their respective store is two/four weeks.

**Accurate bin card**: -Bin card with no discrepancy between the bin card and the physical count is considered accurate

**Up-to-date bin card**: - Bin card which is updated within the previous 30 days. In addition, if the bin card was last updated with the balance of 0 and the facility has not received any of those products since the date of that entry, it is also considered updated.

**Accurate RRF:-**If balance of stock on hand reported in the RRF with the balance on the bin card on the date that the RRF report was completed is equal.

**Acceptable accuracy for RRF:-**If a health facility report is accurate for at least 80% of the products reported.

**Complete IFRR**: -A report which contains the four essential data elements (beginning balance, stock on hand, quantity received, and loss and adjustment)

**Acceptable storage practice**: -The facility should full fill at least 80 % of good storage criterion.

- **Definition of terms**

**Maximum Stock level: -**is the largest amount of each pharmaceutical a facility should hold at any one time i.e 4 month of stock according to IPLS.

**Minimum stock level**: -is the minimum amount of each pharmaceutical a facility should hold at any one time i.e 2 months of stock according to IPLS.

**Average duration of stock outs: -** is defined as how long on average, in number of days, stock outs lasted.

**Lead time: -**The time interval between when new stock is ordered and when it is received and available for use.

# 5. RESULT

## 5.1 Professional and health related characteristics of health facilities of Dire Dawa city administration, April 2018

A total of 16 health facilities were visited during this assessment; of which 2 were hospitals and 14 were health centres. Basic TB treatment service was given in all health facilities; whereas, MDR-TB treatment service was given only in one general hospital. From the 16 health facilities 11(68.75%) of them were using florescence microscope (FM) whereas the rest five (31.25%) were using Ziehl-Neelsen (ZN) microscope and three health facilities were using gene x pert machine for diagnosis in addition to the microscope.

There were 72 pharmacy professionals under pharmacy units; of which 3(4.2%) were master's degree (MSC) holders in clinical pharmacy, 27 (37.5%) were pharmacy degree holders and 42 (58.3 %) were pharmacy diploma holders. Of 16 store managers working in the store 14(87.5%) of them were pharmacy technician and 2(12.5%) of them were pharmacists. Majority of the staffs; 69(95.8%) had taken integrated pharmaceuticals logistics system (IPLS) training and none of them had taken training related to ware house management, laboratory commodity management (LCM) and health commodity management information system (HCMIS) software.

All store managers, 16(100%) were responsible in managing TB drugs and laboratory supplies which were used for TB treatment and AFB staining procedure respectively. None of the store managers were responsible for managing laboratory reagents which were used for AFB staining procedure except for those which don't need reconstitution (Table 1).

All health facilities determine resupply quantities for anti TB drugs where as regional laboratory and PFSA determines resupply quantities for laboratory reagents and supplies for health facilities respectively. Past consumption was a factor that affects the quantity ordered by all health facilities for first line anti TB drugs where as past consumption and service report was a factor that affects the quantity ordered for second line anti TB drugs.

PFSA was responsible for transporting anti TB drugs and supplies to all health facilities using its own vehicle whereas; laboratory unit was responsible for collecting laboratory reagents for AFB staining procedure from regional laboratory using the facilities vehicles.

**Table1:** Socio-demographic characteristics of health professionals of Dire Dawa city administration, April 2018

| s.n | | Variables | | Frequency (%) |
|---|---|---|---|---|
| 1 | Health facilities using | FM microscope | | 11(68.75%) |
| | | ZN microscope | | 5(31.25%) |
| | | Gene xpert machine | | 3(18.75%) |
| 2 | Health facilities giving | Basic anti-TB service | | 16(100%) |
| | | MDR -TB service | | 1(6.25%) |
| 3 | Professions under pharmacy unit | MSC (clinical pharmacy) | | 3(4.2%) |
| | | Pharmacist | | 27(37.5%) |
| | | pharmacy technician | | 42(58.3%) |
| 4 | Professional qualification under pharmacy store | Pharmacist | | 2(12.5%) |
| | | Pharmacy technician | | 14(87.5%) |
| 5 | Store managers responsible in managing | Anti- TB drugs | | 16(100%) |
| | | Laboratory supplies | | 16(100%) |
| | | Laboratory reagents(which need reconstitution) | | 0(0%) |
| 6 | Service year(store manager and pharmacy head) | 6month-1 year | | 1(3.1%) |
| | | 1 year-3 year | | 10(31.25%) |
| | | >3years | | 21(65.6%) |
| 7 | Delivery modality from PFSA | Direct | | 16(100%) |
| | | Indirect | | 0(0%) |
| 8 | Training taken by store manager | IPLS | Trained | 14 (87.5%) |
| | | | Not trained | 2(12.5%) |
| | | Laboratory commodity management | Trained | 0(0%) |
| | | | Not trained | 16(100%) |
| | | Ware house management | Trained | 0(0%) |
| | | | Not trained | 16(100%) |
| | | HCMIS | Trained | 0(0%) |
| | | | Not trained | 16(100%) |

## 5.2 LMIS performance of anti-TB commodities

### 5.2.1 Utilization of logistic management information system (LMIS) tools

All health facilities were using RRF, IFRR and bin card. Whereas, only 4(25%) of the health facilities' TB clinic and 3(18.8%) of laboratory unit use bin card for stock control. Thirteen (81.25%) of health facilities had automated recoding systems which is called health commodity management information system (HCMIS).

**Table 2**: utilization of logistic management information system tools in public health facilities of Dore Dawa April, 2018

| S.no | Tools | Utilization at HF | | Utilization at DUs | |
|---|---|---|---|---|---|
| | | Utilize (%) | Notutilize (%) | TB clinic | Laboratory unit |
| 1 | Bin card | 16(100%) | 0(0%) | 4(25%) | 3(18.8%) |
| 2 | IFRR | 16(100%) | 0(0%) | 16(100%) | 16(100%) |
| 3 | RRF | 16(100%) | 0(0%) | 16(100%) | 16(100%) |
| 4 | HCMIS(Automated RRF record) | 13(81.3%) | 3(18.7%) | 16(100%) | 16(100%) |

### 5.2.2 Stock record availability, updating practices and accuracy

All first line anti TB drugs had bin card in all health facilities store except for Ethambutol 400mg which had bin card only in 9(56.75%) of facilities. Of 105 available bin cards for first line anti-TB drugs 42(40%) were not updated. The average bin card accuracy rate was found to be 77.2% with the range of 62.5% for RHZE to 93.75% for Ethambutol 100mg (Table 3).

**Table 3:** Percentage of health facilities with bin card available, updated and accurate for first line anti-TB commodities in Dire Dawa city administration, Dire Dawa, April 2018 (N=16)

| | | Bin card availability | | Bin card updated | | Bin card accuracy | |
|---|---|---|---|---|---|---|---|
| s.n | List of products | Available n(%) | Not available n(%) | Updated n (%) | Not updated n (%) | Accurate n (%) | Not accurate n (%) |
| 1 | E -400mg | 9(56.3%) | 7(43.7%) | 3(33.4%) | 6(66.6%) | 7(77.8%) | 2(22.2%) |
| 2 | E- 100mg | 16(100%) | 0(0%) | 9(56.3%) | 7(43.7%) | 15(93.7%) | 1(6.3%) |
| 3 | INH-100mg | 16(100%) | 0(0%) | 10(62.5%) | 6(37.5%) | 13(81.3%) | 3(18.7%) |
| 4 | INH-300mg | 16(100%) | 0(0%) | 11(68.7% | 5(31.3%) | 12(75%) | 4(25%) |
| 5 | RH 75/50mg | 16(100%) | 0(0%) | 12(75%) | 4(25%) | 11(68.7%) | 5(31.3%) |
| 6 | RHZ75/50/150mg | 16(100%) | 0(0%) | 9(56.3%) | 7(43.7%) | 13(81.3%) | 3(18.7%) |
| 7 | RHZE/RH kit | 16(100%) | 0(0%) | 9(56.3%) | 7(43.7%) | 10(62.5%) | 6(37.5%) |
| | | | **Average** | **60%** | **40%** | **77.2** | **22.8** |

MDR TB treatment service was given only in one hospital in the city administration. Thus from the assessed second line medicines six (75%) of the drugs had bin card in the store; of this five (62.5%) of bin cards were updated. In contrast to this none of the bin cards were accurate when compared with physical inventory.

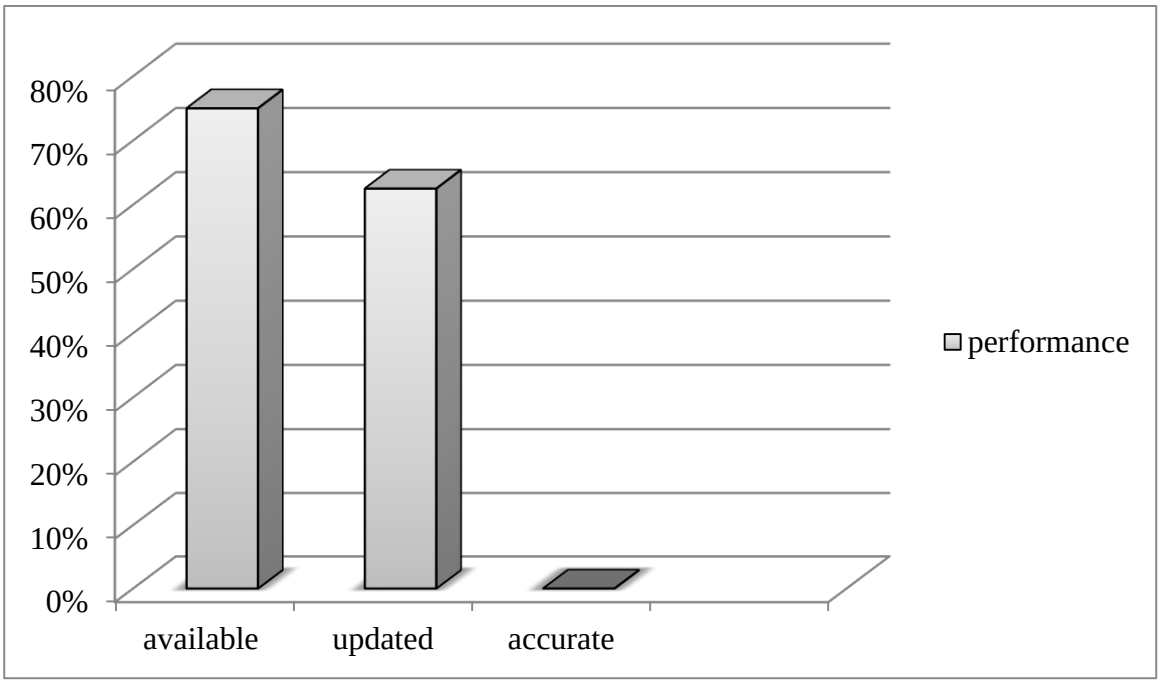


**Figure 2**: Percentage of drugs with bin card available, updated and accurate for second line drugs at MDR TB treatment service in Dire Dawa city administration April 2018

Only 6 (37.5%), 7(43.75%) and 1(6.25%) of the health facilities had bin card for frosted end microscope slide, wooden applicator sticks without cotton and sputum cup respectively. The rest six supplies had no bin card in all health facilities store (Table 4). None of the laboratory reagents had bin card in the main pharmacy store. Thus it is less important to show accuracy rate and updating practice for only these supplies.

**Table 4:** Percentage of health facilities with bin card available for TB laboratory commodities in Dire Dawa city administration, April 2018

| s.n | List of commodities | #HF | BC available | BC not available |
|---|---|---|---|---|
| 1 | Frosted end microscope slide | 16 | 6(37.5%) | 10(62.5%) |
| 2 | Wooden applicator stick w/out cotton | 16 | 7(43.75% | 9(56.25%) |
| 3 | Sputum cup | 16 | 1(6.25%) | 15(93.75%) |
| 4 | Filter paper | 16 | 0(0%) | 16(100%) |
| 5 | Lens cleaning solution | 5 | 0(0%) | 5(100%) |
| 6 | Immersion oil | 5 | 0(0%) | 5(100%) |
| 7 | Lens paper | 5 | 0(0%) | 5(100%) |
| 8 | Xpert MTB/RIF cartridges | 3 | 0(0%) | 3(100%) |
| 9 | Falcon tube | 3 | 0(0%) | 3(100%) |

### 5.2.3 Report and requisition form (RRF) data accuracy

None of the health facilities were 100% accurate for all type of products. Only 4(25%) of the health facilities had acceptable accuracy rate for products reported for the last reporting period. Fifteen (93.8%) of health facilities were not accurate for at least three drugs. When disaggregated, the accuracy ranges from 12(75%) for RHZE/RH kit to 3(33.3%) for Ethambutol 400mg.Eight of the facilities were not accurate for INH 100 mg and 300 mg (Table 5).

