Addis Ababa University
College of Business and Economics
School of Commerce
Department of Logistics and Supply Chain Management

Assessment on the Supply Chain Performance of Anti TB Drugs in Public Health Facilities under City Government of Addis Ababa Health Bureau

By: Zebiba Mekonen

July, 2017
Addis Ababa

Addis Ababa University, College of Business and Economics, School of Commerce,
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Assessment on the Supply Chain Performance of Anti TB Drugs in Public Health Facilities under City Government of Addis Ababa Health Bureau

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Art to Addis Ababa University, College of Business and Economics, School of Commerce in Logistics and Supply Chain Management

By: Zebiba Mekonen

Advisor: Dr. Matiwos Ensermu (Associate Prof.)

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Approved by Board of examiners

Dr. Matiwos Ensermu Advisor	_____ Signature	_____ Date
Dr. Shiferaw Mitiku Internal Examiner	_____ Signature	_____ Date
Dr. Tadewos Mentta External Examiner	_____ Signature	_____ Date

Declaration

I, Zebiba Mekonen declare that this paper is a result of my independent research work on the topic entitled **"Assessment on the Supply Chain Performance of Anti TB Drugs in Public Health Facilities under City Government of Addis Ababa Health Bureau"** in partial fulfillment of the requirements for the **Degree of Masters of Art in Logistics and Supply Chain Management at Addis Ababa University, College of Business and Economics, school of Commerce**. This work has not been submitted for a degree to any other university. All the references are also duly acknowledged.

Zebiba Mekonen

Signature _____

Date _____

Confirmation

This is to certify that Zebiba Mekonen has carried out this research work on the topic entitled **"Assessment on the Supply Chain Performance of Anti TB Drugs in public Health Facilities under City Government of Addis Ababa Health Bureau"** under my supervision. This work is original in nature and has not been presented for a degree in any University and it can be submitted for the partial fulfillment of the requirements for the award of the degree of Masters of Art in Logistics and Supply Chain Management.

Matiwos Ensermu (PhD)

Signature_____

Date_____

Acknowledgment

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Zebiba Mekonen

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List of Abbreviations and Acronyms

ART	Anti-retroviral therapy
CGAAHB	City government Addis Ababa health bureau
DOT	Directly observed therapy
FEFO	First expired first out
FMOH	Federal minister of Health
IFRR	Internal facility report and resupply form
IPLS	Integrated Pharmaceuticals Logistics System
LIAT	Logistic indicator assessment tool
LMIS	Logistic management information system
MDG	Millennium development goals
MDR TB	Multi-drug resistant Tuberculosis
PFSA	Pharmaceuticals Fund and Supply Agency
PLMP	Pharmaceuticals Logistics Master Plan
RHB	Regional health bureau
RRF	Report and requisition form
RR-TB	Rifampicin resistant tuberculosis
SDG	Sustainable Development Goals
SDP	Service delivering points
TB	Tuberculosis
WHO	World health organization
XDR	Extensively drug-resistant tuberculosis

Abstract

Supply chain performance is key for the success of health programs hence measuring performance is essential to identify system inefficiency and away to improve. The aim of this study was to assess the supply chain performance of Anti TB drugs in public health facilities under city government of Addis Ababa health bureau. A cross-sectional descriptive study was conducted at selected health facilities in Addis Ababa by using selected supply chain indicators. A total of sixty four facilities were selected by using stratified random sampling method. Structured questionnaires interviews, facility records and physical observation were used to collect quantitative data. The research revealed that all the hospital and health center studied had the necessary recording and reporting formats but the average percentage of facilities utilized bin card were 75% and 80.7% at hospital and health center. Updated bin card were 82.8% at hospital and 90.8% at health centers. Order entry accuracy in the RRF were 86.9 % and 92.5% at hospital and health centers respectively. All the hospitals and 93% of the health centers refilled in less than a month time. Percentage of facilities received based on the requested quantity was more than 80% both at the hospitals and health center. Average availability of Anti TB drugs on the day of visit were 72.5% and 68% at the hospital and health center respectively. Availability of pediatric formulation were low, only 40% of hospital and 43.3% of health centers had RH (60+30) mg tablet in the day of visit. Similarly only 20% of hospital and 17.5% of health center had pediatric tablet RHZ (60+30+150) on the day of visit. Availability of recording and reporting format is encouraging. However, their utilization and accuracy is relatively low. Order lead time is good but order fill rate needs improvement. Most facilities storage condition meet acceptable criteria but average availability of anti TB drug is low. Specially pediatric anti TB drugs are out of stock or not managed in majority of facilities in the day of visit and during the six month prior to the survey. Even though majority of the indicators shows supply chain improvement, huge gap observed in the availability of pediatric anti TB drugs. Significant number of health facilities stock out or not managed the pediatric formulation on the day of visit and during the six month prior to the survey. Efforts should be made to narrow the observed performance gap and special attention should be given to avail the pediatric anti TB drugs in the health facilities.

Keywords: *Addis Ababa, Anti TB, Performance, Supply chain*

Chapter One

1. Introduction

1.1 Background of the Study

Tuberculosis (TB) has existed for millennia and remains a major global health problem. It causes ill-health in millions of people each year and in 2015 was one of the top 10 causes of death worldwide, ranking above HIV/AIDS as one of the leading causes of death from an infectious disease. This is despite the fact that with a timely diagnosis and correct treatment, most people who develop TB disease can be cured (WHO, 2016).

TB is a major public health problem throughout the world. About a third of the world's population is estimated to be infected with tubercle bacilli and hence at risk of developing active disease (FMOH, 2012).

Tuberculosis (TB) is an infectious disease caused by Mycobacterium tuberculosis, a rod-shaped bacillus called "acid-fast" due to its staining characteristics in laboratory. Tuberculosis is most commonly transmitted by inhalation of infected droplet nuclei (the dried residua of larger respiratory droplets), which are discharged in the air when somebody with untreated sputum-positive pulmonary TB coughs or sneezes (FMOH, 2012).

The best estimate is that there were 1.4 million TB deaths in 2015, and an additional 0.4 million deaths resulting from TB disease among HIV-positive people. In terms of cases, the best estimates for 2015 are that there were 10.4 million new TB cases (including 1.2 million among HIV-positive people), of which 5.9 million were among men, 3.5 million among women and 1.0 million among children. Overall, 90% of cases were adults and 10% children, and the male: female ratio was 1.6:1 (WHO, 2016). In addition to this drug-resistant TB poses a grave and overarching challenge. More than half a million people develop multidrug-resistant TB (MDR-TB) each year. Extensively drug-resistant TB (XDR-TB), an even more severe form of the disease, has been reported in 105 countries. In spite of all the effort made, three out of four people with drug-resistant TB are not accurately diagnosed, and less than a quarter of those estimated to have the disease start treatment each year (Stop TB partnership, 2015).

Tuberculosis and Leprosy have been recognized as major public health problems in Ethiopia. Efforts to control tuberculosis began in the early 1960s with the establishment of TB centers and sanatoriums in three major urban areas in the country (FMOH, 2012).

According to World Health Organization (WHO) global TB report of 2016, Ethiopia is among the 30 high TB burden countries and among the 30 high MDR/RR-TB burden countries in the world. Based on WHO global TB report 2016 there were an estimate 191,000 (192 per 100,000) incident case of TB in Ethiopia in 2015. And estimated 25,000 deaths (26 per 100,000) due to TB reported in the same period. In this reporting period, there were an estimate 6200 (6.2 per 100,000) incidence case of MDR/RR-TB in Ethiopia.

From 2000 to 2015, global and national efforts to reduce the burden of tuberculosis (TB) disease were focused on achieving targets set within the context of the Millennium Development Goals (MDGs) (WHO, 2016).To build on the achievements of directly observed therapy (DOTS) and address the remaining challenges, the STOP TB strategy was launched by WHO in 2006 to help achieve the millennium development goals for TB in 2015. Ethiopia also adopted this strategy to achieve the national TBL and TB/HIV targets. This Strategy has six components where DOTS remains the most important component of the strategy (FMOH, 2012). The sub components of pursue high quality DOTS expansion and enhancement are providing standardized treatment with supervision and patient support and ensure effective drug supply and management which have direct relationship with the performance of drug supply chain management.

The MDGs (2000–2015) have now been superseded by the Sustainable Development Goals (SDGs), which have an end date of 2030. Similarly, WHO's Stop TB Strategy has been replaced by the End TB Strategy, which covers the period 2016–2035(WHO, 2016).

Pharmaceuticals Fund and Supply Agency (PFSA) was established in 2007 by Proclamation No. 553/2007 based on the Pharmaceuticals Logistics Master Plan (PLMP). The Agency is mandated to avail affordable and quality pharmaceuticals sustainably to all public health facilities and ensure their rational use(PFSA, 2015).In 2009 to execute this mandate PFSA, in partnership with its support partners—the USAID |DELIVER PROJECT, Supply Chain Management Systems (SCMS), and others in the sector—developed and began implementing the Integrated Pharmaceuticals Logistics System (IPLS).

Prior to the beginning of IPLS, various health programs including family planning, HIV and AIDS, tuberculosis (TB), and malaria used their own vertical logistics systems to deliver medicines (Shewarega *et al*., 2015).

IPLS integrates the management of essential pharmaceuticals including the following pharmaceuticals that were used to be managed vertically: HIV/AIDS, Malaria, TB and

Leprosy, EPI, MCH and purchased essential drugs. It is the primary mechanism through which all public health facilities obtain essential and vital pharmaceuticals (PFSA, 2015).

The goal of a health logistics system is much larger than simply making sure a product gets where it needs to go. Ultimately, the goal of every public health logistics system is to help ensure that every customer has commodity security. Commodity security exists when every person is able to obtain and use quality essential health supplies whenever he or she needs them. A properly functioning supply chain is a critical part of ensuring commodity security—financing, policies, and commitment are also necessary (USAID/DELIVER, 2011). Effective supply chains not only help ensure commodity security, they also help determine the success or failure of any public health program. Well-functioning supply chains benefit public health programs in important ways by increasing program impact, enhancing quality of care and improving cost effectiveness and efficiency (USAID/DELIVER, 2011).

To show improvement in operations, many supply chain management specialists consider implementing supply chain performance indicators or metrics as one of the simplest, least expensive, and least time-consuming activities (Aronovich *et al.,* 2010).

The study will examine the supply chain performance of Anti TB drugs in the facilities under city government of Addis Ababa health bureau (CGAAHB).

1.2 Statement of the Problem

Much of the total global burden of disease is attributable to diseases that are preventable or treatable using modern pharmaceutical drugs. Efficient and effective supply chains are critical to ensuring medicines are available when and where patients that need them, especially in low and middle-income countries where high costs may limit the supply of drugs (Whitney, 2010).

