



ADDIS ABABA UNIVERSITY

SCHOOL OF COMMERCE

**Factors Contributing to the Expiry of Human Immunodeficiency Virus,
Tuberculosis and Family Planning Pharmaceuticals: The Case of Public
Health Facilities in Addis Ababa, Ethiopia**

By:

Meron Kifle (B.Pharm.)

September 2021

Addis Ababa, Ethiopia



Factors Contributing to the Expiry Human Immunodeficiency Virus, Tuberculosis
and Family Planning Pharmaceuticals: The Case of Public Health Facilities in
Addis Ababa, Ethiopia

A research report

Submitted to the graduate school of Addis Ababa University, School of Commerce, In partial
Fulfillment of the Requirements for the Master's Degree in Logistics and Supply Chain
Management

By

Meron Kifle (B.Pharm) ID. GSE/5739/11

Advisor

Matiwos Ensermu (Asst. Prof)

September 2021

Addis Ababa, Ethiopia

Declarations

I hereby declare that the thesis entitled;” Factors Contributing to the Expiry Human Immunodeficiency Virus, Tuberculosis and Family Planning Pharmaceuticals: The Case of Public Health Facilities in Addis Ababa, Ethiopia” is original and has not been submitted for other or the like in this university, college or any other institutions. It does not contain any material partly, or wholly, published or written by others except those references quoted in the text.

Student Name

Meron Kifle

Student Signature and date:

Certification

This to certify that Meron Kifle has carried out her thesis work on the topic entitled; “Factors Contributing to the Expiry Human Immunodeficiency Virus, Tuberculosis and Family Planning Pharmaceuticals: The Case of Public Health Facilities in Addis Ababa, Ethiopia” under my guidance and supervision. Accordingly, I hereby assure that this work is appropriate and standard enough to be submitted for the reward of Maters of Arts Degree in Logistics and Supply Chain Management.

Name of Advisor

Matiwos Ensermu (Asst. Prof.)

Signature and date

Addis Ababa University
College of Commerce
School of Graduate Studies

Factors Contributing to the Expiry Human Immunodeficiency Virus, Tuberculosis and Family Planning Pharmaceuticals: The Case of Public Health Facilities in Addis Ababa, Ethiopia

By
Meron Kifle

This is to certify that the thesis is prepared by Meron Kifle entitled: Factors Contributing to Expiry of Human Immunodeficiency Virus, Tuberculosis and Family Planning Pharmaceuticals: The Case of Public Health Facilities in Addis Ababa, Ethiopia and submitted 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 University and meets the accepted standards with respect to originality and quality.

Name of advisor: _____ Signature: _____

Date: _____

Name of internal examiner: _____ Signature: _____

Date: _____

Name of external examiner: _____ Signature: _____

Date: _____

Acknowledgments

Above all, I would like to thank the Almighty God for giving me the will, courage, and strength to pursue and accomplish this study. I am very much grateful to my advisors Dr.Matewos Ensermu for his continuous encouragement, scholastic exchanges on the topic, and spending his time reviewing the document, adding valuable comments and feedback for the compilation of this final thesis work.

My thanks go to the Department of Procurement and Supply Chain Management, School of Commerce, College of Business and Economics, Addis Ababa University for facilitating my study and for the unreserved support and cooperation extended throughout the study. I am also indebted to my family, colleagues and friends for their support and encouragement throughout the study.

My special gratitude also goes to Health facilities and participants of the study who are willingly provided me the necessary data and information for the conduct of the study.

Table of Contents

Acknowledgments.....	iii
List of Tables	xii
Lists of Figures.....	xiii
Acronyms /Abbreviations	ix
Abstract.....	x
Chapter One	1
1. Introduction.....	1
1.1. Background.....	1
1.2. Statement of the problem.....	2
1.3. Objectives of the Study.....	3
1.4. Research Questions.....	4
1.5. Significance of the Study.....	4
1.6. Scope of the Study	4
1.7. Operational definition.....	5
1.8. Organization of the Study	5
CHAPTER TWO	6
2. Review of Related Literature	6
2.1. Introduction.....	6
2.2. Review of Theoretical Literatures	6
2.2.1. Public Health program	6
2.2.2. National ART program	6
2.2.3. TB situation in Ethiopia	7
2.2.4. National TB control strategy.....	7
2.2.5. The national reproductive health strategy	7
2.2.6. National Supply chain system.....	8

2.2.7. Supply Chain Management activity in health facilities	8
2.2.8. Pharmaceutical Supply Chain management activities in health facility	8
2.2.9. Anti-Retroviral Treatment Supply chain.....	8
2.2.10. Pharmaceutical Logistic system.....	9
2.2.11. Logistic Management Information System.....	9
2.2.12. Pharmaceutical Supply Chain management in Ethiopia	10
2.2.13. SCM activities in health facilities and wastage	11
2.2.14. Family Planning Supply Chain in Ethiopia.....	11
2.2.15. Medication wastage	11
2.3. Empirical literature review	12
2.3.1. Supply chain in empirical literature	12
2.3.2. Extent of wastage.....	12
2.3.3. TB medications wastage	12
2.3.4. Medication wastage	13
2.3.5. Findings of studies on factors for expiry and wastage of medicines	13
2.3.6. Factors contributing to expiry of medications.....	14
2.3.7. Determinants of expired program pharmaceuticals	15
2.4. Conceptual framework	16
CHAPTER THREE.....	18
3. RESEARCH METHODOLOGY	18
3.1 Introduction	18
3.2 Study Area	18
3.3 Research Approach.....	18
3.4 Research Design	18
3.5. Study Population and study subjects.....	19
3.5.1. Sampling methods, Sample size and sampling frame.....	19

3.6. Data Types and Sources.....	19
3.7. Data Collection Procedures	20
3.8. Data quality assurance	21
3.8.1. Validity	21
3.8.2. Reliability.....	21
3.9. Data analysis.....	21
3.10. Ethical Considerations	23
CHAPTER FOUR.....	24
4. Results and Discussion.....	24
4.1. Respondent rate of response	24
4.2. Socio-Demographic characteristics of study participants	24
4.3. HIV, TB and FP pharmaceuticals expiry rate.....	25
4.3.1. Most expired pharmaceuticals in HIV programs	34
4.3.2. Contributing factors for expiry of pharmaceutical in HIV, TB and FP program	34
4.4. Association of variables (Findings of inferential statistics).....	41
4.4.1. Finding of multiple regression analysis result.....	42
4.5. Qualitative findings of the study	46
CHAPTER FIVE.....	53
5. Summary of findings, conclusion and recommendations.....	53
5.1. Summary of major findings of the study	53
5.2. Conclusion	54
5.3. Recommendations.....	55
5.4. Research limitation and area of future research.....	56
References	57
Annexes:.....	61

List of Tables

Table 1: Characteristics of study participants.....	24
Table 2: Respondent average age and work experience.....	25
Table 3: Expiry rate of program pharmaceuticals with their mean expiry rate.....	26
Table 4: Type of pharmaceuticals expired in HIV program.....	26
Table 5: Type of pharmaceutical expired in FP program	29
Table 6: The most pharmaceutical expired, frequency and expired money in ETB in public health facilities of A.A.....	31
Table 7: Poor performance of supplying hubs (EPSA) of the facility mean and standard deviation.....	35
Table 8: Improper forecasting and quantification of the facility and mean and standard deviation.....	35
Table 9: Improper inventory management practice of the facility and mean and standard deviation.....	37
Table 10: Over procurement of the facility and mean and standard deviation.....	38
Table 11: Improper implementation of health system of the facility and mean and standard deviation.....	39
Table 12: Mean level of agreements on independent variable.....	41
Table 13: Independent variables with their mean and standard deviation of variables	46

Lists of Figures

Figure 1: Conceptual Framework for factors contributing to expiry of pharmaceuticals, Adapted from variables of different literatures described above, 2021	17
Figure 2: Type of pharmaceutical expired in TB program.....	29
Figure 3: HIV, TB and FP Programs and expiry rate	31

Acronyms / Abbreviations

AIDS	Acquired Immune Deficiency Syndrome
ART	Anti-Retroviral Therapy
DOT	Directly Observed Treatment
EPI	Expanded Program on Immunization
EPSA	Ethiopian Pharmaceutical Supply Agency
HAART	Highly Active Antiretroviral Therapy
HCMIS	Health Commodity Management Information System
HIV	Human Immune Virus
TB	Tuberculosis Bacteria
FP	Family planning
IPLS	Integrated Pharmaceutical Logistic System
LMIS	Logistics Management Information System
MCH	Maternal and Child Health
MOH	Ministry of Health
PHPs	Public Health Programs
RH	Reproductive Health
SC	Supply Chain
SPSS	Statistical Package for Social Sciences
WHO	World Health Organization

Abstract

Expired pharmaceuticals pose a threat to the health care system and the environment. Moreover, expiry of Human Immunodeficiency Virus (HIV AIDS), Tuberculosis (TB) and Family Planning (FP) pharmaceuticals might lead to loss of resources in resource-limited countries like Ethiopia where pharmaceuticals for these programs is expensive. The objective of the study was to assess the factors that contributes to the expiry of HIV, TB and FP pharmaceuticals in the case of public health facilities in Addis Ababa, Ethiopia. A facility-based descriptive cross-sectional study with mixed method study design was followed to identify factors contributing expiry of pharmaceuticals for HIV AIDS, TB. Quantitative data was collected from health centers pharmacy on service related HIV, TB and FP treatment and services. On the other hand, qualitative data was collected from selected pharmacy heads of health facilities, selected sub cities of, Addis Ababa city administration health Bureau and Addis Ababa hubs of Ethiopian pharmaceuticals supply agency (EPSA). All health facilities included in the study were encountered expiry of pharmaceutical used for HIV within the previous one-year period.

Significant level of expiry of pharmaceuticals used for HIV, TB and FP treatment was observed. In HIV pharmaceuticals, 42.7% of health facilities encountered expired TDF/3TC/EFV 1000 mg, 32.3% for RH 150/75 mg and 43.8 % for combined oral contraceptive tablet. Regression analysis result showed that improper forecasting and quantification is significant factors contributing for expiry of pharmaceuticals used for HIV, TB and FP at 95% level of confidence ($p=0.02$). The total monetary value of expired pharmaceutical used for HIV, TB and FP in the studied health facilities in Ethiopian Fiscal year of 2012 was close to 4,228,064 ETB. Average pharmaceuticals expiry rate was found to be 3.73%. Provision of training on regimen change on HIV, TB and FP treatment and integration of services with program managers are important to reduce expiry of pharmaceuticals.

Keywords: *Expiry of Pharmaceuticals, HIV, TB, FP, Addis Ababa, Health Facilities*

Chapter One

1. Introduction

1.1. Background

Medicines are an important key component of the health care services. Medicines should meet the required standard of quality for to use safely and effectively. In addition, essential drugs must be available in adequate quantity to meet the public demand and better to focus on patients who cannot afford. Health and essential medicines drug policies give priority for achieving equitable distribution of essential medicines (Quick, 2003). However, essential and lifesaving medications expired at health facilities becoming significant. Expiry of pharmaceuticals occur because of inefficiencies in medicines supply management, poor management of treatment policy change and duplicated procurement (Nakyanzi *et al.*2010).

Worldwide, the amount of expired medications in supply chains is growing because of lax supply chain management, inadequate storage practices, and an overabundance of medications. In nations with few resources, like Ethiopia, when there is a shortage of medications, the situation is quite critical (. Unused/expired pharmaceuticals pose a threat to both the health care system and the environment. Given the budget constraints in financing the health care system to gather with the huge amount of wastage and disposal costs of those unused medications in low- and middle-income countries will pose a huge threat to the health care system and the economy in general (Ebrahim *et al.*, 2019).

Countries are facing with increased cost in the health care system due to expiration of medicines that also affects individual patient financial capabilities. The challenge of disposing expired medicines has its own economic and environmental damage. Besides the financial losses executed on the health care systems of countries and on individual patients, the disposal of expired medications is equally problematic. These pharmaceutical products contain biologically active and often toxic substances (Alnahas *et al.*, 2020). The improper disposal of unused and expired medication challenges the environment (Bashaar *et al.*, 2017). For this reason, managing the supply chain is important to prevent loss that occurs with misuse, expiry and theft.

In practice, medications wastage cannot be eliminated. However, carefully examining contributing factors and identifying the most common and expensive medications involved is certainly worthwhile, and may help in recognizing the most suitable measures to reduce medication wastage (World Health Organization, 2017).

Studies conducted in Uganda showed that the key contributing factors for expiry of medicines in the supply chain include, inadequacies in medicines supply chain and logistics management such as procurement and use of medicines without adequate plan and reason. In addition, negligence in stock monitoring, lack of awareness of basic expiry prevention tools, staffs at health facilities not included in the preparation of list and process of procurement. Moreover, giving priority to supplier who provide incentives and giving priority for personal profit during procurement, procurement by central or third party organizations, overstocking and poor management of treatment policy change and duplicate procurement were other factors (Nakyanzi *et al.*, 2010).

In Ethiopian, researches mainly focuses on medicines availability, and there is limited published research on the type and percentage of expired medicines with the significant factors for expiry. Thus, this study is aimed at assessing factors contributing to the Expiry of HIV, TB and FP Pharmaceuticals at Public Health Facilities of Addis Ababa

1.2. Statement of the problem

Pharmaceuticals represent a large portion of the costs in the healthcare system accounted for 20-60% of health spending in developing and transitional countries (Mezid, 2014). Health system requires essential medicines to prevent, treat and diagnose different health problems. However, availability of essential medicines at time need is becoming a serious challenge that affects functions to manage health related problems. For example, shortage of essential medicines experienced in South Africa especially among chronic patients who experienced complications or fatalities (Sauls, 2016). A difficulty in selection, procurement, distribution, storage and use, gaps in supply chain have an effect on medicines to be expire (Nakyanzi *et al.*, 2010).