**Table 5:** Percentage of health facilities with accurate RRF for the last report in Dire Dawa city administration, April 2018

| s.n | Product type | # HF | Accurate RRF report n (%) | Not accurate RRF report n (%) |
|---|---|---|---|---|
| 1 | Ethambutol (E) 400mg | 9 | 3(33.3%) | 6(66.7%) |
| 2 | Ethambutol (E)- 100mg | 16 | 9(56.25%) | 7(43.75%) |
| 3 | INH - 100mg | 16 | 8(50.0%) | 8(50%) |
| 4 | INH-300mg | 16 | 8(50.0%) | 8(50%) |
| 5 | RH -75/50mg | 16 | 9(56.25%) | 7(43.75%) |
| 6 | RHZ - (75mg/50mg/150mg) | 16 | 11(68.75%) | 5(31.25% |
| 7 | RHZE/RH kit | 16 | 12(75.0%) | 4(25%) |
| | | | **57.1%** | **42.9%** |

For MDR TB drugs which were managed only in one hospital, only four (50%) drugs were accurately filled on the reporting form, the rest 4 were not accurately filled.

**Table 6:** List of second line drugs with last accurate and inaccurate report of Dire Dawa city administration April 2018 (N=1)

| s.n | Drugs with accurate report | Drugs with inaccurate report |
|---|---|---|
| 1 | Cycloserine 250 mg | Capreomycine 1 gm |
| 2 | Pyrazinamide 400mg | Prothionamide 250 mg |
| 3 | PAS 4 mg | Levofloxacilline 250 mg |
| 4 | Moxifloxacilline 400 mg | Kanamycine 1 gm |

Of the assessed 16 health facilities half of the health facilities had SOP for LMIS.RRF accuracy had significant association with presence of logistic management information system (LMIS) SOP and frequency of stock taking practice which was revealed by fishers exact test and likelihood ratio respectively ($p<0.05$). (Table 7)

**Table 7:** Association of RRF accuracy with contributing factors in health facilities of Dire Dawa city administration, Dire Dawa, April, 2018

| Variable | | RRF accuracy | p-value |
|---|---|---|---|
| LMIS SOP | fisher's exact test | Exact Sig. (2-sided) | 0.019 |
| | | Exact Sig.(1-sided) | 0.019 |
| Frequency of stock taking practice | likelihood ratio | Asymp. Sig. (2-sided) | 0.046 |

### 5.2.4 Completeness of report and requisition form (RRF)

None of the health facilities had complete RRF report in which all columns were filled. Of the reviewed RRF (n=16), none of the health facilities had filled stock on hand at dispensing unit (DU) for all products. Whereas 3 of the reports had no loss /adjustment and days out of stock filled for all products. None of TB laboratory diagnostic supplies used for AFB staining procedure were reported to PFSA in the reviewed report.

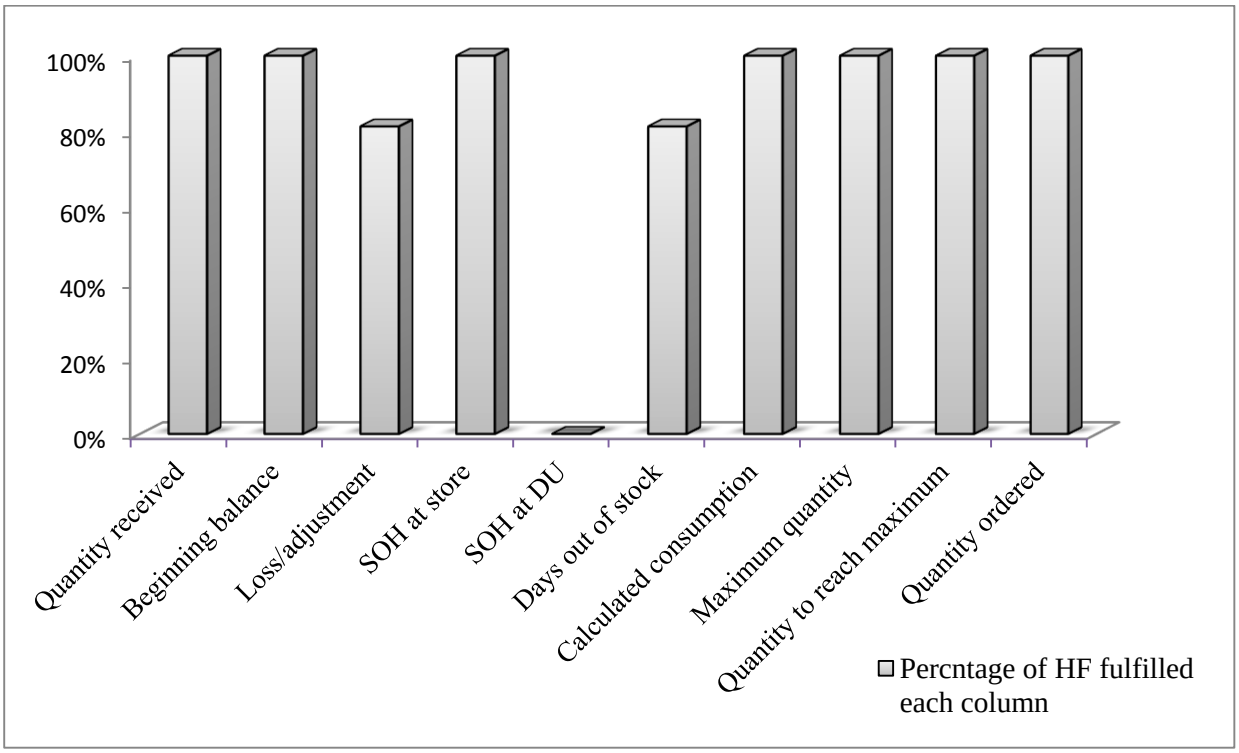


**Figure 3:** Completeness of RRF report with respect to each column in health facilities of Dire Dawa city administration, April 2018 (N=16)

### 5.2.5 Internal facility requisition and report (IFRR) reporting rate and completeness

All health facilities DUs (TB and laboratory) report their IFRR every 2 weeks except one health facility's TB clinic which submit every month. Based on this the reporting rate was 69.4% and 66.7% for TB unit and laboratory unit respectively. The finding of this research shows that from actually submitted IFRR reports 85.3% of TB clinic and 86% of laboratory unit IFRR were complete which contains beginning balance, stock on hand, quantity received, and loss and adjustment. The rest miss either of the four essential data.

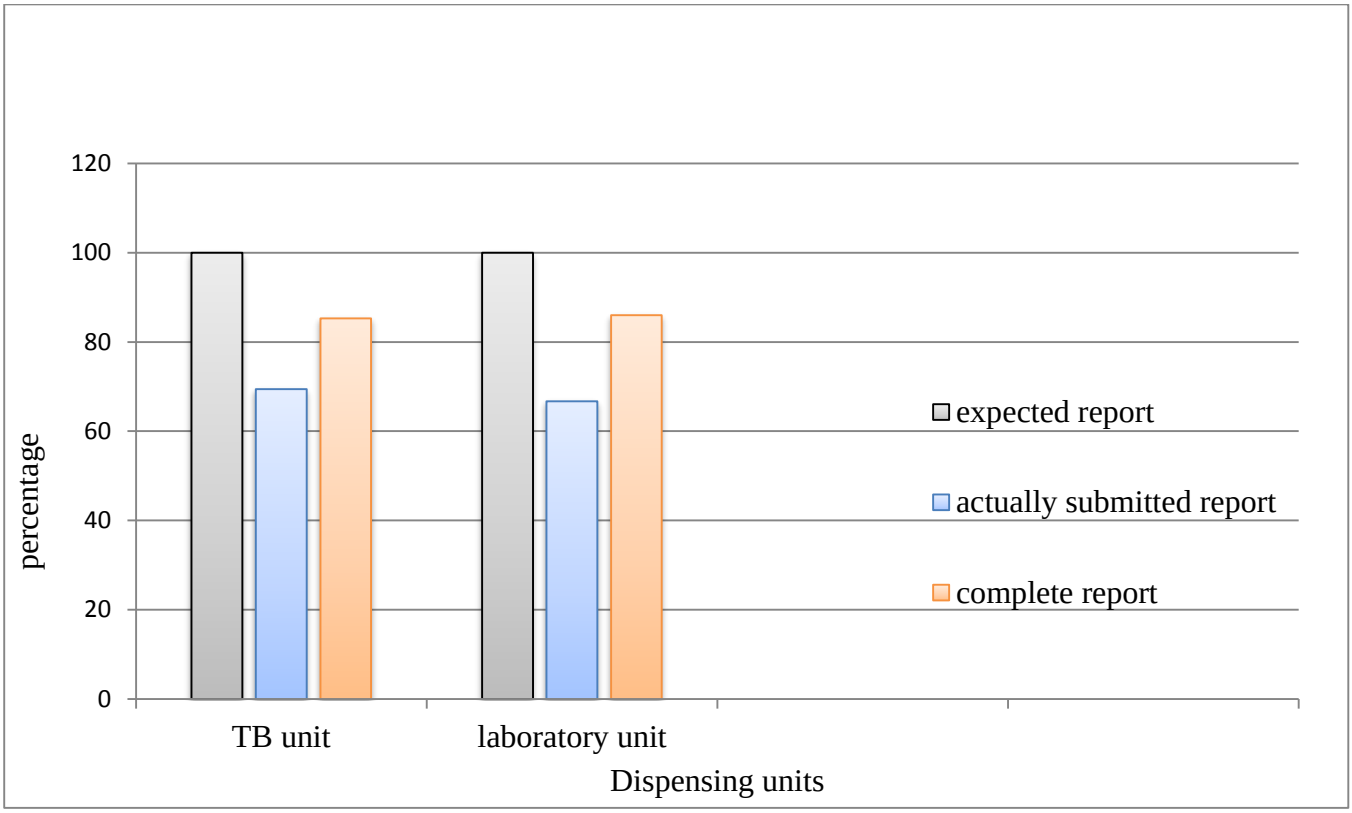


**Figure 4** Reporting rate and completeness of IFRR in health facilities of Dire Dawa city administration, April 2018

### 5.2.6 Emergency order

Half of the health facilities placed at least one emergency order in the last 6 months prior to data collection; for commodities paediatrics FDC RHZ, RH, Ethambutol 100mg, cartridge and falcon tube.

## 5.3 Inventory control system and stock status of anti-TB commodities

### 5.3.1 Supervision, inventory taking practice and lead time

Eleven (81.3%) health facilities had received supervision within the last month just prior to the day of data collection time. Five (31.25%) of them received in the past 1 to 3 months ago. When we come to inventory taking practice, five (31.25%) of the study facilities had stock taking quarterly, four (25%) of them bimonthly, four (25%) of them annually and two (12.5%) of them at any time during issuing.

In addition to this, the perceived lead time by the store managers were assessed. Based on that, ten of the health facilities perceive that, the lead time for the last order was 3 weeks to 1 month from the order date while four of health facilities perceive 1 to 2 months to receive their order.