Positive health outcomes are highly dependent on how well the health delivery system health information, financing, personnel and supply chain (including supplies) is performing (Aronovich*et al.,* 2010). Health program cannot succeed unless the supply chain delivers a reliable, continuous supply of health commodities to its customer (USAID/DELIVER, 2011). In most health system, the potential for improving the supply process is tremendous, reflecting in part the magnitude of current inefficiencies and waste (Management Science for Health, 2012).

The importance of having medicines and other supplies available at the health facility cannot be overstated, and their availability often depends on how well or how poorly the supply chain

is performing. But, to improve supply chain performance, you must understand how it is currently performing (e.g., it needs to be measured). The information will show where the supply chain is inefficient and will help determine how to address the gaps. Routine monitoring reports show that IPLS is improving information recording and reporting, storage and distribution systems, as well as the availability of essential commodities at service delivering point (SDPs) (Shewarega *et al.*,2015). The key to successfully improving supply chain performance is to focus on those areas that are not only under-performing but, also, those that are aligned with the overall supply chain strategy (Aronovich *et al.,* 2010).

There are surveys done to assess the logistic function of pharmaceuticals in relation to ART medicines, ART and Anti TB laboratory commodities. However, there is a gap in measuring the supply chain performance of Anti TB drugs both nationally and regionally. The purpose of the research is therefore to assess the supply chain performance of Anti TB drugs in public health facilities under City government of Addis Ababa heath bureau.

1.3 Research Question

- What is the inventory record accuracy rate of Anti TB drugs?
- What is the percentage of order entry accuracy for Anti TB drugs in the facilities?
- How long is the average order lead time of Anti TB drugs?
- How effective a distribution of Anti TB drugs in satisfying order made by facilities?
- How good is the storage condition of health facilities?
- What is the stock status and availability of Anti TB drugs in the facilities?

1.4 Research Objectives

1.4.1 General objective

The general objective of the study is to assess the supply chain performance of Anti TB drugs in the health facilities under City Government of Addis Ababa Health Bureau by using selected supply chain performance indicators.

1.4.2 Specific objectives

- To assess the inventory control performance of facilities for Anti TB drugs
- Assessing facilities ability to enter order correctly in to their order processing system
- Measuring the order lead time of products in the facilities
- To determine how effective a distribution is in satisfying the customer order
- To analyze the storage condition of health facilities
- To determine availabilities and stock status of Anti TB drugs in the facilities

1.5 Significance of the Study

The study has the following significance

It will provide information about the status of the supply chain performance of Anti TB drugs for Addis Ababa city health bureau, policy makers and stakeholders. In addition the study will help to identify the strength and the gaps of the supply chain performance of health facilities. Recommendation will be given on where to focus and how to improve the observed gaps in the supply chain of anti TB drugs and help to enhance the anti TB service for the public.

Moreover the study contribute to anyone who works, manage, support and improve public health logistic system .It also help the reader to enrich knowledge in the area and show away for further studies

1.6 Scope of the Study

The scope of the study includes to assess the supply chain performance making the focus on Anti TB drugs in the public health facilities under city government of Addis Ababa health bureau. Hospitals and health center under the regional health bureau included in the study and selected anti TB drugs are studied. The scope of the study did not include the federal hospitals in Addis Ababa. In addition to this private health facilities and other NGO health facilities are not part of this study.

1.7 Limitation of the Study

The sample is taken from one city administration, Addis Ababa where many of the organization working on the supply chain resides and the distance of the health facilities with the supplying organization is in good proximity. This may not represent the other area of the countries with different geographical as well as organizational context. The study is cross sectional type conducted for short period of time, studying the supply chain for short period reflects the performance of the study period only the finding will be indicative but not necessarily representative. In addition, not getting similar studies make it difficult to compare the result.

1.8 Definition of Terms

Anti TB drugs- Drug used for the treatment of TB

Frist line anti TB drugs- the first choice of anti TB drug combinations used in the standard treatment of TB both for adult and pediatric patients

Pediatric formulations - Anti TB drug preparation for pediatric patients

IPLS- Integrated pharmaceutical logistics system, is the primary mechanism through which all public health facilities obtain essential and vital pharmaceuticals.

PFSA- Pharmaceutical fund and supply agency, governmental organization mandated to supply essential public health medicines (including Anti TB drugs) to the public health facilities throughout the country.

Tuberculosis (TB) - is an infectious disease caused by Mycobacterium tuberculosis.

LIAT- logistic indicator assessment tools, a quantitative data collection instrument developed by USAID | DELIVER PROJECT, is used to conduct a facility-based survey to assess health commodity logistics system performance and commodity availability at health facilities

1.9 Organization of the Thesis

The thesis structured into five chapters.

Chapter I – Introduction in this stage the author briefly discusses the background information about the research topic which is supply chain of health commodities and indictors measuring the performance of supply chain of health commodities and hence anti Tb medicines. Then the chapter presents the statement of the problem, research question, research objectives, scope of the study and its limitation. At last elaborate the significance of the study in the field of supply chain management in the public health programs.

Chapter II- Literature review made by reviewing relevant materials in the field of supply chain management of pharmaceuticals, performance measuring indicators and measuring the performance of supply chain of pharmaceutical and its implication towards the success of public health programs.

Chapter III-Research methodology in this chapter the research methods, research design, sampling techniques and the data types and data collection methods and tools used for the study described.

Chapter IV- In this chapter results, discussion and interpretation part of the study covered.

Chapter V- In this chapter, the summary of major findings, conclusion and recommendation are made accordingly.

Chapter Two

2. Review of Related Literature

2.1 Supply Chain Management

According to the Council of Supply Chain Management Professionals (CSCMP) — "Supply chain management encompasses the planning and management of all activities involved in sourcing and procurement and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies.

Supply chain management is also defined, as "the coordination and management of a complex network of activities involved in delivering a finished product to the end-user or customer" (Hervani and Sarkis, 2005). The supply chain management includes the logistics activities plus the coordination and collaboration of staff, levels, and functions. The logistics activities in the supply chain management includes the operational components like quantifications, procurement, inventory management, transportation and fleet management, data collection and reporting (USAID/DELIVER ,2011).Supply chain activities cover everything from product development, sourcing, production, distribution to the end customer and logistics, as well as the information systems needed to coordinate these activities.

Supply Chain Management integrates supply and demand management within and across companies. An integrated supply chain management streamlines processes and increases profitability by delivering the right product with the right quality and quantity, to the right place, at the right time, and at the lowest possible cost. In addition, the supply chain management also facilitates customer service improvements. It enables the management of inventories, transportation systems and whole distribution networks so that organizations are able to meet or even exceed their customers' expectations.

To facilitate the flow of product, information shared up and down the supply chain, this enables the parties in the supply chain to plan appropriately and to meet their current and future needs.According to Lambert and Cooper (2000), operating an integrated supply chain requires continuous information flows, which in turn assist to achieve the best product flows. Since the major objective of supply chain management is to reduce or eliminate the buffers of inventory that exists between organizations, cost reduction, product time to market reduction and

flexibility enhancing in chain through the sharing of information on demand and current stock levels (Gunasekarana, 2004).

2.2 Health Supply Chain Management and Logistic

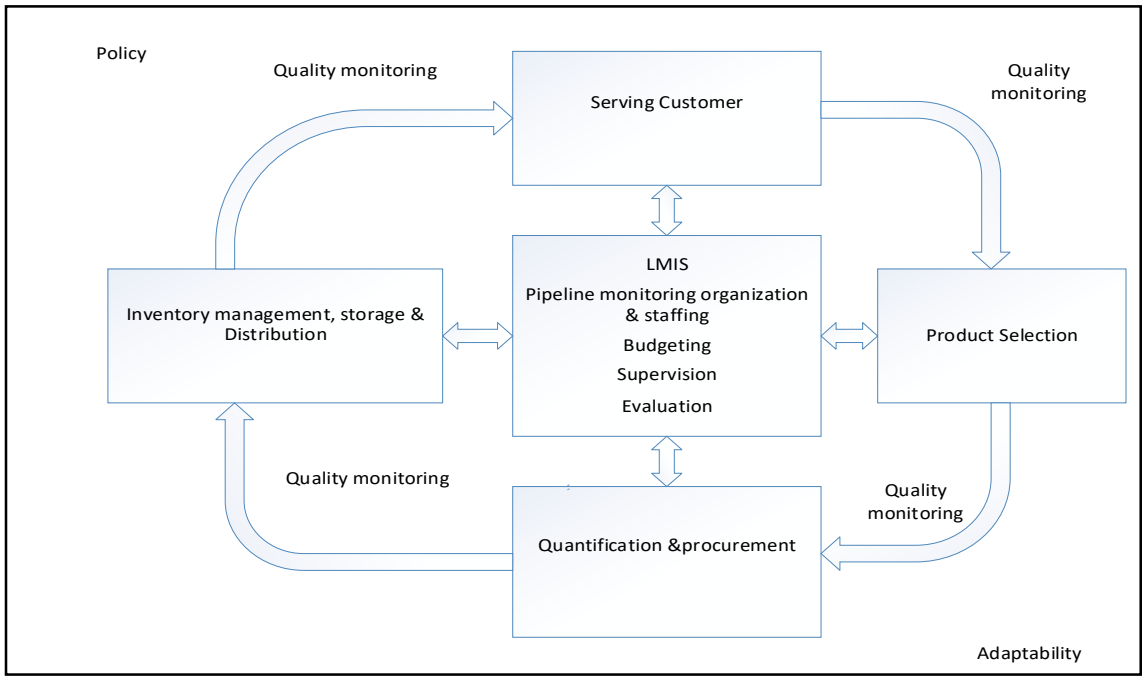
The supply chain is an important element in logistics development for all industries. It can improve efficiency and effectiveness of not only product transfer, but also information sharing between the organizations in the supply chain. In recent years, effective supply-chain management has emerged as a significant competitive advantage for companies in very different industries (Chopra and Meindl, 2000). The same logic applied with the health supply chain management.

