

ADDIS ABABA UNIVERSITY
SCHOOL OF COMMERCE
DEPARTMENT OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT



DETERMINANTS OF STOCK-OUTS OF FIRST LINE ANTI-TUBERCULOSIS DRUGS:
THE CASE OF PUBLIC HEALTH FACILITIES OF ADDIS ABABA.

BY

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Determinants of Stock-Outs of First Line Anti-Tuberculosis Drugs: The Case of Public Health Facilities of Addis Ababa.

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DECLARATION

I, Kassech Sintayehu, declares that this thesis work entitled “**Determinants of Stock-Outs of First Line Anti-Tuberculosis Drugs: The Case of Public Health Facilities of Addis Ababa**” is my original work in partial fulfillment of the requirement for the award of Degree of Master of Arts in Logistics and Supply Chain Management. I also declare that it has never been presented in other university and that all resources and materials used in the thesis have been duly acknowledged.

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STATEMENT OF CERTEFICATION

This is to certify that research under taken by Kassech Sintayehu under my advising entitled with: **“Determinants of Stock-Outs of First Line Anti-Tuberculosis Drugs: The Case of Public Health Facilities of Addis Ababa”** submitted to the AAU in partial fulfillment of the requirements for the Degree of Master of Arts in Logistics and Supply Chain Management complies with the regulations of the Addis Ababa University and meets the accepted standards with respect to originality and quality.

Advisor Name: **Busha Temesgen (PhD)**

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ACRONYMS AND ABBREVIATIONS

CI	Confidence Interval
EPSA	Ethiopian Pharmaceuticals Supply Agency
FDRE	Federal Democratic Republic of Ethiopia
FMOH	Federal Ministry of Health
FMHACA	Food Medicine and Health Care Administration
IPLS	Integrated Pharmaceuticals Logistics System
KI	Key Informant
LIAT	Logistics Indicators Assessment Tool
LMIS	Logistics Management Information System
LSAT	Logistics System Assessment Tool
OOS	Out of Stock
RHB	Regional Health Bureau
RRF	Report and Requisition Form
SPSS	Statistical Package for Social Sciences
USAID	United States Agency for International Development
WHO	World Health Organization

ABSTRACT

Reliable and affordable supplies of health commodities are critical for the success of the health sector. This is particularly very important when it comes to infectious diseases such as Tuberculosis (TB) where sustainable availability of drugs play an important role in halting the disease progression and development of resistant strains of the causative agent. The objective of the study was to identify determinants of stock outs of first line anti TB drugs at public health facilities under Addis Ababa City Administration Health Bureau. Both descriptive and explanatory research design with mixed approach involving both quantitative and qualitative data collection, analysis and interpretation was employed. Quantitative data was collected from drug store managers of health facilities providing TB treatment and qualitative data from Addis Ababa hubs of the Ethiopian Pharmaceuticals Supply Agency (EPSA), Addis Ababa City Administration Health Bureau and selected heads of pharmacy departments of health facilities. More than half of the health facilities encountered stock out for at least one of first line anti TB drugs with the period of previous one-year to the date of the visit. Significant level of stock out was observed in pediatrics formulations with 39.8% of health facilities stocked out for RH 75/50 mg and 16.9% for RHZ 75/50 mg and the stock out level for Ethambutol 100 mg & Isoniazid 100 mg also calls for much attention. Regression analysis showed poor performance of supplier (EPSA) is the significant determinant for stock out of first line anti TB drugs at 95% level of confidence ($p=0.00$). The problem with pediatrics formulation is persisting, the reason mainly being negligence by health facilities in not placing early orders since pediatrics cases only arrive intermittently, hence thought as these cases are not available. Poor performance by the supplying hub (delay in supply, inadequate supply, and stock outs there) was found to be the main determinant for stock outs. This calls for collaboration among stakeholders working especially on Tuberculosis and pharmaceuticals supply in preventing stock outs for anti TB drugs and to strengthen the drug supply system in general.

Keywords: *Stock out, Anti TB Drugs, Information Communication Technologies, Health System Support, Performance of the Supplying Hub, Public Health Facilities, Addis Ababa*

CHAPTER ONE

INTRODUCTION

1.1. Background of the study

Tuberculosis (TB) is a communicable disease which is a majorly causing morbidity and is among the top 10 causes of mortality globally ranking above HIV/AIDS (WHO 2019).

The recent Global Tuberculosis Report showed that in the year 2018 an estimated 10.0 million people have got the disease globally (WHO 2019). Ethiopia is among the 30 high TB burden countries globally and according to the recent estimation 151 new TB cases per 100,000 population exist in the year 2018 (WHO 2019).

Medicines are basic for health care provision and its limited access hampers achievement of the health systems' objectives of equity, efficiency, and health development (WHO 1978).

As per the Ethiopian Food, Medicine and Health Care Administration and Control Authority (EFMHACA), safe, effective, and affordable medicines of the required and assured quality, in adequate quantity should always be available for the provision of proper healthcare service (EFMHACA 2015).

Although the global community currently is paying much attention on health issues, poor availability of medicines, especially in public sector is a key barrier to its access .This especially is in developing countries, especially for the poor with only 51.8 % of public health facilities having availability of selected essential medicines on average in the period 2007-2011 (Force 2012).

Anti-tuberculosis drugs are among the essential medicines and most of the drugs which are important to treat tuberculosis disease are included in the essential medicines list of Ethiopia except some new drugs which are newly recommendation for TB treatment and are in the wait list to be considered for inclusion in the essential medicines list of Ethiopia during the next revision.

Success of the health sector necessitates reliable and affordable supplies of health commodities (Adzimah et al. 2014). This is very important in the case of infectious diseases such as Tuberculosis (TB) as sustainable availability of anti TB drugs play an important role in cutting progression of the disease and development of drug resistant mycobacterium.

Stock-outs of medicines have a profound effect on health in various ways. Some adverse effects of drug stock outs include treatment interruptions, loss of confidence in health systems, additional cost, demotivation of clinicians and care givers, and providers (Masters 2013, Zuma 2013), increased risks of drug resistance and adverse effects on disease epidemiology (Zuma 2013, Medicines sans frontiers et al .2016), and consequently, leading to increased morbidity and mortality for many patients thereby posing a major challenge to public health (Kaakeh et al. 2011, Medicines sans frontiers et al .2016).

According to a study conducted by Pasquet et al. (2010), on the impact of stock out on HIV infected patients to stock-outs adversely affected at least 11% of population on treatment resulted in 30% treatment modification and discontinuation. Besides, stock out of anti TB drugs caused 2.14% and 1.43 % reduction in TB cure rate and treatment success rate respectively (Koomen et al. 2019).

According to findings of the assessment conducted by the Ethiopian Food, Medicines, and Health Care Administration and Control Authority, and Pharmaceutical Fund and Supply Agency (PFSA) in collaboration with WHO on the pharmaceutical sector of Ethiopia, the availability of basket of key medicines in the public health facilities' was found to be 72.4% and 70.7%, respectively, with encouraging finding on medicines for treating infectious diseases for which availability being >80% (EFMHACA 2017).

Stock-outs result from single or multiple causes and studies have identified many possible causes of stock out including, poor communication, coordination among stakeholders, poor inventory management practice (Mungu 2013), educational level of stock managers , poor practice of use of ICT by stock managers (Adusei and Awunyo-Vitor 2014) and poor availability of transportation and road infrastructure (Zuma 2013, Adzimah et al. 2014). Besides, others found unexpected demand changes or fluctuations, limited health budgets, raw material problems, frequently changing regulatory requirements to be causes for stock outs (Hedman 2016). Besides, Damtew et

al. ,2019 found out that supply of short expiry drugs from a supplying warehouse in addition to inadequacy of budget as factors contributing to stock out of drugs.

Despite the many efforts by the government of Ethiopia to achieve 100 % availability of anti TB medicines , still there are complaints from health facilities on stock out of these drugs and the same has been reported from Addis Ababa city Administration Health Bureau on the recent annual TB program review meeting that there were stock out for TB medicines in public health facilities providing TB treatment services . This is in contrary to the finding of pharmaceutical sector assessment of Ethiopia Of 2016 where there was >80% availability of drugs for infectious diseases. The extent and determinants of this stock out is not clearly known. Therefore, there is a need to investigate the level and causes of stock out for drugs used in the treatment of Tuberculosis to put appropriate actions in place.

Although many of the mentioned studies are looking at availability, studies undertaken to examine the determinants of stock outs especially for anti-Tuberculosis drugs are limited globally and there are only limited published studies conducted at assessing the levels and determinants of stock outs of anti TB drugs in Ethiopia especially at the study area.

Therefore, this study is aimed at investigating the levels and determinants for stock outs of first line anti TB drugs with focus on public health facilities under Addis Ababa city administration health bureau thereby verify how much real the complaints is and recommend a solution to responsible stakeholders to mitigate the determinants to improve availability of these anti TB drugs.

1.2. Statement of the problem

Frequent shortages of essential drugs have been challenging the world burdening and putting health systems a further cost (Hedman 2016).

Even though essential drugs should reach patients, its shortage is a major barrier to access of these drugs in Sub-Saharan African countries. In a response to this shortage different initiative were taken at global level on improving access to and availability of essential health products including drugs, supplies and equipment in developing countries (Force 2012).

As per the study conducted in Malawi on average health facilities were found to be out of stock for drugs for treating pneumonia almost half of the year and anti-malaria drugs were stocked out for 42-138 days of the year (Lufesi et al. 2007).

Cameron et al (2009) and Pasquet et al (2010) found that stock-outs of essential medicines has been adversely impacting morbidity, mortality, and disease epidemiology in sub-Saharan Africa. Despite substantial financial aid from international donors for procurement of health products especially for infectious diseases such as tuberculosis, stock outs of these life-saving drugs related to prevalent infectious diseases are still widespread in Africa.

Finding from the recent service readiness assessment in Ethiopia shows that the availability of most essential drugs was < 50 % (Ethiopian Public health institute 2017).

Tuberculosis is ninth leading cause of morbidity globally with its rank above HIV/AIDS. Since most deaths from TB could be prevented with rapid diagnosis and appropriate treatment, adequate quantities of internationally quality assured medicines be available always be available at health care facilities for proper implementation of TB control program (WHO 2017).

Despite the significant threat of the disease to the public and the need for adequate quantities of safe and quality assured medicines for implementation of Tuberculosis control program ,there are some evidences and claims regarding stock outs of anti TB drugs from Addis Ababa which are also verified by limited number of researches in the area and other countries and the presentation made by Tegegn 2019 on annual national tuberculosis program review meeting .

According to research finding of Mekonen 2017, 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, with 40% of hospitals and 43.3% of health centers had pediatric formulation of RH tablet and with only 20% of hospitals and 17.5% of health centers had pediatric tablet RHZ on the day of visit.

Frequent discussions with warehouses supplying these health facilities reveal that adequate stocks are already available at their warehouse and the health facilities can easily collect during shortages of such drugs as these facilities are found with in the same city and at short distance with the supplying warehouses. Though such problems are being raised mostly during program implementation review meetings and different gatherings that concern the TB program of Addis

Ababa City Administration ,the level of these stock-outs and the determinants are not well investigated, and evidences especially on the determinants are not documented so far mainly in A.A. Thus, because of the significance of the problem it is important to know the extent and the influence of the different variables related to stock out of first line anti TB drugs at the public health facilities of Addis Ababa.

Despite the existence of related researches on essential drugs those focusing on availability of anti-TB drugs are very limited especially in Addis Ababa and this will be a good reference for future researchers who wish to study on related problem area.

1.3. Research Questions

- What is the extent of the stock out of first line anti TB drugs at public health facilities of Addis Ababa?
- To what extent does poor performance of supplying warehouse contribute to stock outs of first line anti TB drugs at public health facilities of A.A?
- To what extent does the use of information and communication technology (ICT) in inventory management contributes to preventing stock outs of first line anti TB drugs at public health facilities of A.A?
- To what extent do health system support activities contribute to reduced stock outs of first line anti TB drugs at public health facilities under A.A?

1.4. Objectives of the Study

1.4.1. General Objective

The overall objective of the study is to investigate and identify the determinants for stock outs of first line anti TB drugs at public health facilities under Addis Ababa City Administration Health Bureau, Ethiopia.

1.4.2. Specific Objectives

- ❖ To identify the extent of the stock out of first line anti TB drugs at public health facilities of Addis Ababa.