Expired medicines stock indicate waste of resources that cannot be afforded in resource-constrained nations. Drugs and supplies, being expensive commodities, need to be utilized optimally to avoid wastage. Furthermore, it is important that patients access the necessary medicines in order to control the disease burden (Tumwine, 2010).

Drug expiry public hospital pharmacies of the Sekhukhune District in the Limpopo province cost the department of health and lower the quality of healthcare services (Mashishi, 2015). Expiry of medicines in supply facilities was common among medicines for vertical health programs including Vitamin A capsules, antiretroviral medicines, anti-tuberculosis agents, chloroquine, sulfadoxine/pyrimethamine and nystatine tablet (Nakyanzi *et al.*, 2010) The impact of pharmaceutical waste is therefore multifaceted. In an economic sense, this waste entails a massive loss of financial resources (Alnahas *et al.*, 2020).

Ethiopia has a number of health programs that requires efficient pharmaceuticals supply system for effective and efficient implementation. The national assessment conducted on the public health pharmaceutical supply system in 2004 identified a number of challenges in the Supply chain (SC) of health commodities. The major challenge in the health system of the country was medicines wastage. Eight percent of medicine was expired from the total of medicines procured in 2003. Lack of accountability and proper documentation, and reporting mechanism for expiry of medication created information gaps for proper forecast. These poor performances contributed for high expiry rate. A study conducted in southwest Shoa zone of Ethiopia showed that space of medicines stores was occupied by huge amount of expired and damaged medicines (Geberemariam *et al.*, 2019).

Thus, due to significance of the problem of pharmaceuticals expiry in the study area it is important to know the extent and the factors that contribute for expiry of pharmaceuticals used in HIV, TB, and FP program at public health facilities of Addis Ababa.

1.3. Objectives of the Study

1.3.1 General Objective

- To identify the factors contributing for expiry of pharmaceuticals used in HIV, TB, and FP program at public health facilities in Addis Ababa.

1.3.2 Specific Objectives

- To determine the magnitude of expired pharmaceutical used for HIV, TB and FP programs at the public health facilities in Addis Ababa
- To identify the most expired pharmaceutical used for HIV, TB and FP programs at the public health facilities in Addis Ababa.

- To identify the factors contributing expiry of pharmaceutical used for HIV, TB and FP programs at the public health facilities in A.A
- To determine the effect of improper implementation of health system on expiry of pharmaceutical used for HIV, TB and FP programs at the public health facilities in A.A.

1.4 . Research Questions

- What is the magnitude of expiry of pharmaceuticals used for HIV, TB, and FP program at the public health facilities in Addis Ababa?
- Which types of pharmaceutical are mostly expired pharmaceutical used for HIV, TB and FP programs at the public health facilities in Addis Ababa?
- What are the contributing factors to pharmaceuticals expiry in the case of HIV, TB, FP programs at public facilities in Addis Ababa?

1.5 . Significance of the Study

A major challenge health facilities experience is expiry of pharmaceuticals. Hence, this study helps health facilities, EPSA, the regional health bureau and policy makers, donor agencies and program supporting agencies to understand the current condition related to expiry. It also will be an input for future action plans to decrease expiry and strengthen drug supply management system. The research findings can be used to design an applicable system for the management of medications with small or no amount of expired drugs which advance the entire supply chain productivities. The result of this study will be used as model data for future studies in the area by providing awareness to the problem.

1.6 . Scope of the Study

This study is limited to public health facilities providing HIV, TB and FP treatment services in Addis Ababa and focused on pharmaceuticals used in the treatment of these diseases conditions. In addition, central hub of Ethiopian Pharmaceutical Supply Agency (EPSA) and Addis Ababa EPSA hub were included in the study. In addition, the study focuses on factors contributing for pharmaceutical expiry, extent and degree of medicines expiry and the type of medications expired in respective health facilities.

1.7. Operational definitions

- **Inventory management:** It is a systematic method to sourcing, storing and retailing inventory; both raw materials (constituents) and finished goods (products).
- **Pharmaceutical expiry:** It indicates expiry of drugs.
- **Pharmaceutical expiry rate:** it is the proportion calculated by dividing the expired value in monetary forms to the total value of drugs received in the period 2012 Ethiopian fiscal year
- **Family planning:** It is defined as the capability of individuals and couples to forestall and achieve their preferred number of children and the spacing and timing of their births. It is reached through use of contraceptive methods and the treatment of involuntary infertility
- **Unused medications and wasted medications:** Defined as medications that were expired, which may be usable or not planned for any future use.
- **Pharmaceutical wastes:** They are wastes that are produced from the hospital in the use of medicines during diagnosis, treatment, immunization, compounding and manufacturing.
- **Anti TB Drugs:** Those drugs that are used in the prevention and cure of Tuberculosis.
- **Anti HIV Drugs:** They are drugs which are found under the national essential drug list and are used to lessen the amount of virus (viral load) in a patient's body. This combination of drugs is referred to as highly active antiretroviral therapy (HAART).

1.8. Organization of the Study

The study is structured in three chapters. The first chapter includes the background of the study, statement of the research problem, research questions, objectives, significance, scope and limitations of the study and operational definitions. The second chapter covers review of related literatures (both theoretical and empirical) and conceptual framework. In the third chapter, the methodology of the study including description of the study area, research approach used with design, population and sample for the study, data sources, types, and collection measures and analysis technique used and ethical considerations for data collection.

Chapter Two

2. Review of Related Literature

2.1. Introduction

In this chapter, relevant literatures are reviewed presented in two parts of theoretical and empirical. It comprises some theoretical reviews which identify different factors that are thought to be relevant to the study. Topics related to public health program, national ART program, TB situation in Ethiopia, national TB control strategy, the national reproductive health strategy, national SC system, Supply chain management (SCM) activity in health facilities, pharmaceutical supply chain management in Ethiopia, pharmaceutical SCM activity in health facility and wastage, ART SC and FP SC in Ethiopia are covered. Empirical literature review showing what previous findings present to support the theoretical review part. The conceptual framework of the study that classifies and defines variables relevant to the study along with the relationships among them is also showed in this chapter.

2.2. Review of Theoretical Literatures

2.2.1 Public Health programs

The use of medicines is an important aspect of many public health programs that are designed to improve the health of a target population, their cost to the health budget is between 6% in developed countries and 45 % in some developing countries. The medicines are important not only because of their capacity to treat and prevent diseases and to support PHPs, but also because the confidence of the public in the health policies of their countries is inextricably linked to their confidence in the availability of medicines that are safe and effective (WHO, 2006).

2.2.2. National ART program

Ethiopia introduced ART in 2003 in selected health facilities following the issuance of the national antiretroviral treatment (ARTs) drugs supply and use policy in 2002. Free ARV service was launched in 2005 in public hospitals and 2006 in health centers. At the end of 2017, 415,578 adult and 21,385 children under the age of 15 were on ART. Ethiopia has now developed HIV/AIDS prevention care and treatment strategic plan in an investment case approach which is being implemented from 2015-2020. This strategic plan aims to pave the path for ending AIDS

by 2030 through averting 70,000-80,000 new HIV infections and saving about half a million lives till 2020. The targets set in this plan are in line with the three 90s (90-90-90) targets set by UNAIDS to help end the AIDS epidemic.

The 90-90-90 targets to be reached by 2020 includes 90% of all people living with HIV will know their HIV status, 90% of all people with diagnosed HIV infection will receive sustained ARV therapy and 90% of all people receiving anti-retroviral therapy will have viral suppression (MOH 2018)

2.2.3. TB situation in Ethiopia

TB is a public health problem significantly affecting low and middle income countries. It has a dire consequence by affecting the young and those who are thought to be productive and resulting in a serious burden to the health system and exploiting the individual's household economy.

2.2.4. National TB control strategy

Ethiopia adopted the directly observed therapies (DOTs) strategy since 1997 after a successful pilot program with the development of the first combined TB and leprosy prevention and control program manual. The national TB program has also re-prioritized the key strategic interventions in the five-year national TB strategic plan that paves the way towards achieving the following:

- END TB 90 - (90)-90 targets set for 2020.
- Ensure 90% of all people with tuberculosis diagnosed and treated
- Ensure 90% of the key populations in the country are diagnosed and treated
- Ensure 90% of people diagnosed successfully complete treatment with services to ensure adherence and social support. (FMOH 2017-2020, FMOH 2018)

2.2.5. The national reproductive health strategy

The revised national RH strategy (2016-2020) states that the goal of FP is to reduce unintended pregnancies and enable individuals to achieve their desired family size.

2.2.6. National Supply chain system

Federal Ministry of health (FMOH) through PFSA started implementing IPLS since 2009. Before the existence of IPLS, there were so many problems in the management. The Management of health commodities is that led to frequent stock out and wastage of health commodities. Management of essential pharmaceuticals using IPLS substitute what previously was managed vertically. Public health facilities get medications through this system (Participants manual 2019).

2.2.7. Supply Chain Management activity in health facilities

SCM is core component of health sector for health programs and services .it is correctly applied in public health institutions can contribute a greatly assuring access to health supplies public health institutions and thus for positive health outcomes.

The public mission health SC manger therefore has an essential role in the realization of global public health goals, for improving maternal health, reducing child mortality and combating HIV/AIDS, malaria and other diseases.

2.2.8 Pharmaceutical Supply Chain management activities in health facility

The complexity of pharmaceutical SC results from the involvement of multiple large independent organizations of very diverse nature. The goals of pharmaceutical SC obviously emphasize regulatory compliance and safety of products, but also include leveraging information to be more responsive to the needs of consumers.

2.2.9 Anti-Retroviral Treatment Supply chain

Management of ARV SC has become difficult. This is due to an increase in number of people, number of sites providing ART services and new ART medications that leads to increase variety of medication provided. Proper inventory management avoids over stocking, under stocking and stock out, minimizes wastage of product from damage and expiry of the pharmaceuticals (Gabriel and Tefesse.2017).

Ensuring an effective SC for ART requires an uninterrupted supply of HIV /AIDS commodities, especially ARVs. A wide range of pharmaceutical products and equipment are needed for diagnosis, treatment, care and prevention of HIV /AIDS. These include medicines to treat HIV infections, antiretroviral (ARV) medicines to prevent and treat opportunistic infections (OIs)

medicines for palliative and supportive care: medicines to prevent and treat sexually transmitted infection (STIs); medicine to treat HIV –related cancers; diagnostic test kits for HIV and other laboratory reagents. Contraceptives: condoms; protective gears for infection preventions and health worker safety; and a host of consumable medical and laboratory supplies and equipment.

It is important to have uninterrupted stock availability of ARV. For achieving this continuous supply inventory management is crucial. Stock out and expiry of medications can be prevented with proper management of inventory (Gabriel and Tefesse, 2017).

Anti-retro-viral (ARV) are parts of essential medicines that must have nonstop supply to the patient. However, it has its own unique characters that range from the medicine nature to how it's used. This makes supply chain management of ARVs makes every series of section to work in integration.

Low and middle-income countries lack data on ART service and ARV medicines. Even if there are data, it lacks fullness and accuracy. This are the common problems face in this countries for proper quantification. A data which is accurate and full will have a positive output in the quantification process of ART medication in order to have continuous supply. (Berhanemeskel et al 2016)

2.2.10 Pharmaceutical Logistic system

Pharmaceutical selection pharmaceuticals may constitute as much as 40 % of the health care budget in developing countries Selection of medicines has a considerable impact on the quality of care and the cost of treatment. It is one of the logistics management activities where intervention is most cost effective. More commonly, the selection and uses of essential medicines are limited to public sector health facilities.

2.2.11 Logistic Management Information System

Logistic management information is the system of records and reports that you use to collect, organize and present logistics data gathered across all levels of the system. It collects data about pharmaceuticals, this information system used for routine activities such as filling routine request of health facilities (participant manual 2019)

LMIS is important for all public health commodity distribution system .it is especially critical for HIV/AIDS commodities that have high value and requires special handling procedures, without

LMIS implementation. Programs will inevitably waste valuable resources through prolonged and frequent stock outs, over stocks and losses.

A well-implemented LMIS reduces the likelihood of stock outs and over stocks that can waste scarce resources and lead to product expiration, especially given the short life of HIV test kits. One of the special characteristics of ARV drugs have short shelf life (expiry) due to this they need special attention (Gabriel and Tefesse.2017)

The important issue is regarding management of pharmaceuticals is management of medicine wastes pharmaceuticals. Damages ranging from the package of the medicine itself to expiry of medication makes pharmaceuticals unfit for use. This waste not only affects the potential of health sector to work to optimum but also have environmental damaging effect (Mezid, 2014).

2.2.12 Pharmaceutical Supply Chain management in Ethiopia

Ethiopia pharmaceutical SCM system had numerous challenges. This includes availability of medication in required time, storage condition not to the standards set, poor stock management, affordability issue and improper uses of medicines. Pharmaceuticals need to be managed properly because pharmaceuticals constitute up to 40 % health care budget, poor medicines management obstructs access to medicines; result in wastage and health hazard, medicines are part of the line between the patient and health services.