Healthcare supply chain management is the management of the flow of medical products and services from manufacturer to patient. In health care managing the supply chain is very complex and fragmented process. As in the commercial supply chain and logistics activities the main goal of health supply chain and logistics is to ensures that the right product, in the right quantities, in the right condition, are delivered to the right place, at the right time, for the right cost. In logistics, these rights are called the six rights. In fact, pharmaceutical supply chain management practice should be applied to achieve maximum efficiency since it deals with essential medicines. Essential medicines are medicines that significantly affect the common cause of morbidity and mortality, including acute respiratory, diarrheal disease, HIV/AIDS, Measles, malaria, maternal and prenatal mortality, tuberculosis, cardiovascular and other chronic disease. Moreover, medicine have special importance for the reason medicine save life and improve health, promote trust and participation in health services, they are also costly, different from other consumer products and improvements in the supply and use of medicine is possible. (Management Science for Health, 2012)

According to the USAID/DELIVER (2011) “The goal of a health logistics system is much larger than simply making sure a product gets where it needs to go. Ultimately, the goal of every public health logistics system is to help ensure that every customer has commodity security. Commodity security exists when every person is able to obtain and use quality essential health supplies whenever he or she needs them. A properly functioning supply chain is a critical part of ensuring commodity security—financing, policies, and commitment are also necessary”. Beside ensuring commodity security an effective and well-functioning supply chain determine the success and failure of public health program, it also benefit the public

health programs in many ways by increasing program impact, enhancing quality of care and improving cost effectiveness and efficiency (USAID/DELIVER,2011).

Pharmaceutical logistics management includes the four basic logistics functions that support the six rights of logistics as depicted in the logistics cycle below.



(Source: USAID/DELIVER, 2011)

Figure 1. Logistic cycle

In the framework, the process is cyclic to indicate that the activities are repetitive over time and each major activity are affected by the other activities, each function build on the previous functions and leads logically to the next. Serving customer, product selection, quantification, procurement and inventory management depends on and affected by the other activities. Selection should be based on actual experience with health needs and medicine use, procurement requirements follow from selection decisions and so forth. In the center of the pharmaceutical logistics cycle represent the management support functions: organization, financing and sustainability, information management and human resource management. These management support inform and impact the other elements around the logistics cycle and hold them to work together (USAID/DELIVER, 2011& Management Science Health, 2012)

The basic structure of the pharmaceutical supply system for public health service in a country should established and the pharmaceutical supply chain management practice should be applied to achieve maximum efficiency. Although many variations exist, according to Management Science for Health (2012) five basic approaches are used for organizing pharmaceutical supply for public health services.

1. Central medical store (CMS): Traditional public sector pharmaceutical supply system, in which medicines are procured and distributed by central government unit.
2. Autonomous supply agency: an alternative to the CMS system, managed by an autonomous or semi-autonomous pharmaceutical supply agency.
3. Direct delivery system: a decentralized, non-CMS approach in which medicines are delivered directly by suppliers to districts and major facilities. The government pharmaceuticals procurement office selects the supplier and establishes the price for each item, but the government does not store and distribute medicines.
4. Primary distributor (or prime vendor system): Another non-CMS system in which the government pharmaceutical procurement office establishes a contract with one or more primary distributors as well as separate contracts with pharmaceutical supplier. The contracted primary distributor receives medicines from the suppliers and then stores and distributes them to districts and major facilities.
5. Primarily private supply: An approach used in some countries that allow private pharmacies in or near government health facilities to provide medicines for public sector patients.

In Ethiopia, the FMOH initiated a comprehensive supply chain strategic planning process, emphasizing the integration of all products into one supply chain, in late 2006, the Ministry approved the Pharmaceutical Logistics Master Plan (PLMP) and consequently PFSA was established by proclamation in 2007. The agency mandate is to avail affordable and quality pharmaceuticals sustainably to all public health facilities and ensure their rational use. To execute its mandate in the area of pharmaceuticals supply in an efficient and effective manner, integrated pharmaceuticals logistics system (IPLS) was introduced. IPLS is the term applied to the single pharmaceuticals reporting and distribution system based on the overall mandate and scope of the PFSA. IPLS integrates the management of essential pharmaceuticals including the following pharmaceuticals that were used to be managed vertically: HIV/AIDS, Malaria, TB and Leprosy, EPI, MCH and purchased essential drugs. (PFSA, 2015 and Shewarega *et al.,* 2015) In IPLS health program pharmaceuticals are ordered every two months by hospitals and

health centers by using standard format called (Report and Requisition form)RRF and pharmaceuticals delivered by PFSA to these facilities directly or indirectly every other month. Internal facility report and resupply form (IFRR) is the standard report form used by dispensing units in the facility to report and request for resupply from the store. Direct delivery sites are facilities that receive program pharmaceuticals directly from PFSA hubs whereas non-direct delivery sites are health centers that receive products from PFSA hubs through Woreda Health Offices (WoHOs) and health posts report to health centers by HPMRR form monthly and collect pharmaceuticals from those health centers accordingly. Anti TB drugs and related commodities are among one of the essential medicines that managed through IPLS in integration with the other program products. PFSA is the sole supplier of all program medicines including anti TB medicines to all public health facilities in the country. And IPLS is the supply chain system through which all public health facilities get their supplies.

In IPLS the basics logistic functions at the health facility level are logistics management information system (LMIS), inventory control system and storage of pharmaceuticals under each function different activities performed.

2.3 Supply Chain Performance Measurement

Supply Chain Performance refers to the extended supply chain's activities in meeting end-customer requirements, including product availability, on-time delivery, and all the necessary inventory and capacity in the supply chain to deliver that performance in a responsive manner. (Hausman, 2004)

Performance measurement enables supply chain to strategically manage and continuously control achieving of objectives. It provides the necessary assistance for performance improvement in pursuit of supply chain excellence. To be successful supply chain needs continuous improvement, to achieve this it needs performance measures or metrics to support the supply chain performance improvement. It is important not only to measure the right logistics indicators, it is important to measure them well (Aronovich *et al.,* 2010). The quality of performance indicator is important in the supply chain performance measurement, according to Keepler (1999) the characteristics of good performance measures are to be quantitative, easy to understand, visible, measure only what is important, encourage appropriate behavior, defined and mutually understood it also encompass both the output and inputs, to be multidimensional, use economies of effort and one that facilitate trust.

According to model developed by Edward Frazelle (2001), there are four main categories of supply chain performance metrics: quality, time, financial, and productivity.

Quality: These indicators tell you how well you are performing a specific activity—a common logistics indicator in this classification is accuracy— including order accuracy, inventory accuracy, picking accuracy, etc.

Time: These indicators focus on the time intakes to complete specific activities and show operational effectiveness.

Financial: These indicators help managers identify the supply chain cost drivers and help move toward a more efficiently managed supply chain.

Productivity: These indicators examine how well resources are used.

It is very important to view these indicators holistically to make sure they are harmonized and not working against each other and to identify the tradeoffs required to strategically improve overall supply chain performance.

The selection of right performance metrics is very crucial issue, the appropriate measures do not only offer a means of tracking how far an organization is from achieving its objectives, but also provide a means of communicating strategy and encouraging its implementation (Agami *et al.,* 2012) There are countless metrics that can be used by managers to evaluate operations. These measures are often industry specific, and different measures should be used to assess organizational performance based on the nature of the organization (Elrod C, Murray S & Bande S, 2013). According to USAID/DELIVER (2008) the logistic indicator assessment tool (LIAT), a quantitative data collection tools can be used to measure the performance of process involved in the supply chain management of health commodities. The core logistic indicators measured includes accuracy of logistics data for inventory management, percentage of facilities that receive the quantity of products ordered, percentage of facilities that maintain acceptable storage conditions, percentage of facilities that experienced a stock out at any point during a given period or at the time of the visit, order fill rate and inventory accuracy rate and many other related indicators.

2.4 Significance of measuring supply chain performance for health programs

Supply chain performance is very essential for the success of health programs. “Positive health outcomes are highly dependent on how well the health delivery system, health information, financing, personnel and supply chain (including supplies) is performing.” (Aronovich *et al.,* 2010).

To increase the supply chain performance and to avail pharmaceuticals sustainably at the health facilities it needs an understanding of how the system currently perform and system needs to be measured. Measuring the supply chain performance by making use of different performance indicators will help to identify the system its inefficiency and help to address the deficiencies. Indicators are variables that measures change, they are useful tools for mangers to track the performance of a particular aspect or activities of the pharmaceutical supply system as well as the performance of the overall system. Performance indicator facilitate tracking a program’s progress towards a desired goal, to achieve such result indictors should meet the criteria of clarity, usefulness, measurability, reliability, validity and acceptance by stakeholders (Management Science for Health,2012)

The importance of availability of medicines at the health facilities is very essential for the success of the program moreover availability of medicines at the health facilities is the reflection of how well or how poorly the supply chain is performing. Health program cannot succeed unless the supply chain delivers a reliable, continuous supply of health commodities to its customer.

Household and patient survey around the world have found that pharmaceutical availability is a major determinant of where patient go for health care and how satisfied they are with that care in addition availability of medicine affect the productivity of health staff. When pharmaceuticals are not available the patient seeking, the care dropped and the health staff left idle. Irregular pharmaceuticals supply can be a greater constraint for program effectiveness than inadequate numbers or training of health professionals (Management Science for Health, 2012).

According to Gunasakaran (2004) performance measurement is an important aspect of successful supply chain management. And successful supply chain management of health system is essential to achieve the six rights of logistic and in turn to have a successful health outcomes and hence health programs.

Chapter Three

3. Methodology of the Study

3.1 Study Area

The study was conducted in Addis Ababa the capital city of Ethiopia. The city is located at the heart of the country at an altitude ranging from 2100 meter in the south to 3000 meter in the north which makes Addis Ababa the third highest city in the world. The city occupies a total of 540 Sq. Km, it is the largest as well as the dominant political, economic, cultural and historical city of Ethiopia. It is were Africa Union, united Nation Economic commission for Africa(UNECA)and numerous other continental and international organization based. The city is divided in to ten sub-city and there are 116 woredas in the city administration (City government of A.A, 2013). According to central statistics agency (2012/2013) report the city has an estimated population of 3.04 million. Currently the city government health bureau has 6 hospital and 94 health center where all provide Anti TB service.

3.2 Research Approach

Quantitative data was collected through the structured questionnaire by physically interviewing the respondent and site observation to collect primary data for the survey (Annex 1).

3.3 Research Design

Facility based descriptive cross-sectional survey was used to assess the supply chain performance of anti TB drugs in health facilities under city government of Addis Ababa Health Bureau. Quantitative data was collected by using structured questionnaire adopted from LIAT originally developed by USAID/ DELIVER project modified according to the study objective. Indicators selected based on their significance for the research problem and the availability of required data.

3.4 Population and Sampling

The study was conducted in Addis Ababa city; the study population were health facilities under city government of Addis Ababa health bureau providing anti TB service to the public. The health facilities were divided in two strata the first were hospitals under AACGHB and the second were health centers under the city administration. Out of the 100 health facilities administered under the health bureau, all 6 hospitals and 58 randomly selected health centers were included in the study. The sample size for the health centers was calculated using the formula for probability random sampling

n= (z2pq) + ME2/ME2+z2pq/N (Cochran, W.G, 1977)

Where n is the sample size, z confidence level, p is previous proportion and q is 1-p. ME is marginal error and N is population size.