- ❖ To identify the extent of effect of the poor performance of supplying warehouse (EPSA) on stock out of first line anti TB drugs at public health facilities of Addis Ababa
- ❖ To assess the contribution of ICT use in inventory management in reducing stock outs of first line anti TB drugs at public health facilities of A.A
- ❖ To find out the extent of effect of health system support activities in reducing stock out of first line anti TB drugs at public health facilities of A.A.

1.5. Significance of the Study

Stock out of anti TB drugs is the major challenge of health facilities and the public health program in general. Hence, this study may help health facilities , EPSA , regional health bureaus and policy-makers in understanding the present situation related to stock outs of anti TB drugs and plan for future course of action to improve the availability and strengthen the overall drug supply management system with lessons learned from the findings. The findings from this study will help to eventually meet the demand of health facilities and patients thereby develop public confidence in health systems. The study is expected to be significantly important in contributing to the underdeveloped area of research related to stock out and the findings of this study may add to knowledge base of the concerned and those interested on the topic in addition to its support to academic and other researchers in pointing the area of future concern and will serve as a reference for future work on the topic. It will also help partners, and donors as an evidence for mobilizing resource and identifying area that need technical focus.

1.6. Scope of the Study

For convenience of data collection, this study focused on public health facilities providing TB treatment services and only considered first line anti TB drugs or those used in the prophylaxis and treatment of drug susceptible TB disease. Besides, took in to account the supplying warehouse which involve two EPSA hubs/warehouses supplying health facilities in Addis Ababa. This study has taken in to consideration only selected variables such as health system support, ICT, and supplier performance and other variables such as budgeting, quantification and procurement, supply chain design, regulatory issues and others which might contribute to stock-outs were not considered in this study.

1.7. Limitations of the study

The major limitation of this study is related to the data source used for collection of the stock out data where secondary data sources ,mainly bin cards were used and sometimes it was difficult to get updated bin cards which was resolved by triangulating data from paper based ,electronic bin cards and further requesting the drug store managers. Inadequate number of research papers on the subject especially from Ethiopia is another limitation which made comparison of the findings difficult.

1.8. Definition of Terms

- ❖ **Medicines:** medicine is a drug taken to cure or ameliorate any symptoms of an illness or medical condition.
- ❖ **Drug:** is any substance that causes a change in an organism's physiology or psychology when consumed
- ❖ **Essential medicines/drugs** are those that are always intended to be available within the context of functioning health systems in adequate amounts, in the appropriate dosage forms, with assured quality and adequate information, and at a price the individual and the community can afford.
- ❖ **Anti TB Drugs:** Those drugs which are under the national essential drug list and used in the prevention and treatment of Tuberculosis.
- ❖ **First line anti TB Drugs :** the first choice of anti TB drugs used for preventing and treating drug susceptible Tuberculosis both in Adult and pediatric patients, in Ethiopia these include: Formulations for adults TB patient Kit or RHZE/RH (150+75+400+275 mg/150+75 mg) and Isoniazid 300 mg and formulations for pediatric patients include : RHZ (75/50/150 mg), RH (75/50 mg), Isoniazid 100 mg, Ethambutol 100 mg
- ❖ **Stock out:** Complete absence of one or more of the anti TB drugs at the time of and within the period of 12 months immediately preceding the study
- ❖ **Availability of Anti TB Drugs within one-year period prior to study:** the percentage of tracer Anti TB Drugs continuously available in a health facility within one-year prior to study. The long-term product availability can be measured by the percentage of products continuously available in a health facility for the time of interest (1 year).

- ❖ **Public Health Facility:** Places which are responsible for providing health care services with government owned in general and having an additional service for Tuberculosis diagnosis and treatment

1.9. Organization of the thesis

The thesis is organized into five chapters with the first chapter covers background for the study statement of the research problem, research questions, objectives of the study, significance of the study, scope of the study, limitations of the study and definition of terms. The second chapter covers review of literatures of both theoretical and empirical related to the study area and conceptual framework adapted from previous study findings. The third chapter deals with methodology applied for the study including description of the study area , research approach to be used with the selected research design , population and sample for the study, data sources and types, data collection procedures to be used and ethical considerations for data collection and finally the data analysis technique are described. Chapter four summarizes the findings of the study and interpretation /discussions of the findings. Chapter five has four sections and is about summary of findings, conclusions, recommendations, and suggestions for future study. The annex contains data collection instrument used in the research work and some other relevant supplementary materials.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter presents the review of relevant theoretical and empirical literatures. Though, the great majority of stock out studies that have been published are empirical in nature, this chapter comprises some theoretical review which identifies different factors considered relevant to the study. These cover topics related to Tuberculosis (TB) and National TB control program, strategies, concepts related to essential drugs and the pharmaceuticals supply chain management system of Ethiopia including for anti TB drugs. Empirical studies related to the topic of the study and variables involved are also included. Eventually the conceptual framework of the study which categorizes and describes variables relevant to the study along with the relationships among them is also depicted in this chapter

2.1. Theoretical Literatures Review

2.1.1. Definition and Attributes of Stockout Events

An out of stock (OOS) or stock out event happens when an item is not available for sale as intended (Gruen & Corsten 2008).

A stock-out event occurs due to exhaustion of available inventory and it can occur along the entire supply chain. It is a condition in which demand for an item cannot be satisfied from the current inventory (Adusei and Awunyo-Vitor 2014).

OOS can be described with multiple attributes, and thus there are multiple OOS rates that are calculated and reported as described below. The attributes are shown as a rate over a given measurement period.

1. **Number of occurrences over time:** “Item OOS event rate.” Is measured as the simple number of OOS events for an item over a given unit of time, for example, “six times per month.” This measurement is useful when comparing the rate against among items in a category. It is the number of OOS events for an item over a given unit of time

2. **Number of simultaneous occurrences:** “Category OOS event rate.” where the number of items in the category that are OOS at the time the measurement is taken are summed and expressed as a percentage of the total number of items intended for sale. For example, if the category has 20 items for sale, and at a given time there are five items that are OOS, then the Category OOS event rate is 25 percent.
3. **“OOS duration rate.”** Over a given period of measurement, the OOS duration rate is calculated as the total time that the item is OOS divided by the total selling time available of the measurement period. For example, if a store is open 24/7, and if during a given week of measurement an item was OOS for 20 hours, then the OOS duration rate would be 12 percent (20 OOS hours/168 possible selling hours). In short, it is defined as:
During a given measurement period, the total time that the item is OOS / the total selling time available.
4. **Shelf Availability:** “Shelf Availability Rate.” This is directly related to the OOS Duration Rate, which refers to the probability that shoppers will find the item when they enter the store. This is calculated as 100 percent - OOS Duration Rate.

5. Lost Sales:

5a. Lost Unit Sales: “OOS lost unit sales rate.” Over a given period of measurement, the total number of estimated sales unit losses due to OOS divided by the total number of sales units sold plus the estimated sales unit losses.

5b. Lost Monetary Sales: “OOS sales loss rate.”, is the total estimated monetary sales volume losses due to OOS divided by the total sales plus the estimated dollar sales losses. It is calculated for over a given period of measurement.

6. **OOS Customer Impact Rate:** $1 - [(\text{the number of estimated baskets the item would have appeared} - \text{the actual number of baskets the item appeared}) / \text{the number of estimated baskets the item would have appeared}]$

(Gruen & Corsten 2008).

2.1.2. Access to Essential Drugs and Magnitude of Stock out

Access to essential drugs is vital to the proper functioning of health system. Therefore, the provision of safe, effective, and affordable essential drugs of the required quality and adequate quantity to the public with special focus to people who cannot afford is a priority of health and drug policies (Quick 2003).

Cognizant of this, many countries in the world developed and implemented National Medicines Policy taking into consideration access, quality, safety, and rational use as key strategic objectives. In most of developing countries from the total government spending on health system, up to 50 % of the expenditure goes to medicines. There is a national policy in Ethiopia to provide some medicines free of charge for patients avoiding out-of-pocket payment for medicines used to treat malaria, tuberculosis, HIV/AIDS and other sexually transmitted diseases and vaccines.(FMOH, EFMHACA & WHO 2017, MSH 2012)

A considerable reduction in common health problems can be achieved if carefully selected and cost-effective medicines are available and appropriately used (MSH 2012).

Essential medicines should always be available at health facilities , with the ideal standard level of stock out to be achieved should be zero (0) meaning 100% of those drugs should always be available but for monitoring purpose in Ethiopia this indicator is measured as % of health facilities that have > 80% of the tracer products at the time of visit (PFSA 2014).

As per the data from WHO, shortages of essential medicines have been reported from every country regardless of the income status and its management is expensive to health systems, causing additional costs for replacement of medicines and consuming significant time of the staff (Hedman 2016).

According to WHO (2010) as cited by Fredrick and Muturi (2016) higher level of stock outs of medicines in both public and private sectors, as well as a wide variation in prices , making essential medicines unaffordable to people with lower income.

Despite different efforts to improve supply chains, as per Corsten and Gruen 2004, the average global stock out levels is about 8%.

2.1.3. Determinants of Stock Out

Stock out is influenced by different variables known as causes for stock outs categorized at large as: downstream supply chain related practices and upstream supply chain related practices. Problems in downstream practices such as listing, store ordering, inventory keeping, placement and replenishment and upstream supply chain related practices in general include warehouse activities, forecasting inaccuracies, communication problems and delay in transportations are seen to cause stock out (Ehrental and Stolzle 2013).

Corsten & Gruen presented the causes for stockout as process based which mainly are three in general are ordering, replenishing, and planning. The ordering practice might cause stock outs if the order is too little, placed lately or with wrong forecasted; replenishment practices might cause stock outs due to inadequate shelf space, lack of adequate signal to retail management or poor back-room inventory handling procedure and the replenishment issue may occur at upstream level of store when warehouse inventory fail to meet retailer orders. The planning practices may cause stock outs when there is incongruence between shelf capacity and replenishment frequencies and when purchase frequencies are not well considered (Corsten & Gruen 2004).

Causes for stock out can also be categorized as pre-store causes and in-store causes. The pre-store causes are related to direct suppliers or retailer's distribution center and occur due to suppliers' fulfillment problems or delivery problems like general planning, communication, and unreliable transportation. The in-store causes for stock outs include listing problems, physical shipment problems, incoming goods cover deficits, store inventory problems and replenishment problems. More specifically, in-store practices causing stock out are found to be data inaccuracy, forecast and ordering inaccuracy, infrequent replenishment, inadequate shelf capacity, poorly maintained perpetual inventory system and inefficient movement of products from backroom to store shelves (Gruen & Corsten 2007).

Continuous information exchange regarding availability and delivery reduces uncertainty for the total supply chain and creates the opportunity for maximum flexibility. With fast, dependable order response, inventory can be committed as required, resulting in increased turnover and improved availability (Bowersox D J et al., 2002).

Close connection exists between the design and management of supply chain flows (product, information and funds) and the success of a supply chain where appropriate design for supply chains is used to manage supply chain flows effectively by facilitating sophisticated information exchange to provide real-time data sharing (Chopra and Meindl 2007).

IT systems that facilitate both upstream and downstream collection of information to strengthen coordination, communication and transparency between stakeholders at the national, regional and global level should be fundamental principle in all actions towards addressing shortages of essential medicines in health systems (Hedman, 2016, Corsten & Gruen 2004,).

The same concept applies in health system where stock-out or out of Stock is the complete absence of a specific formulation and/or dosage of medicine at a given public health facility (Medicines san frontiers et al., 2016). Establishment of an inventory control is the best tool which serves informing the responsible personnel when to order or issue, how much to order or issue and to maintain an appropriate stock level to avoiding shortages and oversupply (Deliver 2011).

Stock out of medicine are mainly caused by the failure of delivery of products timely and as per the requested quantity, poor practice of selection, quantification and procurement , unreliable data and late submission of report and requests from health facilities , poor information exchange, poor fleet management system at distribution point (PFSA 2014).

2.1.4. The pharmaceutical supply chain management system of Ethiopia

Supply chain management entails the planning and management of each of activities in sourcing and procurement as well as associated logistics management activities. Coordination and collaboration with partners in the supply chain network such as suppliers, intermediaries, third party service providers and customers are also part of supply Chain Management. Supply chain management helps to integrate supply and demand management within and across companies (PFSA 2014).