The challenge of the public pharmaceuticals .SC management are disorganized forecasting, redundant procurement, non-need –based donation and procurement, standard storage and distribution facilities, high pharmacy, high pharmaceuticals wastage rate greater than 8 %.(Alemu *et al.*, 2020)

Ethiopia has a number of health programs that requires efficient pharmaceutical SC system for their effective and efficient implementation (Mengistu and Tibeb 2020). The national assessment conducted on the public health pharmaceutical SC in 2004 identified a number of challenges in the SC of health commodities, where set of vertical programs involving multiple stakeholders were responsible for managing SC for ART, TB, family health, EPI etc.

Pharmaceutical fund and supply agency a semi –autonomous agent under federal ministry of health, was nationally established by the house of people’s representatives with a mandate to run and coordinate the whole in pharmaceutical supply chain operation for public health system. This

national pharmaceutical supply system reform has given rise to the designing of an IPLS. As a primary mechanism to ensure un-interrupted supply and continuous availability of quality – assured essential medicine at all public health (Tilahun *et al.*, 2016).

2.2.13 SCM activities in health facilities and wastage

Medicines expire with poor stock control. Poor stock control calls for complaints of a myriad of abuse, the most common being pilferage (theft), buildup of expired medicines without disposal which occupies spaces and may lead to waste recourses.

Poor medicine supply management practices result in scarcity of essential medicines, high fees, poor quality, theft, medicinal expiry, irrational prescription and incorrect use of medicines by patients which in turn causes loss of totally 70 % of the original expenditure.

Overstocking of drugs normally results in a high number of expired medicines, high cost of storing excess stock and high occurrences of pilferage of high potent medicines (Gebremariam and Unade, 2019)

2.2.14 Family Planning Supply Chain in Ethiopia

Contraceptive security exists when people are able to choose, obtain and use contraceptive products whenever they need them. Ethiopia is currently using an IPLS for managing contraceptives to gather with other program commodities.

Contraceptives should be always in full supply to maintain appropriate level of stock at all –time using the necessary inventory control tools.

Management of contraceptives supplies involves various other functions too; forecasting, planning contraceptive supply, financing contraceptives, procurement ware housing and storage, transport and distribution and inventory control procedure (FMOH 2011).

2.2.15 Medication wastage

Medication waste management is of a great importance because of the potential environment hazards and public health risks (Ebrahim *et al.*, 2019).

2.3. Empirical literature review

2.3.1. Supply chain in empirical literature

Public health supply chain in most developing countries is designed and implemented to meet demands of specific program. Some of the examples of vertical or standalone public health supply chains are supply chain systems for TB, HIV/AIDS, family planning, malaria, vaccines and so on. As a result, the public health SC systems are very fragmented and undeveloped.

The different health programs have multiple parallel SCM but all perform similar functional activities. However, as the health programs mature and funding from donors' decline, there are interests and efforts for integration to take over. Because of these and recent worldwide notion to improve and integrate public health SC, Ethiopia government started moving to make the public health SCM more efficient and integrated.

In 2003 when free ARV was launched the requirement of those providing logistic service was meet with challenge of the market meeting high capacity logistics providers. That can accommodate the arrival of products of combinations (Tsfaye 2015).

2.3.2. Extent of wastage

32.6 billion dollars was spent by the global fund in its 2016 report. This program focused on HIV, TB and malaria. This is used to reduce the effects these diseases have on developing countries. Appropriate management of this can of funds can have a significant effect in decreasing the effects of those diseases and associated factors (Boche *et al.*, 2020).

From the total inventory value of 111,032,284.25 dollar of program commodities, us \$2,283,640.662 or 21% was lost in one year in Ethiopia. The highest recorded wastage (13.1% of their value) was that of anti-malaria medicines and the wastage rate of program commodities in the agency was 2.1% individual evaluation of the wastage rate of program commodities show significant wastage. The wastage rate of malaria (13.18%) and TB commodities (4.1%) were more than a hundred times the acceptable standard (Boche *et al.*, 2020).

2.3.3. TB medications wastage

The first main source of waste generated through the TB grant will originate from expired or unusable medicines and from the TB testing of patients. The Kyrgyz government is very strict

Concerning the import of pharmaceuticals. A max 20 % of the expiry time of a pharmaceutical product is allowed to have passed at the time the product is arriving at the customs in kyrgyzsan and pharmaceutical with short expiry times need a special approval by MOH (Ute 2015).

2.3.4. Medication wastage

There are several key public health related implication of medication wastage, these include the economic burden on both individual stakeholders and society arising from direct costs of unused medications as well as disposal cost and environmental issue, associated with wastage disposal there are additional indirect costs, such as wasted time with little consistency between studies (Tilahun *et al.*, 2016).

2.3.5. Findings of studies on factors for expiry and wastage of medicines

Medication waste management is of a great important because of potential environmental hazards and public health risks. A study conducted at king Abdulaziz medical city during 1 month of study period of 2061 items of medications left unused. In another study conducted at king Khalid university hospital, found that during 1 month of study period of total of 265 items out of 1218. from there antibiotic preparation were the most common unused. Also again study conducted at a tertiary hospital in Dareselam, Tanzania, identified the existence of medications wastage at medical wards is anti-ineffective and cardiovascular.

In four hospital pharmacies store a waste of ETB 606,545 medications were found in the year 2009 E.C. The minimum of wastage was at hospital ETB 46,540.7 and maximum wastage was athospital 4.ETB 223,856.50 from this unused study finding a total of 605 medications were found wasted at the pharmacy stores of the 4 hospitals in 1 fiscal years (Ebrahim *et al.*, 2019).

The pharmaceutical services department in the Limpopo province of South Africa uses 0.05 drug expiration in public hospital pharmacies the expired stock report in Jane furse hospital oct 2020 stated that the drug expiration should not exceeding the 0.05% of the annual allocated budget.

Jane Furse memorial hospital (JEMH) in the sekhukhu district of Limpopo province had an estimated R18213 value of expired drugs for the 2009/2010 financial years. It was stated that the percentage value of expired stock for financial year 2009/2010 would be 0.17 % (expired value which is above the 0.05 would be the acceptable maximum value of drugs of to expired for years 2009/2010 (Mashishi, 2015).

The studies in public hospital pharmacies of Sekhukhune district /Limpopo province shows that a total amount of expired stock for pharmaceutical and surgical sundries is R86815 for financial year 2010 /2011 in public hospital pharmacies of Sekhukhune district. Report of short-dated drugs from hospital pharmacies indicate a number of drugs which hospital pharmacies indicate a number of drugs which common expired before dispense to patient.

In the financial year 2010/2011 public hospital pharmacies of Sekhukhune district had exceeded the 0.05% of expired stock value. An amount of R86815 values of expired stock was found for the financial year under review, being 0.08 % which is the total expired stock value over total expenditure. Emergency and slow-moving drug were common to expire in all facilities (sauls 2016)

2.3.6. Factors contributing to expiry of medications

Program medication and antibiotics were the most frequently waste wasted types of medications. The reason was push distribution system for program medication by PFSA. Pushing program products and sometimes revolving drug fund items that were near expiry and sometimes unnecessary at the health facility were pushed (Ebrahim *et al.*, 2019)

In King Khalid university hospital and king Abdulaziz medical city physicians non adherence to national and international treatment guidelines regarding the use of medications especially antibiotics and due to patients non adherence to medications (Ebrahim *et al.*, 2019)

One research conducted in Awi zone, Amhara regional state in health facilities the finding of qualitative study shsowed that the reason for wastage is that prescription patterns by prescribers, quantification problem, poor data quality, lack of properly functioning drug and therapeutics committee (DTC). In addition, during service expansion data not being available and problems in reporting consumption data from wards, not considering quantity on order were mentioned lack of inventory management skill by the store man/women.

And other reason between PESA and the health facilities and PFSA with regard to certain products (misoprostol and combined oral contraceptives (COC) which does not have a common unit of measure that sometimes result in over procurement of that product than the ordered quantities (Ebrahim *et al.*, 2019)

Another study on expiration of drugs in public hospital pharmacies of in Limpopo province, participant says the reason for the expiration of drug are lack of the use of first expiry first out and first in first out principles, massive orders of rarely used medical products, motivational drugs for specific patient lack of computer system usage (Mashishi 2015)

In Uganda, a study showed that poor management of a change in treatment policy was associated with expiry of massive stocks medicines, abandonment of stock monitoring, not knowing preventive methods for prevention of expiry of medications, and not including staffs feedback lead to expiry of medicines (Nakyanzi *et al.*, 2010).

2.3.7. Determinants of expired program pharmaceuticals

Expiry rate: The percentage of the stock of products, in value, that are unusable because of expiration o during a period to the total value of the products received during the same period plus the quantity of the products found during the beginning of the period.

Expiry rate= $\frac{\text{Expired stock of products during a period in monetary value}}{\text{Beginning stock plus received stock during the same period in monetary value}} * 100$

Beginning stock plus received stock during the same period in monetary value

This indicator can be calculated for any facility that manages pharmaceutical of interest. It can be measured over any period but it is preferable to be calculated for unusable (expired) stock within a quarter. It is usually calculated whenever a physical inventory is taken. Unusable (expired) stock that has been accumulated for long period and were not disposed previously (expiry items that were transferred from previous quarter) should not be included during calculation of this indicator. In addition, Items that were unusable (expired) during the quarter reviewed but were disposed with in the quarter should be taken in to consideration during calculation. This indicator is one of the performance indicators to have efficiency gain and one of the HSTP indicators to measure reduction of wastage from 8% to 2%.

Source=Bin cards, stock cards, inventory sheet, disposal reports, HCMIS

Pharmaceutical wasted due to expiration over a period of one year in percentage:

% stock expiry stock = $\frac{\text{expired stock of an item during 1 year}}{\text{Beginingstock} \downarrow \text{quantityrecivedoftheitemduring1year}} * 100$

Beginingstock

The following formula was used to calculate the pharmaceuticals expiry rate at the hospitals.

Expiry rate= $\frac{\text{Total value of pharmaceutical expired during the period}}{\text{Total stock available for sale in the period}} * 100$

Total stock available for sale in the period (Boche et al .2020 and MOH 2019)

2.4. Conceptual framework

The study used a conceptual framework adapted from the different literatures reviewed to show all factors that could be factors contributing to pharmaceuticals expiry the case of HIV, TB, and FP program at public health facilities of Addis Ababa in the study area.

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.

Independent Variables

Dependent Variable

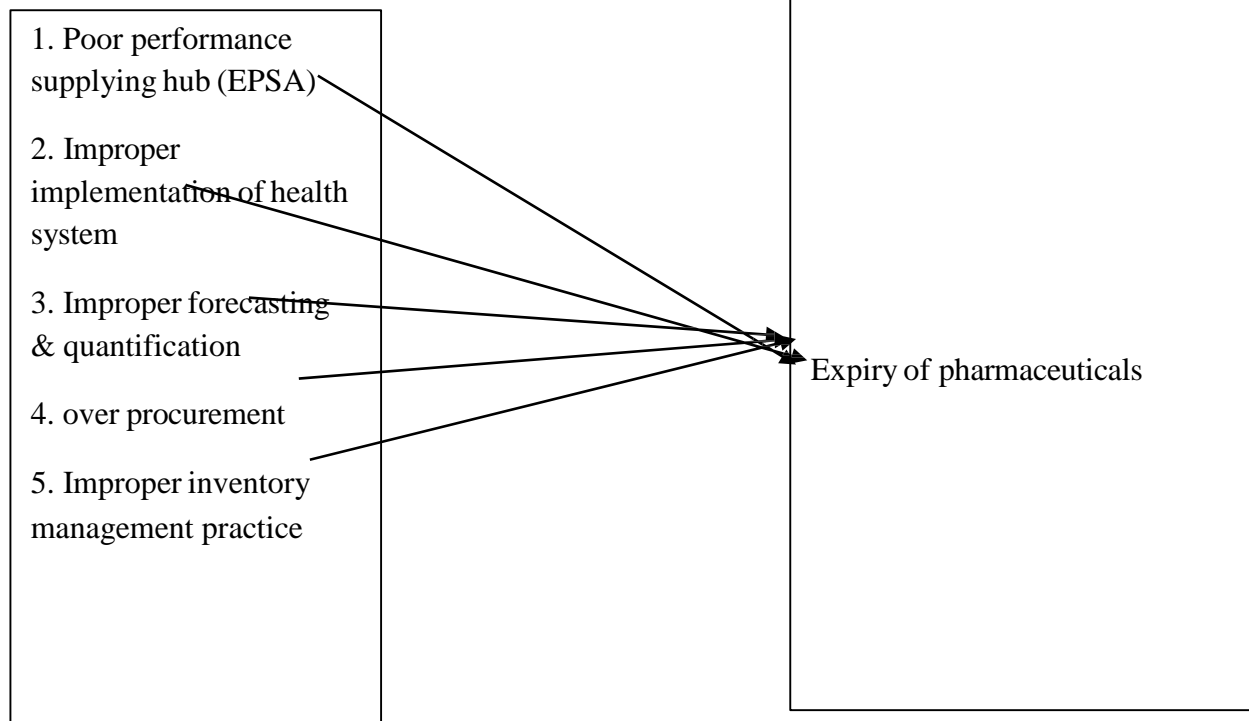


Figure 1: Conceptual Framework *for factors contributing to expiry of pharmaceuticals, Adapted from variables of different literatures described above, 2021*

Chapter Three

3. Research Methodology

3.1. Introduction

A Research Methodology encompasses the entire approach to a research and provides clear guidance on how to design and apply research studies such as the included in this chapter; the study area, the research approach, sampling design and techniques, data sources and types, data collection instruments to be used and methods of data analysis. It also shows ethical considerations in conducting the research.