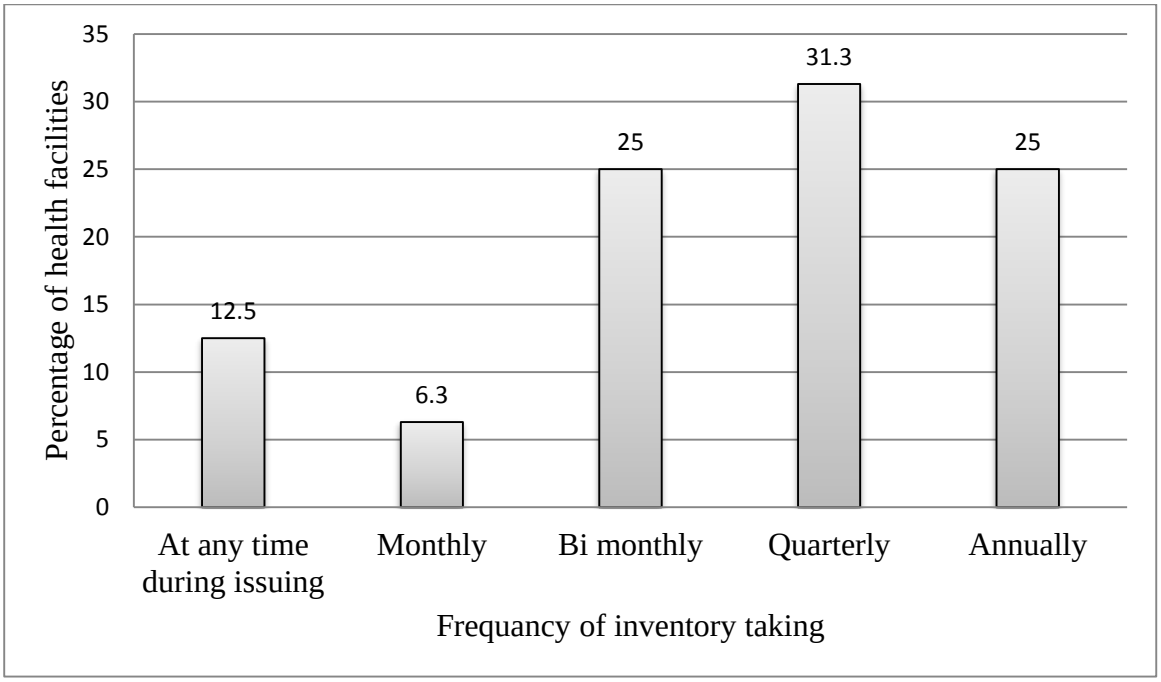


**Figure 5:** Inventory taking practice of health facilities in Dire Dawa city administration, April 2018

### 5.3.2 Order fill rate by product (line fill rate)

Ten (62.5 %) of health facilities had a line fill rate for more than 80% of products they ordered. When disaggregated by product, fifteen (93.8%) of the health facilities received quantity of products ordered for INH 100 and 300 mg in the last report. One health facility received lesser quantity of products ordered for Ethambutol 100 mg, INH 100 mg and INH 300mg (Table 8).Of the requested second line anti TB drugs, all drugs were supplied by

PFSA as per the requested quantity for the last report. Even if laboratory supplies are expected to be reported with drugs every two month, none of the health facilities report to PFSA for the last reporting period.

**Table 8:** Order fill rate for the last report for health facilities of Dire Dawa city administration, April 2018 (N=16)

| s.n | Anti TB commodities | % HF that received quantity of products ordered n (%) | % HF that received lesser quantity of products ordered n (%) | % HF that received more quantity of products ordered n(%) |
|---|---|---|---|---|
| 1 | E- 400mg | 13(81.3%) | 3(18.7%) | 0(0%) |
| 2 | E- 100mg | 13(81.3%) | 1(6.2%) | 2(12.5%) |
| 3 | INH - 100mg | 15(93.8%) | 1(6.2%) | 0(0%) |
| 4 | INH-300mg | 15(93.8%) | 1(6.2%) | 0(0%) |
| 5 | RH - 75mg +50mg | 11(68.7%) | 2(12.5%) | 3(18.8%) |
| 6 | RHZ 75+50+150mg | 10(62.5%) | 1(6.3%) | 5(31.2%) |
| 7 | RHZE/RH kit | 12(75%) | 0(0%) | 4(25%) |

### 5.3.3 Stock status by commodity type

Only four (25%) of facilities had stock within the established minimum-maximum stock levels for Ethambutol 100mg and INH 300mg.Three (16.8%) of facilities had below the minimum stock level for INH 100mg, RH 75/50 mg and RHZE/RH kit. Eleven (68.75%) of facilities had above the maximum stock level for Ethambutol 100mg and INH 100mg (Table 8). For second line drugs and laboratory reagents it is impossible to measure using this indicator; because, for second line drugs inventory control is not merely based on consumption. It is based on both consumption and number of patients available in the quarter and number of new patients to be enrolled (morbidity data). Whereas laboratory reagents have no placed maximum /minimum stock level at which orders need to be placed. All health facilities use stock remaining in the laboratory to calculate how much to order and placed there order any time when needed using formal letter.

**Table 9:** Stock status of first line anti TB drugs in health facilities of Dire Dawa city administration, April 2018 (N=16)

| s.n | Commodities | Facilities with less than the minimum stock level n (%) | Facilities with higher than the maximum stock level n (%) | Facilities within the minimum-maximum stock level n (%) |
|---|---|---|---|---|
| 1 | E- 400mg | 9(56.3%) | 3(18.75%) | 4(25%) |
| 2 | E- 100mg | 1(6.25%) | 11(68.75%) | 4(25%) |
| 3 | INH- 100mg | 3(18.75%) | 11(68.75%) | 2(12.5%) |
| 4 | INH-300mg | 2(12.5%) | 10(62.5%) | 4(25%) |
| 5 | RH-75mg + 50mg | 3(18.75%) | 10(62.5%) | 3(18.75%) |
| 6 | RHZ -75mg + 50mg + 150mg | 6(37.5%) | 7(43.75%) | 3(18.75%) |
| 7 | RHZE/RH kit | 3(18.75%) | 10(62.5%) | 3(18.75%) |

## 5.4 Storage conditions of health facilities

The storage condition of the health facilities was assessed based on visual inspection using indicators as per good pharmacy practice standards for storage condition indicated in logistic indicators assessment tool (LIAT). Based on this, the finding of this research showed that only 8 (50%) of the study facility have fulfilled good storage condition criterion (≥80% positive response to the indicators). When disaggregated by facility level the primary hospital fulfil 75%, the general hospital 58.3% and the rest health centres fulfilment range from 58.3% to 100 %. In addition to this 50% of health facility had storage guideline in the store. All of the surveyed facilities 16(100%) had storage area which was visually free from harmful insects and rodents, were not exposed to direct sun light and cartons and products were protected from water and humidity. However only 9 (56.25%) of the facilities had relatively sufficient space for medicines storage and free space for future expansion (Annex 3).

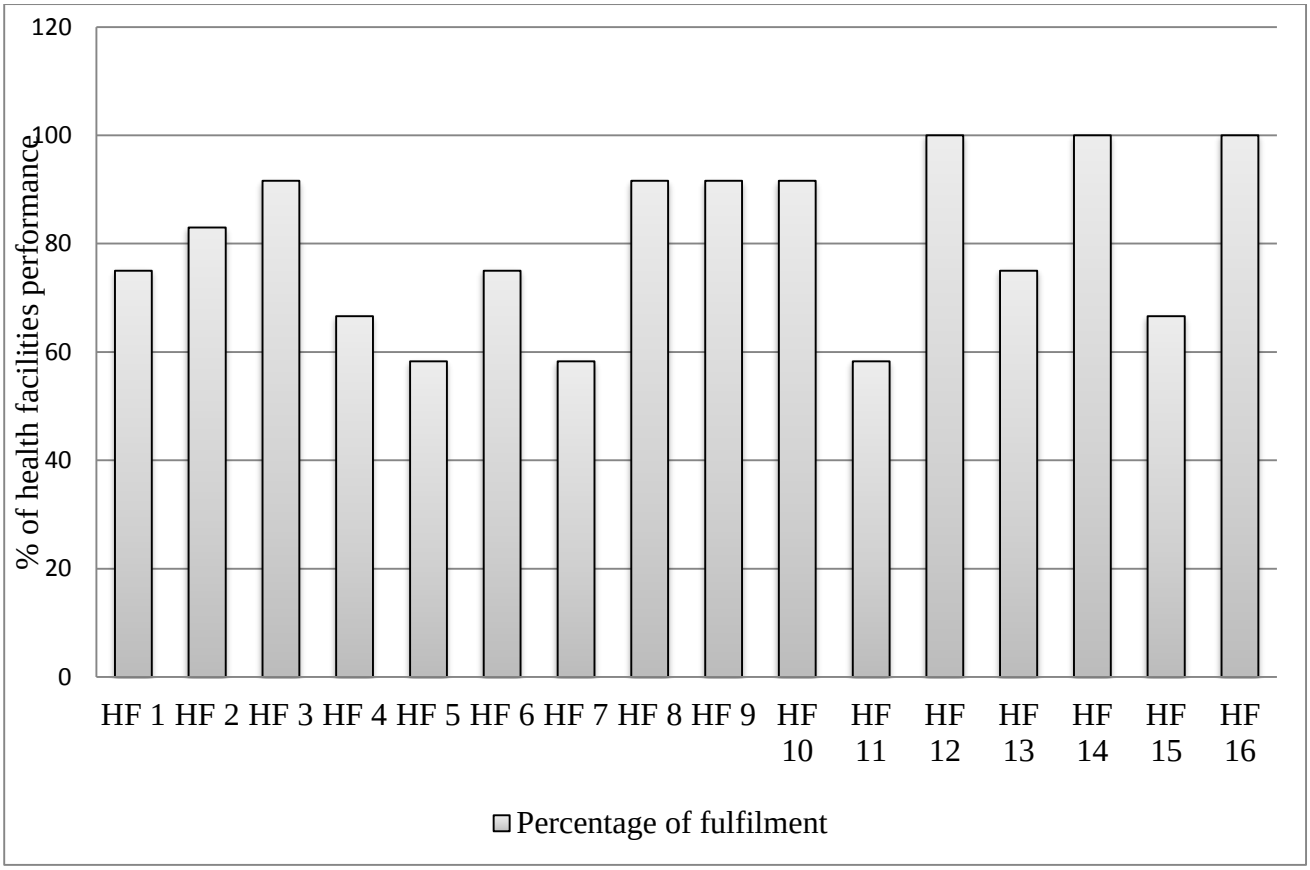


**Figure 6:** The performance of HF with regard to good storage practices (≥80% to positive response criterion) in Dire Dawa city administration, April 2018 (N=16)

The fisher's exact test revealed that the storage conditions of medicines had significant association with the presence of storage guide line in the store (P<0.05).

**Table 10:** Association of HFs adherence to good storage practice standards and contributing factors in HFs of Dire Dawa, city administration April, 2018

| Variable | Storage condition | |
|---|---|---|
| | fisher's exact test | |
| | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
| storage guide line | 0.041 | 0.020 |

## 5.5 Value of unusable anti TB commodities as a result of damage or expiration

The amount of medicines wasted within the last nine months (July 2017-March/2018) i.e. starting from the new budget year up to data collection time were assessed to calculate the value of wastage of medicines. The monetary values of the medicines were calculated based on the medicines unit price obtained from PFSA. Based on this a total of 84,275.04 ETB was lost because of medicines wastage/expiry from all health facilities. Receiving near expiry, fail

to practice FEFO, over supply of medicine from PFSA and regimen change was reported as the reason for wastage in 56.3%, 50%, 43.8% and 56.3% of health facilities respectively. Receiving near expiry, fail to practice FEFO and regimen change had significant association with wastage of products ($p < 0.05$), which was revealed by fisher's exact test (Table 11).

**Table 11:** Value of unusable stock for anti TB commodities in public health facilities of Dire Dawa city administration, April 2018 (N=16)

| S.№ | List of wasted Medicines | Unit | Quantity | Unit price ( ETB) | Tot price (ETB) |
|---|---|---|---|---|---|
| 1 | Ethambutol 100 mg | 100 | 23 | 70.1 | 1612.6 |
| 2 | Ethambutol 400mg | 672 | 24 | 420 | 10080 |
| 3 | Kanamycine 1 gm | Vial | 470 | 62 | 29140 |
| 4 | P-aminosalicylate | sachet | 300 | 32 | 9600 |
| 5 | RH60/30 | Tablet | 3158 | 1.04 | 3284.32 |
| 6 | RH60/30 | 84 | 201 | 86.99 | 17484.99 |
| 7 | RHZ 60/30/150 | Tablet | 2076 | 1.26 | 2615.76 |
| 8 | RHZ 60/30/150 | 84 | 99 | 105.63 | 10457.37 |
| | | | | **Total** | **84,275.04 ETB** |

**Table 12:** Association for wastage (expiry) of anti TB commodities and contributing factors for wastage (expiry) in health facilities of Dire Dawa city administration, April 2018 (N=16)

| | | Fishers exact test | |
|---|---|---|---|
| s.n | Variables | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
| 1 | Receive near expiry | 0.035 | 0.024 |
| 2 | Fail to practice FEFO | 0.007 | 0.003 |
| 3 | Regimen change | 0.035 | 0.024 |

## 5.6 Availability or Stock out of anti TB commodities

Availability of products can be expressed indirectly as stock out of products. Based on this half of the health facilities had stock continuously available for $\geq$ 80% of products they manage for the past 6 months which can be considered as good. When disaggregated by product type fifty percent of the health facilities were stocked out of INH 300mg and RHZ in the past six month with mean stock out duration of 10.8 and 18.9 days respectively. Five of the facilities were stocked out of RH with mean stock out duration of 2.81 days. RHZE was

not stocked out in all of the study facilities within the last 6 months. In addition, 66.6% of health facilities had stock out of Ethambutol 400mg with mean stock out duration of 70.5 days. (NB: the percentage of stock out for the past six month was calculated for those products having bincards thus the result should be interpreted in caution. In this case for only Ethambutol 400 mg (Table 13).