Here 89% availability of medicines from previous study (Shewarega *et al.,* 2015), 5% margin of error and 95% confidence level were used.

3.5 Data Source and Type

Health care professionals working in the supply chain management of anti TB drugs in the selected health facilities and the documents used in the supply chain management of anti TB drugs considered as the source of data. Primary data collected through the interview by using structured questionnaires and observation of the site while conducting physical counts.

3.6 Data Collection Procedures

The primary data collected through structured questionnaire adopted from LIAT which is originally developed by USAID/DELIVER project and modified according to the research objective and a set of standard indicator selected to measure the supply chain performance of Anti TB drugs. For quality assurance purpose and to check the validity and reliability of the data, orientation was given to data collectors, the tool pre-tested in some facilities, feedback collected and some modifications made before beginning of actual data collection. Interview conducted by physically meeting the respondent and recording the response in the questionnaire. Observation were also means of primary data collection while conducting physical count of products to compare the figure with the recorded documents. Secondary data

collected from different literatures, research paper, article and Journal through internet and from library used in addition to health facility documents to build the literature review.

3.7 Ethical Consideration

The proposal and study protocol submitted to Addis Ababa University School of Commerce and get the approval first, then the school issue a support letter to city government of Addis Ababa health bureau. Ethical clearance obtained from Addis Ababa Public Health Research and Emergency Management Core process after reviewing the proposal and the study protocol. Then, city government of Addis Ababa health bureau issue a supporting letter to the selected health facilities before the beginning of the study. The consent of the respondent was asked and the name of respondent and the health facilities kept confidentially throughout the study.

3.8 Result Dissemination

Results of the study will be disseminated to Addis Ababa Public Health Research and Emergency Management Core Process, Addis Ababa University, College of Business and Economics School of commerce and Organization working on the supply chain management of program pharmaceuticals.

3.9 Data Entry and Analysis

The data collected was entered in to EpiData version 3.1 and transferred to statistical package for social science (SPSS). The data collected was checked for completeness; data cleaning and analyzing performed by using SPSS version 20 and results displayed through appropriate graphs, table and percentages.

Chapter Four

4. Results and Discussion

4.1 Results

In this study, a total of 64 health facilities under city government of Addis Ababa health bureau were included out of which all the six hospitals and 58 randomly selected health center were studied. From all the health facilities a total of 64 health professionals were interviewed, facilities records and report seen as well as physical observation were done. Out of the sampled health facilities one hospital and health center were found not providing anti TB service and not managing any of the anti TB drugs hence exempted in the data analyzed.

4.1.1 Availability, utilization and accuracy of inventory data record and reports

In IPLS, there are different types of standard recording and reporting formats to be used for proper functioning of supply chain management of pharmaceuticals. The availability and proper utilization of such standard formats like Bin card, RRF and IFRR are very good indicator of supply chain performance and studied in this survey.

4.1.1.1 Availability and utilization of bin card

The availabilities of Bin card was found to be very high 100% both at the hospitals and health centers. All hospital and health centers reviewed had inventory recording bin card at the time of visit. The average percentage utilization of bin card for anti TB medicines in both facility type and its update status also studied. Average bin card used for anti TB medicine at the hospital and health center were 75% and 80.7% respectively. Percentage of facilities with bin card updated were 82.8% and 90.8% in hospitals and health centers (Table 1). To consider bin cards up-to-date, they had to be 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 that product since the date of that entry, it is also considered updated. More over the percentage of updated bin card were calculated from facilities that utilized bin cards for the products assessed.

Table 1. Percentage of facilities where bin card were used and updated for Anti TB drug by product and facility types, Addis Ababa, 2017

Product	Hospitals		Health Centers	
	Bin card Used(no)%	Bin Card Updated(no)%	Bin card Used (no)%	Bin Card Updated (no)%
RHZE/RH adult kit	(5)100	(4)80	(55)96.5	(54)98.2
Ethambutol 400mg	(5)100	(4)80	(54)94.7	(53)98.1
Streptomycin 1 gm	(5)100	(4) 80	(55) 96.5	(50)90.9
Isoniazid 300mg	(5)100	(4)80	(55)96.5	(50) 90.9
RH(60+30)mg	(2)40	(2)100	(38)66.7	(30)78.9
RHZ(60+30+150)mg	(1)20	(1)100	(12)21.1	(10)83.3
Ethambutol 100mg	(3)60	(2)67.7	(48)84.2	(46)95.8
Isoniazid 100 mg	(4)80	(3)75	(51)89.5	(46)90.2
Average	**75**	**82.8**	**80.7**	**90.8**

(Source: Own survey, 2017)

All the hospitals 100% use bin card for all adult drugs RHZE/RH kit, Ethambutol 400mg, Streptomycin 1gm and Isoniazide 300mg. Where more than 95% of health center use bin card for these adult preparations. The hospital bin card utilization shown to be low for pediatric preparations, only 20% use bin card for RHZ (60+30+150) mg and 40% for RH (60+30) mg. Use of bin card in health center were also 21.1% for RHZ (60+30+150) mg and 66.7% for RH (60+30) mg.

Among the utilized bin cards in hospitals 80% of them updated for the adult drugs including the RHZE/RH kit. And 98.2% of health center updated bin card for RHZE/RH kit and more than 90% for the other adult products. The percentage of facilities with updated bin card were increased for the pediatric products both at the hospital and health center. It found to be 100% for both RHZ (60+30+150) mg and RH (60+30) mg in the hospital and more than 80% in the health center.

4.1.1.2 Accuracy of data record on the bin card

The survey was also assessed the quality of inventory data recording on the bin card by cross-checking the accuracy of the bin card balance with the physical inventory count for each of the selected Anti TB drugs on the day of the visit. (Table 2) Despite the low percentage of bin card updated hospitals inventory data record accuracy was high, all the data on the updated bin card were found to be 100% accurate when cross checked with the physical inventory value observed on the day of visit. However health centers inventory data record exhibited some level of discrepancy, ranging from 3.7% to 20%. RHZE/RH kit shown the least discrepancy in 3.7% of health centers. Higher percentage of discrepancy were seen for RHZ (60+30+150) mg and RH (60+30) mg in 20% and 16.7% of health centers.

Table 2: Percentage of health facilities with updated bin card and discrepancy in the data record by product and facility type, Addis Ababa, 2017

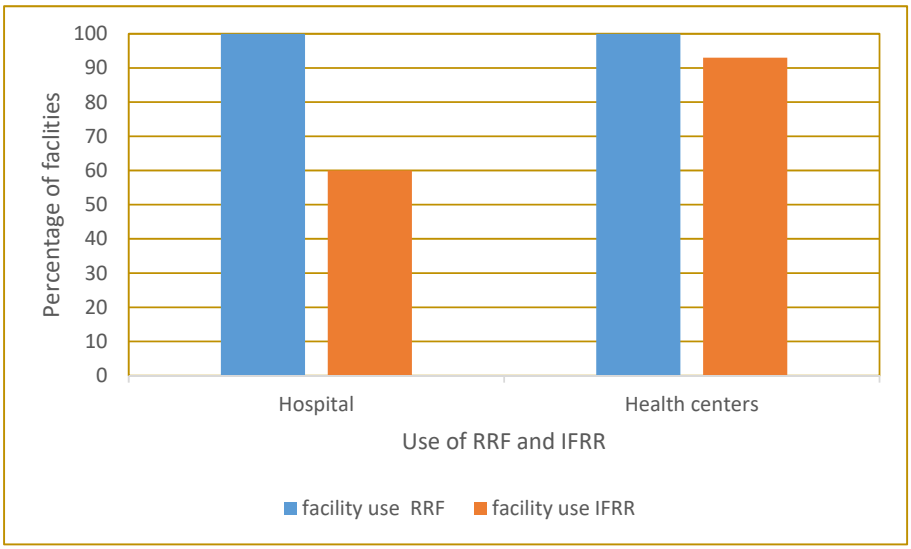
Product	**Hospitals**		**Health Centers**	
	Facilities with up dated bin card (no)%	**Facilities With discrepancy (no)%**	**Facilities with updated bin card (no)%**	**Facilities with discrepancy(no)%**
RHZE/RH adult kit	(4)80	0	(54)98.2	(2)3.7
Ethambutol 400mg	(4)80	0	(53)98.1	(3)5.7
Streptomycin 1 gm	(4)80	0	(50)90.9	(9)18
Isoniazide 300mg	(4) 80	0	(50)90.9	(4) 8
RH(60+30)mg	(2)100	0	(30)78.9	(5)16.7
RHZ(60+30+150)mg	(1)100	0	(10)83.3	(2) 20
Ethambutol 100mg	(2)67.7	0	(46)95.8	(2)4.3
Isoniazide 100 mg	(3)75	0	(46)90.2	(6)13
Average	**82.8**	**0**	**90.8**	**11.2**

(Source: Own survey, 2017)

4.1.1.3 Availability and utilization of reporting formats

Logistic reports move data up and down through the supply chain and help in decision making. To facilitate correct and consistent reporting in IPLS facilities use RRF and IFRR to send their reports to PFSA and facility store for resupply. The study discovered the availability, use and accuracy of these reporting formats for anti TB drugs. All the reporting format were available in all of the health facilities. RRF were used and completed in 100% of the facilities for anti TB drugs. However the percentage of facilities that used IFRR regularly were shown only 60% at the hospitals and 93 % at the health centers. (Figure 1)

Figure 2. Percentage of facilities used RRF and IFRR by facility types, Addis Ababa, 2017

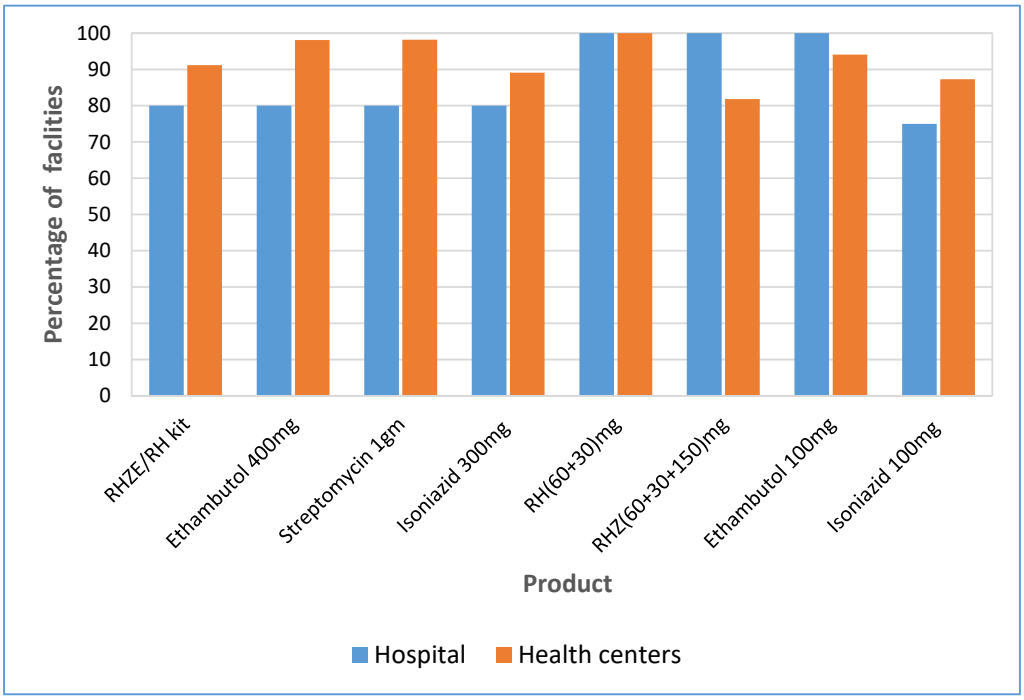


(Source: Own survey, 2017)