3.2. Study Area

The study was conducted at public health facilities and EPSA central hubs and EPSA Addis Ababa hub. Addis Ababa city is governmentally divided into 11 sub-cities. There are 104 public health facilities (98 Health Centers and 6 hospitals) which are under control of Addis Ababa Health Bureau. These health facilities obtain supplies of pharmaceuticals from two hubs of EPSA. At present, all of the 98 health centers and six of the hospitals provide HIV, TB diagnostic, and treatment and FP services (Tegegn, 2019).

3.3. Research Approach

The study applied a mixed approach, which uses both quantitative and qualitative data for the study. It helps understand a research problem more by using both types of data to build up on the finding (Creswell 2009). Quantitative approach is preferred in when analyzing factors so this study will largely apply quantitative approach. Qualitative data was collected from few people with the aim of supporting the quantitative result using open-ended questions for participants at different level than those used for quantitative data.

3.4. Research Design

Research design is a blueprint plan on how to conduct the research. In this study explanatory research design was used because the researcher wants to measure causal relationships between the dependent (expiry of pharmaceuticals) and independent variables (poor performance of supplying hub (EPSA), improper implementation of health system, improper forecasting & quantification, over procurement and improper inventory management practice). This study is

based on the already existing evidences related factors contributing to pharmaceuticals expiry: The case of HIV, TB and FP Programs at Public Health Facilities in Addis Ababa and going to identify the factors contributing (causes) expiry.

3.5. Study Population and study subjects

The study population of this study were all public health facilities in Addis Ababa. The target population for this study was drug store managers of public health facilities of Addis Ababa providing HIV, program store managers from two supplying pharmaceutical warehouses (EPSA hubs), TB diagnosis and treatment and FP services.

3.5.1. Sampling methods, Sample size and sampling frame

Census eliminates sampling error as there was no element of chance is left. Therefore, highest accuracy is obtained and provides data on all individuals in the population (Zegeye *et al.*, 2009).

As the total population of the study is small in size and to allow 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 of 104 health facilities providing HIV/TB/FP treatment services.

Two EPSA distribution centers, health facility pharmacy department, pharmacy team leader, one sub city logistic officer and RHB logistic officer were used for the qualitative data collection.

A sampling frame is simply a list of government health facilities that meet the specific criteria for the study. First, a complete list of government health facilities that are being supplied by the logistics system under evaluation. For this study, the list of 104 government health facilities providing HIV, TB diagnostic and treatment FP service was obtained. Besides, 2 distribution centers for pharmaceuticals (EPSA), there is 1 sub city pharmaceutical store and 1 Regional Health Bureau logistics officer.

3.6 . Data Types and Sources

The study involved primary and secondary sources of data. Primary data has been collected from firsthand experience; it has not published, more reliable, and valid, and secondary data is it is less expensive and collected from a source that has already been published such as books, databases, records etc. (Kabir, 2016).

For the purpose of this study, the primary sources was drug store manager and Pharmacy department team leaders of the public health facilities, one sub city pharmaceutical logistics officer, leaders for each of HIV/TB/FP case team and pharmaceutical logistics case team of the RHB and program drugs distribution coordinator from each of the two distribution centers EPSA. These sources were contacted to collect data on factors contributing for expiry which was on quantitative and qualitative type.

The secondary sources for this study were tools in the Dagu, Health Commodity Mnagement Information System (HCMIS), Bin card, and registration of expired pharmaceuticals record in the previous one-year period starting from Hamle 1 /2011 –Sene 30 /2012 E.C.

3.7 . Data Collection Procedures

Data collection is the process of getting and measuring data on variables, it is established to answer stated research questions (Kabir, 2016).

The quantitative data collection was done by surveying all of the public health facilities providing HIV, TB diagnostic and treatment FP services. Qualitative data wre collected using open ended interview questions from selected participants). The findings on quantitative and qualitative methods were discussed after the data was collected.

In this study retrospective data was collected on expiry situations in the course of one year was done at the same time collecting data on contributing factors for expiry. Likert scale questionnaire was used to gather quantitative information from the public health facilities store man.

Qualitative data was getting in-depth interview from pharmacy department case team leader, program pharmaceuticals distribution centers coordinator (EPSA), RHB pharmaceutical logistics case team leader, one sub city pharmaceutical logistic officer were interviewed. First consent was getting from interviews then, interviews were recorded on a mobile voice recorder. A secondary source of data on expiry was collected from LMIS or HCMIS, bin card and expiry registration book for the previous 1-year (Hamle 1/2011-Sene 30/2012).

3.8. Data quality assurance

In data quality assurance, well organized checklists and structured questionnaire were created to avoid bias during and after collection of data.

3.8.1 Validity

Validity means the degree to which an instrument measures. The questionnaire and the checklists were tested on 2 public health facilities as a pretest and minor comment was added after the pre-test. Then, validity was checked by asking expert opinion on the study subject matter.

3.8.2 Reliability

Reliability means finding stability and consistency that result to be multiplied and it is absence of error of the degree can be measured. Cronbach Alpha is important to show alpha level of the questionnaires and the scale. In case of the number of variables, low number of variables result in a low result of alpha.

Alpha value of 0.8 or above indicates that there is the similarity in the variables and Alpha value of 0.7 indicates there is no similarity between questions (Burns, R.P. and Burns, R, 2008). The data of the reliability test was done by SPSS. Then the result Cronbachs alpha coefficient of 21 questions was 0.73.

3.9. Data analysis

The collected data was checked for its completeness and cleaned, coded and entered in to SPSS (version 23). Descriptive statistics was used to describe the variables such as frequency, percent, the mean and the standard deviation. Multiple regressions in inferential statistics were used to see the effect of independent variables on the dependent variables. Then regression analysis of the dependent variables was done. (Field 2005).

Equation of general multiple regression is:

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

Where;

Y: is the outcome variable

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

β_0 : is a constant /Intercept,

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_n$ are coefficients (slopes) of the first, second, third, fourth, fifth and nth predictor ($X_1, X_2, X_3, X_4, X_5, \dots, X_n$) respectively.

The study has five independent variables to determine the relationship between the dependent and independent variables equation of regression can be used

$$y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + e_i$$

X_1, X_2, X_3, X_4, X_5 are independent variables contributing factors for expiry such as poor performance of supplying hub (EPSA), improper implementation of health system, improper forecasting and quantification, over procurement and improper inventory management practices

The collected data was entered in to SPSS and the formulas used to calculate pharmaceuticals expiry rate at for the study was took from the participant manual of good dispensing practices and pharmaceutical SC management: participant manual, (MOH 2019) and Assessment of inventory management practice at EPSA A.A. Ethiopia. The expiry rate of pharmaceuticals used for the HIV, TB and FP

Expiry rate= Total value of pharmaceutical expired during the period *100

Total stock available for sale in the period (Boche et al .2020 and MOH 2019)

In most health facilities the expiry rate of pharmaceutical was calculated by HCMIS (dagu), in some health facilities the software didn't calculate the expiry rate in this case manual calculation is done.

Finally, qualitative data was done manually and the demographic data was done by SPSS.

3.10. Ethical Considerations

Letter was received from Addis Ababa University, School of commerce and contacted to Addis Ababa City Administration Health Bureau for the permission. Permission was received before the data collection.

Before data collection, permission was obtained from all public health facilities based on the letter of support and ethical clearance. Data were collected after a clear oral presentation of the aims and importance of the study. Oral informed consent was obtained from the organizations and interview participants after a clear presentation of the purpose of the study and its benefit. Participants were assured about the confidentiality of their information obtained in the study by excluding any personal identifier in the data collection form and anonymization of quotes to prevent statements that could be traced back to individuals. Interviewees were assured and encouraged to talk about their views on this issue rather than about their company's position. Finally, interview participants were asked their permission to record the interview and were informed and assured of the right to refuse or terminate at any point in the interview and the audio record from the interview only remained in the hands of the investigator.

CHAPTER FOUR

4. Results and Discussion

4.1. Respondent rate of response

The data was collected from one hundred four (104) health facilities that provide HIV, TB diagnostic and treatment and FP. Some of health facilities was excluded from the study due to the COVID 19 situation; some health facility did not provide the given services. Therefore, 100 questionnaires were distributed to respondents and 96 were replied with a response rate of 96 %.

4.2. Socio-demographic characteristics of study participants

In this study, majority of them were female (53.1%) and majority (78.1%) were pharmacist by profession. The mean age and work experience of respondent was 32 years and 5 years respectively. Close to 92% of them received training on IPLS and 65.6% on HCMIS (Table 1 and 2).

Table 1: Characteristics of study participants

Gender	Frequency	Percentage
Male	45	46.9
Female	51	53.1
Profession		
Pharmacy	75	78.1
Other	21	21.9
Educational Qualification		
Diploma	25	26
BA/BSc	70	72.9

MBA/MSc	1	1
Others	0	0
IPLS training		
Yes	88	91.7
No	8	8.3
HCMIS training		
Yes	63	65.6
No	33	34.4

Source- From SPSS 21, August 2021

Table 2: Respondent average age and work experience

Item	Min	Max	Mean	Standard deviation
Age	24	52	31.58	4.708
Work experience	0.5	16.0	4.818	3.088

Source- From SPSS 21, August 2021

4.3. HIV, TB and FP pharmaceuticals expiry rate

To calculate the expiry rate of HIV, TB and FP pharmaceuticals in the health facilities ((one year data of EFY 2012, HCMIS, bin cards, and expiry registration book was used. The study result showed that 100 % of public health facilities have expired HIV pharmaceuticals, 98% for TB pharmaceuticals and 81.2% for FP pharmaceuticals were expired in 2012 EFY .The study found that the pharmaceuticals used in HIV, TB and FP expiry rate differs from to facility . Thus, the mean expiry rate of pharmaceuticals for the HIV, TB and FP programs were found to be 3.73.

This study shown that expiry rate 3.73 was very high than targeted as nationally which is below 2% in Health sector Development Goal IV (HSDP IV) (Gebremariam *et al.*, 2019).

To prevent financial loss, it is useful to decrease pharmaceutical expiry and to avoid stock out of program pharmaceuticals at the health facilities (Gebremariam and Unade, 2019.)

Table 3: Expiry rate of program pharmaceuticals with their mean expiry rate

Program pharmaceutical	Minimum expiry rate	Maximum expiry rate	Mean expiry rate	Standard deviation
HIV	1	4.80	1.99	0.696
TB	0	2.5	0.80	0.603
FP	0	2.88	0.93	0.698
Total	1.10	6.80	3.73	1.32

Source: From SPSS 21, August 2021

In this study, the most expired pharmaceuticals used for HIV, TB and FP was identified. When these program pharmaceuticals were expired, it affects the quality of patient's life and the care giver. Pharmaceuticals supply should not be disrupted because it affects the management of chronic diseases in the health facilities (Berhanemeskel *et al.*, 2016)

In this study, the expiry rate for the three program pharmaceuticals was higher. This may cause ds stock out of program pharmaceuticals and the drugs will not available at that health facilities and result interruption of treatment (Table 4, 5 and figure 1).

Table 4: Type of pharmaceuticals expired in HIV program.

Item	Frequency	Percentage (%)
TDF/3TC/EFV 1000 mg	41	42.7
TDF/3TC/EFV 1200 mg	15	15.6
HIV TEST KIT ABON	1	1
AZT/3TC/NVP 140 mg ped	3	3.1
TDF/3TC 300/300 mg	2	2.1
Cotrimoxazole 960 mg	1	1
AZT/3TC 450 mg	5	5.2
AZT SYRUP	2	2.1
AZT/3TC 90 mg	3	3.1
NVP SYRUP	4	4.2
AZT/3TC/NVP650 mg	7	7.3
3TC 150 mg	1	1
Lopinavir/Ritonavir syrup	2	2.1
EFV 200 mg	1	1
HIV TEST KIT STAT PACK	2	2.1
EFV 600 mg	2	2.1
EFV 50 mg	1	1
DTG 50 mg	3	3.1