A supply chain consists of every party involved in fulfilling a customer request and 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 and overall value addition. In recent years, effective supply-chain management has emerged

as a significant competitive advantage for companies in very different industries (Chopra and Meindl 2007).

The Ethiopian Pharmaceuticals Fund and Supply Agency (PFSA) was established by Proclamation No. 553/2007 in the year 2007 with the purpose of significantly improving sustainable availability of quality assured pharmaceuticals at an affordable price to the public. The Agency is mandated to avail affordable and quality pharmaceuticals sustainably to all public health facilities and ensure their rational use. Following its establishment, the integrated pharmaceuticals logistics system (IPLS) has been developed and implemented since 2010 with the objective of efficiently and effectively execute its mandate in pharmaceuticals supply (PFSA 2017).

The IPLS integrates the management of essential pharmaceuticals including those used by HIV/AIDS, Malaria, TB and Leprosy, EPI, family health programs as well as purchased essential pharmaceuticals and it is the principal mechanism through which all public health facilities in Ethiopia obtain essential and vital pharmaceuticals. Products included on the National pharmaceuticals procurement List (NPPL) are supplied and managed through the IPLS (PFSA 2017).

2.1.5. Anti -Tuberculosis Drugs Supply Chain & Logistics Management System in Ethiopia

The success of the End TB strategy requires an adequate and uninterrupted supply of drugs. Thus, National TB program in collaboration with the Ethiopian Pharmaceuticals Supply Agency (EPSA) ensures uninterrupted and sufficient supply of TB commodities through timely and appropriate selection, quantification, procurement, warehousing, distribution, and inventory management systems (FMOH 2017).

Anti TB drugs and related commodities are among one of the essential medicines that managed through IPLS. EPSA is an agency with a prime responsibility of managing the pharmaceutical logistics system of the country and is the sole supplier of all program medicines including anti TB medicines to all public health facilities in the country (PFSA 2017).

2.2. Empirical Literatures Review

2.2.1. Findings of Studies on Magnitude and Impact of stock out

A Surveys conducted at Uganda, Kenya and Ghana have shown that availability of essential medicines was very low, with over 30% of those expected to be available were out of stock the facility (Masters 2014).

According to WHO (2010) as cited by Fredrick and Muturi (2016) only 38.1% of public health facilities are found to be stocked with generic medicines compared to the private sector. When comparing the cost in both facilities the average cost of these medicines is 250 % more than the international reference price in the public health facilities whereas the same item is available in 63.3% of private health facilities and the cost on average was about 610% more than the international reference price.

The extent, customer reaction and causes of stock out are seen to vary among global regions Studies show that in western Pacific countries the extent of stock out in average is seen to be, 22.2% in the Philippines & 79.2% in Mongolia. The situation of public sector availability of generic medicines also showed similar variability across World Bank income groups, ranging from 27% in upper-middle income countries to 44.3% in lower-middle income countries with more variability was seen in low-income countries (9.7% in Yemen to 79.2% in Mongolia) than in higher income groups (Cameron et al 2009).

A research at health facilities of South Africa revealed 20% of health facilities reported a stock-out of at least one ARV and/ or TB-related medicine on the day of contact and 36% during the three months prior to contact (Hwang et al. 2019)

According to the finding of assessment of the pharmaceutical sector in Ethiopia conducted by the Federal Ministry of Health, an average availability of key essential drugs in public health facilities in the six regions varied with 81.4% Amhara region and 66.05% SNNP region showing relatively the highest availability of essential drugs in Amhara region and lowest availability in SNNP region and Addis Ababa had a 74.15% availability of essential medicines (FMOH, EFMHACA & WHO 2017). Regarding anti TB drugs stock outs, Teklehaymanot (2018) reported that high stock out rate of Isoniazid (INH) 100 mg as compared to other anti TB drugs.

Irrespective of the causes, stock outs lead to increased costs for health systems. As per Kaakeh et al (2011) an additional labor cost of responding to shortages in the United States was estimated at US\$ 216 million per annum. Drug shortages are found to have a significant impact on patient care activities and increasing institutional costs in health facilities (Baumer et al, 2004).

Stock-outs are an important measure of health service readiness, and clinics without consistent and adequate availability of essential medicines are inadequately prepared to provide quality health services (Wagenaar et al, 2014).

2.2.2. Findings of Studies on Determinants for stock outs of drugs

Different studies reviewed specific to health commodities showed that stock outs can be caused by factors related to higher level suppliers such as insufficient deliveries from the higher level stores, distribution system inefficiencies, uneven distribution of drugs among health facilities, long lead times ; those factors related to health system support such as unexpected demand changes , unreliable data from peripheral facilities , distance from warehouse and lack of- training , supervision and dedicated logistics staff (Lufesi et al. 2007, Hedman, 2016, Wagenaar et al.2014).

72% of stock outs across the world are attributed to store practices like late and insufficient orders, inaccurate forecasts or shelf restocking problems, mismanaging inventory (Corsten & Gruen 2004, Gruen et al., 2002).

A supply chain design also is contributing to stock outs in that a decentralized healthcare system as can improve delivery and improve access by eliminating barriers of time and transportation (Fredrick and Muturi 2016).

Besides, there are issues related to the use of information communication technologies (ICT) such as absence of an information systems for tracking stock and associated documentation (Adzimah et al. 2014), absence of electronic stock management systems, and communication channels and platforms (Zuma 2013).

A recent study on availability of drugs showed that unreliable data from peripheral facilities has been a major problem in most low- and middle-income countries, contributed to poorly coordinated stock management and ineffective forecasting (Hedman, 2016).

The determinants of stock out of interest to the current study are explained as follows:

Information Communication Technologies (ICT) and Stock-out of drugs

To improve efficiency in drug management system appropriate use of information communication technology such as emails, automation LMIS tools is critical. Evidence suggests that use of software in supply chain management improves efficiency especially in ordering, monitoring drug stock position, supply, and accountability (Govt. of Odishe 2014). As per the finding of Fredrick and Muturi (2016) ICT was the most significant variable influencing stock-outs of essential medicines in public health facilities and the same was reported by Adzimah et al (2014), that poor management information systems for tracking stocks lead to gaps in the control of orders at all levels thus contributing to stock-outs of essential medicines.

Lack of electronic stock management systems contributes to stock out at health facilities even though medicine was reported to be available in the Medical Depot (supplier). Thus, there should be an electronic medicine supply management system starting from the Medical Depot to all the health facilities to allow for monitoring of stock levels, ordering patterns, and expiry dates to prompt appropriate action including placing of orders on reaching the minimum stock levels (Zuma 2013).

Automated systems can result in more rapid availability of quality logistics data than manual systems due to real time reporting. It enables for entry of data by multiple users and facilitate up automatically back at more than one site. Information can be communicated between multiple locations such as from laboratory to physician (Fraser et al, 2005)

A pilot study in Tanzania showed the use of mobile phones, SMS messages and electronic mapping technology for collection and reporting of logistics data on anti-malarial medicines improved response rate for stock count data and contributed to reduced stock outs (Barrington et al. , 2010).

Health System Support

Lack of activities related to system support such as shortage of skilled human resources to manage medicine stock, delayed ordering and monitoring of the stock levels, lack of training and

supervision in the facility, long process needed (bureaucracy) by the facility to authorize orders for medicines at facility level contributed to stock out (Zuma 2013, Lufesi et al. 2007).

Besides, Fredrick and Muturi (2016) identified that staff qualifications, supply chain design and monitoring and oversight mechanism have been significantly associated with stock outs of essential medicines.

Performance of the supplying medical store

Research studies on availability of pharmaceuticals showed that stock out at supplying hub (Temesgen 2017), delayed deliveries from the Medical Depot contributed to stock out (Zuma 2013, Lufethesi et al. 2007).

Therefore, this study will use the conceptual framework below to determine the effect of the different factors on stock out of anti TB drugs focusing on health facilities of Addis Ababa. It is from this conceptual framework that the research design of the study in the next chapter was made as well as the design of the data collection instrument and data analysis.

2.3. Conceptual Framework

The study adapted a conceptual framework which borrowed constructs from the different literatures reviewed to map out factors that could be determinant for stock out of anti TB drugs in the study area.

According to Jabareen (2009), conceptual framework as a network, or “a plane,” of interlinked concepts that together provide a comprehensive understanding of a phenomenon or phenomena. A conceptual framework is not merely a collection of concepts but, rather, a construct in which each concept plays an integral role. (Jabareen 2009).

The goal of the conceptual framework is to categorize and describe variables relevant to the study and map relationships among them.

The conceptual framework of this study is based on key concepts of the study and related literature review. The conceptual framework will then be used to analyze the results of the study.

The conceptual framework categorizes determinants for stock out of anti TB drugs as follows:

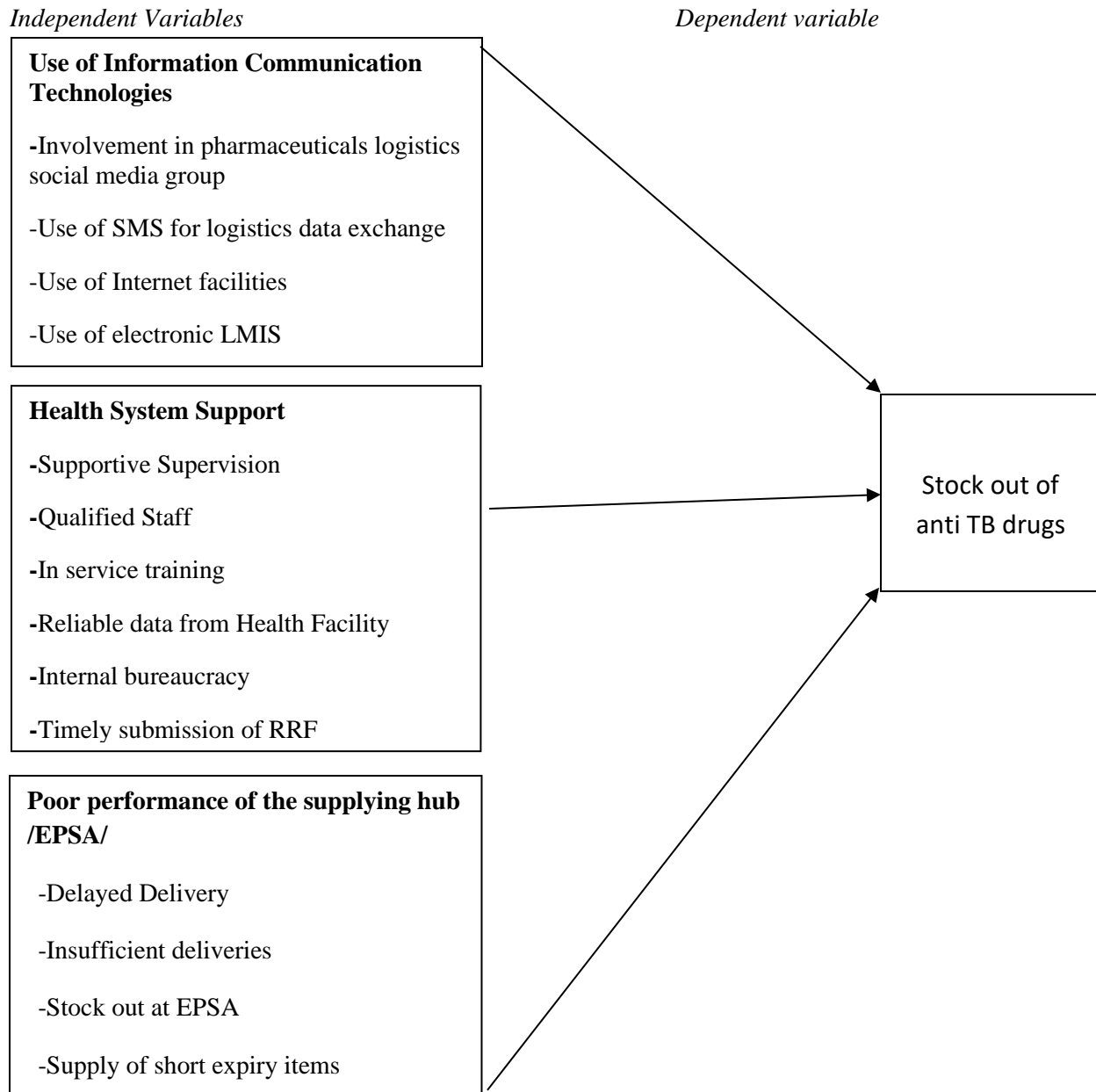


Fig 1: Conceptual Framework for determinants of stock out of anti TB drugs

Source: Researcher's Own Construct with adaption of variables from different literatures described above, 2019

CHAPTER THREE

RESEARCH METHODOLOGY

This chapter describes the entire approach or methodology followed during the entire study. It deals with the sampling frame, study area, research design, population of the study, sample and sampling techniques, data source and types, data quality assurance, data analysis and ethical considerations taken while conducting the research.