4.1.1.4 Accuracy of order entry

The data entry accuracy of RRF reports were also checked by comparing stock on hand reported on the RRF with the balance on the bin card on the date that the RRF report was completed. Average data order entry accuracy on RRF was 86.9 % at hospital and 92.5% at health centers. The minimum accuracy were observed in 75% of hospitals for Isoniazid 100mg and 81.8%of health centers for RHZ (60+30+150) mg at health center. All the adult anti TB medicines (RHZE/RH, Ethambutol 400mg, Streptomycin and Isoniazid 300mg) experienced 80% accuracy rate at hospitals. Three pediatric medicine (RH (60+30) mg, RHZ (60+30+150) mg and Ethambutol 100mg) had 100% order entry accuracy rate at the hospitals. The order entry accuracy rate on RRF at the health center range from 81.8% for RHZ (60+30+150) mg to 100% for RH (60+30) mg.

Figure 3. Percentage of health facilities with accurate order entry on RRF by the products and facility type, Addis Ababa, 2017

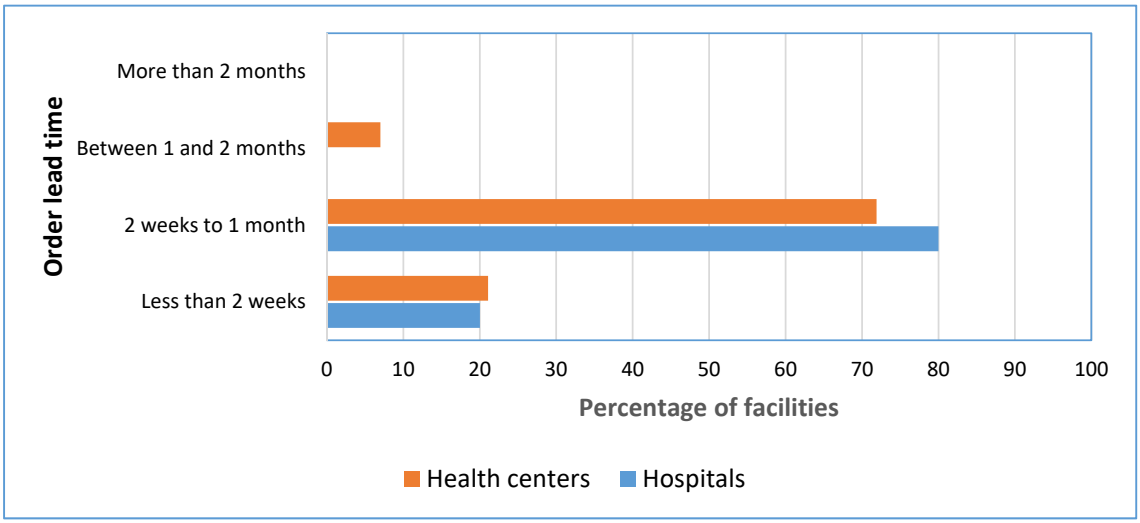


(Source: Own survey, 2017)

4.1.2 Order lead time

Order lead time is the average duration of time between the dates an order placed and when it was received. The study revealed the perceived lead time of anti TB medicine both at hospitals and health centers by assessing the perceptions of facility staff on the timeliness and the resupply lead time of products. Regardless of the type of product, 100 % of hospitals said they usually received product they request within one month. Out of which 20%received with less than two weeks and the rest 80% said resupplied their order between 2 weeks and 1 month duration of time. Majority of health center, 93% replied that they usually received products requested within one month or less. Only 7 percent of the health centers reported to wait more than 1 month to 2 months to receive products after placing orders. There were no facility both at the hospital and health center that waited more than 2 month for order resupply.

Figure 4. Percentage of facilities with perceived order lead time for anti TB medicine by facility type, Addis Ababa, 2017

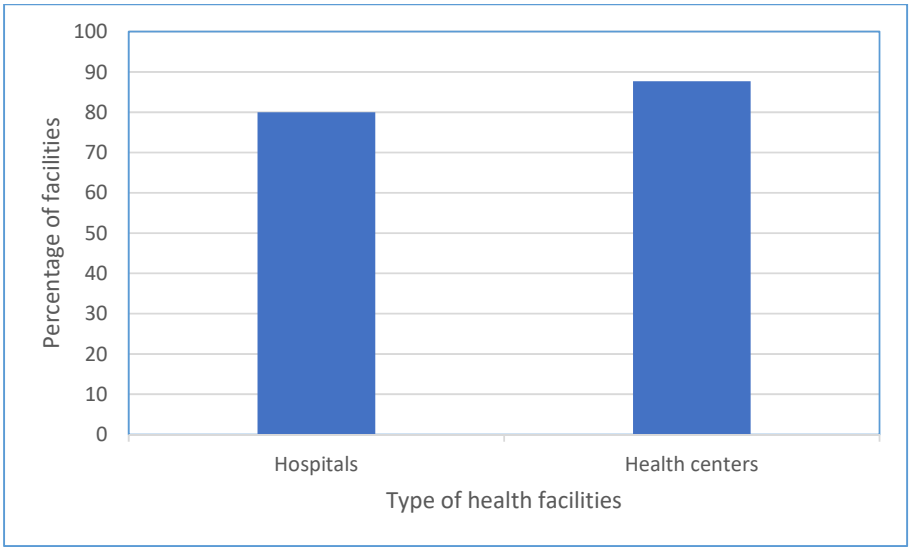


(Source: Own survey, 2017)

4.1.3 Order fill rate

The perceived order fill rate, the perception of facility staff whether they usually get the quantities of anti TB drugs they order or not were assessed. Majority of facilities, 80% of hospitals and 87.7% of health centers replied that they usually get the quantity of products they ordered.

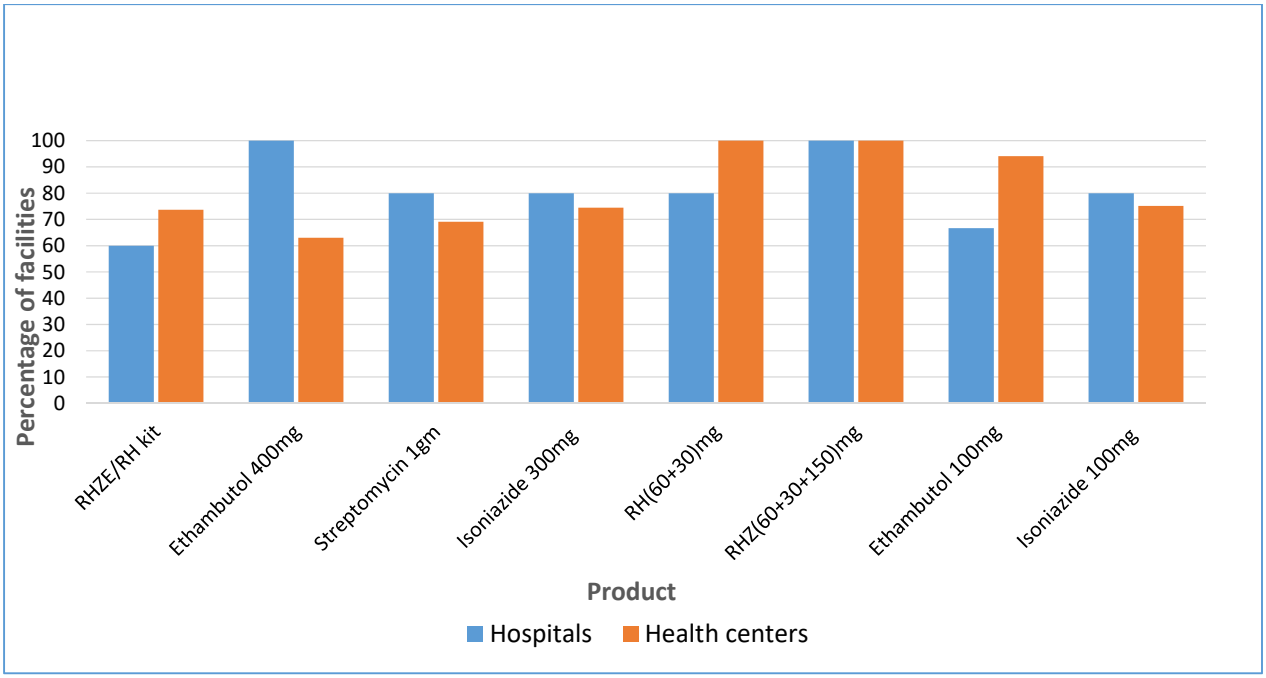
Figure 5. Percentage of facilities with perceived order fill rate of anti TB drugs by facility type, Addis Ababa, 2017



(Source: Own survey, 2017)

In addition to the perception of health facility staff the study tried to assess the actual percentage of facilities that received the quantity of the anti TB drug they ordered. This was done by comparing the most recent quantity ordered of the selected anti TB drugs from RRF with the same period quantity received from the receiving record of health facilities. Note that this indicator is calculated only for facilities with information on both quantity ordered and received for the products assessed. The study revealed that the average percentage of facilities refilled based on their request were 80.8% and 81.2% at hospitals and health centers respectively. The facilities order fill rate for RHZE/RH kit were 60% at hospital and 73.7% at health centers.

Figure 6. Percentage of facilities refilled based on their request by product and facility type, Addis Ababa, 2017



(Source: Own survey, 2017)

4.1.4 Storage conditions

Pharmaceuticals require good storage condition that fulfill the standards criteria to maintain product integrity and quality. In this study eleven standard criteria were used to assess the storage conditions of health facilities and anti TB drugs. (Appendix 2) Logical arrangements of pharmaceuticals, product protected from direct sun light and secured with lockable keys were the criteria met by 100% of hospitals and health centers. Shortage of storage space for the existing product and possible expansion were the least fulfilled storage condition by both facilities 60% and 63.2% of hospitals and health centers respectively. In addition cleanness and mishandling of product were observed in 60% of hospitals (Table 3).