Total	96	100
-------	----	-----

Source- From SPSS 21, August 2021

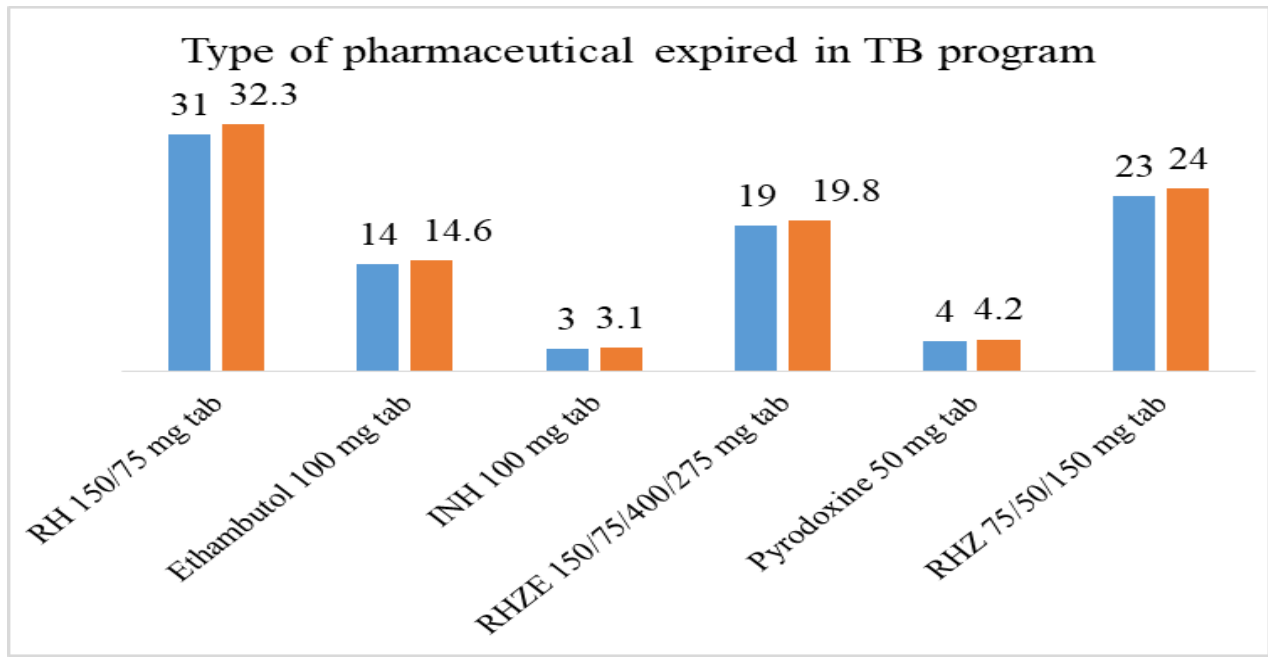


Figure 2: Type of pharmaceuticals expired in TB program

Source-: From SPSS 21, August 2021

Table 5: Types of pharmaceuticals expired in FP program

Item	Frequency	Percentage
Combined oral contraceptive tablet	42	43.8
Emergency pill 0.75 mg tab	8	8.3
Levonorgestrel (mini pill) 0.03 mg tab	2	2.1
Jadelle set	3	3.1
Mifeprystone/misoprostol 200 mg/200mcg kit	13	13.5
IUCD set	5	5.2
Depo provera 150 mg/ml injection	2	2.1
Implanon set	3	3.1

Total	78	81.2
--------------	-----------	-------------

Source- From SPSS 21, August 2021

The above table showed that 41 health facilities have expired TDF/3TC/EFV 1000 mg and 15 health facilities have expired TDF/3TC/EFV 1200 mg medicines. In TB pharmaceuticals, .31 of health facilities have expired RH 150/75 mg tablets and 23 health facilities have expired RHZ 75/50/150 mg tablets. Expiry of these pharmaceuticals is a challenge due to the presence of many patients. Strict adherence is needed in antibiotic therapy especially in ART and TB treatment. In some health center, expired program pharmaceuticals were found on store shelves (Berhanemeskel *et al.*, 2016).

In FP pharmaceuticals, 42 health facilities had expiry of combined Oral Contraceptive (COC) and 13 of health facilities had expiry of Mifeprostone /Misoprostol 200 mg/200 mcg kit. A large amount of COC was expired in the health facilities and the qualitative finding supported these.

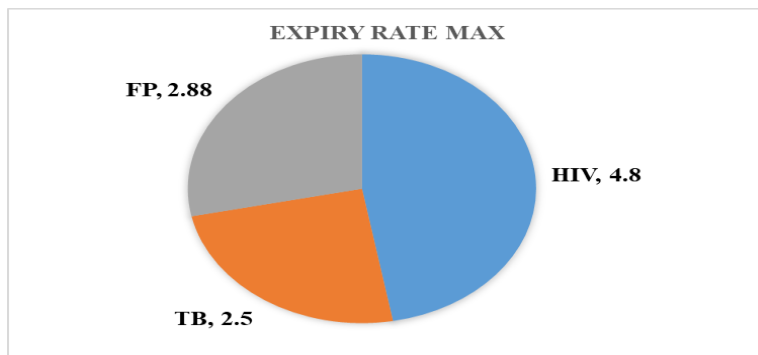
-In this study shown that almost all health facility has expired HIV pharmaceuticals. Thus implies that these program pharmaceutical supply chain management have some problem. 3,579,320 ETB of money was expired in 2012 EFY for HIV pharmaceuticals 96,716.00 ETB ,for TB and 555,025.20 ETB for FP was expired .In total, 4,228,064.20 ETB was expired for the three programs. For the three program maximum expiry rate was 6.8% for the HIV 4.8 %, for TB and FP 2.50,2.88 respectively. In addition to expired pharmaceuticals, disposal cost for the expired pharmaceuticals was a big problem. (Alnahas *et al.*, 2020)

If HIV pharmaceuticals were expired, large amount of resources are wasted because HIV pharmaceuticals are very expensive. (Berhanemeskel *et al.*, 2016).

A research conducted in Oromia region southwest shoa zone, 500,522.09 ETB was lost and wastage rate was 7.5% (Gebremariam, 2017). Tull 2018 stated that the total money expired was higher and another study stated that about US \$ 550,000 wasted for antiretroviral and antimalarial doses recently expired was 10 million in national medical store in Uganda.

As linked to a study conducted by Dantie *et al* (2020) a total of 942,067.40 ETB was lost due to expiry, lost from health facilities. It was 2.5% of wastage rate was recorded and mainly

649,370.70 ETB from hospital. In the financial year 2010/2011 public hospital pharmacies of Sekhukhune district had surpassed the quantity of R 86 815 value of stock was found expired. (Mashishi, 2015).



Source- From SPSS 21, August 2021

Figure 3: HIV, TB and FP Programs and expiry rate

Figure 3 showed that the highest HIV pharmaceutical was for, 41 (42.7%) for TDF/3TC/EFV 1000 mg tablet and lowest for HIV test kit (ABON), cotrimoxazole 960 mg,3TC 150 mg, EFV 200 mg and EFV 50 1 (1%). In case of TB pharmaceutical, RH 150 /75 mg, 31(32.3%) was the highest and the lowest was INH 3 (3.1%). For FP, 42 (43.8) for COC and lowest for Depo Provera 150 mg /ml injection and levonorgestrel (mini pill) 0.03 mg tablet.

Table 6: The most program pharmaceuticals expired, frequency and expired money in ETB in public health facilities of A.A.

Expired HIV pharmaceutical	Number of facility pharmaceuticals expired (%)	Expired pharmaceutical in ETB	Expired TB pharmaceutical	Number of facility pharmaceuticals	Expired pharmaceutical in ETB	Expired FP pharmaceutical	Number of facility pharmaceuticals expired (%)	Expired pharmaceutical in ETB

				expired (%)				
TDF/3TC/ EFV 1000 mg	42.7%	2,282,789	RH 150/75 mg	32.3	22,834	Combined oral Contraceptive	43.8%	384,765
TDF/3TC/ EFV 1200 mg	25.6%	281,621	Ethamb utol 100 mg	14.6	21,452	Emergency pill 0.75mg	8.3%	66,256
HIV test kit ABON	1%	58,600	INH 100 mg	3.1	2,326	Levonorge strel (mini pill) 0.03mg	2.1%	22,900
AZT/3TC/ NVP 140 mg	3.1%	64,375	RHZE 150/75/4 00/275 mg	19.8	19,824	Jadelle set	3.1%	57,480
TDF/3TC 300/300m g	2.1%	24,450	Pyrodox ine 50 mg	4.2	10,620	Mifeprost one /Misoprost ol 200mg/20 0mcg kit	13.5%	10,666.20
Cotri 960 mg	1%	9876	RHZ 75/50/15 0 mg	24.0	23,196	IUCD set	5.2%	24,990

AZT/3TC 450 mg	5.2%	66,566	-	-	-	Depo provera 150mg/ml injection	2.1%	8150
AZT syrup	2.1%	15,964	-	-	-	Implanon set	3.1%	14,150
AZT/3TC 90 mg	3.1%	43,119	-	-	-	-	-	-
NVP syrup	4.2%	40,724	-	-	-	-	-	-
AZT/3TC/ NVP650 mg	7.3%	330,470	-	-	-	-	-	-
3TC 150 mg	1%	19,250	-	-	-	-	-	-
Lopinavir/ Ritonavir syrup	2.1%	30,764	-	-	-	-	-	-
EFV 200 mg	1%	28,000	-	-	-	-	-	-
HIV test kit stat pack	2.1%	85,549	-	-	-	-	-	-
EFV 600 mg	2.1%	22,233	-	-	-	-	-	-

EFV	50	1%	9856	-	-	-	-	-	-
mg									
DTG	50	3.1%	192,054	-	-	-	-	-	-
mg									

Source- From SPSS 21, August 2021

4.3.1 Most expired pharmaceuticals in HIV programs

Most frequent HIV pharmaceutical expired was TDF/3TC/EFV 1000 mg tablet 41 (42.7) and the least frequency are observed 3TC 150 mg, EFV 200 mg and EFV 50 mg tablets.

In the studied health facilities, majority of patients uses TDF/3TC/EFV and NVP based regimens. These were affected by the health facility quantification and procurement planning for the budgets years.

4.3.2 Contributing factors for expiry of pharmaceutical in HIV, TB and FP program

Poor performance of supplying hubs (EPSA), improper forecasting and quantification, improper inventory management practices, over procurement and improper implementation of health system were reported as main contributing factors (Table 7, 8, 9 10) presented in table 7.

Table 7: Poor performance of supplying hubs (EPSA) of the facility mean and standard deviation

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Std.Devat ion
Near expiry medicines (< 6months) are being delivered to the health facility	8(8.3%)	1(1%)	3 (3.1%)	42 (43.8%)	42(43.8%)	4.14	1.120
Donation received irrespective of need	10(10.4%)	16(16.7%)	12 (12.5%)	34 (35.4%)	24 (25%)	3.48	1.314
Total mean						3.81	1.02

Source- From SPSS 21, August 2021

Table 8: Improper forecasting and quantification of the facility and mean and standard deviation

Item	Strongly disagreed	Disagree	Neutral	Agree	Strongly agree	Mean	Std.De viation
Absence of functional DTC in the health facility	44(45.8%)	22(22.9%)	6 (6.3%)	17(17.7%)	7(7.3%)	2.18	1.369
Selection of medicines are not based on available essential medicines list in the health	47(49%)	34(35.4%)	2(2.1%)	11(11.5%)	2(2.1%)	1.82	1.066

facility							
Nonparticipation of clinicians in medicine selection and quantification of the facility	21(21.9%)	33(34.4%)	12(12.5%)	23(24%)	7(7.3%)	2.6	1.269
No accurate data available in the health facility to facilitate quantification of medicines	26(27.1%)	53(55.2%)	3(3.1%)	11(11.5%)	3(3.1%)	2.08	1.023
Presence of over stocked medicines due to improper forecasting of need in the facility	24(25%)	30(31.3%)	9(9.4%)	22(22.9%)	11(11.5%)	2.65	1.376
Standard treatment guideline violated in forecasting	36(37.5%)	30(31.3%)	11(11.5%)	16(16.7%)	3(3.1%)	2.17	1.194
Quantified by vertical program	11(11.5%)	43(44.8%)	19(19.8%)	18(18.8%)	5(5.2%)	2.61%	1.080
Sellers incentive influence quantification	42(43.8%)	35(36.5%)	9(9.4%)	6(6.3%)	4(4.2%)	1.91	1.077
Total mean						2.25	0.63

Source- From SPSS 21, August 2021

Table 9: Improper inventory management practice of the facility and mean and standard deviation

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Std Deviation
Poor stock management like using neither FIFO nor FEFO in stock management	41(42.7%)	40(41.7%)	6(6.3%)	6(6.3%)	3(3.1%)	1.85	1.005
Lack of electronic stock management tools that automatically capture medicines expiry in the health facility	58(60.4%)	23(24%)	5(5.2%)	7(7.3%)	3(3.1%)	1.69	1.069
Weak or no mechanisms for medicine expiry monitoring and evaluation in the health facility	39(40.6%)	37 (38.5%)	8(8.3%)	10(10.4%)	2(2.1%)	1.95	1.050
Lack of accountability for stock-outs and	27(28.1%)	16(16.7%)	16(16.7%)	28(29.2%)	9(9.4%)	2.75	1.384

expiry of medicines in the facility							
No knowledge about FIFO and FEFO	79(82.3%)	16(16.7%)	0	1(1%)	0	1.20	0.473
Total mean						1.888	0.71

Source- From SPSS 21, August 2021

Table 10: Over procurement of the facility and mean and standard deviation

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Std Deviation
Medicines are purchased without procurement plan/policy in the facility	45(46.9%)	40(41.7%)	3(3.1%)	8(8.3%)	0	1.73	0.876
Total mean						1.73	0.87

Source- From SPSS 21, August 2021

Table 11: Improper implementation of health system of the facility and mean and standard deviation

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Std Deviation
Abrupt changes of treatment practices results medicines expiry in the	12(12.5%)	12(12.5%)	8(8.3%)	35(36.5%)	29(30.2%)	3.59	1.366

facility							
Poor communication and coordination with key stakeholders (health bureau/office, suppliers, NGO's)	14(14.6%)	23(24%)	5(5.2%)	37(38.5%)	17(17.7%)	3.21	1.376
Lack of system to move nearly expired medicines facility to facility	14(14.6%)	34(35.4%)	14(14.6%)	21(21.9%)	13(13.5%)	2.84	1.300
Lack of knowledge and skills of pharmacy professionals In medicine supply management	50(52.1%)	33(34.4%)	5(5.2%)	6(6.3%)	2(2.1%)	1.72	0.970
The shortage of pharmacy human resources in the facility	21(21.9%)	16(16.7%)	9(9.4%)	27(28.1%)	23(24%)	3.16	1.510
Total mean						2.90	0.75

Source- From SPSS 21, August 2021

The mean values of agreement for variables over procurement, improper inventory management practices, improper forecasting and quantification the agreement level of respondents is higher

for the poor performance of supplying hubs (EPSA) and improper implementation of health system.