**Table 13 :** Percentage of health facilities that experienced a stock out for first line drugs on the day of visit and in the past 6 months in Dire Dawa city administration, April 2018 (N=16)

| s.n | Commodities | # of health facilities | Facilities stock out on the day of visit n (%) | Facilities stock out any time in the past 6 months n (%) | Mean # of days (range) of stock outs in the past 6 months |
|---|---|---|---|---|---|
| 1 | E- 400mg | 16 | 9(56.25%) | 6(66.7%) | 70.5 [0,180] |
| 2 | E- 100mg | 16 | 0(0%) | 2(12.5%) | 2.06 [0,23] |
| 3 | INH-100mg | 16 | 1(6.25%) | 3(18.75%) | 15.1 [0,180] |
| 4 | INH-300mg | 16 | 1(6.25%) | 8(50%) | 10.8 [0,88] |
| 5 | RH 75mg + 50mg | 16 | 2(12.5%) | 5(31.25%) | 2.81 [0,13] |
| 6 | RHZ 75mg + 50mg + 150mg | 16 | 7(43.75%) | 8(50%) | 18.9 [0,120] |
| 7 | RHZE/RH –kit | 16 | 0(0%) | 0(0%) | 0 [0,0] |

MDR TB treatment service was given at one hospital in the city administration. Of the eight second line anti TB drugs only p-amino salicylate (PAS) 4gm was stock out on the day of visit and for the past 6 months for 15 days. On average 12.5% of drugs were stocked out.

Two types of microscopes were used for diagnosing TB which are called ZN microscope and FM microscope. These two microscopes use different type of supplies and reagents. Because, most of the health facilities don't use bin card for these supplies and reagents, it was impossible to know whether a stock out happened in the past 6 month. Therefore, only stock out on the day of visit was assessed. Based on this, all health facilities using ZN microscope was stocked out of lens cleaning solution and lens paper. Filter paper, sputum cup and

wooden applicator stick without cotton were available in 10(62.6%), 6(37.5%) and 2(12.5%) of health facilities respectively. All health facilities were not stocked out of frosted end microscope slide. The three health facilities which uses gene xpert machine were not stocked out of xpert MTB/RIF (Expert Mycobacterium Tuberculosis/Rifampicin test) cartridges and falcon tube.

**Table 14:** Percentage of health facilities stocked out for laboratory supplies and reagents in Dire Dawa city administration, April 2018

| s.n | Supplies and reagents | No of facilities | Stock out on the day of visit n (%) |
|---|---|---|---|
| 1 | Frosted end microscope slide | 16 | 0(0%) |
| 2 | wooden applicator without cotton | 16 | 2(12.5%) |
| 3 | Sputum cup | 16 | 6(37.5%) |
| 4 | Filter paper | 16 | 10(62.5%) |
| 5 | Lens cleaning solution | 5 | 5(100%) |
| 6 | Lens paper | 5 | 5(100%) |
| 7 | 1% basic carbol fuchsin | 5 | 2(40%) |
| 8 | Oil immersion | 5 | 2(40%) |
| 9 | 1% Auramine O in alcohol | 11 | 0(0%) |
| 10 | Phenolic solution for Auramine | 11 | 0(0%) |
| 11 | 0.5% or 3% acid alcohol solution | 16 | 1(6.25%) |
| 12 | 0.3% or 0.1% methylene blue | 16 | 1(6.25%) |
| 13 | Xpert MTB/RIF cartridges | 3 | 0(0%) |
| 14 | Falcon tube | 3 | 0(0%) |

**Reason for stock out**

The reasons for stock out of anti TB commodities in the health facilities include delay from PFSA to resupply 6(37.5%), stock out at re-supply point 2(12.5%), low demand (low consumption) 9(56.3%),regimen change11(68.8%) and delay to request 6(37.5%)(figure 8).

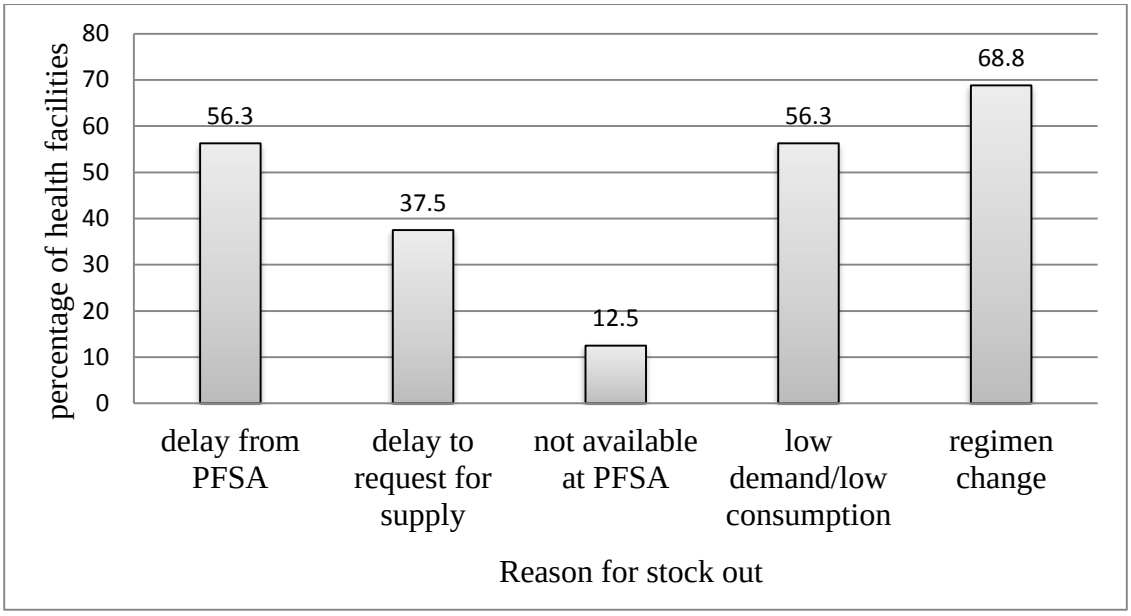


**Figure 7:** The reason for stock out of anti TB commodities in health facilities of Dire Dawa city administration, April, 2018

The stock out of medicines had significant association with delay from PFSA ($p<0.05$), low demand/low consumption ($p<0.05$) and regimen change ($p<0.05$) which was revealed by fishers exact test.

**Table 15:** The association of stock out rate of anti TB commodities and factors for stock out in health facilities of Dire Dawa city administration, April 2018 (N=16)

| | | Stock out rate | |
|---|---|---|---|
| | | Fishers exact test | |
| s.n | Variables | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
| 1 | Delay from PFSA | 0.041 | 0.020 |
| 2 | Low demand/low consumption | 0.041 | 0.020 |
| 3 | Regimen change | 0.026 | 0.013 |

## 5.7 Challenges in inventory management performance of anti TB commodities

The qualitative data was collected through an in-depth face to face interview of key informants (KI) (i.e. Pharmacy head, store manager and laboratory unit coordinators). A total of 12 KI was interviewed. The data was analysed thematically by categorizing in to four thematic areas. The areas include human resource, capacity building and information, management support and inventory management related challenges.

### 5.7.1 Challenges related to human resource

Most of the interviewed personnel (store managers) mentioned that; involvement of the store managers in dispensing practice and night duty program increase the work burden on the store managers which is a challenge to keep logistic data always accurate and quality. For example, one respondent said that:

"….*I ask to resign from the store many times but nobody is willing to work in the store*"

The other respondent said that:

"……..*When I work in dispensary I shut (close) the store. Sometimes a patient may not get the drug even if the drug is available in the store*."

The other challenge mentioned by the KI was absence of daily labourer for loading and unloading commodities when it arrives the health facility. Some of the respondents said that; store managers are responsible for unloading and arranging commodities in the store which takes time and a challenge to complete all logistic records timely. One respondent said that;

"……*the reason for hating my profession is working as labourer. Even for this, there is no incentive."*

### 5.7.2 Challenges related to capacity building and information system

The other challenge mentioned by the key informants was lack of training or capacity building programmes. Most of key informants who were using computerized LMIS said; we were not able to use the computerized health commodity management information system (HCMIS) in full manner. We know only few features of the software and also we cannot fix even minor problem. Sometimes the software generates wrong report for example; it says expired while the drug is not expired. As the respondents said; to correct this, store managers call for IT technician and he will come after a week if he was not around. Because of this there is interruption of work. The other challenge mentioned by the key informants was lack of training or capacity building program about laboratory reagents and supplies they manage. One respondent said;

*"……we simply manage these commodities without knowing there purpose."*

The automated recording system minimize errors and improve recording accuracy, save time and can generate report in short time. In the other way dependence on the computer is one disadvantage. Some store managers who were using the computerized LMIS said that using both electronic and manual bin card is redundancy. Even if interruption of power supply is a challenge, working only with the computer is enough. That is why manual bin cards are not updated most of the time.

The other challenge mentioned by some of the KI was presence of poor communication or information between program managers and pharmacy professionals. As mentioned by the KI; dose of paediatrics drugs for TB treatment was changed before 3-4 months. Nobody told us this regimen change. One respondent said that:

*''……..sometimes we are not considered as part of the health care team. Any information reaches us lately.''*

### 5.7.3. Challenges related to management support

Some of the respondants mentioned that; poor management support as one challenge. As they said; the health facility head didn't respond to their question timely and didn't follow their work. They didn't enforce those healthcare workers who didn't report complete IFRR timely. One respondent said that;

*"…….The facility head come to store when only stock out happens."*

Some of the respondents mentioned that; infrastructure problems like inadequate storage space, light problem and lack of ventilator or air conditioner (AC) as a challenge which were not solved by the facility managers. One respondent said;

"*……we have enough space to renovate the store but the facility manager fail to do so, because of inadequacy of space some drugs are in this store and some of them are in the other store which is not suitable for management. I will be happy if one large store is built for pharmacy."*

The other respondent said that;

" *.....We had no light and we use generator. I go to urban health facilities to prepare a report because the generator is "ON" during the night time only.* "

The other challenge identified by key informants was lack of DUs adherence to their schedule. Most of the store managers said that; sometimes DUs come on the same day for resupply and increase work load on the store manager. At that time, we didn't care for quality of records rather focus on issuing the products. In addition, dispensing units bring false SOH report because they didn't use bin card. The facility managers didn't enforce DUs to adhere to their schedule and prepare quality report.

### 5.7.4 Challenges related to inventory management

Fail to practice FEFO principle by PFSA is another challenge mentioned by KI. As the respondents said; Sometimes PFSA send products with long expiry for the first report and short expiry for the second report and sometimes deliver near expiry drugs which was a reason for expiry of products at health facility.

The other challenge mentioned by respondents were; late delivery or longer lead time to resupply by PFSA.As the respondents said; PFSA deliver products mostly after one month of report submission which is one reason for stock out. There was frequent stock out of Ethambutol 100mg, 400mg, paediatric FDC RHZ and INH 100mg from PFSA which was a challenge. In addition to the stock out of drugs most of KI mentioned that; frequent stock out of laboratory supplies and reagents were a challenge in delivering service.

One respondent said that;

" *……the RRF I prepare don't include laboratory supplies; because PFSA don't deliver to us. I procure in bulk once from private wholesales and PFSA allocates for health facilities by itself when it avails the commodities* "

Over supply or under supply of products by PFSA was mentioned as a challenge by respondents. One respondent said that;

"*…….before 2 month we request Kanamycin 100 pk, but PFSA resupply us 1000pk which is 10x fold. Because of this we suffer for storage space*."