Table 3. Percentage of facilities meeting specific acceptable storage conditions by facility type, Addis Ababa, 2017

Storage conditions	Hospitals (no)%	Health centers (no)%
Logical arrangement of pharmaceuticals	(5)100	(57)100
Bin Cards use	(5)100	(55)96.5
pharmaceutical separated from unwanted and expired items	(4)80	(57)100
ID labels and expiry dates visible	(4)80	(55)96.5
Arrangement facilitate FEFO	(4)80	(55)96.5
Products protected from direct sunlight and high heat	(5)100	(57)100
Clean, trash free and well organized	(3)60	(55)96.5
Sufficient space for existing products and reasonable expansion	(3)60	(36)63.2
Storage area secured and lockable	(5)100	(57)100
Free from harmful insects and rodents.	(5)100	(56)98.2
Products are in good conditions and properly handled	(3)60	(52)91.2

(Source: Own survey, 2017)

4.1.5 Stock availability

To assess stock availability at health facilities, the survey collected data on stock on hand on the day of visit and made observation of the records for the past six months prior to the survey on the selected anti TB drugs by facility type. The result revealed that all hospitals had all the four adult Anti TB drugs in their stock on the day of visit. However the availabilities of pediatric anti TB drugs were generally low20% of hospitals had RHZ (60+30+150) mg. Availability of other pediatric drug RH (60+30) mg and ethambutol 100mg at the hospital were 40% on the day of visit. Availability of anti TB medicine at the health center rage from 17.5 % for RHZ (60+30+150) mg to 93 % for Adult RHZE/RH kit on day of visit. (Table 4)

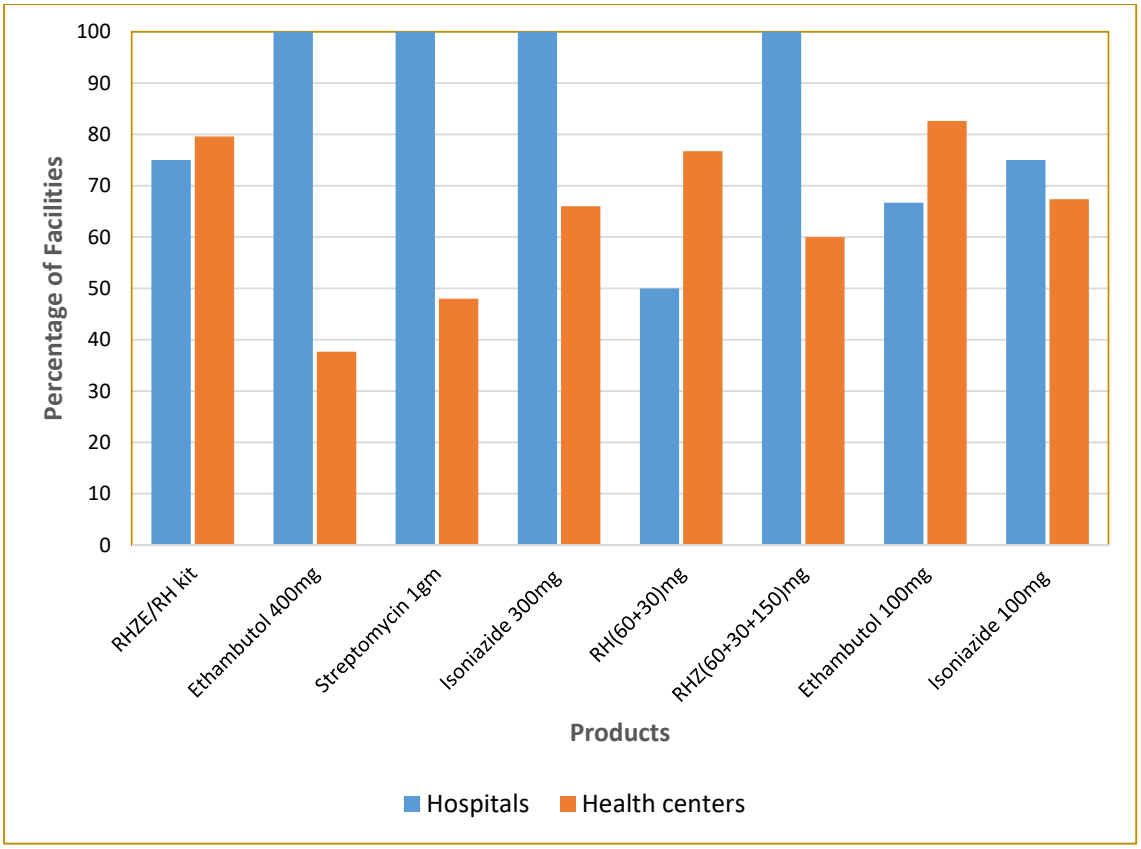
Table 4. Availability of Anti TB medicines on day of visit by facility type, Addis Ababa, 2017

Product	**Type of facilities**	
	Hospitals (no)%	**Health centers (no)%**
RHZE/RH kit	(5)100	(53)93
Ethambutol 400mg	(5)100	(40)70.2
Streptomycin 1gm	(5)100	(46)80.7
Isoniazide 300mg	(5)100	(47)82.5
RH(60+30)mg	(2)40	(27)47.3
RHZ(60+30+150)mg	(1)20	(10)17.5
Ethambutol 100mg	(2)40	(47)82.5
Isoniazide 100mg	(4)80	(40)70.2
Average	**72.5**	**68.0**

(Source: Own survey, 2017)

Data were also collected on the availability of the selected anti TB medicines throughout the six-months prior to the assessment. The study revealed the average percentage availability of anti TB drug during the six month prior to the survey to be 83.3% at hospitals and 64.8% at the health centers. The availability of RHZE/RH kit at the hospital were 75% and 79.6% at health centers. The least available item were RH (60+30) mg 50% at hospitals and Ethambutol 37.7% at the health centers. Since stock availability during the six month were collected from bin card record note that percentage availability was analyzed for products with updated bin card.

Figure 7. Availability of Anti TB medicines in six months prior to survey by product and facility type, Addis Ababa, 2017



(Source: Own survey, 2017)

4.2 Discussion

The success of public health program is highly depend on the performance of the supply chain. Hence performance measurements are very essential to assess how well the supply chain is functioning and to address the inefficiencies and improve the health service.

In this study, supply chain performance of first line Anti TB medicines were analyzed by considering different supply chain performance indicators in health facilities under Addis Ababa city government health bureau.

The availability of recording and reporting formats are very essential to capture logistic data and send reports from one level to the higher to make informed decision throughout the supply chain. In this study the availability of Bin card, RRF and IFRR at the health facilities were 100%. All hospital and health centers had inventory recording bin card and reporting formats (RRF and IFRR). The result is comparable with a little bit of increment with the IPLS national survey on IPLS where bin card, RRF and IFRR availability were more than 90% at hospital and 80% at health center (Shewarega *et al.,* 2015). Similarly 92.2% availability of IPLS recording and reporting formats were reported on the survey done in Addis Ababa on HIV and TB laboratory commodities (Tilahun *et al.,* 2016) .The increase in availability observed in our finding could be attribute the distance health facilities have from the distribution center. Where the health facilities are more accessibility for supervision, communication and distribution of the standard formats. Study done in Uganda Anti TB logistic system also indicate that most units have the necessary tools to capture the logistics information (Mujasi *et al.,* 2009).

Even though the availability of such format was very encouraging the consistent utilization and accuracy of the data is vital for the success of inventory management. The average utilization of bin card was 75% and 80.7% at hospital and health centers respectively. This result is also comparable with IPLS national survey (Shewarega *et al.,* 2015) were hospital bin card utilization were 73% but show increased percentage of utilization at health centers which was 64%.In addition the result show raised percentage when compared with 50% utilization at hospital and 54% utilization of bin card at health centers (Desale *et al.,*2013). Actually the later study was on HIV and TB laboratory commodity where utilization of the bin card for such commodity type may not be the same as that of drugs. Utilization of RRF in our survey was 100% both at hospital and health center, comparable result of 100% and 94% RRF utilization in the hospital and health center were observed in the study done in Addis Ababa (Tilahun *et al.,* 2016).

The use of IFRR was 60% at hospital and 93% at health center in our survey not aligned with the IPLS survey result which was 91% at hospital and 87% at health center. The result differ because in our survey we considered the IFRR used by TB clinics for Anti TB drugs. However in the national survey any one of the dispensing unit used IFRR were taken which make the utilized percentage superior (Shewarega *et al.,* 2015).

Percentage of updated bin card were 82.8% and 90.8% at hospital and health centers respectively. On the study done on HIV/AIDS related commodities supply chain management in public health facilities of Addis Ababa percentage of updated bin card were 96.7% at the hospitals and 85.7% at the health center relatively (Berhanemeskel *et al.,* 2016).The result is comparable with some level of improvement this may be attributed to the attention and support given for HIV/AIDS program drugs. Study done in Uganda stated stock cards regularly updated in many sites for anti TB medicines (Mujasi *et al.,* 2009). In this survey among the updated bin card, data record accuracy were very positive 100% of the hospital and 88.8% of the health centers. In addition to this the study discovered order entry accuracy on RRF. Majority of health facilities order entry were good, average accuracy rate of 86.9% and 92.5% in hospitals and health centers for anti TB medicines viewed. All the results seen were comparable with IPLS national survey with some improvement in all the percentages. The average percentage of updated bin card were 60% at both facilities. Bin card accuracy of 77% and RRF accuracy of 82% both at the hospital and health center were observed (Shewarega *et al.,* 2015). Some level of improvement shown in reported percentage. The result may be attributed to the continuous service improvement over the years in IPLS through supervisions, mentoring and trainings. Moreover catchment area advantages of city will be a plus since it is near to RHB offices, central and A.A branch PFSA and other partners.