3.1. Description of Study Area

Addis Ababa city is administratively subdivided into 10 sub-cities and has a total population of 3,686, 068 Million. There are One Hundred Four (104) public health facilities with 98 Health Centers and 6 public hospitals which are under the direct control of Addis Ababa City Administration Health Bureau. These health facilities receive supply of pharmaceuticals from two hubs of the Ethiopian pharmaceuticals supply agency (EPSA). Currently, all the 98 health centers and only 4 of the hospitals provide TB diagnostic and treatment services (Tegegn 2019).

3.2. Research Approach

This study applied a mixed approach, which is a procedure for collecting, analyzing and “mixing” both quantitative and qualitative data at some stage of the research process within a single study, to understand a research problem more completely by utilizing the strengths of both data. Mixing both types helps to better understand a research problem by converging /triangulating broad numeric trends from quantitative research and the detail of qualitative research, to deeply explain the statistical and quantitative results from the sample study (Creswell 2009).

Since quantitative approach is best when we deal with factors influencing an outcome and understand the predictors, this study mainly applied quantitative approach followed by qualitative data collection from few people with the aim of supporting the quantitative result.

3.3. Research Design

Research design is a blueprint and detailed plan on how to conduct the research. The way researchers develop a research design is dependent on the research questions. In this study both descriptive and explanatory research design was applied because the researcher is going to measure

causal relationships between the dependent (levels of stock out) and independent variables (determinants of stock out). Explanatory research aims at establishing the cause and effect relationship between variables. In case of explanatory research, the researcher uses facts or information already available to analyze and make a critical evaluation of the data/information to understand why things are the way they are. It is a continuation of descriptive research and builds on exploratory and descriptive research going beyond merely describing the characteristics and to analyze and explain why or how something is happening with measuring causal relations among the different variables involved (Zegeye et al.2009). Thus, this study was based on the already existing evidence related to stock out of First line anti TB drugs at health facilities of Addis Ababa and going to identify the determinants (causes) for the stock out.

3.4. Population and Sample

The population is all individuals of interest to the researcher and sample is a subset of the population that the researchers typically going to study. Due to different reasons researchers may not be able to study the entire population of interest, in such case it is important to select a representative sample of the population from which it was selected (Marczyk G. et al .2005).

The target population for this study were all public health facilities of Addis Ababa providing tuberculosis diagnosis and treatment services which totally are One Hundred Two (102) health facilities, one Regional Health Bureau, two (2) supplying pharmaceutical warehouses (EPSA hubs). Drug store manager were mainly contacted from the public health facilities. From the Regional Health Bureau, relevant person for TB/HIV and pharmaceutical logistics case team participated and from the supplying pharmaceutical warehouses (EPSA hubs) the distribution coordinator for program drug participated in the study.

3.5. Sampling frame

A sampling frame is simply a finalized list of facilities that meet the specific criteria of the assessment. First, an updated and complete list of health facilities that are being supplied by the logistics system under evaluation, for this study the list of 102 health facilities providing TB diagnostic and treatment service were obtained from Addis Ababa City Administration Health Bureau. Besides, 2 supplying hubs for pharmaceuticals (EPSA hubs) and 1 Regional Health Bureau were included.

3.6. Sampling methods and Sample size

Census and non-probability sampling methods were used according to the study unit involved. Census eliminates sampling error as there will be no element of chance is left, hence highest accuracy is obtained and provides data on all individuals in the population (Zegeye et al.2009).

As the size of population of the study is small and to have sufficient sample size for the statistical analysis of the association between the independent and dependent variables of the study, census was applied to include all the eligible public health facilities providing TB treatment services in Addis Ababa.

Purposive sampling which is anon probability technique was followed to purposefully include the two EPSA hubs, selected heads of pharmacy departments of health facilities and the Regional Health Bureau for the qualitative data collection.

3.7. Data Sources and Types

In the study both primary and secondary sources of data were used. Primary data is the one that has been collected from firsthand experience; it has not been published yet and is more reliable, valid, authentic, and objective as compared to secondary data. Secondary data is collected from a source that has already been published in any form including books, records, databases etc and it is less expensive (Kabir 2016).

For the purpose of this study the primary sources were drug store manager and heads of pharmacy department of the health facility, relevant person from TB/HIV case team and pharmaceutical logistics case team of the Regional Health Bureau and program drugs distribution coordinator from each of the two EPSA hubs. These sources were contacted to collect data on determinants of stock outs which will be of both quantitative and qualitative type, according to the participants.

The secondary sources for this study were tools in the Logistics Management Information System (LMIS) for recording stock-out levels particularly reviewed were bin cards for the target drugs.

3.8. Data Collection Procedures

Data collection is the process of gathering and measuring information on variables of interest, in an established systematic fashion that enables one to answer stated research questions, test hypotheses, and evaluate outcomes (Kabir 2016).

The quantitative part of data collection was done by surveying all of the public health facilities providing TB diagnostic and treatment services and concurrently collecting qualitative data with open-ended questions from few participants to have in depth insight into the variables under study (levels of stock out and determinants) (Creswell 2009). The results of both quantitative and qualitative methods were discussed together after collection of both data.

In this study retrospective collection of data on stock out situations in one-year was done at the same time collecting data on determinants for stock-outs.

Self-administered structured questionnaire with Likert scale was used to collect quantitative data from the facility drug store manager.

Qualitative data was collected with personal in-depth interview from purposefully selected heads of the pharmacy departments who are experience and have adequate knowledge of the topic. Totally Five (5) pharmacy heads were interviewed, and it needed no further interviewing as the response from of the respondents was almost the same (data saturation). Besides, in addition to the head of pharmacy department , qualitative data collection was done from program drugs distribution coordinators from the two EPSA hubs, both TB/HIV and pharmaceutical logistics case teams from the Regional Health bureau were interviewed with semi structured open ended interview guide. In-depth interviews were recorded on a digital voice recorder after getting informed consent from interviewees.

Secondary sources were used to record stock-outs and extract such data for analysis. Structured record review of data from Logistics Management Information System (LMIS) tools having TB drugs was done using structured observation checklist to extract stock out data for the for previous 1 year until the date of data collection was done.

The data collection questions for primary source and checklists for secondary data sources was adapted from tools of other researchers and Logistics System Assessment Tool (LSAT)

respectively and indicators to measure stock-outs was utilized from Logistics Indicators Assessment Tool (LIAT) and tools developed by the pharmaceuticals fund and supply agency.

Three (3) data collectors who have previous experience with surveys and familiar with supply chain management were selected to assist the principal investigator (PI) during the data collection. They were trained by the PI before the data collection is initiated.

3.9. Data quality assurance

To succeed in data quality assurance structured questionnaire and observation checklists was designed in clear and standard way and the most care was taken to avoid bias in pre and post data collection activities.

3.9.1. Validity

Validity refers to the extent to which an instrument measures what is supposed to measure. The tools were pilot tested before use on 2 of non-study health facilities and minor editions were made based on feedbacks from the pilot test. Moreover, validity was checked with collecting comments from relevant experts. After pilot testing and collecting comments from experts, the questionnaire was revised to incorporate the feedback that was provided. The valuable comments, corrections, suggestions given by the research experts assisted in the validation of the instrument. Accordingly, changes were made on the first draft in terms of eliminating, adding, or rewording some of the items included in that draft

3.9.2. Reliability

Reliability refers to the consistency and stability of findings that enables findings to be replicated and it is the degree to which there is an absence of measurement error. Cronbach's Alpha is very useful in developing attitude scales and questionnaires as the alpha level (or reliability) indicates if the items are measuring the same construct. The number of test items, item interrelatedness and dimensionality affect the value of alpha. A low value of alpha could be due to a low number of questions, poor interrelatedness between items or heterogeneous constructs.

An alpha of 0.8 or above is regarded as highly acceptable for assuming homogeneity of items, while 0.7 is the limit of acceptability (Burns, R.P. and Burns, R. 2008). According to another

statistician an alpha coefficient between 0.64–0.85 reported to be adequate and between 0.61–0.65 reported to be moderate indicated that the measurements are reliable as they have a relatively high internal consistency (Perry et al 2004). Hence, for the reliability test of the data Cronbach’s alpha was calculated using SPSS and based on this, the overall Cronbach's alpha coefficient of 14 items was 0.70 and the result for each of independent variables is presented below. Though individual values are below 0.7 which might be mainly attributed to the low number of test items but still the values show that the correlation among variables was in a moderate to adequate level, hence acceptable for further analysis.

Table 3.1. Reliability statistics result

Variable	N items	Cronbach’s Alpha
Information Communication Technologies	4	0.68
Health System Support	6	0.61
Poor performance of the supplying hub /EPSA/	4	0.67

Source SPSS Analysis from Survey 2020)

Furthermore, the trustworthiness, instrumental utility and coherence of the data was verified for qualitative data.

3.9.3. Ethical Consideration

Ethical clearance was received from Addis Ababa University school of commerce and all the necessary permissions from concerned officials was received prior to data collection.

To keep the confidentiality of the data given by respondents, the respondents were not required to write their names and were assured that their responses were treated in strict confidentiality. The purpose of the study and reasonably expected possible benefit to the respondent, the health facility and to all concerned bodies was disclosed in the introductory part of the questionnaire and interview guide.

All interviews were conducted at places convenient to interviewees to maintain their privacy. Besides, anonymity was maintained throughout the process of data management and analysis using a unique code for each participant.

3.10. Data Analysis

Statistical Package for Social Science (SPSS) version 20 was used to perform the analysis for quantitative data and thematic (categorical) analysis was used for qualitative data.

Descriptive statistics was used for describing the variables within our data sets. For this, frequency tables of counts and percentage, measures of central tendency (the mean), measures of dispersion (range and standard deviation) were applied. The result was presented in table and graphically.

Inferential statistics was applied with the use of multiple regression which is used to predict, the influence or effect that two or more independent variables (determinants for stock out such as ICT, health system support & performance of the supplying hub) have on the dependent variable (anti TB drug stock out rate). As recommended by Field, to carry out a regression analysis the dependent variable should be quantitative, and the independent variable be categorical and the variable under this study fulfill such requirement (Field 2005).

The general multiple regression equation is

$$y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + e_i$$

Where,

Y is the outcome variable

e_i is the difference between the predicted and the observed value of Y for the i^{th} participant. It is an error term that is normally distributed with mean 0 and variance σ^2

β_0 is a constant /Intercept,

$\beta_1, \beta_2, \beta_3, \beta_n$ = are coefficients (slopes) of the first, second, third and nth predictor ($X_1, X_2, X_3, \dots, X_n$) respectively.

Error or disturbance term is introduced into the model because it is clearly unrealistic for a model to perfectly predict a variable as it is impossible to control every possible condition that may interfere with the dependent Variable (Field 2005).

In this study since we have three independent variables the following regression equation will be employed to determine the relationship between the dependent and independent variables

$$y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + e_i$$

X_1, X_2, X_3 are independent variables determinants for stock out such as ICT, health system support & performance of the supplying hub

e is an error term that is normally distributed with mean 0 and variance σ^2 .

In addition to its use for measuring the outcome variable quantitative data collected using observation checklists was used to calculate the following parameters using formulas from LIAT and pharmaceuticals supply chain System Monitoring & Evaluation Training Manual as mentioned below (PFSA 2014, Deliver 2005, WHO 2007 and Gruen & Corsten 2008).

The average stock out rate of the tracer anti TB products will be calculated as follows which indicate the stock out rate for a specific facility and this rate will be used as an outcome value operationalized to analyze its association with the independent variables .

1. *category stock out rate =*

$$\frac{\text{\# of products in the category that are OOS at the time the measurement}}{\text{Total \# of products reviewed}} * 100$$

Besides, the following additional data will be analyzed for the general understanding of the situation.