None availability of laboratory professionals working in the regional laboratory, lack of transport and power interruption was some of the challenges mentioned by KI. As the respondants said; laboratory professionals working in the regional labratory were not available most of the time and therefore they borrow from other health facilities when stock out happens which is time consuming. In addition to this rural HF receive these reagents

when ambulance goes to the urban HFs, unless otherwise there is no way to bring the reagents which is one contributing factor for stock out. All KI working in gene xpert sites raise power interruption as a challenge in which TB diagnosing laboratory reagents were wasted when the light goes off.

# 6. DISCUSSION

Well-functioning inventory management provides a reliable supply of commodities so that more people are likely to use superior health service. In addition, it provides reliable information to make evidence based decision and also reduces losses and stock out of commodities due to wastage and shortage respectively. Therefore there should be an appropriate inventory management performance to ensure a reliable supply of commodities (4).The finding of this study emphasized on inventory management performance using indicators like stock record and stock report availability and accuracy, stock out rate, value of wasted stock & storage condition of commodities and challenges associated with inventory management at health facility level.

## 6.1Logisticmanagement information system performance of anti-TB commodities

Finding of this research showed that, all health facilities were using LMIS tools like RRF and IFRR which is in line with a research done in Oromia region, East Shewa zone where these tools were utilized in all heath facilities (24).In addition, only 4(25%) of the health facilities TB clinic and 3(18.8%) of laboratory unit use bin card for stock control which is against the standard of integrated pharmaceutical logistic system of the country, which states dispensing units should maintain bin card for all commodities kept in DUs in order to make evidence based decision(3).The in-depth interview also implicated that, DUs bring false SOH data during reporting time due to non-utilization of bincards.

This study revealed that only 60% and 62.5% of the available bincards for first line and second line drugs were updated respectively which was lower than a research done in Namibia which shows 100% of bincards were updated. The difference may be due to the type of and quantity of products included. In consistence with this, the key informants had also pointed out, workload in the store and relaying only on computerized recording system were mentioned as a reason for not updating some of the manual bincards. When we look for bin card accuracy rate, in this research the average bin card accuracy rate for first line drugs were found to be 77.2% which is comparable with an assessment done in Namibia which was 75.0% (25).

Regarding laboratory commodities, this study documented that none of the health facilities had bin card for all TB laboratory diagnostic reagents in the pharmacy store. This result is lower than a research done in Addis Ababa which shows 50% hospitals and 54% of health centres were using bin card for all TB laboratory diagnostic reagents in the main pharmacy

store. This difference may be due to the place where the commodities were managed; Majority of labratory reagents were not managed in the pharmacy store in the present study where as in Addis Ababa all laboratory reagents were managed in the main pharmacy store (13).In contrast to all this findings; the national standard states that any personnel responsible for the management of pharmaceuticals should maintain up- to-date and accurate bin card for each product; in order to make evidence based decision (3).

With regard to RRF accuracy, the finding of this research showed that 75% of the health facilities report was not accurate for at least 80% of anti TB drugs. For second line drugs which were managed only in one hospital half of the drugs were not accurately filled on the report form. In consistence with these findings, assessment done in Malawi also shows poor LMIS data quality/report inaccuracy was a major obstacle in supply chain system (26). In addition to this, the key informants had also acknowledged the existence of inaccurate logistic report due to workload in the store. The finding of this research also identifies absence of LMIS SOP is a contributing factor in keeping logistic report accurate. This was also true in the case of a study conducted in Bayelsa state, Nigeria which identified lack of SOP affect the quality of logistic data (27).

The finding of this research showed that, none of the health facilities had complete RRF; all lack at least one essential data element from the report part (ending balance at dispensing unit, loss /adjustment).This finding is higher than a research done in Addis Ababa which shows 7.7% of the facilities' report were incomplete which lack at least one essential data element from report part (16).The difference may be due to the type and quantity of commodities included; in the Addis Ababa research only two anti TB commodities were included.

The finding of this research showed that from actually submitted IFRR reports 85.3% of TB clinic and 86.0% of laboratory unit IFRR were complete which contains beginning balance, stock on hand, quantity received, and loss and adjustment. The finding is comparable to a research done in Addis Ababa which shows 87.5% of the health facilities IFRR were complete which contains beginning balance, stock on hand, quantity received, and loss and adjustment. In relation to this, the frequency of reporting for TB clinic and laboratory unit was 69.4% and 66.7% respectively which shows poor adherence of schedule placed as per the standard of integrated pharmaceutical logistic system of the country (3,16).

The nationally placed minimum-maximum inventory control system is intended to avoid placing emergency orders so that health facilities always have enough stock. This finding shows that half of the health facilities had placed one or more emergency order for the past six months prior to data collection which is in line with the national survey done for IPLS (5). In addition, the response of the key informants gives an insight into the reason behind placing emergency order; in which longer lead time to deliver products by PFSA was mentioned as a reason for placing emergency order by most of the respondents.

## 6.2 Inventory control system and stock status of anti TB commodities

Order fill rate was calculated only for the drugs because laboratory supplies and reagents were not included in the report. Based on this, the finding of this research showed that 62.5% of the health facilities were resupplied for at least 80% of products they request. Anti TB drugs which are used for adults like RHZE/RH kit, INH 300mg and Ethambutol 400 mg were resupplied with the requested quantities in more than 70% of facilities for the last report which is in line with the national IPLS survey which shows adult anti TB drug like RHZE were resupplied in more than 70 % of facilities (5).In addition, this finding shows only 68.7% and 62.5% of HF receive paediatrics RH and RHZ respectively with the requested quantity. In association with this, the key informants reported that; most of the time stock out or shortage of paediatrics anti TB drugs were happened at PFSA, so that paediatrics drugs were not resupplied in the requested quantity.

The finding of this research showed that 11(68.75%) of the facilities were over stocked for Ethambutol 100mg and INH 100mg whereas 10(62.5%) of the facilities were over stocked for adult TB kit, paediatrics RH and INH 300 mg. In addition to this 6(37.5%) of the HFs were under stocked for paediatrics RHZ whereas 3(18.75%) of HFs were under stocked for INH 100mg, RH and RHZE/RH kit. In contrast to this finding; the national standard recommends the stock for any product should be always between maximum and minimum level. Overstock and under stock is an indicator of poor inventory control system which will result products for expiration and stock out respectively (3).

## 6.3 Storage condition

With regard to storage condition, the finding of this study revealed that half of the study facilities didn't fulfil the criteria of good storage condition (≥80 positive response) which is comparable with the national survey of IPLS which states 55% of the facilities met acceptable storage conditions (5).Regarding storage space,43.75 % of the facilities had no

sufficient space for medicines storage and also free space for future expansion which leads to congestion and inability to do inventory management. This was supported by the qualitative result in which insufficient storage space was mentioned as a challenge in good storage practice. In support of this finding, a research done in Namibia, Nigeria and in sub Saharan Africa showed that inadequate warehouse infrastructure (storage capacity) and inadequate warehouse management( lack of expertise of human resources and insufficient operational processes) are some of the challenges in good storage practice (17,21,25). The present study had also shown that storage guideline has an association with good storage practice. In line with this, guideline for improving performance of logistic management system; which is developed by USAID/DELIVER identified that; storage guideline as a factor that affect good storage practice, result in lack of consistency in practice and non-accountability of staffs (28).

### 6.4 value of wasted medicines

This study also described the value of wasted medicines due to expiry and damage. Based on this a total of 84,275.04 ETB was lost because of medicines wastage. Parallel to this finding, a research done in Namibia shows there was large amount of anti-TB drugs wasted due to expiry. As revealed by chi-square test, there is statistically significant association between wastage and receiving near expiry medicines, fail to practice FEFO by the store manager and new regimen change by TB program which was the same as identified in Namibia (25).The qualitative result revealed that, power supply was a challenge especially in those health facilities that had gene xpert machine resulting in wastage of laboratory reagents. This was also mentioned as a challenge in Bayelsa state, Nigeria which results in deterioration of laboratory diagnostic reagents(27).

### 6.5 Availability or stock out of anti-TB commodities

The most important outcome of supply chain management is availability of stock at health facilities. Stock outs in any health system represent a critical failure of the supply chain system. The finding of this research showed that paediatrics RHZ and RH were stocked out for the last six months in 50% and 31.25% of health facilities respectively. In support of this finding an assessment done in Malawi and west Gojjam Amhara region showed that sock out were happened for these products in the past six month (12,26). In consistence with this; the key informants mentioned that stock out and shortage of paediatrics FDC of anti TB drugs were happening most of the time.

In the other way, this research finding showed; none of the facilities were stocked out of RHZE/RH kit for the past 6 month which is in line with a research done in East Shewa, Oromia region(24).But, lower than a research done in Kano; Nigeria and Tanzania which shows 19.7% and 21% of HFs were stocked out of adult anti-TB kit respectively (17,18).This difference may be due to TB kit implementation was newly introduced in Ethiopia as compared to Nigeria in which more attention was given for the kit implementation whereas Tanzania didn't implement TB kit at the time of survey. Implementation of TB kit minimizes the risk of stock out and improve patient adherence to the drugs (7,29).

Regarding availability of laboratory commodities, this study showed 37.5% of health facilities were stocked out of sputum cup on the day of visit, which was higher than a research done in Amhara region which shows only 3.7% of health facilities were stocked out of sputum cup (11). This difference may be due to the health facilities assessed in Dire Dawa didn't report supplies with drugs rather PFSA distributes with allocation which may contribute to stock out. A research done in Uganda also identifies shortage of TB diagnosing supplies like sputum cup which support this finding (19). Additionally this research finding showed 40 % of health facilities were stocked out for 1% basic carbon fuchsine which was parallel to research done in west Amhara region which states shortage of reagents for AFB staining procedure were found in 41.3% of facilities(30). Finally the finding of this research showd that all (n=5) health facilities using ZN microscope were stocked out of lens cleaning solution and lens paper at the time of visit which is supported by a research done in west Gojjam which states presence of an intermittent supply of laboratory reagent for ZN staining technique/microscope (12).But this finding was higher than a research done in west Amhara region that states microscope lens cleaning solution and lens paper were not found in 63.2% and 44.3% of facilities respectively (11).The difference may be due to sample size difference in which 201 facilities were assessed in the west Amhara region and five health facilities were assessed in this research. Lastly, this study revealed delay from PFSA to resupply, regimen change by program managers and low demand by clients were reasons or contributing factors for stock out. This was also true in the case of study conducted in west Gojjam, Namibia, Malawi and Nigeria which identified the same reasons for the observed stock out (12,25–27).

## Limitation of the study

- Non availability of similar researches done in Ethiopia to compare some of the result

# 7. CONCLUSION

From this study it can be concluded that availability, utilization of bin card at dispensing units, updating practice and accuracy of stock keeping record (bin card) were poor for the commodities as a whole. Especially, for laboratory commodities little attention was given by pharmacy professionals in record keeping.In addition to this,quality of formats which were used for reporting (RRF,IFRR) were also poor. It can be concluded that poor reporting mechanism were there for laboratory commodities. A maximum/minimum inventory control system is designed so that facilities always have enough stock to serve their clients and to prevent emergency orders. However, half of health facilities placed emergency order which can be concluded that the inventory control system was poor.

Most facilities were not stocked according to the recommended two to four months of stock. For almost all products assessed, overstocking was higher than under stocking, which might lead to stock being wasted or expire. Storage condition for half of health facilities was not acceptable. Even if the wastage rate was not calculated due lack of data, there was significant amount of money wasted due to wastage. Overall, the availability of adult anti-TB drug especially RHZE/RH kit was generally good; even if there was some variation among facilities and product type. But there were frequent stock outs of paediatrics anti-TB drugs and laboratory commodities, which is an indicator of weak supply chain.

In general, from this study we can conclude that the inventory management performance of anti-TB commodities using different measuring indicators like utilization and updating practice of logistic records, accuracy rate for logestic records and reports, inventory control system, storage condition, wastage and stock availablity was found to be poor which needs improvement.

# 8. RECOMMENDATION

Based on the findings of this research the following recommendation can be forwarded for health facilities, PFSA, city administration health bureau and other concerned bodies.