The mean value of poor performance of supplying hubs variable was higher than the other mean.

Making use of the Likert scale from strongly disagree (1) to strongly agree (5), if attained mean value 1-1.8 means the participants strongly disagree, a mean value 1.81-2.6 means respondents disagreed, 2.61-3.4 means the participants agreed to some extent (moderate) a mean value 3.41-4.2 represents participants agree and respondents highly agreed if the mean value is above 4.21-5 according to this standard the variables are categorized as shown in table 12.

Table 12. Mean level of agreements on independent variable

Independent Variable	Mean level of agreement	Category
Poor performance of supplying hubs (EPSA)	3.8	Agree
Improper forecasting and quantification	2.2	Disagree
Improper inventory management practices	1.8	Disagree
Over procurement	1.7	Disagree
Improper health system implementation	2.9	Agreed to Some Extent

Source- From SPSS 21, August 2021

4.4 . Association of variables (Findings of inferential statistics)

Inferential statistics was used to evaluate cause and effect relationship between the independent and dependent variables. Before performing regression analysis assumption was made in linearity, normality, multi-collinearity and homoscedasticity (constant variance of the errors).

Linearity: In multiple regressions the first postulation is to see relationship between the independent and dependent variables can be characterized by a straight line. A simple way to check this is by producing scatter plots of the relationship between each of our independent and dependent variable (statistics solution, 2021). For regression, this has to be met and in the

current data a normal probability plot of residuals against the foreseen values and the plot showed fairly straight-line following linearity.

Normality: regression assumes that the variables have normal disseminations. Visual examination of data plots, skew, kurtosis and p-p plots give information about normality. (Osborne and waters, 2002). The annex histogram justifies this with little deviations from normality and the assumptions for homoscedasticity as shown in the scatter plot and histogram.

Multi collinearity: points out the linear relationship between the independent variables. Collinearity shows two variables that are close perfect linear combination to one another. There are systems used to distinguish multi collinearity are correlation coefficient and variance inflation factors. Scatter plot is a graphical method that implies the linear relationship between pairs of independent variables. It is significant to look for any scatter plots that seem to show a linear relationship between pairs of independent variables (Shrestha, 2020).

As Mooi *et al* (2018) stated that a tolerance of below 0.10 shows that multi collinearity is a problem. The VIF is just the communal value of the tolerance. Thus, VIF values above 10 indicate collinearity issue.

VIF and acceptance statistics for current data were pulled out as presented on regression coefficient table C below. As it can be seen, VIF value for all independent variables was less than 10 (1.450 to 3.005 and allowed variation (tolerance) for each independent variable was more than 0.2 (0.415 to 0.690) which indicates the absence of high correlation between independent variables, hence no apprehension and accepted for regression.

4.4.1 Finding of multiple regression analysis result

Multiple regressions were performed between category factors contributing to expiry of pharmaceuticals as the dependent variables; poor performance of the supplying hubs (EPSA), improper forecasting and quantification, improper inventory management practices, over procurement and improper implementation of health system as independent variables the results is in table. The model summary table the adjusted R² of 0.189 indicated that 18.9% changes on expiry rate of HIV, TB, and FP pharmaceutical in public health facilities of AA. This could be attributed to change in poor performance of supplying hubs (EPSA), improper forecasting and quantification, improper inventory management practices, over procurement and improper

implementation of health system. The remaining 81.1% could be explained by other variables that are not included in this study.

Finding of Model Summary^a

Model	R	R Square	Adjusted RSquare	Std. Error of the Estimate
1	.607 ^a	.368	.189	1.19002

Source- From SPSS 21, August 2021

In regression analysis, ANOVA table was produced and it helps to see the significance of the regression model and the model was significant at F=2.055, P=0.013. This shows that the overall regression model is significant at 95% level of confidence.

Finding of ANOVA table^b

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	61.122	21	2.911	2.055	.013 ^b
	Residual	104.794	74	1.416		
	Total	165.916	95			

Source- From SPSS 21, August 2021

Regression coefficients tables showed that the studied independent variables, improper forecasting and quantification and improper implementation of health system have a significant effect and positive linear relationship with the of expiry rate of public health facilities. Improper implementation of health system has important effect but undesirable effect that means improper forecasting and quantification and improper implementation of health system significant effect on expiry for HIV, TB and FP pharmaceutical with t=2.376, p=0.020 and t=-

2.309, $p=0.023$. The not adequate knowledge on the standard treatment guidelines might be contributing factor (Sauls, 2016)

Finding of Regression Coefficients^c

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	2.824	0.796		3.547	0.001		
Poor supplying hubs performance	0.121	0.031	0.094	0.924	0.358	0.923	1.084
Improper forecasting and quantification	0.532	0.224	0.254	2.376	0.020	0.839	1.192

Improper inventory management practices	0.090	0.227	0.049	0.398	0.692	0.637	1.570
Over procurement	0.194	0.169	0.129	1.150	0.253	0.761	1.315
Improper health system implementation	-0.433	0.188	-0.247	-2.309	0.023	0.835	1.197

Source- - From SPSS 21, August 2021

In the interpretation of individual coefficients in this study, the beta was used because independent variables were measured on Likert scales. Depending on these values, the relative effect of the independent variables on the dependent variables can be identified (Field 2005, mooii2018). Thus, table 13 shows the standard deviations of each of the variables. the regression equation is expiry of pharmaceutical used in HIV, TB and FP= $2.824+2.376$ (Improper forecasting and quantification)

Table 13: Independent variables with their mean and Standard deviation of variables

Item	Mean	Standard deviation
Category expiry rate	3.73	1.32
Poor performance of supplying hubs	3.81	1.02
Improper forecasting and quantification	2.25	0.63
Improper inventory management practices	1.88	0.71
Over procurement	1.73	0.87
Improper implementation of health system	2.90	0.75

Source- From SPSS 21, August 2021

4.5. Qualitative findings of the study

Interviews were conducted with department of pharmacy case team leaders, sub-city logistic officers, logistics and supply chain officers in Addis Ababa health bureau, forecasting and capacity building officer in EPSA (a total of 11). Among the eleven interview participants, eight were male and three were female. Most of them were in the age group 30-39 (mean 34.0 and STD 5.6) years with bachelor degree. The work experiences of these respondents ranged from 3 to 13 (mean 7.5 and 3.3) years.

The interview was conducted to gather information about the type of pharmaceuticals expired in the research period, current situation of pharmaceutical expiry in their health facility, factors contributing for expiry of pharmaceutical in their health facility, how an expired pharmaceuticals affect service provision in their facility, efforts made by the facility to prevent /reduced expiry of pharmaceuticals, and recommendations to minimize the expiration of these drugs for the future

Type of Program pharmaceuticals expired during the study period

Nearly all of the respondents indicated that the same medicines were expired from the three programs. They mentioned that efavirenz based (TDF/3TC/EFV), and NVP based drugs were expired among HIV pharmaceuticals and pediatrics RH and COC and Implanon from TB and family planning respectively.

Current situation of pharmaceutical expiry in the health facilities

One key respondent answered to this question by saying that, *“First we use FIFO method then we look at the expiry date and we then discard the expired drugs. We have no other way to check expiration of drugs. We only check the labels on the drugs.”*

The other key informant said the following, *“We use two methods. The first is the daga itself shows us the expired and near expired drugs. The other is, when the drugs are six months near expiration, we ask other health centers if they need those drugs and we will pay back borrowed drugs if there is one.”*

The third key respondent gave answer as the following, *“We have bins in our pharmacy store and the HCMIS also tells us which are near expiration dates. After selecting the near expiration dates under 6 months, we keep what we need for our stock and transfer the rest to other facilities.”*

Another key respondent said that, *“In the past, dagu was pointing out and reporting to us, but currently because dagu has stopped, we use first-in- first out method which helps us in finding the expired ones and we do this monthly.”*

“We have a dagu 2 system which lets us know if they are near expiry or below 6 months expiry dates; it reminds us to use them early or to transfer them to other in need facilities. In addition to dagu we also use bin cards to assess them physically.” This was a response of one of the informants.

Another participant also mentioned the use of bin cards by stating that, *“We use bin card and we also have an expiry date chart which our computer uses.”*

One key informant responded to this question regarding EPSA and stated that, *“the system shows it to us all. It shows us near expires and the actual expired medicines. When there are near expired drugs, we push them to health facilities.”*

Factors contributing for expiry of pharmaceutical in the health facilities

Regarding the contributing factors for the expiry of these pharmaceuticals, all of the participants have the same ideas in which all can be included in response of one of the key informants; *“First it is the problem of EPSA because it brings near expired drugs to us. Sometimes we give them back but sometimes they refuse to take back; and because there could be other medicines along, we take the near expiration without question. And as a result, the drugs get expired on us. When it is near expiration, they don’t only give us what we asked for but also more than the amount we asked.”*

Effect of Expired Pharmaceuticals on service provision of the health facilities

One of the key informant expressed the impact of expired pharmaceuticals on service provisions as follows.

“It affects the service, but we ask for the consumed drugs before that happens. We add it on the remark telling them that the expiry date of the drug is near”, said one of the respondents.

Another informant attested the issue as follows.

“It affects a lot. Sometimes there will be near expired drugs and there will not be new ones to replace them so we have to use all of it until the exact expiry date. And after that we have to go looking for refills in other health centers because EPSA doesn’t have new ones. This is also one

effect on the service.”

One respondent said, *“There are times when the service is not provided at all. It is obvious that clients should take what they prefer to take and we are not expected to put pressure on them.”*

Another respondent mentioned the following, *“It affects the service directly and indirectly. If we are out of stock of a certain medicine and EPSA provides us every two months, our clients could be going around in other health institutions looking for it.”*

While all of the key respondents agreed about the effect of the expiration of these drugs on the service, one respondent has a different idea and she said, *“Nothing happens to the service, the service is never interrupted.”*

Efforts made by the facility to prevent/ reduce expiry of pharmaceuticals

The first respondent said that, *“First, when EPSA brings the drugs, it should bring long expiry date drugs. Of course, this is a program and it is given through aids but as soon as they receive the medications EPSA should be able to diffuse them to the health centers. Sometimes they tell us they don’t have certain medicine and we start giving the long expiry date drugs and all of a sudden, they bring us the near expiry date drugs. That could be a store management problem at EPSA because they are not giving away the near expiry date drugs. So, what they should be doing is, to give medicines with near expiry dates first and hold on to those with longer expiration dates. The second is, as a health institution, we have to have data of our patients and how much drugs we are looking for and transfer the rest for hospitals and other health centers in need before the expired date nears.”*

Another key participant stated that, *“First the person in charge of the pharmacy store should make sure the consumption data is provided and has to get the right report from dispensary. These days there is a lot of pressure on the store person which makes it difficult to do the best of the job. In order to overcome this problem, there should be additional man power in the pharmacy store to share the load. I believe the main thing is to provide the right consumption which could be handled well if there could be additional store person.”*

For this question, almost all of the respondents agreed that the solution for minimizing the expiry of the drugs is for EPSA not to receive near expiry medicines from the donors or giving out the near expired drugs to the health institutions first. In this case one respondent said the following; *“First it is better if people working at the top level management will not bring us near expiry drugs*

and also I endorse the facilities not to accept those drugs.”

Other respondents said that it is better if substances are distributed according to the consumption. One participant stated that *“We have to do things in quantification and should be consumption based which could end up in no expiry at all. They should provide us with the data we only give them and EPSA should see the intention. And I also believe report should be online to see what is happening where.”*

Additional concerns raised by key informants

One of the key informant stated the issue as follows.

“I believe most of the responsibilities lies on EPSA. We know there is shipment process and they mostly give us the near expired drugs, but after the medications get here, it is important to distribute the near expired ones first and keep the long ones for future uses. And we should continue to transfer when we have more than needed.”

Another respondent said that, *“As a professional, I suggest that the process should be modernized from the source. There are times when the medicine comes to our country with expiry date less than 8 months. And when it reaches us, it is almost expired. So, it would be great if the process is changed from the source.”*

Some of the participants share the idea of the stakeholders working in cooperation to minimize expiration of these drugs.

“Generally, because these drugs (HIV and TB) are very important especially in relation with drug resistance; and if there is inappropriate inventory or a risk of expiration, they should not be discontinued because the consequence is very dangerous. Therefore, the stake holders and facilities should be working hand to hand.” And the other said that, *“This is a program that never has to stop so all stake holders should work together in order to minimize the expiry of these drugs.”*

One key informant stated that, there is even a situation in which patients are not getting any batch because of expiration.

“Currently AZT/3TC adult is expired and the only option is to wait. For example, in family planning, instead of letting them choose among the many varieties, they are forced to take drugs they don't want to. Other example is, B6 is stopped now and as a result people taking INH instead

are developing side effects.”

A key respondent said that EPSA and other stakeholders are not even concerned about the expiration of these drugs and stated as in the following way.

“To tell you the truth, we are not worried about their expiration more than we are worried about how to dispose them. Because facilities are getting these drugs cost free, their only cost is the disposal fee and/or the storage space. Because of this we don’t really want to research the root cause of their expiration and I think that it is a debt our country has to pay in the future and we really need to focus on why these drugs expire.”

Addressing research questions

According to the findings of both descriptive and inferential analysis, the research questions are answered as follows.

1. What is the extent of expiry of pharmaceuticals used for HIV, TB, and FP program at the public health facilities in A.A?