2. % of facilities that experienced a stock out of a specific product that it is expected to provide, at any point, within a defined of time =

$$\frac{\text{number of facilities that experienced a stock out of a specific product}}{\text{total number of facilities that are expected to offer that product}} * 100$$

The outcome will be stock out at any point during a given time period:

3. *Percentage of time anti-TB drugs were out of stock in the previous 1 year =*
*total number of stock-out days for all anti-TB drugs *100*
365 × number of anti-TB drugs in the study

Finally, qualitative data was handled manually and categorized and individually coded on paper with themes related to the topics were identified and added as an explanation for the findings of quantitative analysis.

CHAPTER FOUR

RESULTS, DISCUSSION, AND INTERPRETATION

This chapter presents study results considering the objectives with discussion of the result. The results and discussions were further substantiated with previous findings of the different related literatures reviewed.

4.1. Response Rate

Though the plan was to collect data from one hundred two (102) TB treatment providing health facilities ,due the current Covid 19 pandemic fourteen (14) health facilities which are found to be Covid 19 treatment and isolation centers were excluded from the study and hence , questionnaire was distributed to only 88 respondents of these health facilities. Among these 88 questionnaires 83 were collected, checked for completeness, and found to be valid for analysis.

The valid questionnaires which formed the analysis yielded 94.3 % response rate and 5.7 % non-response rate for which some respondents were having a workload and claimed they could not fill out the questionnaire.

4.2. General information and demographic characteristics of respondents

The purpose of demographic analysis in this research is to describe the characteristics of the respondents such as proportion of males and females in the sample, level of education, work experience , age of respondents and training status pertaining to the integrated pharmaceuticals logistics system and Tuberculosis drug supply management. Hence, these variables are presented and described in table 4.1 below

Table 4.1: General information and demographic characteristics of the study participants

Gender	Frequency	Percent
Male	40	48.2
Female	43	51.8
Level of Education of the respondent		
Diploma	33	39.8
BA/BSC	48	57.8
MBA/MSC	2	2.4
IPLS Training Status		
Yes	74	89.2
No	9	10.8
Anti TB DSM Training status		
Yes	13	15.7
No	70	84.3

Source: Analysis of Survey data September 2020, using SPSS20.

Mean Age and Work Experience of Respondents in years

Item	Minimum	Maximum	Mean	Std. Deviation
Age	23	52	30.79	5.511
Work Experience	0.6	13.0	5.499	3.1105

Source: Analysis of Survey data September 2020, using SPSS20.

There were 40 (48.2%) male and 43 (51.8%) female participants revealing that gender balance by drug store managers with very minimal higher proportion of female. The level of education held by respondents indicated that majority of the respondents 47 (57.8 %) hold a bachelor's degree, diploma levels was 33 (39.8 %) and postgraduate level were only 2.4% as shown in Table 4.1. The result on the average age and the work experience of respondents revealed 31 years and 5 & half years respectively.

74 (89.2%) of respondents trained on IPLS while as opposed to this only 13 (15.7%) received TB DSM training, showing the remaining 84.3% have never received any training on TB DSM

4.3. Descriptive Statistics

4.3.1. Levels of Stock Out for Anti TB Drugs

Stock Out Rate of Anti-Tuberculosis Drugs

To assess the level of stock out for first line anti-Tuberculosis drugs at the health facilities, data on stock out of these drugs was collected ,for the previous one year up to date of data collection , through observation of the records on six of drugs used for prophylaxis and treatment of drug susceptible TB (first line anti TB drugs). The result revealed that 54(65 %) of health facilities encountered stock out for at least one of these drugs during the study period. This rate is similar to the finding in districts of South Africa where the 2013 stock out survey showed a wide range at district level but to over 50% in five districts of one of the provinces of south Africa (Seunanden & Day 2013). Besides, the current finding is almost similar with the one identified regarding laboratory commodities where 60.5% of facilities in Addis Ababa reported that they usually run out of at least one ART monitoring test and TB laboratory commodities before resupply (Desale et al. 2013).

Ranges used by Nyanwura and Esena (2013) were used to describe availability:

- $\leq 50\%$ very low
- 51-65% low
- 66-80% fairly high
- $> 80\%$ high

The present study found wide variations on stock out level for category of first line anti TB drugs across the health facilities with the stock out during the study period varied from 0 to 100%. The average stock out level was 27.3% with a standard deviation of 3.99, this means that 27.3% of these drugs was stocked out with in the study period or mean percentage availability was 72.7%. This level is higher than the finding in Gahana, 2013, where the mean percentage availability of twenty (20) selected essential medicines was 85% (SD \pm 17) meaning the stock out level for the category of essential medicines studied was 15% (Nyanwura, & Esena 2013). The current result is comparable with the findings in the year 2012 at health facilities in Ghana, Kenya, and Uganda low, with over 30% of the expected drugs were stocked out (Masters 2013). According to the

above range the current result which is 27.3% average stock out or 72.7% mean percentage availability can be described as a fairly high.

Besides, as compared to study conducted by Gruen & Corsten 2008 in non-pharmaceutical commodity in Brazil ,with the average stock out rate of 8.3 % (SD ± 6.8),the current result is much higher despite the fact that these drugs should always be available to avoid the risk of drug resistant TB and poor treatment outcome that would result due to treatment interruptions.

Regarding the total time first line anti TB drugs were stocked out within a year reveals variability in results from no time with stock out to 26% of time with average being 4%. This means on average these drugs were not available for 4% of the year (365 days).

49(59%) of health facilities were found to have first line anti TB drugs continuously available during the period of study for $\geq 80\%$ these drugs or encountered stock outs for $\leq 20\%$ of the drugs in the category. This rate is lower as compared to the assessment result of the pharmaceutical sector of Ethiopia where medicines for treating infectious diseases for which the percentage availability for basket of medicines being $>80\%$ in all of health facilities (EFMHACA 2017). To describe this availability, the ranges used by Nyanwura and Esena 2013 have been used (Nyanwura and Esena, 2013) and accordingly, 59% of these facilities have high level of availability of first line anti TB drugs. But as these drugs have no alternatives to be used each of the items to be available always and any stock out level should not be tolerated.

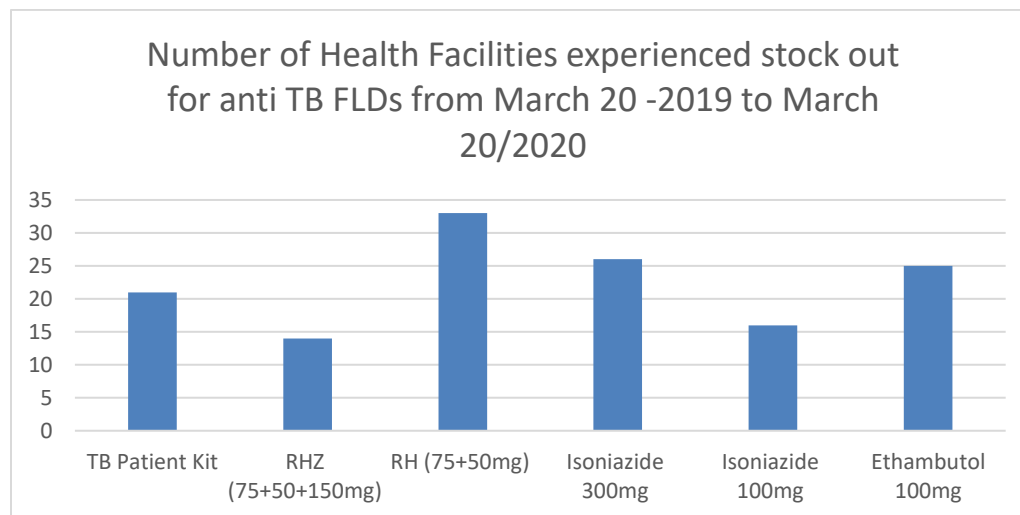


Figure 2: Number of Health facilities experienced stockout of for first line anti TB drugs from March 20,2019 to March 20,2020

Source: Analysis of Survey data May 2020, using SPSS 20

As depicted in the chart above 21(25.3%) of health facilities were stocked out for TB patient kit and 26(31.3%) were stocked out for Isoniazid 300 mg , this rate is much higher as compared to the finding of assessment conducted in the year 2017 by Mekonen where only 7% of facilities were stocked out for TB Patient Kit and 17.5% fo Isoniazid 300 mg (Mekonen 2017). But the result in the current observation is consistent with the finding from qualitative data especially as one of key informants said regarding stock out of TB patient Kit:

“TB patient Kit was stocked for about 3 months and the reason mainly was delay in shipment from the external supplier compony and I think delay in payment from the country also contributed to the shipment delay” (KI 1)

Significant level of stock out was observed in peditrics formulations of these drugs ,33(39.8%) of health facilities stocked out for RH75/50 mg and 14(16.9%) encountered stock out of RHZ75/50 mg which is lower than the rate found by Mekonen where 57 % and 82.5% of health centers were stocked out for RH and RHZ in 2017respectively. The higher level of stock out found by Mekonen in 2017 might be due to the transition to newer peditrics formulations at the same period and the old formulations were under phaseout stage and due to transition time most of the facilities encountered stock outs until the supplying hub delivers these drugs for all of the health facilities. Still the stock out rate for peditrics formulations is significant and persisted to some extent, as verified from the qualitative data collection and the reason being negligence by health facilities to place early request for these drugs before patient arrive. Nationally peditrics patient groups are limited in number and only arrive to health facilities intermittently and this created negligence on keeping these drugs as a reserve. Even though all anti TB drugs should always be available at health facilities most of the health facilities were stocked out for peditrics formulations and not manage it at all.

One of key informants said:

“Tracer drugs including anti TB drugs should always be available at health facilities but there is knowledge gap at health facilities on identifying which anti TB Drugs to request especially new formulations such as new peditrics formulations, even sometimes requests are made on already phased out formulations such as E400 mg and also newly introduced items were not captured by request and requisition formats ,thus some still use the old format and mistakenly request already

phased out drugs and drop the one should be requested hence, most of the time stock outs reported were artificial ”.KI 2

Regarding this pediatrics formulations another key informant said:

“When you request responsible people at health facilities on availability of Pediatrics anti TB formulations, they mainly tell you that these items are stocked out , and they blame the supplying hub for this but in reality most of the time early requests on these items were not being placed because the number of pediatrics patients are small and arrive for treatment very intermittently. Hence, this created negligence at health facilities and attention was not being paid, and they tend to request these drugs after patient arrive to their facility, or they refer the patient to another facility which stocked these drugs claiming they don’t have the drug to start the treatment”. KI 3

Even if there was significant level of stock out, it is important to note that facility specific stock-out does not necessarily imply that a patient does not receive treatment as some of the health facilities were mentioning that they have a practice of borrowing from nearby health facilities once patient comes and try to manage the patient. These should be explored more in future studies. One of a key informant said:

“Currently, we don’t have complete item for treating pediatrics patients, this is because there are not pediatrics cases at our facility but when a patient comes we borrow from a nearby health facility and no patient has been made to leave without treatment.” KI 4

Majority 54(65.1%) of the health facilities in the study had documented stock out for at least one anti TB drug while only 29(34.9%) not encountered stock outs for any of these drugs.

Average duration of stock outs

As shown in table 4.2 below from the facilities the average duration of stock outs in days was found to be lowest for RHZ 75/50/150 mg and highest for Ethambutol 100 mg.

Table 4.2: Response of Health Facilities on Stock out for each of anti TB Drugs in as of March 20/2019 to March 20/2020

First Line Anti TB drugs	Facilities stock Out n (%)	# of Days of Stock Out Mean (range)
TB Patient Kit	21 (25.3%)	12.93 (0-158)
RHZ 75/50/150 mg	14(16.9%)	5.22 (0-79)
RH 75/50 mg	33(39.8)	16.81 (0-128)
INH 300 mg	26 (31.3%)	18.30 (0-203)
INH100 mg	16(19.3%)	9.84 (0-240)
Ethambutol 100 mg	25(30.1%)	24.24 (0-194)

Source: Analysis of Survey data May 2020, using SPSS 200

Frequency of stock outs

Taking the average number of stock outs the most frequently stock out was observed for INH 300 (0.66 with a maximum of 6 times of stock outs with a year) and followed by RH75/50 mg for which the mean frequency of 0.6 observed with maximum of 3 times of stock outs in the same period.