**To health facilities of Dire Dawa**

- Logestic record which is the back bone of supply chain, helps to have a reliable data and able to make right decision. So health facilities should use, update and keep this record accurate in store and dispensing units for all commodities they manage.
- Facilities should prepare and send complete and accurate report for PFSA regularly, since it affects the resupply quantity.
- Dispensing units should prepare and send complete and accurate report for the facility store as per the placed schedule.
- Health facilities should improve the inventory control system so that they can always able to maintain the maximum/minimum stock level in the range and minimize the number of emergency orders they place.
- Health facilities should have and follow good storage practice guideline to ensure quality drugs reach for patients.
- Those health facilities which have insufficient storage space should plan to renovate their store by communicating with the concerned stakeholders.
- Health facilities should hire daily labourer for loading and unloading so that the store managers concentrate only on their work and keep the LMIS to the maximum quality.
- Health facilities should buy ultra-power supply (UPS) or generator as reserve for power saving in case of power supply interruption so that wastage will not happen for laboratory reagents.

**To Dire Dawa city administration health bureau**

- The city administration health bureau should increase frequency of supervision for health facilities; on utilization of records, quality of LMIS tools and their storage practice to be in accordance with the standard.
- Program managers on the health bureau should announce when there is any regimen change by consulting all stakeholders; to prevent stock outs like that one happened on paediatrics RHZ and RH.

- The city administration health bureau and other stake holders should give training for store managers regarding HCMIS so that it is user friendly and get maximum benefit from the software.
- The city administration health bureau and other stake holders should give training for pharmacy professionals regarding laboratory commodity management so that the laboratory reagents are managed by the pharmacy professionals accordingly.
- The city administration health bureau should enforce health facilities to build standard storage place for pharmaceuticals.
- Regional laboratory should have regular communication/schedule with health facilities in order to facilitate delivery of reagents.

**To pharmaceutical fund and supply agency of Dire Dawa**

- PFSA should deliver products only as per the requested quantity by the health facilities.
- PFSA should deliver products on time as per placed schedule on integrated pharmaceutical logistic system of the country.

**To researchers**

- Further studies should be conducted to explore additional challenges exhaustively in all health facilities and along all the supply chain practice.

# 9. REFERENCES


1. Management science for health. Management Strategy in Improving Health Service. Vol. 10. 2013. 1125-1156 p.
2. USAID Deliver. The Logistics Handbook: A Practical Guide for the Supply Chain Management of Health Commodities. Second edi. Arlington: USAID | DELIVER PROJECT; 2011. 6-50 p.
3. Pharmaceutical fund and supply agency. Standard Operating Procedures ( SOP ) Manual for the Integrated Pharmaceuticals Logistics System in Health Facilities of Ethiopia. 2nd editio. Ethiopia: PFSA; 2015. 7-56 p.
4. Embrey M. Managing Access to Medicines and Health Technologies. 2012th ed. Ebrey M, editor. Arlington, VA; 2012. 1125-1267 p.
5. Pharmaceutical fund and supply agency. National Survey of the Integrated Pharmaceutical Logistics System. 2015;(February).
6. World health organization. Global tuberculosis report. Geneva Swezerland; 2017.
7. Federal Ministry Of Health. National guidleine for TB,DR-TB and leprosy in Ethiopia. 2017.
8. Federal ministry of health. Guidelines for clinical and programmatic management of TB, TB/HIV and leprosy in Ethiopia. 2013;
9. World health organization. Guidance for countries on the specifications for managing TB laboratory equipments and supplies. Geneva , Switzerland; 2012. 10-176 p.
10. World health organization. Tuberculosis Medicines Technology and Market Landscape. Geneva Swezerland; 2013.
11. Sinishaw MA, Gebregergs GB. Distribution and Availability of Essential Tuberculosis Diagnostic Items in Amhara. PLoS ONE 10(12) e0141032 doi101371/ journal.pone0141032. 2015;1–8.
12. Gebreegziabher SB, Yimer SA, Bjune GA. Qualitative Assessment of Challenges in Tuberculosis Control in West Gojjam Zone , Northwest Ethiopia : Health Workers ' and Tuberculosis Control Program Coordinators ' Perspectives. Hindawi Publ Corp. 2016;2016:1–8.
13. Desalegn A, Taye B BG. Assessment of laboratory logistics management information system practice for HIV/AIDS and tuberculosis laboratory commodities in selected public health facilities in Addis Ababa, Ethiopia. Pan African Med Journal. 2013;8688:1–8.

14. USAID Deliver. LABORATORY LOGISTICS HANDBOOK. 2009;(June).
15. Sporrong SK, Traulsen JM, Kabtimer WD, Habtegiorgis BM, Teshome D. Developing and sustaining human resources in the health supply chain in Ethiopia : barriers and enablers. 2016;1–11.
16. Tilahun A, Geleta DA, Abeshu MA, Geleta B TB (2016). Assessment of Integrated Pharmaceutical Logistic System for the Management of HIV / AIDS and Tuberculosis Laboratory Diagnostic Commodities in Public Health Facilities in Addis Ababa , Ethiopia. J Pharm Care Heal Syst. 2016;3(2):1–10.
17. Gulma K, Abubakar M, Mohammed BL et. a. stock status assessment of health commodities used in the management of HIV / AIDS and TB in Kano state , Nigeria. J Pharm Res. 2015;14(2):33–41.
18. Jaya C, Joy K, Jennifer T TS. Tanzania TB and Leprosy Logistics System Assessment. Quantitative and Qualitative Results from the LIAT and the LSAT. Arlington, VA; 2011. Report No.: 1.
19. Cattamanchi A, Miller CR, Tapley A, Haguma P, Ochom E, Ackerman S, et al. Health worker perspectives on barriers to delivery of routine tuberculosis diagnostic evaluation services in Uganda : a qualitative study to guide clinic-based interventions. BMC Health Serv Res. 2015;1–10.
20. Daniel G, Tegegnework H, Demissie T, Reithinger R. Pilot assessment of supply chains for pharmaceuticals and medical commodities for malaria , tuberculosis and HIV infection in Ethiopia. Trans R Soc Trop Med Hyg. 2012;106(1):60–2.
21. Schöpperle A. Analysis of challenges of medical supply chains in sub-Saharan Africa regarding inventory management and transport and distribution. Westminster, London; 2013.
22. Dire Dawa city administration mayor office. Dire Dawa city administration socio-demographic data. 2010;
23. USAID Deliver. Logistic Indicatore Assessment Tool ( LIAT ). 2005th ed. Arlington, VA: John Snow,Inc./DELIVER.; 2005. 1-42 p.
24. Gurmu TG, Ibrahim AJ. Inventory management performance of key essential medicines in health facilities of East Shewa Zone , Oromia Regional State , Ethiopia Oromia Bölgesel Devleti Doğu Shewa , Etiyopya ' da ki sağlık tesislerinde en önemli. Cukurova Med J. 2017;42(2):277–91.
25. Owunna C, Chana Chapchet R, Ntege C and NN. Assessment of the TB Pharmaceutical Management System in Namibia. Arlington, VA:; 2011.

26. Chana RC. Assessment of the Logistics and Supply Chain Management of Anti-TB Medicines. Arlington; 2011. Report No.: 1.
27. Omo-emmanuel UK, Chinedum OK, I OE, Michael O, Negedu-momoh O. Evaluation of Laboratory Logistics Management Information System in HIV / AIDS Comprehensive Health Facilities in Bayelsa State , Nigeria. Int J Curr ResMed Sci. 2017;3(1):21–38.
28. USAID Deliver. Guide for Malaria Commodities Logistic Management System;MTP approch for improving performance of logistic management system. Arlington, VA: Management Sciences for Health; 2013. 3-69 p.
29. Rational Pharmaceutical Management (RPM) Plus. Patient Kits Promote Good Tuberculosis Pharmaceutical Management. 2010;2006(February 2006).
30. Balew M, Amare H, Alemu A E a. Tuberculosis Laboratory Diagnosis Quality Assurance among Public Health Facilities in. PLoS ONE. 2015;134(1):10–8.

## ANNEXES

Annex 1: List of commodities assessed

| S.N | First line drugs | Medicine symbol | strength |
|---|---|---|---|
| 1 | Ethambutol | E | 400mg |
| 2 | Ethambutol | E | 100mg |
| 3 | Isoniazid | INH | 100mg |
| 4 | Isoniazid | INH | 300mg |
| 5 | Rifampicin/Isoniazid | RH | 75mg+50mg and 60/30 mg |
| 6 | Rifampicin/Isoniazid/Pyrazinamide | RHZ | 75mg/50mg/150mg and 60/30/150mg |
| 7 | Rifampicin/Isoniazid/Pyrazinamide Ethambutol and Rifampicin/Isoniazid kit | RHZE/ RH | 150mg /75mg/400mg /275mg and 75/150 mg |
| | Second line drugs | | |
| 1 | Capreomycine injection | Cm | 1 gm |
| 2 | Cycloserine tablet | Cs | 250mg |
| 3 | Prothionamide tablet | Pto | 250mg |
| 4 | Levofloxacilline tablet | Lfx | 250mg |
| 5 | Pyrazinamide tablet | Z | 400mg |
| 6 | p-amino salicylate | PAS | 4mg |
| 7 | Kanamycine injection | Km | 1 gm |
| 8 | Moxifloxacilline tablet | Mfx | 400mg |

| | | |
|---|---|---|
| | Laboratory supplies and reagents | |
| 1 | Frosted end microscope slide | 1% Auramine O in alcohol |
| 2 | Applicator wooden without cotton | phenolic solution for Auramine |
| 3 | Lens cleaning solution | 0.5% or 3% acid alcohol solution |
| 4 | Lens paper | 0.3% or 0.1% methylene blue |
| 5 | Sputum cup | 1% basic carbol fuchsin |
| 6 | Filter paper | oil immersion |
| 7 | Falcon tube | Xpert MTB/RIF cartridges |

Annex 2: List of indicators used to assess the inventory management performance of anti TB commodities

| Sn | Indicators | Data source |
|---|---|---|
| | Indicators used to assess LMIS performance | |
| 1 | % HF utilizing bin card in major dispensing units (TB and laboratory unit) | Assessing the units and observation |
| 2 | % Bin cards available and updated by product | Bincards review |
| 3 | % Bin cards accurate by product | Bincards review |
| 4 | % HF with accurate RRF report for at least 80% of the products reported | RRF report and physical inventory |
| 5 | % HF that submitted complete RRF report for the most recent reporting period | Review of RRF |
| 6 | % of complete IFRR reports (which contains the four essential data's) submitted to the store | Review of IFRR |
| 7 | % HF that had placed an emergency order | Review of RRF and respondents |

| | | |
|---|---|---|
| | Indicator used to assess inventory control system and stock stataus | |
| 8 | % of HF that received quantity of products order | RRF review and model 19 |
| 9 | % of HFs adequately stocked(between minimum /maximum stock level) on the day of visit | Bin card,IPLS SOP |
| 10 | % of HFs that are under stocked (below minimum) on the day of visit | Bin card,IPLS SOP |
| 11 | % of HFs that are overstocked(above maximum) on the day of visit | Bin card,IPLS SOP |
| 12 | **%** HF that fulfil acceptable storage condition | Observation of store |
| 13 | Value of un usable stock | Expiry registration sheet,PFSA price list,model 19 |
| | Indicator used to assess availability of anti TB commodities | |
| 14 | % of HF with stock continuously available for at least 80% of the products for the past 6 months | Review of bin card and observation |
| 15 | % of HFs that experienced a stock out for the past 6 month | Review of bin cards |
| 16 | % of HFs stocked out on day of visit | Review of bin card and observation |

Annex:3 Health facilities adherence to good pharmacy practice standards in health facilities of Dire Dawa city administration, April, 2018 (n=16)

| S.№ | Descriptions | Yes | No | Adherence % (n) |
|---|---|---|---|---|
| 1 | Products are arranged on shelves with arrows pointing up, and identification labels and expiry dates and/or manufacturing dates are visible. | 12 | 4 | 75% |
| 2 | Products are stored and organized in a manner accessible for first-to-expire, first-out (FEFO) counting | 7 | | 43.75% |

| | | | | |
|---|---|---|---|---|
| | and general management. | | 9 | |
| 3 | Cartons and products are in good condition, not crushed due to mishandling. If cartons are open, determine if products are wet or cracked due to heat/radiation (fluorescent lights in the case of condoms, cartons right-side up for Depo-Provera®). | 15 | 1 | 93.75% |
| 4 | The facility makes it a practice to separate damaged and/or expired products from usable products and removes them from inventory. | 15 | 1 | 93.75% |
| 5 | Products are protected from direct sunlight. | 16 | 0 | 100% |
| 6 | Cartons and products are protected from water and humidity. | 16 | 0 | 100% |
| 7 | Storage area is visually free from harmful insects and rodents. | 16 | 0 | 100% |
| 8 | Storage area is secured with a lock and key, but is accessible during normal working hours; access is limited to authorized personnel. | 14 | 2 | 87.5% |
| 9 | Products are stored at the appropriate temperature according to product temperature specifications. | 9 | 7 | 56.25% |
| 10 | Roof is maintained in good condition to avoid sunlight and water penetration. | 15 | 1 | 93.75% |
| 11 | Storeroom is maintained in good condition (clean, all trash removed, sturdy shelves, organized boxes). | 10 | 6 | 62.5% |
| 12 | The current space and organization is sufficient for existing products and reasonable expansion | 9 | 7 | 56.25% |

**Informed consent**

Institute of health sciences

Department of pharmacy

Pharmaceuticals supply chain management postgraduate program me

Informed consent form:

Dear respondent I am a postgraduate student in Pharmaceuticals supply chain management at Jimma University and I am conducting a research study on anti TB commodities inventory management performance in health facilities of Dire Dawa city administration. The results of this study hope fully will improve the inventory management performances of the health facilities.