The analysis finding 96 (100%) of public health facilities of A.A encountered expiry of pharmaceutical used for HIV, TB and FP during the study period. Besides, 86 (89.5%) these health facilities encountered expiry rate for > 2.20% of the pharmaceutical used for HIV, TB and FP.

2. Which types of pharmaceuticals are mostly expired pharmaceutical used for HIV, TB and FP programs at the public health facilities in A.A?

Overall, 32 kinds of expired pharmaceuticals were recorded in all health facilities assessed in the period EFY 2012. The most common types of expired pharmaceuticals for HIV, FP and TB were stated in table 4.4, 4.5 and figure 2 for the three programs.

3. To what extent poor performance of supplying hub contribute to expiry of pharmaceuticals used for HIV, TB and FP programs at the public health facilities in A.A?

Poor performance of supplying hubs is not significantly predicted expiry of pharmaceuticals used for HIV, TB and FP ($t=0.924$, $p=0.358$), cannot play a significant role in expiry of these pharmaceuticals.

4. To what extent does improper forecasting and quantification contribute to expiry of pharmaceuticals used for HIV, TB and FP programs at the public health facilities in A.A?

Improper forecasting and quantification are significantly predicted expiry of pharmaceuticals used for HIV, TB and FP ($t=2.376$, $p=0.02$) have a positive relationship means when improper forecasting and quantification increase expiry of these program pharmaceutical also increase.

5. To what extent does improper inventory management practice contribute to expiry of pharmaceuticals used for HIV, TB and FP programs at the public health facilities in A.A?

Improper inventory management practice is not significantly predicted expiry of pharmaceuticals used for HIV, TB and FP ($t=0.398$, $p=0.692$), cannot play a significant role in expiry of these pharmaceuticals.

6. To what extent does over procurement contribute to expiry of pharmaceuticals used for HIV, TB and FP programs at the public health facilities in A.A?

Over procurement is not significantly predicted expiry of pharmaceuticals used for HIV, TB and FP ($t=1.150$, $p=0.253$), cannot play a significant role in expiry of these pharmaceuticals.

7. To what extent does improper implementation of health system contribute to expiry of pharmaceuticals used for HIV, TB and FP programs at the public health facilities in A.A?

Improper implementation of health system is significantly predicted expiry of pharmaceuticals used for HIV, TB and FP ($t=-2.309$, $p=0.02$)

Limitations of the study

The foremost limitation of this study was that the data was collected only from public health facilities. This may not give sufficient understanding of the actual side from private health facilities which also provide the diagnosis, and treatment service for HIV, TB and FP; thus, endorsing future research to increase the scope of the study to these facilities. In addition to the above limitation, the study targeted only pharmacy store people, pharmacy heads, EPSA delivery coordinator for programs, and regional health bureau (RHB) pharmaceutical logistics case team leaders; and did not include those involved in the diagnosis and management of these programs. The other restraint of this study is that it is only conducted in A.A and not in the other regions of Ethiopia. It also considered only selected independent variables.

CHAPTER FIVE

5. Summary of Findings, Conclusion and Recommendations

In this chapter, the summary of major findings of the study, conclusions and recommendations were included.

5.1. Summary of major findings of the study

The study was aimed to assess the Factors contributing to the Expiry of HIV, TB and FP Pharmaceuticals: The Case of Public Health Facilities in Addis Ababa

The study focused on the magnitude of expiry rate of pharmaceutical, the most expired pharmaceutical and the contributing factors by using mixed data collection method; and it attempted to provide full image of pharmaceuticals used in HIV, TB and expiry in public health facilities of Addis Ababa.

The findings from the study are summarized as follows.

- Public health facilities under Addis Ababa city Administration health bureau encountered expiry of HIV, TB and FP pharmaceuticals 96 (100%), 94(98%) and 78 (81.2%) respectively during the study period EFY 2012.
- Significant level of expiry for pharmaceuticals used in HIV, TB and FP was observed in health facilities with HIV pharmaceuticals 41(42.7%) in TDF/3TC/EFV 1000 mg, for TB pharmaceuticals 31 (32.3%) in RH 150 /75 mg and for FP pharmaceuticals 42 (43.8) in combined oral contraceptives.
- According to a store person from a hospital, EPSA offered unrequested near expiry HIV commodities together with requested items which are causes for expiry commodities at health facilities
- Stock out for AZT/3TC 450 mg tablet is due to national expiry batch.
- Apart from therapeutic benefits in this study, the total monetary value of expired pharmaceuticals for three programs in EFY 2012 was found to be 4,228,064 ETB.
- The average value of pharmaceutical expiry per program was estimated to be 3,579,320; 96,716 and 555,025.20 ETB in HIV, TB and FP respectively.

- It is important to take the necessary preventive strategies by the health facilities, by EPSA, by the government and donor in turn to optimize over all financial loss incurred to them.
- Level of agreement the key informant interviewed should that poor performance of supplying hubs resulting the program pharmaceutical expiry. There is a high agreement by respondents regarding the poor performance of supplying hubs activities followed moderate agreement by the improper implementation of health system at the health facilities and relatively disagreement with the improper forecasting and quantification, improper inventory management practice and over procurement. Mean score for the 5 variables being 3.81, 2.90, 2.25, 1.88 and 1.73 respectively on a five –point Likert scale.
- Improper forecasting and quantification are significant determinant for expiry of pharmaceuticals used in HIV, TB and FP, every 0.63 increased rating on Improper forecasting and quantification, additional 0.254 standard deviation (33%) records on expiry can be expected in increase expiry that is significant at $t=2.376$, $p=0.02$, which is limited knowledge of standard treatment guidelines (STGs) and external prescribing influence that may be influenced by these underlying contributing factors.
- Poor performance of supplying hubs, improper inventory management practices, over procurement were not found to be a significant predictor for expiry rate for HIV, TB and FP pharmaceuticals and significance and negative correlation exists in improper implementation of health system, these is due to change in treatment policy should be associated to the expiry of ARV at these health facilities.
- HIV, TB and FP program pharmaceutical expiry is not inevitable because EPSA procure some reserve and all key informants suggested that EPSA should supply program pharmaceutical less than 6-month expiry date. Delivered based on the facility consumption by pull system, when EPSA procure nationally procure pharmaceutical with long expiry date there are suggestions made to improve medicines expiry.

5.2. Conclusion

The study made an effort to identify the contributing factors to the expiration of HIV, TB and FP Pharmaceuticals. According to the current study, there is a high overall rate of medicine expiration for HIV, TB and FP, which comes at a substantial financial expense to the country.

Interview participants have identified inadequate inventory management practices, absence of medicine management policy, and lack of execution of standards as the primary causes of the medication's expiration.

According to the study, in order to ensure effective delivery of pharmaceutical products for HIV, TB and FP, supply chain agencies should pay attention to the money lost when the products expire. Supplying agency (EPSA) at all levels has to pay attention and implement robust inventory management system for effective supply of medicines at health facilities.

5.3. Recommendations

Among the three programs, pharmaceuticals for HIV and TB pharmaceutical attention is needed for DTG, NVP based and RH as high rate of expiry was reported. . Thus EPSA should further assess the situation at health facilities and make sure that these drugs are not be stocked out due to expiry.

Collaboration is critical to strengthen the drug supply system created by EPSA, MOH, health facilities and donor to strength the overall pharmaceutical supply chain management and having regular discussion on preventive strategies of pharmaceutical expiry.

Integrated supportive supervisions should be done jointly with different stakeholders to identify and reduce or prevent expiry problem and store man should also be regularly engaged in such supervision.

*EPSA hubs should also conduct supportive supervision to assessment health facilities.

*Trainings on regimen change on the HIV, TB and FP treatments should be integrated with the program managers (especially drug store managers and clinicians providing HIV, and TB treatment and diagnosis and FP service) should be trained together to decrease expiry and drug resistance which resulted because of drug interruptions.

*Even though proportion of HIV patients with TB and HIV with DTG allergy and pediatric TB patients' infection is very minimal as compared to HIV and TB patients, the service should not be interrupted. Attention should be given by the health facilities, regional health bureau, EPSA and all other concerned bodies.

*it is recommend to improve communication especially between the EPSA and health facilities to prevent expiry.

5.4. Research limitation and area of future research

*Hence studies focusing on the three program pharmaceuticals expiry are limited, comprehensive research particularly considering additional study partakers from the supply warehouse (EPSA hubs) is needed.

*The study included and identified limited variables only that are factors for expiry of program drugs. Since the current regression model explained only 18.9 % of factors that contributed to the expiry of program drugs; and there are other variables that could explain 81.1% of expiry; further research is suggested to include additional variables.

*The current study could not address the expiry of RDF pharmaceutical; hence, further study is suggested to understand the extent and factors for expiry of RDF pharmaceutical.

* Even though analyzing the pharmaceutical expiring in the public health facilities of A.A. is useful, the study looked at the public health facilities instead of referral government and private hospitals and focused on the three programs of pharmaceutical only and not of other programs.

*The present study is conducted in A.A. public health facilities and further study is recommended to be done in other regions of the country as well.

References

- Adimasu, T., 2017. Assessment of pharmaceuticals distribution system: The case of pharmaceuticals fund and supply agency.
- Alemu, T., Jemal, A., Gashe, F., Suleman, S., Sudhakar, S. and Fekadu, G., 2020. Integrated pharmaceutical logistics system implementation in selected health facilities of Ethiopia: The case of four wollega zones. *Research in Social and Administrative Pharmacy*.
- Alnahas, F., Yeboah, P., Fliedel, L., Abdin, A.Y. and Alhareth, K., 2020. Expired Medication: Societal, Regulatory and Ethical Aspects of a Wasted Opportunity. *International Journal of Environmental Research and Public Health*, 17(3), p.787.
- Bashaar, M., Thawani, V., Hassali, M.A. and Saleem, F., 2017. Disposal practices of unused and expired pharmaceuticals among general public in Kabul. *BMC public health*, 17(1), pp.1-8.
- Berhanemeskel, E., Beedemariam, G. and Fenta, T.G., 2016. HIV/AIDS related commodities supply chain management in public health facilities of Addis Ababa, Ethiopia: a cross-sectional survey. *Journal of pharmaceutical policy and practice*, 9(1), p.11.
- Boche, B., Mulugeta, T. and Gudeta, T., 2020. Assessment of Inventory Management Practices at the Ethiopian Pharmaceuticals Supply Agency, Addis Ababa, Ethiopia. *Integrated Pharmacy Research & Practice*, 9, p.175.
- Burns, R.P. and Burns, R., 2008. *Business research methods and statistics using SPSS*. Sage.
- Creswell, J.W. and Creswell, J.D.. *Research design: Qualitative, quantitative, and mixed methods approach*. Sage publications.
- Damtie, T.A., Ibrahim, A.J. and Yikna, B.B., 2020. Supply chain management performance of HIV/AIDS commodities and factors affecting it at health facilities of SNNPRS of Ethiopia; from the perspective of achieving 90-90-90 strategies. *Integrated pharmacy research & practice*, 9, p.11.
- Ebrahim, A.J., Teni, F.S. and Yimenu, D.K., 2019. Unused and Expired Medications: Are They a Threat? A Facility-Based Cross-Sectional Study. *Journal of primary care & community health*, 10, p.2150132719847857.

Federal democratic republic of Ethiopia ministry of health .2011.national Guideline for family planning services in Ethiopia.

Federal democratic republic of Ethiopia ministry of health .2018. National guidelines for TB DR-TB and leprosy in Ethiopia .6th edn.

Field, A., 2005. Exploratory factor analysis. *Discovering statistics using SPSS*, pp.619-680.

Gabriel, T. and Tafesse, T.B., 2017. Supply Chain Management of Antiretroviral Drugs in Public Health Facilities in Eastern Ethiopia. *Journal of Young Pharmacists*, 9(4).

Gebremariam, E.T., 2017. *Assessment of Medicines Wastage and its Contributing Factors in Selected Public Health Facilities in South West Shoa Zone, Oromia Regional State, Ethiopia* (Doctoral dissertation, Addis Ababa University)

Gebremariam, E.T., Gebregeorgise, D.T. and Fenta, T.G., 2019. Factors contributing to medicines wastage in public health facilities of South West Shoa Zone, Oromia Regional State, Ethiopia: a qualitative study. *Journal of pharmaceutical policy and practice*, 12(1), p.29.

Gebremariam & Unade, T.T., 2019. Assessment of Medicine Supply Management and its 10. *Quality Assurance Practice in Health Centers in South West Shoa Zone, Oromia Regional State, Ethiopia. Journal of Pharmaceutical Care & Health Systems*, 6(1), pp.1-2.

Jabareen, Y., 2009. Building a conceptual framework: philosophy, definitions, and procedure. *International journal of qualitative methods*, 8(4), pp.49-62.

Kabir, S.M.S, 2016. Methods of Data Collection Retrieved from <https://www.researchgate.net/publication/325846997> on 15 November 2019

Kagashe, G.A., Makenya, F.B. and Buma, D., 2014. Medicines wastage at a tertiary hospital in Dar Es Salaam Tanzania. *Journal of Applied Pharmaceutical Science*, 4(6), pp.98-102.

Kamba, P.F., Ireeta, M.E., Balikuna, S. and Kaggwa, B., 2017. Threats posed by stockpiles of expired pharmaceuticals in low-and middle-income countries: a Ugandan perspective. *Bulletin of the World Health Organization*, 95(8), p.594.

Marczyk, G., DeMatteo, D. and Festinger, D., 2005. *Essentials of research design and methodology*. John Wiley & Sons Inc.