4.3.2. Determinants for Stock outs of Anti TB Drugs

The extent to which the respondents agreed with the given statement concerning the different determinants for stock out is presented in table 4.3 below. These include practice of Information and Communication Technology (ICT), health System Support Activities, performance of supplying hub as presented below in table 4.3 ,4.4 & 4.5 respectively.

Table 4.3: Information and communication technology (ICT) use practice of the Facility Frequency (%)

Items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Std. Dev
Involvement of the facility in logistics Social media group (telegram, viber)	9 (10.8%)	4(4.8%)	6(7.2%)	38(45.8%)	26 (31.3%)	3.82	1.241
Practice of the facility using SMS for exchange of logistics information	12(14.5%)	16(19.3%)	4(4.8%)	32(38.6%)	19(22.9%)	3.36	1.402
Use of internet by the facility for Exchanging logistics information	18(21.7%)	21(25.3%)	2(2.4%)	21(25.3%)	21(25.3%)	3.07	1.552
Use of electronic LMIS by the facility	4(4.8%)	3(3.36%)	2(2.4%)	34(41%)	40(48.2%)	4.24	1.019
Aggregate Mean ICT						3.62	0.941

Table 4.4: Health System Support Activities at the Health Facility Frequency (%)

Items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Std. Dev
The facility received supportive supervision	2(2.4%)	1(1.2%)	6(7.2%)	49(59%)	25(30.1%)	4.13	0.793
Pharmaceuticals in the drug Store are Managed by academically qualified staff	0	1(1.2%)	0	25(30.1%)	57(68.7%)	4.66	0.547
Existence of in-service training related to pharmaceuticals logistics management	4(48%)	6(7.2%)	1(1.2%)	45(54.2%)	27(32.5%)	4.02	1.036
Reliable logistics data sent to EPSA	2(2.4%)	0	4(4.8%)	33(39.8%)	44(53%)	4.41	.797
Pharmaceuticals are ordered by the facility without any bureaucracy	3(3.6%)	11(13.3%)	3(3.6%)	38(45.8%)	28(33.7%)	3.93	1.113
RRF is timely submitted to EPSA	0	3(3.6%)	1(1.2%)	32(38.6%)	47(56.6%)	4.48	.705
Aggregate Mean of agreement level on HSS activities						4.27	0.498

Table 4.5: Poor Performance of the Suppl 1Table 4.5: Poor Performance of the Supplying Hub (EPSA) Frequency (%)

Items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Std. Dev
Delay of anti TB drug supply from EPSA	3(3.36%)	21(25.3%)	6(7.2%)	41(49.4%)	12(14.5%)	3.46	1.129
EPSA supplies anti TB drugs reducing quantity Ordered	8(9.6%)	16(19.3%)	5(6%)	48(57.8%)	6(7.2%)	3.34	1.161
There has been Stock out of anti TB Drugs at EPSA in the previous year	13(15.7%)	17(20.5%)	5(6%)	36(43.4 %)	12(14.5%)	3.20	1.350
The Facility faces supply of short expiry anti TB drugs by EPSA	8(9.6%)	21(25.5%)	6(7.2%)	38(45.8%)	10(12%)	3.25	1.238
Aggregate Mean of agreement level on EPSA performance						3.31	0.869

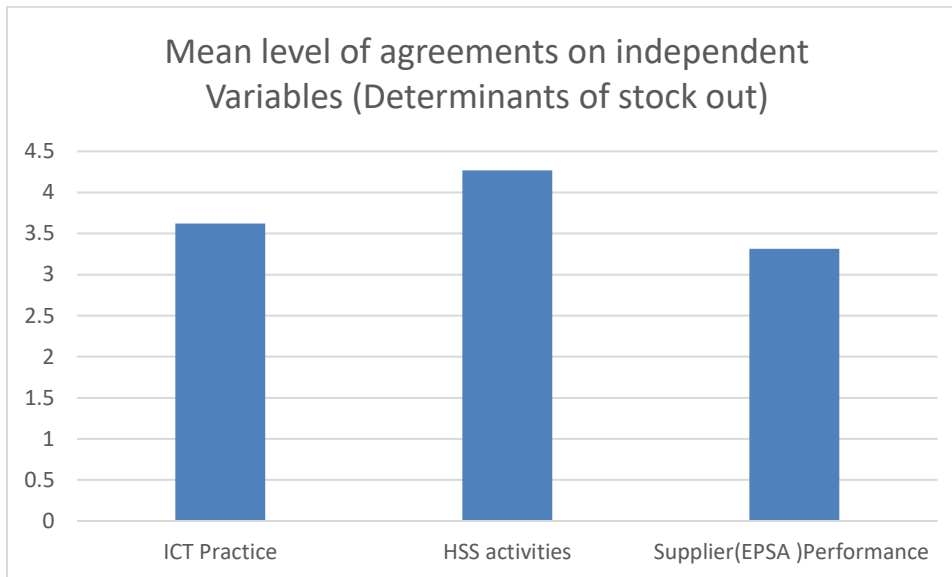


Figure 3: Mean Level of agreements on Independent Variables

Source: Analysis of Survey data May 2020, using SPSS 20

Tables and chart above show that the mean scores for variables range from 3.31 to 4.27 on a five-point Likert scale. Hence, as compared to the mean values of agreement for items related to ICT practice and performance of the supplying hub (EPSA) the agreement level of respondents is

higher for the existence of health system support activities. The finding regarding ICT is similar with the findings of Fredrick and Muturi 2016 who identified the existence ICT in the management of medicines in health facilities.

Regarding the finding about existence of health system support especially pertaining to existence of supportive supervisions from higher level, it is in agreement with the one identified by Damtew et al. 2019 ,with every health facility received a supportive supervision but regarding in service training, although almost all of the respondents received the basic training on pharmaceuticals logistics management (IPLS), about 85% haven't received any training on program specific drugs management ,the same is true with Damtew's finding as any of participants received training on program specific (maternal and child health) commodities management (Damtew et al. 2019)

Finally, assessing the performance of supplier (EPSA) as measured by delayed delivery, reduction from ordered quantity, stock out of the products at EPSA and the supply of products with near expiry though the mean score was smaller as compared to other variables still there exists moderate agreement with the respondents. There are different previous studies from other countries who have got the same result pertaining to supplier performance such as delay of supplies (Fredrick and Muturi 2016, Zuma 2013, Lufesi et al. 2007), stock out at supplying hub (Temesgen 2017, Zuma 2013, Vasconcellos & Sampaio 2008).

Making use of the Likert scale from strongly disagree (1) to strongly agree (5), if obtained mean value is 1-1.8 means the respondents are strongly disagreed, a mean value 1.81-2.6 means respondents are disagreed, 2.61-3.4 means the respondents agreed to some extent (moderate), a mean value 3.41-4.2 represents the respondents agree and respondents are highly agreed if the mean value is above 4.21-5. According to these standards the variables are categorized as shown in Table 4.6 below.

Table 4.6: Mean and Categories of the independent Variables

Independent Variable	Mean level of agreement	Category
Information & communication technology (ICT) use practice of the Facility	3.62	Agree
Health System Support Activities at the Health Facility	4.27	Highly Agree
Poor Performance of the Supplying Hub (EPSA)	3.31	Agreed to Some Extent

4.4. Inferential Statistics

Inferential statistics was employed to assess cause and effect relationship between the independent and dependent variables.

Multiple linear regression analysis was used to test the proposed model and predict the causal relationship between the factors and stock out levels, after testing the different assumptions of regression analysis.

4.3.1. Assumptions for Regression Analysis

Linearity, normality, multicollinearity, homoscedasticity (constant variance of the errors) were checked before conducting the regression analysis and the result is as follows.

Linearity

Linear data is where scores are fairly in straight line and not a curve .It is a relationship that produce a straight line of plots, or a close approximation, on a scatter graph (Burns, R.P. and Burns, R. 2008). For regression this has to be met and in the current data a normal probability plot (normal pp plot) of the residuals against the predicted values and the plot showed fairly straight-line confirming linearity as shown in Annex 1.

Normality

Normality is achieved when a distribution perfectly symmetrical and unimodal. In normal distribution the most frequently found scores are in the middle of the range with extreme scores becoming progressively rarer towards the tails of the graph (Burns, R.P. and Burns, R. 2008). The annexed histogram justifies this with no major deviations from normality, besides the data fulfils the assumptions for homoscedasticity as shown in the scatterplot and histogram.

Multicollinearity

Multicollinearity exists when there are very high correlations between independent variables (IV's) and considering regression analysis this should be avoided. The Variance Inflation Factor (VIF) measures the impact of collinearity among the IV's in a multiple regression model on the precision of estimation. It expresses the degree to which collinearity among the predictors degrades the precision of an estimate and typically a VIF value > 10.0 is of concern.

Variance Inflation Factor (VIF) and Tolerance statistics for the current data were extracted as presented on regression coefficient Table 4.6 below. As it can be seen, VIF value for all independent variables was less than 10 (1.006 to 1.398) and allowed variation (Tolerance) for each independent variable was more than 0.2 (0.715 to 0.994) which indicates the absence of high correlation between independent variables , hence no concern and accepted for regression.

4.3.2. Outputs of Multiple Regression Analysis and Interpretation

Multiple regression was performed between category stock out rate as the dependent variable (DV) and ICT practice, existence of health system support activities and performance of supplier (EPSA) as independent variables (IV’s) the results are presented in Table 4.6 below. As depicted in model summary table 4.6 a , the adjusted R² of 0.403 implying that 40.3% changes on stock-out rates of first line anti TB drugs in public health facilities of Addis Ababa could be attributed to changes in ICT practice ,health system activities of the health facilities and changes in the supplier (EPSA’s) performance at 95% confidence interval .The rest 59.7% could be explained by other variables which are not included in the current study.

Table 4.6 Multiple regression of independent variables with anti TB drugs stock out rate

a. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.652 ^a	0.425	0.403	0.22173

As part of the regression analysis ANOVA table produced and was used to establish the significance of the regression model and the overall ANOVA (table 4.6 b) results indicates that the model was significant at F = 19.461, p = 0.000. This shows that the overall regression model is significant at 95% level of confidence.

b. ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.870	3	0.957	19.461	0.000 ^b
	Residual	3.884	79	0.049		
	Total	6.755	82			

a. Dependent Variable: Category stockout rate

b. Predictors: (Constant), Poor Performance of Supplying hub (EPSA), Health System Support Activities at the Facility, Information, and communication technology (ICT) use practice of the Facility

The table 4.6c below shows that among the studied independent variables, poor performance of the supplier (EPSA) have significant effect and a positive linear relationship with the category stock out rate of public health facilities that means poor performance of EPSA uniquely and significantly contribute to the prediction of stock outs rates of fist line anti TB drugs with $t = 7.624$, $P < 0.01$ this is in agreement with the finding by Vasconcellos and Sampaio (2008) where supplier was the most responsible for stock outs .

Regression Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	-0.425	0.230		-1.846	0.069		
Information and communication technology (ICT) use practice of the Facility	-0.032	0.031	-0.105	-1.045	0.299	0.715	1.398
Health System Support Activities at the Facility	0.024	0.058	0.041	0.409	0.684	0.719	1.391
Poor Performance of Supplying hub (EPSA)	0.215	0.028	0.653	7.624	0.000	0.994	1.006

a. Dependent Variable: Category stockou rate

Source: Analysis of Survey data May 2020, using SPSS 20

The individual beta coefficients in the table above are used to identify the magnitude of the effect of independent variables on the dependent variable but in this study since the independent variables were measured on Likert scales where direct comparison of the effects of the independent variables with one another cannot be done. In such cases standardized beta coefficients (β s) should be used to compare the relative effect of differently measured independent variables as the values for standardized betas are not dependent on units of measurement. Hence for the interpretation of individual coefficients in the current study the β s were used because independent variables were measured on Likert scales. The standardized beta coefficient are measured in standardized deviation units and tells us the effect of a single standardized deviation that the outcome will get due to one standard deviation change of the independent variable. Depending on these values, the relative effect of the independent variables on the dependent variable can be identified. Consideration of only significant β s are needed as insignificant β s do not statistically differ from zero (Field 2005, Mooi 2018). Thus, table 4.7 below shows the standard deviations for each of the variables. According to this the regression equation is established using the significant determinants.