In IPLS facilities order their request to PFSA every two month and plan to get refill with in the month the scenario were the same for Anti TB medicines. The study discovered the perceived lead time of anti TB medicines by assessing the professional perception. The result shown were 100% of the hospitals said they usually got their refill within a month. Out of which 20% of hospitals within 2 weeks and 80% of hospitals between 2 weeks and 1 month time. On top of this 93% of the health centers said they got there refill with in 1month time. Out of which 21.1% of them within 2 weeks and 71.9% between 2 weeks and 1 month. Only 7% of the health center said they received the order between 1 to 2 month times. Similar result observed on the study done on HIV related commodities in Addis Ababa where 100% of hospital received in less than 1 month time and 84.2% of health center refiled in less than month time

(Berhanemeskel *et al.,* 2016). When we compared with the national IPLS survey were 80% of the facilities refilled within a month (Shewarega *et al.,* 2015). The lead time show improvement this may be related with the proximity the facilities had with the supplying PFSA hub. This indicator is one that show the success of the supply chain where majority of facilities get the product within a month as planned and agreed with PFSA. The same finding observed in Uganda were supplies usually delivered on time (Mujasi *et al.,* 2009).

The facilities perceived order fill rate were studied for anti TB medicines by interviewing the staffs. It was revealed that more than 80% of both hospitals and health center usually got the quantity of anti TB drugs they ordered. The result show large improvement when compared with the perceived fill rate of national IPLS survey which were 37% for program drugs. Similarly the average actual fill rate in our study were 80.8% for hospitals and 81.2% for health center. The result is higher when compared with the national survey fill rate which was around 60% in average at both the facilities. In this IPLS national survey the adult anti TB drug RHZE were among the tracer drugs studied and exhibit order fill rate of 75% and 68% at hospital and health centers respectively (Shewarega *et al.,* 2015).Which is closer to the current study with some level of increase. The percentage increased in order fill rate also attributed to the system improvement in the supply chain of anti TB medicines and IPLS implementation through time. Enhanced order fill rate is one of the important performance measure which indicate supply chain efficiency.

Observations and interviews with facility staff were used to evaluate the adherence of health facility stores to list of standard criteria. This study discovered that majority of the health facilities store met acceptable number of standard criteria. In the survey, three criteria met by 100% the facilities were logical arrangement, pharmaceutical protected from direct sun light and store secured with key. More over majority of the facilities fulfill the acceptable storage condition which was greater than 80%. Where the result observed in IPLS survey is comparably low where 43% of hospitals and 63% of health centers had acceptable storage conditions (Shewarega *et al.,* 2015).On both studies health center did better than hospitals this may be related with the larger amount of product managed and the relative work load in the hospital than in the health center. Out of the desirable storage condition studied, criteria least met by the hospitals were the storeroom is maintained in good condition (clean, no trash, sturdy shelves, and boxes well-organized), sufficient space for existing product and expansion and products are in good condition, not crushed due to mishandling all achieved by 60% of hospitals. The storage condition least fulfilled by health center were sufficient space for

existing product and expansion only 63.2% of the health center have sufficient space. Parallel result observed in Uganda where most of the unit studied had acceptable storage conditions. The criteria most met were following FEFO, expired/damaged drug separated and all were lockable. The criteria least met in this study were limited space. (Mujasi *et al.,*2009)

The most important output of health supply chain is product availability since stock out of essential medicine lead to treatment interruption and drug resistant. Even little percentage stock outs could have serious program implication. In the case of anti TB medicines stock outs may leads to treatment interruption and could be causes for drug resistant form of the disease.Multi drug resistant TB is the resistant form of TB where the treatment is by far expensive, complicated and time taking. In actual sense all stock outs may not cause patient treatment discontinuation. Usually facilities may have some stock in their dispensing unit or may transfer product between facilities when encounter stock outs. Similar justification observed on the assessment done in Malawi Anti TB medicine logistics and supply chain management. (Chana, 2011)

In our study the average percentage of anti TB medicine availability on the day of visit were 72.5% in the hospital and 68% in the health center. Smaller result were observedwhen compared with the availability of essential medicines in IPLS national survey which were 89% for both facilities. In addition, data were also collected on the availability of the selected Anti TB medicines throughout the six-months prior to the assessment from the bin card record. The average availability of anti TB medicine were 83.3% in the hospital and 64.8% in the health center. While availability in six month time were relatively comparable with IPLS national survey were 81.9% at hospitals and 77.3% at health center(Shewarega *et al.,* 2015).In the studies done on HIV and TB laboratory commodities and HIV/AIDS drugs supply chain management even though there exist well designed logistic system IPLS most of the facilities experience stock of the studied products (Desale *et al.,* 2013, Tilahun *et al.,* 2016 and Berhanemeskel, 2016) Similarly in our survey in spite of the other supply chain indicator value were good the average availability observed were low both in the day of visit and during the six month time.

The reduced average availability of anti TB medicine were attributed to result inflated by the minimum availability of pediatric anti TB formulation. To examine this, when we look separately the availability of Adult anti TB medicines, all the product were available in the day of visit (100% available) in the hospital. The availability of adult RHZE/RH kit is also high

93% in the health centers and the other adult preparation were also above 70%. However the availability of pediatric medicines like RH (60+30) mg tablet and RHZ (60+30+150) mg tablet were 40% and 20% in the hospitals and 47.3% and 17.5% in the health center which is very low. In similar study done in Uganda stated that while TB products were available at most facilities pediatric formulations were notably stock out at facilities across the country (Mujasi *et al.,* 2009). Further in this study it was discovered that pediatric drugs managed in limited health facilities. Out of the five hospitals analyzed only one (20%) have all the pediatric formulations. The situation were similar in the health centers only 10(17.5%) of the facilities have all the pediatric formulation. The major reason for this could be since the proportion of pediatric patient is smaller facilities tends to give less attention to it and majorities not manage the product at all.

Chapter Five

5. Summary, Conclusion and Recommendations

5.1 Summary of Major Findings

To achieve goals health system relies on the effectiveness of their supply chain performance, hence it is essential to analyses the performance status. In our study the current supply chain performance of anti TB drugs were analyzed in the sampled facilities.

The availability of recording and reporting formats is vital for implementation of IPLS. The study revealed that all the hospitals and health centers studied had the recording and reporting formats in their premises. Even though the availability of the recording format, bin card was encouraging its average utilization for the selected anti TB medicines were not more than 80% both at hospitals and health centers. Lowest bin card utilization observed for pediatric anti TB drug, RHZ (60+30+150) mg tablet where only 20% of facilities used. Generally the update status and the data accuracy of the utilized bin cards were very good at both facility type. The average percentage of updated bin card were more than 80% at hospital and 90% health center. In the study the observed data recording accuracy were also encouraging where all update bin cards in the hospitals were accurate and around 90% of health centers kept accurate data on their bin cards.

Moreover all the facility use and complete the main reporting format RRF for anti TB medicines with encouraging percentage of order entry accuracy, 86.9% and 92.5% for hospitals and health centers respectively. In IPLS facilities place there order to PFSA every two month and supposed to get their refill within one month. It was witnessed in the study that the perceived order lead time was in accordance with the plan. Most of the facilities believed they get there refill on time, more than 90% of both facilities types got their refill within a month time. Order fill rate, one of the most important supply chain performance indicators were also assessed in our survey and found to be more than 80% both at hospital and health center.The survey result also viewed that majority of the facilities met most criteria's required for storage conditions. The storage criteria least met by both facilities type were not having sufficient space for current use and possible expansion, around 40% of facilities share this shortage. The same percentage of hospital short of fulfilling other criteria like maintaining good storage conditions (cleanness, free of trash) and appropriate handling of products.

In the survey the average availability of anti TB medicine were 72.5% and 68% on the day of visit and 83.3% and 64.8% during the last six month prior to the survey in the hospital and health centers respectively. The observed result appeared to be low, this was because of the very low availability of pediatric anti TB drugs at both facilities. Availability of pediatric formulations RH (60+30) mg were 40% and 47.3% at hospitals and health center. While availability of RHZ (60+30+150) mg were 20% and 17.5% at the hospital and health center respectively. However if we regarded the main adult medicine kit separately, the availability of RHZE/RH adult kit was 100% at hospital and more than 90% at health center on the day of visit which is relatively high.

5.2 Conclusion

The study revealed result of supply chain performance indicators for the sampled facilities studied under the period. Generally availability of logistics recording and reporting format is high; all the facilities have the necessary formats which is vital for the supply chain of drugs. Even though recording bin card availability is encouraging its utilization and update status shows gap which requires improvement. The reporting format RRF accuracy rate is better than the Bin card but also needs work to get better.

Great number of facilities receive their request timely which revealed the strength of the supply chain. However order fill rate is not as good as the lead time it needs effort for further enhancement of the supply chain.

In general, the study conclude that majority of the indicators show supply chain improvement though there are works to be done for further progress. While the availability of first line Anti TB drug kit RHZE/RH (150+75+400+275/150/75) mg is high the average availability found to be low because of the considerably low pediatric Anti TB drugs. Significant number of health facilities stock out or not managing the pediatric formulation on the day of visit and during the six month prior to the survey which needs special attention and effort to change the situation.

5.3 Recommendations

Based on the finding in the study the research recommends the following, the gap observed in the utilization of the recording format need to be improved. In addition, since the quality of record keeping and reporting is essential for various supply chain decision making, it require improvement. This can be achieved by increasing the health professional awareness and skill

through mentoring, supervision or training. Generally the medicine availability is good but the pediatric formulation need special attention and improvement. Even though proportion of pediatric patient is smaller the service shouldn't be denied. It is highly recommended to manage and avail pediatric anti TB medicine in minimum possible quantity in the health facilities. Responsible stakeholders and policy makers in the program should give due attention and put their effort to avert the situation.

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Appendix: Survey Tool

Informed Consent

Introduce yourself and ask facility representatives to introduce themselves.

Good day. My name is Zebiba Mekonen I am doing my graduate thesis. I am conducting a survey regarding the health commodity supply chain performance, particularly related with the supply chain performance of Anti TB drugs in the health facilities under Addis Ababa Health bureau. I am looking at the availability of Anti TB medicines and information about how you order and receive those products. I am visiting selected health facilities throughout the city; this facility was randomly selected to be in the survey. The objectives of the survey are to collect current information on the supply chain performance and stock status of Anti TB medicines. This is not a supervisory visit and the performance of individual staff members is not being evaluated.

The results of this survey will provide information to make decisions and to promote improvements in Supply chain of Anti TB drugs.

I would like to ask the store manager/pharmacy head a series of questions about the products available at this facility. In addition, I would like to actually count selected products you have in stock today and observe the general storage conditions.

Do you have any questions?

May I begin the interview now?

RESPONDENT AGREES TO BE INTERVIEWED ……..... 1 CONTINUES THE INTERVIEW

RESPONDENT DOES NOT AGREE TO BE INTERVIEWED...….2 END THE INTERVIEW

Ask the in-charge to introduce to the person managing commodities. Extend the invitation to the in-charge to stay with but explain that we are aware that they have other responsibilities. Offer to check back with him/her before leaving the facility.

Hand the respondent the list of products that are included in the survey, and explain that we will refer to the list for some of the following questions.