It is my understanding that you are currently involved in pharmacy service at your health facility. I want you to participate in this study to provide information regarding supply chain management practices and the challenges your health facility is currently experiencing with respect to inventory management.

I want to stress that your participation in this study is voluntary and all efforts to protect your identity and keep the information confidential will be taken. Your answers will not be linked to your name and will only be used for this evaluation.

Are you willing to participate in the study?

I agree to participate

I do not agree to participate

If you are Volunteer to participate please answer the following questions

Annex 4: Questionnaire and observation check list

Jimma University

School of Pharmacy

Department of Pharmaceutical Supply Chain Management

Date: _____

First ask to speak to head of the pharmacy. After explaining your purpose asks the following questions, then visit the warehouse, storeroom or other storage area. If you are referred to another staff member keep telling the purpose of the visit before data collection.

Table 1: Facility Services and Infrastructure

| No. | Question | Code Classification | Go To/ Comment |
|---|---|---|---|
| 1 | Name of the facility | | |
| 2 | Region | | |
| 3 | Type of facility | 1= Hospital<br>2=Health centre | |
| 4 | Provide TB Service | 1=YES<br>0=NO | |
| 5 | Product Delivery Modalities from PFSA | 1=Direct<br>2=Indirect | |

Table 2: Background Characteristics of the Respondent (ask pharmacy unit coordinator)

| No. | Question | Code Classification | Go to/ comment |
|---|---|---|---|
| 1 | Title and mobile phone number of person interviewed for this survey | Title: _____<br>Mobile number: _____ | |
| 2 | Number of years and months you have worked at this facility? | Years: _____ Months:_____ | |
| 3 | What is your profession | Nurse.....1<br>Clinical Officer..... 2<br>Druggist……...3 | |

| | | | |
|---|---|---|---|
| | | Pharmacist.....4<br>Other (Specify) _____9 | |
| 4 | How many staff the facility has under the pharmacy unit? | # of pharmacy unit staff /___/ | |
| 5 | Educational qualification of pharmacy unit staff | #of staff with Degree /_____/<br>#of staff with Diploma/_____/<br>Other # /_____/ | |
| 6 | How many of them are trained in IPLS, warehouse management, laboratory commodity management? | Number trained on IPLS____<br>warehouse management___<br>laboratory commodity management _____<br>other _____specify_____ | |

Table 2: Background Characteristics of the Respondent (Ask the store manager)

| No. | Questions | Code Classification | Go To/ Comments |
|---|---|---|---|
| 1 | Name title and mobile phone number of person interviewed for this survey | Name: _____<br>Title: _____<br>Mobile number: _____ | |
| 2 | Number of years and months you have worked at this facility? | Years: _____<br>Months:_____ | |
| 3 | What is your profession | Nurse.....1<br>Clinical Officer..... 2<br>Druggist…….…….3<br>Pharmacist.....4<br>Other (Specify) _____9 | |
| 4 | Type of training you(the store manager )trained | IPLS……1<br>warehouse management…2<br>laboratory commodity management……..3<br>other(specify)……..4 | |
| 5 | Are you responsible for managing TB drugs | Yes_____1 | **If** no who is |

| | | | |
|---|---|---|---|
| | At this facility? (Multiple responses are possible.) | No _____0 | responsible list down |
| 6 | Are you responsible for managing TB Laboratory reagents that are used for AFB testing at this facility? | Yes_____1<br>No _____0 | **If** no who is responsible list down |
| 7 | Are you responsible for managing TB Laboratory supplies that are used for AFB testing at this facility? | Yes_____1<br>No _____0 | **If** no who is responsible list down |

Table 3 LMIS related questions (ask store manager for commodities s/he is responsible)

| No. | Questions | Code Classification | Go To/ Comment |
|---|---|---|---|
| 1 | Do you use the following stock keeping logistics forms to manage health products in this facility? | | |
| | A. bin card/ inventory control card | Yes……..... 1<br>No…… 0 | |
| | B. stock ledger | Yes…… 1<br>No…… 0 | |
| | C. other | Yes……..... 1<br>No…… 0 | |
| 2 | What LMIS forms do you use for reporting/ordering? | | |
| | A. Reporting and requisition from (RRF) | Yes…….. 1<br>No …….,…. 0 | |
| | B. Internal facility reporting and requisition from (IFRR) | Yes ……. 1<br>No …… 0 | |
| | C. Automated system(HCMIS) or electronic RRF | Yes…….....1<br>No ……..0 | |
| | D. other | Yes (specify) 1<br>No ……..0 | |
| 3 | If your answer to Q 2C is yes, have you faced challenge in using | Yes……..1 | |

| | | | | |
|---|---|---|---|---|
| | the computerized LMIS | | No……0 | |
| 4 | Do LMIS report forms include the following? | | | |
| | A. stock on hand | | Yes……..1<br>No……0 | |
| | B. quantities used | | Yes……..1<br>No……0 | |
| | C. losses and adjustments | | Yes……..1<br>No……0 | |
| 5 | Does a completed LMIS report include the following? (must be verified with completed report) | | | |
| | A. stock on hand | Yes……..1<br>No……0<br>Completed report not available…… 9 | | |
| | B. quantities used | Yes ……1<br>No……. 0<br>Completed report not available…… 9 | | |
| | C. losses and adjustments | Yes ……1<br>No……. 0<br>Completed report not available…… 9 | | |
| 6 | How often are these LMIS reports sent to the higher level? (Circle all that apply.) | | Monthly.....A<br>Bi Monthly.....B<br>Quarterly.....C<br>Other | |
| 7 | When was the last time you sent an order/report for products at this facility? | Never……1<br>Within the last month.....2<br>2 months ago……..3<br>3 months ago……..4<br>More than 3 months ago……5 | | |
| 8 | How do you transmit your report/order to the higher level | Send by facility vehicle…….1<br>Picked up by higher level……..2<br>Other<br>(specify)…….3 | | |
| 9 | How did you learn to complete the forms/records used at this | During a logistics workshop…….A<br>On-the-job training ……..….B | | |

| | | | | |
|---|---|---|---|---|
| | facility?(circle all that apply) | Never been trained…….C<br>Other (specify)……..……W | | |
| 10 | Is there written SOP for LMIS practice of all products | | Yes ……1<br>No …….0 | |
| 11 | How many emergency orders for anti TB commodities have you placed in the last 6 months? S<br>(specify for which commodity you placed) | | None……..0<br>1……1<br>2…….2<br>3…….3 | |
| 12 | Does the laboratory unit use the following LMIS formats(must be confirmed) | | | |
| | Bin card | | Yes ……1<br>No ……..0 | |
| | IFRR | | Yes ……..…1<br>No ……..0 | |
| 13 | Does the TB unit use the following LMIS formats(must be confirmed) | | | |
| | Bin card | | Yes ……1<br>No ……..0 | |
| | IFRR | | Yes ……1<br>No ……..0 | |

Table 4 Inventory management related (ask pharmacy store manager for commodities s/he is responsible to manage)

| No. | Questions | Code Classification | Go To/ Comment |
|---|---|---|---|
| 1 | What are the direct sources of supply for the following program commodities at this facility? (Multiple responses are possible.) | | |
| | Anti TB drugs | PFSA_____1<br>RHB/regional laboratory_____2<br>Other (specify)_____3 | |
| | TB laboratory reagents | PFSA_____1<br>RHB/regional laboratory_____2 | |

| | | | |
|---|---|---|---|
| | | Other (specify)_____3 | |
| | TB laboratory supplies | PFSA_____1<br>RHB/regional laboratory_____2<br>Other (specify)_____3 | |
| 2 | Who determines this facility's anti TB commodities resupply quantities?<br>(Circle all that apply.) | | |
| | Anti TB drugs | The facility itself ……A<br>PFSA……...B<br>RHB/regional laboratory……C<br>Don't know……D<br>Other_____W | |
| | TB laboratory reagents | The facility itself ……A<br>PFSA……...B<br>RHB/regional laboratory……C<br>Don't know……D<br>Other_____W | |
| | TB laboratory supplies | The facility itself ……A<br>PFSA……...B<br>RHB/regional laboratory……C<br>Don't know……D<br>Other_____W | |
| 3 | How are the facility's resupply quantities determined? | | |
| | For Anti TB drugs | Formula (any calculation)_____ 1<br>Don't know……..2<br>Other means…….3 | |
| | For TB laboratory reagents | Formula (any calculation)_____ 1<br>Don't know……..2<br>Other means…….3 | |
| | For TB laboratory supplies | Formula (any calculation)_____ 1<br>Don't know……..2<br>Other means…….3 | |
| 4 | | Past consumption.....1<br>Size of the store.....2 | |

| | | | |
|---|---|---|---|
| | What factors affect the quantities you order? | service report.....3<br>Other……..……4 | |
| 5 | Who is responsible for transporting products to your facility? (Circle all that apply.) | Local supplier delivers ……...A<br>Higher level delivers …….....B<br>This facility collects……C<br>Other(specify).....D | |
| 6 | What type of transportation is most often used? | Facility vehicle ……..1<br>Public transportation ……2<br>PFSA ……3<br>Motorcycle……4<br>other (specify) ……5 | |
| 7 | On average, approximately how long does it take between ordering and receiving products for products you manage? | Less than 2 weeks…….. 1<br>2 weeks to 1 month …… 2<br>Between 1 and 2 months….. 3<br>More than 2 months ……. 4 | |
| 8 | When did you receive your most recent supervision visit? | Never received…….. 1<br>Within the last month ……2<br>1 - 3 months ago…….3<br>3 - 6 months ago …….4<br>More than 6 months ago ……5<br>Other (specify) ….. 9 | |
| 9 | How often do you take stock taking | Any time during issuing ……..…1<br>Monthly ……..…2<br>Bi monthly ……3<br>Quarterly ……4<br>Annually……..…5 | |
| 10 | Are there certain commodities that you always stock out of before resupply?(drugs,reagents,supplies) | Yes……..…….1 No…… 0 | |
| | IF NO skip Q no 12 | | |

| | | | |
|---|---|---|---|
| 11 | List the commodities you stock out of most frequently (up to 3 products). | 1._____ 2._____ 3._____ | |
| 12 | Is there written guidelines for storage and handling of all products (e.g., manuals, posters, etc.)? | Yes……1 No …….0 | |