Stock out of anti TB FLDs = -0.425 +0.653 (EPSA)

Table 4.7 Standard Deviations of Variables

Items	Mean	Std. Deviation
Category stock out rate	0.27	0.29
Information and communication technology (ICT) use practice of the Facility	3.62	0.94
Health System Support Activities at the Facility	4.271	0.5
Poor Performance of Supplying hub (EPSA)	3.31	0.87

Source: Analysis of Survey data May 2020, using SPSS 20

This implies that, all the other factors kept constant:

As the rating on poor performance of the supplier (EPSA) (delayed delivery, reduced delivery quantity, stockout at EPSA) increased by one standard deviations (0.87) ,the stock out rate for category of first line anti TB drugs increases by 0.65 standard deviations (0.65*0.29). For every

0.87 increase on rating on poor performance of the supplier (EPSA), extra 0.1885 (18.85%) records on stockout rates can be expected.

This finding agrees with the one identified by in Brazil, where delayed delivery from supplier, incorrect delivery of order, stockout at the Supplier <0.005 (Vasconcellos and Sampaio,2008).

4.4. Addressing Research Questions

Based on the findings of both descriptive and Inferential analysis the research questions are answered as follows:

1. What is the extent of the stock out of anti TB drugs at public health facilities of Addis Ababa?

As per the analysis finding 54(65%) of public health facilities of Addis Ababa encountered stock out for at least one of these drugs during the study period. Besides,34(41%) these health facilities encountered stock outs for $>20\%$ of the first line anti TB drugs which can be said that these 41% of facilities faced high level of stock out.

2. To what extent does poor performance of supplying warehouse contribute to stock outs of anti TB drugs at public health facilities of A.A?

Every 0.87 increased rating on poor performance of the supplying warehouse, additional 18.85% records on stockout rates can be expected or increment in stock out rate that is highly significant at ($t = 7.624, p = 0.00$).

3. To what extent does the use of information and communication technology (ICT) in inventory management contributes to preventing stock outs of anti TB drugs at public health facilities of A.A?

There is no significant effect of ICT use on the stock out rate for category of first line anti TB drugs identified but the correlation analysis of these two variables (stock out rate and the rating on ICT use) show that both are negatively correlated showing increase rating of respondents on ICT usage contributes to decrease on stock out rate .

4. To what extent do health system support activities contribute to reduced stock outs of anti TB drugs at public health facilities of A.A?

Though not significant ,among the variables used to test health system support, both absence of bureaucracy and existence of supportive supervision are negatively correlated with the stock out rate , according to the correlation result ($r=-0.117$ & -0.09), meaning when there is increase on rating on none -bureaucratic procedure for ordering drugs and presence of supportive supervision at the health facilities there is a tendency in decrease in stock out rate of first line anti TB drugs while the rest four variables used to test this construct showed inverse correlations as opposed to the expectation ,hence need further exploration with more compressive study.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATION

This chapter presents the summary of major findings of the study, provides conclusions and recommendations and the suggested areas of further research based on the analyzed data considering to the general and specific objectives of the study.

5.1 Summary of Major Findings

The study was set out to assess the determinants of stock-outs for anti TB drugs at public health facilities of Addis. The major findings of the study are summarized as follows:

- 54(65 %) of public health facilities under Addis Ababa city Administration health bureau encountered stock out for at least one of first line anti TB drugs during the study period March /2019 to March 2020.
- Average stock out level of 27.3% was found for category of first line anti TB drugs across the health facilities with a standard deviation of 3.99 or on average 27.3% of the six drugs were stocked out for at least one day during the study period.
- 4% of the year (365 days) on average first line anti TB drugs were not available at public health facilities of Addis Ababa.
- Significant level of stock out was observed in first line pediatrics formulations with 33(39.8%) of health facilities stocked out for RH75/50 mg and 14(16.9%) encountered stock out of RHZ75/50 mg, the stock out level for ethambutol 100 mg & Isoniazid 100 mg is also high 25(30.1%) and 16(19.3%) respectively .
- Negligence by health facilities to place early request for these drugs before patient arrive is the main reason for stockouts of pediatrics formulations.
- There is high agreement by respondents regarding the existence of health system support activities followed by the existence of ICT practice for pharmaceuticals logistics

management at the health facilities and relatively low level of agreement with the performance of the supplying hub (EPSA). mean scores for the three variables being 4.27 3.62 and 3.31 respectively on a five-point Likert scale.

- Poor performance of EPSA is the significant determinant for stock out of first line anti TB drugs. Every 0.87 increased rating on poor performance of the supplying warehouse, additional 0.653 standard deviations (18.85%) records on stockout rates can be expected increment in stock out rate that is highly significant at ($t = 7.624, p = 0.00$).
- Though ICT use is not found to be a significant predictor for stock outs of first line anti TB drugs, a significant correlation exists between the two variables
- Most of pharmacists were not trained on anti TB drugs management

5.2. Conclusions

The study found out determinants of stock-outs for anti TB drugs at public health facilities of Addis Ababa and the following conclusions were made.

65 % of public health facilities under Addis Ababa city Administration health bureau encountered stock out for at least one of first line anti TB drugs during the one year study period showing there is critical problem regarding availability of these first line anti TB drugs. Significant level of stock out was observed in first line pediatrics formulations especially RH75/50 mg where 33 (39.8%) of health facilities stocked out for this drug for an average of 17 days of the year. Among adult formulations INH 300 mg and TB Patient kit at 31.3% & 25.3% of the public health facilities were stocked out for an average of 18 & 13 days, respectively.

Though the availability of all first line anti TB drugs were generally found to be low, the problem with pediatrics formulation is persisting and the reason for this mainly is not because the drugs are stocked out at the supplying hub rather negligence by health facilities in not placing early orders due to the fact that pediatrics cases not regularly arrive to these health facilities and ,hence, thought as these cases are not available.

The stock out situation at the public health facilities of Addis Ababa shows that there is a risk of treatment interruptions by patients and poor treatment outcome which mainly will contribute to the development of drug resistance tuberculosis.

The significant determinant for stock outs of first line anti TB drugs at public health facilities of Addis Ababa was related to the supplier (EPSA) especially related to delay in supply, inadequate supply, and stock outs with the supplier. This implies despite the existence of utilization of information and communication technology (ICT) and health system support activities at this health facilities , there is substantial level of stock out for first line anti TB drugs for which the main cause to be related to suppliers performance.

Training is another area of concern as most of pharmacists have not been trained on anti TB drugs management, hence knowledge gap on importance of ensuring availability of anti TB drugs thereby avoiding interruptions and risk of development of drug resistance.

5.3. Recommendations

- Among first line anti TB formulations for adults much attention is needed especially in the delivery of INH 300 mg and TB Patient kit as most of the reported stock out case of the public health facilities were on these drugs. Thus, the Ethiopian pharmaceuticals supply agency (EPSA) should further assess the situation at health facilities and make sure that these drugs are timely delivered.
- Collaboration platform to strengthen the drug supply system should be created by the Ethiopian pharmaceuticals supply agency and the ministry of health involving those stakeholders working especially on Tuberculosis, other related programs and pharmaceuticals supply chain management as it will create additional power for EPSA for improving the supply of anti TB and other drugs as well.
- Stakeholders working in Ethiopia such as policy makers, partners, drug supplying company's and warehouses should utilize the finding of this study as abasis and increase their collaboration to strengthen anti TB drugs supply systems taking in to account the increasing risk of drug resistance TB.
- Regular program specific and integrated supportive supervisions should be done jointly with a team of experts from different stakeholders to identify and manage stock out

problems and the supplying warehouse should also be regularly be engaged in such supervision.

- The supplying hub should also conduct structured supportive supervisions to and assessments at health facilities which currently is not being done.
- Trainings on anti TB drugs management has to be provided and provision of trainings should be integrated with the program managers (both especially drug store managers and clinicians providing care for TB patients should be trained together so as to create common understanding on the importance of continuous availability of the drugs and the risk of poor treatment outcome and drug resistance that would result because of drug interruptions).
- Even though proportion of pediatric cases is very minimal as compared to adults the service should not be deprived of. Much attention should be given by the health facilities, Regional Health Bureau, partners, the supplying hub (EPSA), and all other concerned bodies to make sure that pediatric anti TB drugs are available in minimum possible quantity in the health facilities.
- Improved communication especially between the supplying hub (EPSA) and health facilities is recommended for monitoring the delivery status of ordered items and expedite deliveries. Besides, EPSA should access the drug availability status of health facilities through dashboards or other decision-support systems so that supplying decisions be made by quality data, thus avoid maldistributions. Besides, customized dashboard platforms should be made accessible to relevant management bodies (such as Federal Ministry of Health, Regional Health Bureaus and Sub City Health Offices) so as to improve stock data visibility , collaborative decision making and avoid stock outs and maldistributions in general.

5.4. Research Limitation and Areas of Future Research

Generally, studies focusing on anti TB drugs supply are limited hence, comprehensive research especially exhaustively considering additional study participants from the supplying warehouses (the central EPSA and Addis Ababa hubs), administrative units (sub city health offices, Regional Health Bureaus and Federal Ministry of Health) is recommended to add on the limited knowledge.

The current study only included and identified only limited variables that are determinants for stock out of first line anti TB drugs. Since the current regression model explained only 40.3 % of factors that contribute for stock out of first line anti TB drugs and there are other variables that could explain 59.7% of stock outs ,hence further research including additional variables and with more in-depth is proposed.

The current study identified that health system support activities have no significant effect on stock out of first line anti TB drugs besides the correlation with stock out for most of the constructs under this variable is positive hence ,further study to explore this is proposed especially to generally understand the situation regarding health system activities and the quality of these activities.

The current study could not address the effect of stock outs of anti TB drugs on treatment outcome & performance of the national TB program, hence, future study is suggested to understand how much the current stock out impacted service provisions and outcomes.