Section I: Background Characteristics of the respondents

No.	Question	Code Classification	Go To
1	Name and title and mobile phone number of person interviewed for this survey	Name: Title: Mobile Number:	
2	Number of years and months you have worked at this facility?	Years: _____Months: _____	
3	Who is the principal person responsible for managing medical supplies at this facility?	Nurse .....1 Clinical Officer.....2 Pharmacy Technician .....3 Pharmacy Assistant .....4 Pharmacist .....5 Medical Assistant .....6 Other (Specify) _____ 9	
4	Is supplies/stock management the primary role of this person at this facility?	Yes.....1 No 0	
5	How many of them are trained in IPLS?	Number trained /_____/	
6	Educational qualification of pharmacy unit staff	# of staff with Degree /_____/ # of staff with Diploma /_____/ Other # /_____/	

Section II: Facility Services and Infrastructure

No	Question	Code classification	Go to /comment
1	Name of the facility		
2	Region		
3	Zone		
4	Woreda		
5	City/Town		
6	Supplying hub		
7	Type of facility	1 = Hospital 2 = Health Center	
8	Provide Anti TB service	1 = Yes 2 = No	
9	Availability of the following facilities at the health facility store:		
10	Operational electricity on day of visit	1= Yes 2= No	
11	Operational telephone (land line or mobile)	1= Yes 2=No	
12	Operational computer	1= Yes 2= No	
13	Internet access	1= Yes 2= No	

Section III. LMIS information

No.	Questions	Code Classification	Go To/ Comments
1	Do you use the following stock keeping logistics forms to manage health products in this facility?		
2	A. Bin Card	Yes 1 No 0	
	B. Stock card	Yes 1 No 0	
	C. other (specify)	Yes 1(specify) No 0	
3	What LMIS forms do you use for reporting/ordering? (multiple answer possible)		
	A. RRF	Yes 1 No 0	
	B. IFRR	Yes 1 No 0	
	C. HPMRR	Yes 1 No 0	
	C. other	Yes(specify_____1 No 0	
4	Do LMIS report forms include the following?		
	A. stock on hand	Yes 1 No 0	
	B. quantities used	Yes 1 No 0	
	C. losses and adjustments	Yes 1 No 0	
5	Does a completed LMIS report include the following? (must be verified with completed report)		
	A. stock on hand	Yes 1 No 0 Completed report not available 9	
	B. quantities used	Yes 1 No 0 Completed report not available 9	

	C. losses and adjustments	Yes 1 No 0 Completed report not available 9	
6	How often are these LMIS reports sent to the higher level? *(Circle all that apply.)*	Monthly.....1 Bimonthly .....2 Quarterly.....3 Semi-annually.....4 Annually.....5 Other___ 9	
7	When was the last time you sent an order/report for Anti TB medicines at this facility? Must be verified with completed report	Never ..... 1 Within the last month ……2 2 months ago, ... 3 3 months ago, ... 4 More than 3 months ago 5	
8	Does all the columns in RRF are completed for all Anti TB medicines? Must be verified with last completed report.	Yes 1 No 2 Completed report not available	
9	Do TB clinic use IFRR for regular reporting? Must be verified with completed report	Yes 1 No 2 NA 3	
10	How did you learn to complete the forms/records used at this facility? (Circle all that apply.)	IPLS training ……1 On-the-job training .....2 Never been trained..... 3 Other (specify) _____ 9	
11	How many emergency orders for Anti TB medicines have you placed in the last 3 months? If available, ask for documents to verify using RRF	None..... 0 1 ..... 1 2 ..... 2 3 ..... 3 More than 3..... 4 NA 9	
12	Who determines this facility's resupply quantities? (Circle all that apply.)	The facility itself .....1 Higher-level facility (PFSA, RHB,WoHO).....2 Other _____ 9	
13	How are the facility's resupply quantities determined?	Formula (any calculation) _____ 1 Don't know ..... 2 Other means 9	
14	What are the direct sources of supply for Anti TB medicines at this facility?	PFSA.....1 RHB……. .....2 ZHD……..3 WoHO.....4 Other (specify)……. 9	
15	On average, approximately how long does it take between ordering and receiving Anti	Less than 2 weeks ..... 1 2 weeks to 1 month ..... 2 Between 1 and 2 months 3	

	TB products?	More than 2 months 4	
16	Does the facility usually get the quantities of products it orders?	Yes……..1 No……2 DN……3	If Yes or DN …18
17	If No, why not	The resupply point does not have Adequate supply……1 The resupply point was stocked out….2 Order amount changed at the resupply point……3 Other (specify)----------9	
18	Does this facility normally collect or are the pharmaceuticals/commodities delivered?	Collect……..1 Are delivered……2 Both explain…….3	

Section IV: Stock Status

Table 1: (Specify a full six-month period prior to the survey; and the day of visit) Column:
1.Name of all authorized products that will be counted

2. Unit of count for the product

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

3. Whether or not the product is managed at this facility, answer Y for yes or N if no. Note that for some products, at certain levels all facilities should manage the product. In such cases, this column should be marked Y.

4. Record the quantity of product in an open container. Estimate the quantity of the product to 1/4, ½, or 3/4 full using the smaller unit of count established in column 2.

5. Record if the facility is experiencing a stock out of the product on the day of the visit, according to the physical inventory, answer Y for yes or N for no.

6. Record the quantity of expired products. Count all expired products on the day of the visit. If there are products that are near expiry (within one week), note in the comments section.

7. Check if the stock card is available, answer Y for yes or N for no.

8. Check if the stock card had been updated within the last 30 days, answer Y for yes or N for no. Note: If the stock card was last updated with the balance of 0 and the facility has not received any resupply, consider the stock card up-to-date.

9. Record the balance on the stock card.

10. Record if the facility has had any stock out of the product during the most recent 6 full months before the survey, answer Y for yes or N for no.

11. Record how many times the product stocked out during the most recent full 6 months before the survey according to stock cards, if available, or to a key informant if not. Note source information.

12. Record the total number of days the product was stocked out during the most recent full months before the survey.

13. Record the quantity of product dispensed to users or issued from the storeroom during the most recent 6 months before the survey. Note:If the answer to column 4 is N, record NA in this column.
14. Record the number of months the issued data represents (may be less than 6); record the months for which there is any data recorded, including 0. Note: If column 4 is N, record NA in this column.

Maximum months of stock_____

Minimum months of stock _____

Order interval_____

Product	Unit of count	Managed at this facility?	Physical Inventray … Store room	Stoke out today(Y/N)	Quantity of expired products	Stock card available? (Y/N)	Stock card updated? (Y/N)	Balance on stock card	Stock outmost recent 6 months (Y/N)	Number of stock outs	Total number of stoke out days	Total issued (most recent 6 months)	Number of months of data available
1	2	3	4	5	6	7	8	9	10	11	12	13	14
RHZE/RH (150+75+400+275/150/75)mg tablet	Kit												
Ethambutol 400mg tablet	10x10												
Streptomycin 1gm injection	Vial												
Isoniazide 300mg tablet	10x10												
RH(60+30) mg tablet	24x28												
RHZ(60+30+150) tablet	24x28												
Ethambutol 100 mg	10x10												
Isoniazide 100mg tablet	10x10												

Note: For any product that experienced a stock out in the last six months (including the day of the visit), please note reasons (by product).

Section V. Storage Conditions

Table 4. Storage Conditions

No.	Description	**No**	**Yes**	**Comments**
01	Pharmaceuticals are arranged & organized according to a logical categorization, e.g. zoning			
02	Bin Cards are used & updated regularly? (Observe by checking sample BCs.)			
03	Are unwanted items (damaged or expired drugs, non-pharmaceutical items, etc.) in the store room separated from the usable stock?			
04	Products are arranged so that ID labels, expiry dates, and/or manufacturing dates are visible.			
05	Products are stored & organized in a manner which facilitates use of First-to-expire, first-out (FEFO).			
06	Products are protected from direct sunlight and high heat at all times of the day/during all seasons.			
07	The storeroom is maintained in good condition (clean, no trash, sturdy shelves, and boxes well-organized).			
08	The current space and organization is sufficient for existing products and reasonable expansion (i.e., receipt of expected product deliveries for foreseeable future).			
09	Storage area is secured with a lock and key, but is accessible during normal working hours; access is limited to authorized personnel.			
10	Storage area is visually free from harmful insects and rodents. (Check the storage area for traces of bats and/or rodents [droppings or insects].)			
11	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			

Section VI: LMIS Data Quality

Table 2: Usable Stock on Hand at Time of Most Recent LMIS Report

Column:

1. Will be pre-populated with the same products as in table 1.
2. Whether or not the product is managed at this facility, answer Y for yes or N if no.
3. Check if the bin cards and RRF are available, answer Y for yes or N for no.
4. Get the most recent RRF report showing the selected products, and record the stock on hand from the RRF report in column 3.
5. Write the quantity of usable stock on hand from the bin card from the time of the selected RRF report.
6. Calculate the discrepancy
7. Note the reasons for any discrepancy

Product		Usable Stock on Hand (at time of most recent LMIS report)			
	Are order records available (bin card and RRF)? (If NO to RRF or bin card skip to next item – only use acceptable data sources) No=N Yes = Y	According to most recent RRF report	From bin card from time of RRF report	% Discrepancy (col.5–col.4/col.4) *100	Reasons for discrepancy
1	2	4	5	6	7
RHZE/RH (150+75+400+275/150/75) mg tablet					
Ethambutol 400mg tablet					
Streptomycin 1gm injection					
Isoniazide 300mg tablet					
RH (60+30) mg tablet					
RHZ (60+30+150) tablet					
Ethambutol 100 mg					
Isoniazide 100mg tablet					

Section VII. Order Fill Rate

Table 3. Percentage Difference between Quantity Ordered and Quantity Received Column:

1. List the same products as in table 1 or use a sample of those products.

2. Whether or not the product is managed at this facility, answer Y for yes or N if no.
3. Check if the bin cards and RRF are available, answer Y for yes or N for no.
4. Enter the quantity ordered for the last order period for which products should have been received (i.e., don't include open orders whose expected receipt date has not arrived).

5. Enter the quantity received in the last order.

Product	Managed at the facility No=0 Yes = 1	Are RRFs available? No=0 Yes = 1 (If NO Skip to next item – only use acceptable data sources)	Quantity Ordered For Last Order Period	Quantity Received In Last Order/Procurement	Reasons for discrepancy
1	2		3	4	5
RHZE/RH (150+75+400+275/150/75) mg tablet					
Ethambutol 400mg tablet					
Streptomycin 1gm injection					
Isoniazide 300mg tablet					
RH (60+30) mg tablet					
RHZ(60+30+150) tablet					
Ethambutol 100 mg					
Isoniazide 100mg tablet					