Table 5: Report and Requisition Form accuracy assessing checklist

| | | | Usable Stock on Hand (at time of most recent LMIS report) | | | | |
|---|---|---|---|---|---|---|---|
| | | Unit | Managed at this HF(Y/N)(1) | According to most recent RRF report(2) | From BC from time of RRF report(3) | Reason for discrepancy | |
| 1 | **E** 400mg | | | | | | |
| 2 | **E**- 100mg | | | | | | |
| 3 | **INH** 100mg | | | | | | |
| 4 | **INH** -300mg | | | | | | |
| 5 | **RH**-75mg/50mg | | | | | | |
| 6 | **RHZ**75/50/150mg) | | | | | | |
| 7 | **RHZE**/**RH** kit | | | | | | |
| 8 | Capreomycine 1gm | | | | | | |
| 9 | Cycloserine 250mg | | | | | | |
| 10 | Prothionamide250mg | | | | | | |
| 11 | Levofloxacin 250mg | | | | | | |
| 12 | Pyrazinamide 400mg | | | | | | |
| 13 | PAS 4 gm | | | | | | |
| 14 | Kanamycin 1gm | | | | | | |
| 15 | Moxifloxacine 400mg | | | | | | |
| Laboratory reagents and consumables for facilities using Zeihel-Neelsen staining technique | | | | | | | |
| 16 | 3 % Acid Alcohol | | | | | | |
| 17 | 1% basic carbol | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | fuchsin | | | | | | |
| 18 | 0.1% Methylene blue | | | | | | |
| 19 | Oil Immersion | | | | | | |
| 20 | Frosted end microscope slide | | | | | | |
| 21 | Applicator wooden without cotton | | | | | | |
| 22 | Filter paper | | | | | | |
| 23 | Lens cleaning solution | | | | | | |
| 24 | Lens paper | | | | | | |
| | For health facilities who have gene xpert machine | | | | | | |
| 25 | Expert MTB/RIF Cartridges | | | | | | |
| 26 | Falcon tube 50 ml | | | | | | |
| | Laboratory reagents and consumables for facilities using Fluorescence Microscope | | | | | | |
| 27 | 1% Aura mine O in alcohol | | | | | | |
| 28 | phenol solution for Aura mine O | | | | | | |
| 29 | 0.5% Acid alcohol | | | | | | |
| 30 | 0.3% methylene blue | | | | | | |
| 31 | Filter paper | | | | | | |
| 32 | Sputum cup | | | | | | |
| 33 | Wooden applicator sticks with out cotton | | | | | | |
| 34 | Microscope Frosted end slides | | | | | | |

Table 6: Percentage Difference between Quantity Ordered and Quantity Received

| | Anti TB drug and reagent | unit | Quantity Ordered For Last Order Period | Date Order Placed | Quantity Received In Last Order | Date Order Received |
|---|---|---|---|---|---|---|
| 1 | Ethambutol (**E**) 400mg | | | | | |
| 2 | Ethambutol (**E**)- 100mg | | | | | |
| 3 | Isoniazid (**INH**) 100mg | | | | | |
| 4 | Isoniazid (**INH**) -300mg | | | | | |
| 5 | **RH**- (75mg/50mg) for Pedi | | | | | |
| 6 | **RHZ** - (75mg/50mg/150mg) | | | | | |
| 7 | **RHZE**(150mg/75mg/400mg/275mg) and **RH** - (150mg + 75mg) | | | | | |
| 8 | Capreomycine 1gm | | | | | |
| 9 | Cycloserine 250mg tablet | | | | | |
| 10 | Prothionamide 250mg tab | | | | | |
| 11 | Levofloxacin 250mg tablet | | | | | |
| 12 | Pyrazinamide 400mg tablet | | | | | |
| 13 | PAS 4 gm | | | | | |
| 14 | Kanamycin 1gm vial | | | | | |
| 15 | Moxifloxacine 400mg tablet | | | | | |
| | **Laboratory commodities for facilities using Zeihel-Neelsen Staining Technique** | | | | | |
| 16 | 3 % Acid alcohol | | | | | |
| 17 | 1% basic carbol fuchsin | | | | | |
| 18 | 0.1% Methylene blue | | | | | |
| 19 | Oil Immersion | | | | | |
| 20 | Frosted end microscope slide | | | | | |
| 21 | Applicator wooden without cotton | | | | | |
| 22 | Filter paper | | | | | |
| 23 | Lens cleaning solution | | | | | |
| 24 | Lens paper | | | | | |
| | **For HF who have gene xpert machine** | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 25 | xpert MTB/RIF Cartridges | | | | | |
| 26 | Falcon tube 50 ml | | | | | |
| | **Laboratory reagents and consumables for facilities using Fluorescence Microscope** | | | | | |
| 27 | 1% Aura mine O in alcohol | | | | | |
| 28 | phenol solution for Aura mine O | | | | | |
| 29 | 0.5% Acid alcohol solution | | | | | |
| 30 | 0.3% methylene blue | | | | | |
| 31 | Filter paper | | | | | |
| 32 | Sputum cup | | | | | |
| 33 | W.applicator sticks with out cotton | | | | | |
| 34 | Frosted end microscope slides | | | | | |

Table7: Questioner to assess IFRR related questions (from September-February/2010EC)

| | **DUs** | Frequency of IFRR report | Expected no of report | Actually submitted report | No of IFRR that is complete which contains the 4 essential data's |
|---|---|---|---|---|---|
| **1** | TB clinic | | | | |
| **2** | Laboratory unit | | | | |

Table 8: Questioner to assess RRF completeness

| | RRF includes | Beginning balance | Quantity received | Loss/adjustment | Ending balance at DU | SOH at store | Calculated consumption | Days out of stock | Maximum quantity | Quantity to reach max | Quantity ordered |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Yes | | | | | | | | | | |
| 2 | No | | | | | | | | | | |

Table 9 Stock Status (September 1–Febraury 30, 2017/18 and the day of visit)

| Product | Units of count | Managed at this facility? | Bin card available? (Y/N) | Bin card updated? (Y/N) | Balance on Bin card | Stock out most recent 6 months (Y/N) | # of stock outs | Total number of days | Total issued (most recent 6 months) | # of months of data available | Physical ;inventory—Store room | Stock out today? (Y/N) | Quantity of expired products |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ethambutol (**E**) 400mg | | | | | | | | | | | | | |
| Ethambutol (**E**)- 100mg | | | | | | | | | | | | | |
| Isoniazid (**INH**) 100mg | | | | | | | | | | | | | |
| Isoniazid (**INH**) -300mg | | | | | | | | | | | | | |
| **RH**- (75mg/50mg) for Pedi | | | | | | | | | | | | | |
| **RHZ** - (75mg/50mg/150mg) | | | | | | | | | | | | | |
| **RHZE**(150mg/75mg/400mg/275mg) and **RH** - (150mg + 75mg) | | | | | | | | | | | | | |
| Capreomycine 1gm | | | | | | | | | | | | | |
| Cycloserine 250mg tablet | | | | | | | | | | | | | |
| Prothionamide 250mg tab | | | | | | | | | | | | | |
| Levofloxacin 250mg tablet | | | | | | | | | | | | | |
| Pyrazinamide 400mg tablet | | | | | | | | | | | | | |
| PAS 4 gm | | | | | | | | | | | | | |
| Kanamycin 1gm vial | | | | | | | | | | | | | |
| Moxifloxacine 400mg tablet | | | | | | | | | | | | | |

| Product | Units of count | Managed at this facility? | Bin card available? (Y/N) | Bin card updated? (Y/N) | Balance on Bin card | Stock out most recent 6 months (Y/N) | # of stock outs | Total number of days | Total issued (most recent 6 months) | # of months of data available | Physical ;inventory—Store room | Stock out today? (Y/N) | Quantity of expired products |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Laboratory commodities for facilities using Zeihel-Neelsen Staining Technique | | | | | | | | | | | | | |
| 3 % Acid alcohol | | | | | | | | | | | | | |
| 1% basic carbol fuchsin | | | | | | | | | | | | | |
| 0.1% Methylene blue | | | | | | | | | | | | | |
| Oil Immersion | | | | | | | | | | | | | |
| Frosted end microscope slide | | | | | | | | | | | | | |
| Applicator wooden without cotton | | | | | | | | | | | | | |
| Filter paper | | | | | | | | | | | | | |
| Lens cleaning solution | | | | | | | | | | | | | |
| Lens paper | | | | | | | | | | | | | |
| **For HF who have gene xpert machine** | | | | | | | | | | | | | |
| xpert MTB/RIF Cartridges | | | | | | | | | | | | | |
| Falcon tube 50 ml (Leak proof sput | | | | | | | | | | | | | |
| **Laboratory reagents and consumables for facilities using Fluorescence Microscope** | | | | | | | | | | | | | |
| 1% Aura mine O in alcohol | | | | | | | | | | | | | |

| Product | Units of count | Managed at this facility? | Bin card available? (Y/N) | Bin card updated? (Y/N) | Balance on Bin card | Stock out most recent 6 months (Y/N) | # of stock outs | Total number of days | Total issued (most recent 6 months) | # of months of data available | Physical ;inventory—Store room | Stock out today? (Y/N) | Quantity of expired products |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| phenol solution for Aura mine O | | | | | | | | | | | | | |
| 0.5% Acid alcohol solution | | | | | | | | | | | | | |
| 0.3% methylene blue | | | | | | | | | | | | | |
| Filter paper | | | | | | | | | | | | | |
| Sputum cup | | | | | | | | | | | | | |
| Wooden applicator sticks with out cotton | | | | | | | | | | | | | |
| Frosted end microscope slides | | | | | | | | | | | | | |

Table 10. Storage Conditions

Place a check mark in the appropriate column based on visual inspection of the storage facility; note any relevant observations in the comments column**.** ***To qualify as "yes," all products and cartons must meet the criteria for each item.***

| No | Description | Yes | No | Comments |
|---|---|---|---|---|
| 1 | Products are arranged on shelves with arrows pointing up, and identification labels and expiry dates and/or manufacturing dates are visible. | | | |
| 2 | Products are stored and organized in a manner accessible for first-to-expire, first-out (FEFO) counting and general management. | | | |
| 3 | Cartons and products are in good condition, not crushed due to mishandling. If cartons are open, determine if products are wet or cracked due to heat/radiation (fluorescent lights in the case of condoms, cartons right-side up for Depo-Provera®). | | | |
| 4 | The facility makes it a practice to separate damaged and/or expired products from usable products and removes them from inventory. | | | |
| 5 | Products are protected from direct sunlight. | | | |
| 6 | Cartons and products are protected from water and humidity. | | | |
| 7 | Storage area is visually free from harmful insects and rodents. (Check the storage area for traces of bats and/or rodents [droppings or insects].) | | | |
| 8 | Storage area is secured with a lock and key, but is accessible during normal working hours; access is limited to authorized personnel. | | | |
| 9 | Products are stored at the appropriate temperature according to product temperature specifications. | | | |
| 10 | Roof is maintained in good condition to avoid sunlight and water penetration. | | | |
| 11 | Storeroom is maintained in good condition (clean, all trash removed, sturdy shelves, organized boxes). | | | |

| | | | | |
|---|---|---|---|---|
| 12 | The current space and organization is sufficient for existing products and reasonable expansion (i.e., receipt of expected product deliveries for foreseeable future). | | | |

Additional guidelines for specific questions:

**Item 2:** In noting proper product arrangement, consider the shelf life of the different products.

**Item 3:** Check cartons to determine if they are smashed due to mishandling. Also, examine the conditions of the products inside opened or damaged cartons to see if they are wet, cracked open due to heat/radiation, or crushed.

**Item 4:** Conduct the discarding of damaged or expired products according to the facility's procedures (this may differ from one facility to another). Specify if procedures exist and note what they are.

**Item 7:** It is important to check the storage area for traces of rodents (droppings) or insects harmful to the products.

**Item 8:** This refers to either a warehouse secured with a lock or to a cabinet in a clinic with a key.

Table 11: Product wastage (July 1,2017-March 30, 2018)

1. Identify Model numbers of pharmaceuticals received in the specified years
2. Record the quantity of pharmaceuticals expired/damaged in the specified year
3. Take the unit price of each expired product from model 19; if not available, take the current price
4. Calculate cost of pharmaceuticals lost due to expiry, damage and loss for all pharmaceuticals

Note: The total value of pharmaceuticals expired in the specified year from disposal registration form if expired drugs were disposed

| S.N | Name of item | unit | Quantity | Unit price | Total price | remark |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |

## SECTION II:-Qualitative part (in depth interview) with key informants

**ASK pharmacy store manager**

What are the challenges related to inventory management practice in the store? with regard to

- Human resource
- Capacity building and Information
- Management support
- Logistics(resources) needed
- Other challenges

**Ask pharmacy unit coordinators**

What are the challenges associated with pharmacy unit in relation to inventory management? With regard to

- Human resource
- Capacity building and Information
- Management support
- Logistics(resources) needed
- Other challenges

**Ask for laboratory unit coordinator**

What are the challenges associated with laboratory unit in relation to inventory management? with regard to

- transport
- inventory management
- LMIS of TB laboratory reagents