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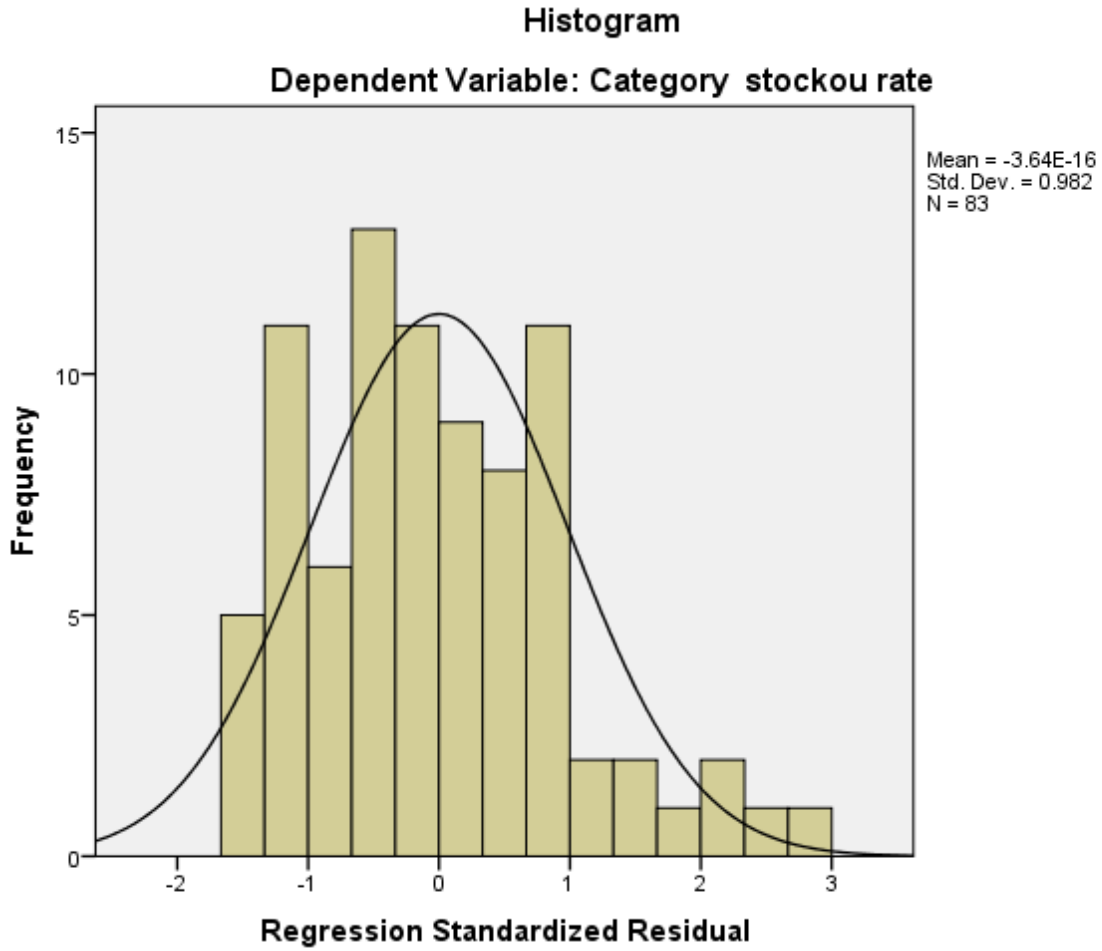
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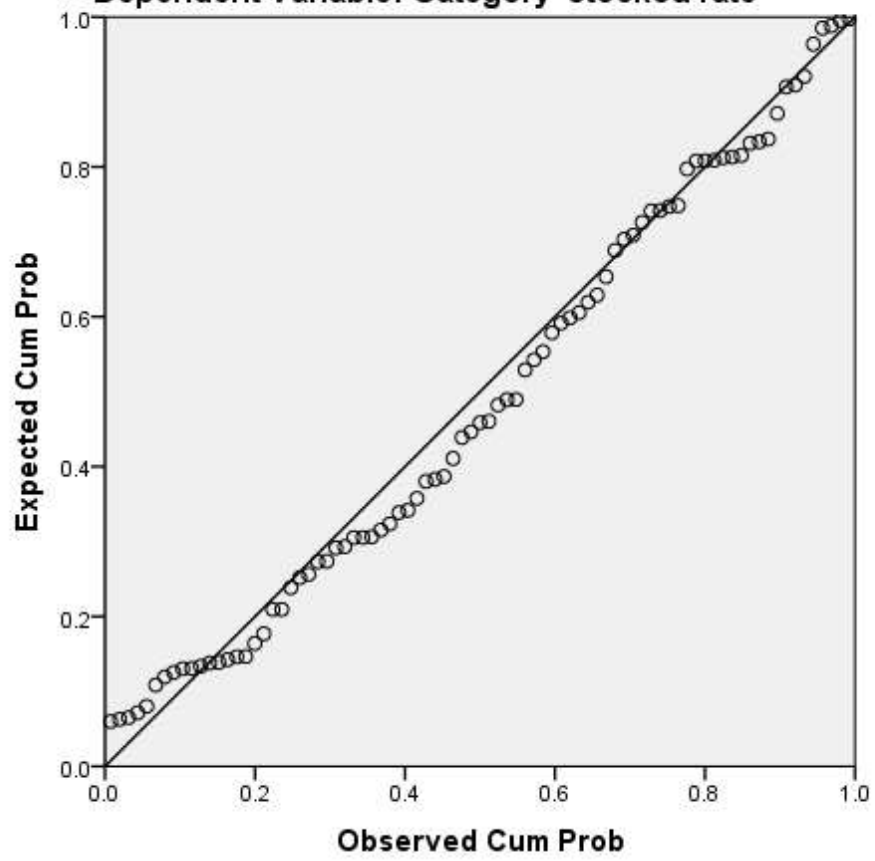
ANNEXES

Annex 1: Normal P-P plot of Regression Standard Residual and scatter plot for multiple regression analysis



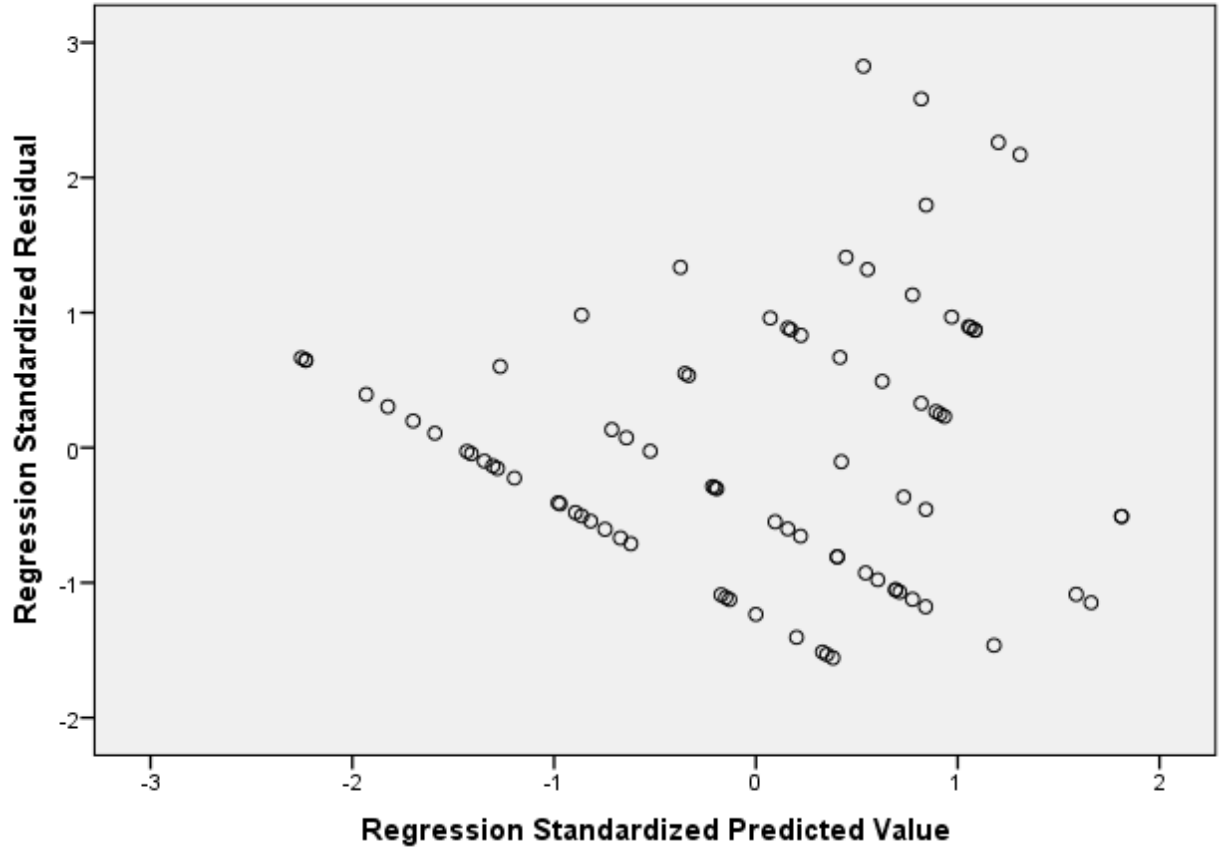
Normal P-P Plot of Regression Standardized Residual

Dependent Variable: Category stockou rate



Scatterplot

Dependent Variable: Category stockou rate



DATA COLLECTION TOOLS

1. CONSENT AND INFORMATION SHEET

Addis Ababa University Addis Ababa University, College of Business and Economics School of Commerce

Dear Participant, My name is Kassech Sintayehu, Post graduate student of Addis Ababa University, school of commerce, department of logistics and supply chain management; I am going to conduct a study and collect data on determinants for stock outs of anti TB drugs at public health facilities of Addis Ababa. The objective of the study is to assess the levels of anti TB drug stock outs from the previous 1 year to date and the determinants for this stock outs. The information you provide will be used to improve availability of anti TB drugs thereby contribute to improved care of TB patients and prevention of drug resistant TB. The study will identify gaps and determinants for stock out of anti TB drugs and provide recommendations for proper interventions by the concerned bodies. Your participation in filling the questionnaires and every aspect of the study is completely voluntary. Your name will not be written on any of the instruments or be kept in any other records and all information that you give me will be kept confidential and you are free to withdraw your consent and to discontinue participation at any time without any consequence. But since your sincere response is very crucial, I hope that you are going to participate in the study.

Thank you in advance for your cooperation!

N.B: If you want to request additional information about the study you can contact Kassech Sintayehu, the principal investigator for the study on:

Tel: 0922402429 or email: skassech@gmail.com

You are now being asked if you have read the information above and if you are willing to participate in the study. We would greatly appreciate your truthful and keen participation in responding to this questionnaire.

Yes, I agree _____

No, I don't agree _____

Participants Signature _____

Thank you!

Part II: General Questions

Please indicate your level of agreement on the statements for each question using the following rating scale by putting “X”

Key: 1= Strongly Disagree, 2= Disagree, 3= Neutral, 4 = Agree, 5 = Strongly Agree

Information and Communication Technology (ICT) Use Practice of the facility						
SN	Items	Five scale rating				
		Strongly Disagree = 1	Disagree = 2	Neutral = 3	Agree = 4	Strongly Agree =5
1	The facility involves in pharmaceutical logistics social media group (Viber, Telegram) for exchanging logistics information					
2	The use of SMS messaging and phone call for exchange of logistics data with stakeholders involved in pharmaceutical logistics management is practiced in the facility					
3	The use of an internet to exchange pharmaceutical logistics data with stakeholders involved in pharmaceuticals logistics management is practiced in the facility					
4	The facility utilizes electronic LMIS					
Health System Support Activities at the Health Facility						
SN	Questions	Four scale rating				
		Strongly Disagree = 1	Disagree = 2	Neutral = 3	Agree = 4	Strongly Agree =5
1	The facility received supportive Supervision from higher level (RHB, EPSA, FMOH etc) in the previous one year					

2	Pharmaceuticals in the drug store are managed by academically qualified staff (Trained Druggist or Pharmacist)					
3	There exists in-service training related to pharmaceuticals logistics management for professionals handling pharmaceuticals					
4	Reliable logistics data is sent from the facility to EPSA is (as verified from last year RRFs cross checked with bin/stock card)					
5	Pharmaceuticals are ordered by the health facility without any bureaucracy					
6	The facility RRF is timely submitted to EPSA (as verified from date of submission for last year RRF)					

Performance of the Supplying Hub (EPSA)

S.N	Questions	Five scale rating				
		Strongly Disagree = 1	Disagree = 2	Neutral = 3	Agree = 4	Strongly Agree =5
1	There exists delay in delivery of anti-TB drugs from EPSA					
2	EPSA Reduces quantity of anti-TB drugs ordered by the facility (it supplies reducing from ordered quantity)					
3	There has been Stock out of anti-TB drugs at EPSA in the previous year					
4	The facility faced Supply of short expiry anti TB drugs by EPSA					

3. OBSERVATIONAL CHECKLIST TO ASSESS LEVEL OF STOCK OUT OF ANTI TB DRUGS

Fill in the columns based on inspection on inventory cards / Bin or Stock cards

S N	Anti TB drug	stock outs within the study period (March 20, 2019 to March 20, 2020 (Yes / No):	If stock out, number of stock outs (Frequency /how many times) within the study period	Total DOS (previous one year up to the day of the study
1	TB patient Kit			
2	RHZ (75/50/150 mg)			
3	RH (75/50 mg)			
4	INH 300 mg			
5	INH 100 mg			
6	Ethambutol 100 mg			

INTERVIEW GUIDE

Guidelines for semi-structured interviews with Pharmacy heads, Respondents from RHB and EPISA. (To be modified for each of the stakeholders during the interview)

Part I: Background Information

1. Sex a) Male b) Female
2. Profession: a) Pharmacy b) Medical lab tech c) Nurse d) Other
3. Age: _____
4. What is your level of education? a) Diploma b) BA/BSc
c) MBA/MSc d) Others (specify)
5. What is your position? -----
6. How many years (months) have you been working in this capacity? -----
7. Have you ever received any training in integrated pharmaceuticals logistics system (IPLS) ?
a) Yes b) No
If yes When? -----
8. Have you ever received any training related to TB DSM?
a) Yes b) No
If yes, When? -----

Part II: General Questions

1. Now I would like you to think about the past 1 year. Have you ever faced SO of anti TB drugs in the previous year (from March 20, 2019 to date)?
2. Which anti TB drugs have been stocked out in the previous year including today?
3. What do you think are the determinants for mentioned Stock outs? (Need for further probing in associated with the variables etc)
 - *The use of information and communication technology (ICT)*
 - *Health system Support*
 - *Performance of EPSA*
4. In your opinion, what can be done to redress these identified determinants and improve availability of anti TB drugs in your facility?

Is there anything else you would like to tell us or ask us?

Thank you very much for your participation in this interview.