Mashishi, K.A., 2015. *Expiration of drugs in public hospital pharmacies of Sekhukhune District, Limpopo Province, South Africa* (Doctoral dissertation).

Megra, a., 2018. Factors affecting routine immunization service delivery in private hospitals in Addis Ababa, Ethiopia (Doctoral dissertation, St. Mary's University).

Mengistu, B. and Tibeb, Z.2020. The effect of integrated pharmaceutical logistic system on user satisfaction and logistics performance of HIV/AIDS commodities: Evidence from public hospitals in Ethiopia. *European Journal of logistics, purchasing and supply chain management* .vol.8 no.3, pp.17-38.

Mezid, M.2014. Assessment of pharmaceutical logistics system in health centers of A.A. Ethiopia.

Ministry of health and child care END TB-Zimbabwe.(2017-2020).National tuberculosis program-strategic plan.

Ministry of health, Ethiopia , 2018.National comprehensive HIV prevention, care, and treatment training for pharmacy professionals. Participant manual.

Mooi, E., Sarstedt, M. and Mooi-Reci, I., 2018. Regression analysis. In *Market Research* (pp. 215-263). Springer, Singapore.

Nakyanzi, J.K., Kitutu, F.E., Oria, H. and Kamba, P.F., 2010. Expiry of medicines in supply outlets in Uganda. *Bulletin of the World Health Organization*, 88, pp.154-158.

Osborne, J.W. and Waters, E., 2002. Multiple Regression Assumptions. ERIC Digest.

Participant's manual.2019.Good dispensing practice and pharmaceutical supply chain management .A.A.

Quick, J.D., 2003. Ensuring access to essential medicines in the developing countries: a framework for action. *Clinical pharmacology & therapeutics*, 73(4), pp.279-283.

Sauls, C., 2016. *Trend in revenue loss due to expired medication at a large urban hospital in Johannesburg, South Africa* (Doctoral dissertation).

Tegegn B., 2014. Addis Ababa Regional Health Bureau Annual TBL, TB/HIV and DR-TB Performance Report 2011 EFY: TBL TB/HIV and DR-TB program Annual Performance Review Meeting /2011 EC.ppt. Adama, Ethiopia

Tesfaye, D., 2015. The study of Ethiopia public health supply chain management: before and after pharmaceuticals fund and supply agency (PFSA) (Doctoral dissertation, St. Mary's University)

Tilahun, A., Geleta, D.A., Abeshu, M.A., Geleta, B. and Taye, B., 2016. Assessment of integrated pharmaceutical logistic system for the management HIV/AIDS and tuberculosis laboratory diagnostic commodities in public health facilities in Addis Ababa, Ethiopia. *J Pharm Care Heal Syst*, 3(2), pp.1-10

Tull, K., 2018. Drug expiry standards in developing countries.

Tumwine, Y., Kutuyabami, P., Odoi, R.A. and Kalyango, J.N., 2010. Availability and expiry of essential medicines and supplies during the 'pull' and 'push' drug acquisition systems in a rural Ugandan hospital. *Tropical Journal of Pharmaceutical Research*, 9(6).

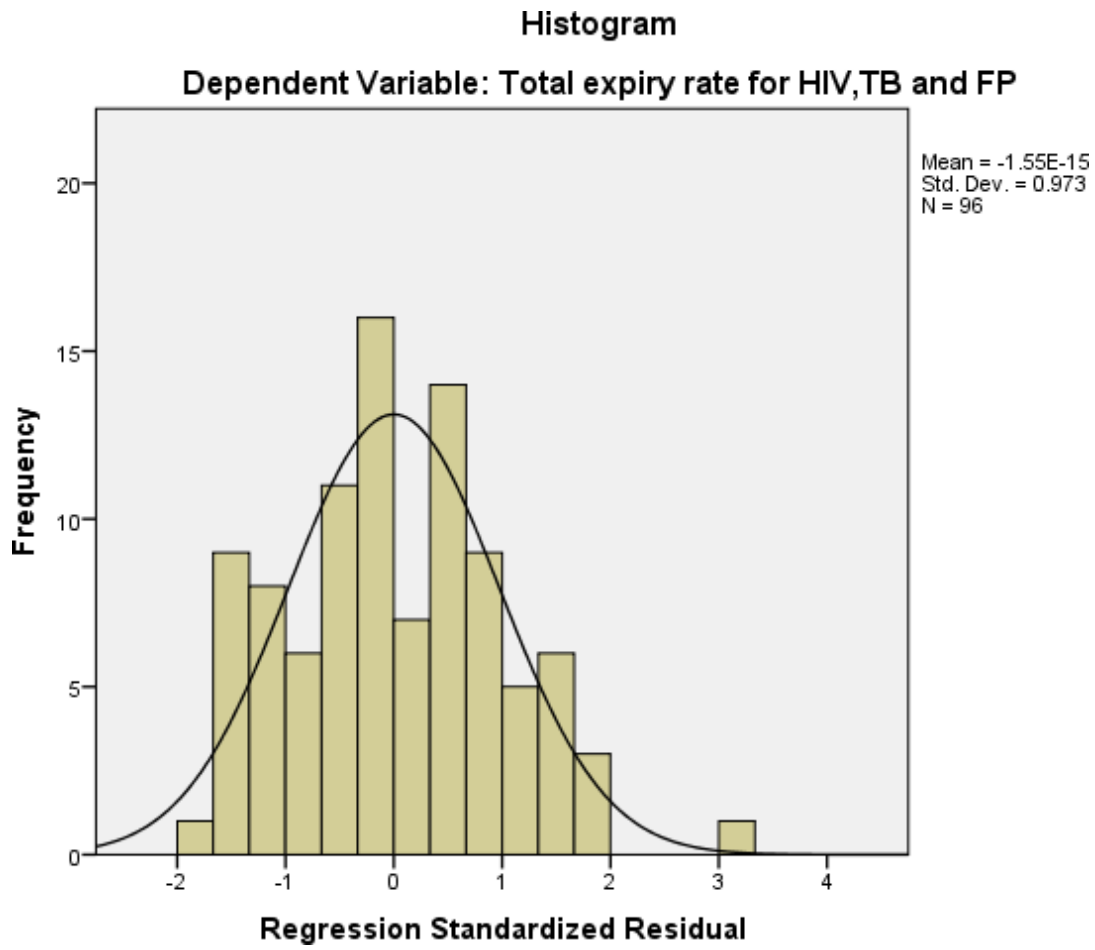
Ute (Dr) ,P.2015.Rapid assessment :health care waste component of global fund HIV/AIDS and TB projects in Kyrgyzstan

World health organization., 2006.Safety medicines in public health programs: Pharmacovigilance an essential tool world health organization.

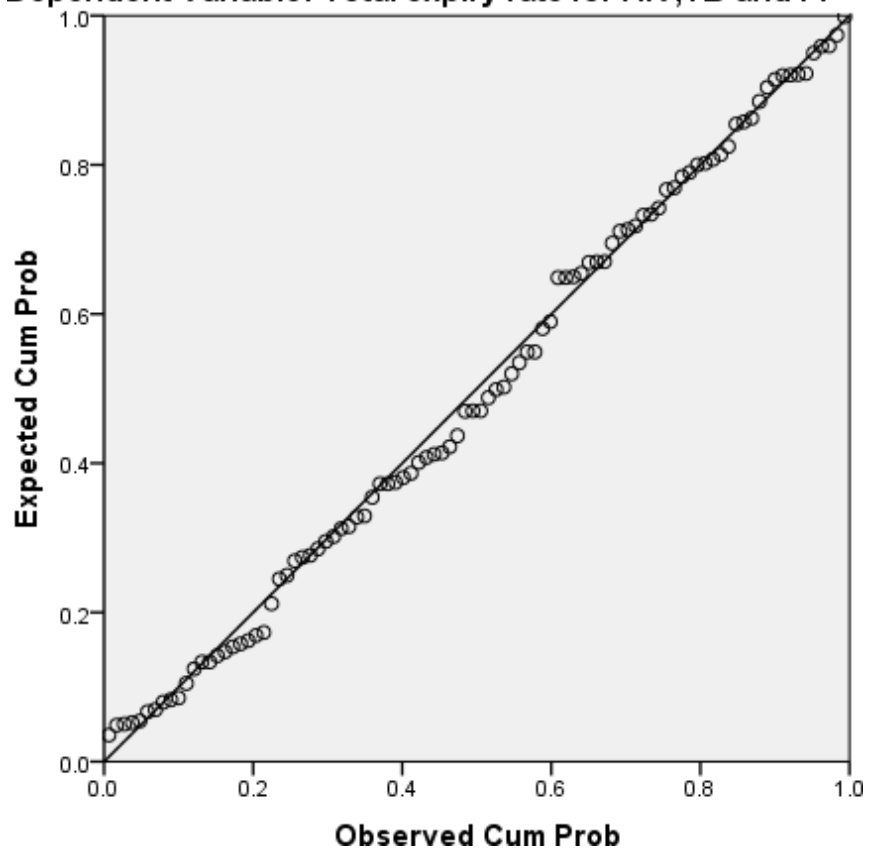
Diriba, G., Hasen, G., Tefera, Y., & Suleman, S. (2023). Assessment of the magnitude and contributing factors of expired medicines in the public pharmaceutical supply chains of Western Ethiopia. *BMC Health Services Research*, 23(1), 791.

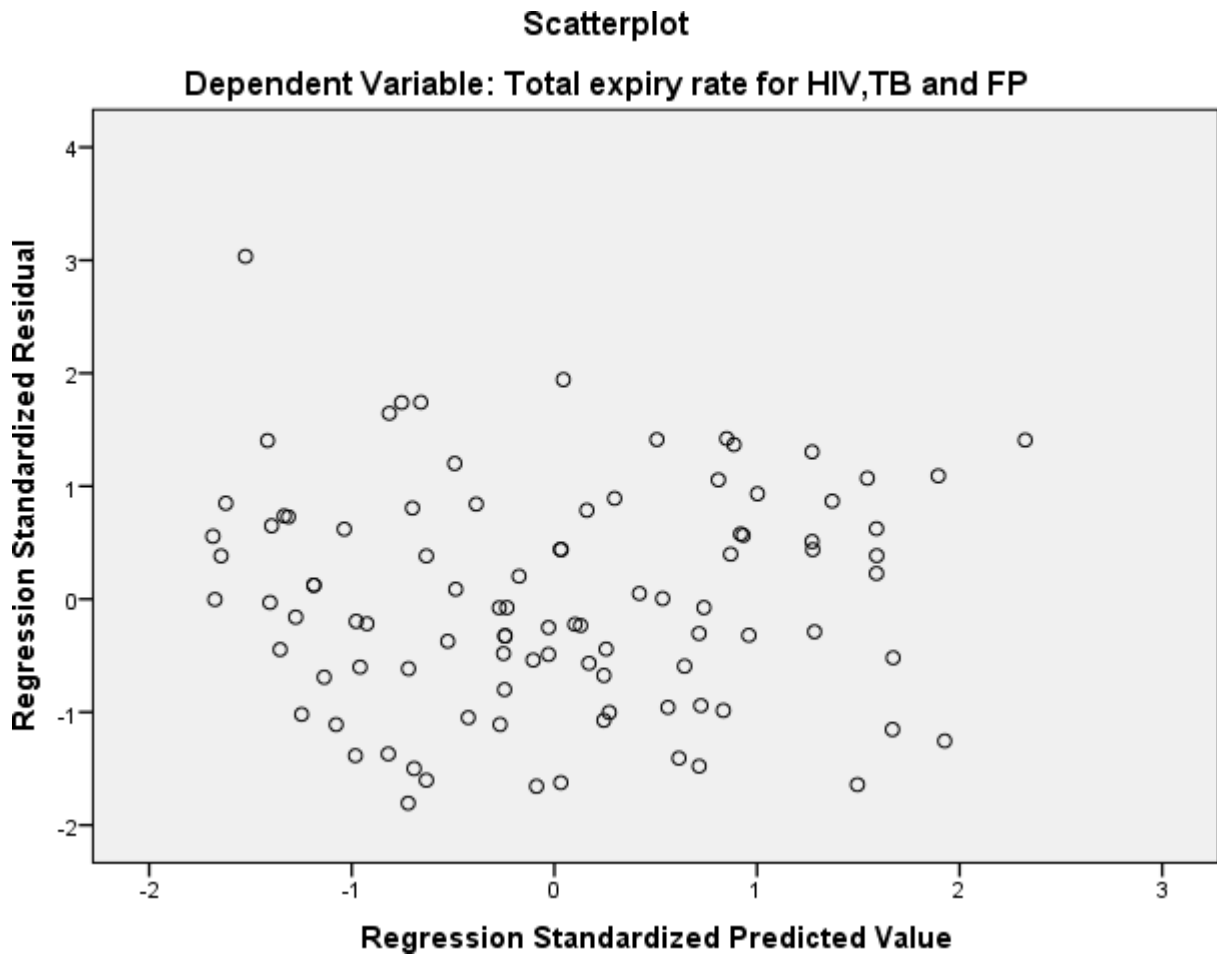
ANNEXES

Annex- 1: Histogram showing total expiry rate



Normal P-P Plot of Regression Standardized Residual
Dependent Variable: Total expiry rate for HIV,TB and FP





CONSENT AND INFORMATION SHEET

Addis Ababa University

College of Commerce

School of Graduate studies

Dear Participant, My name is Meron Kifle, 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 factors contributing to pharmaceuticals expiry the case of HIV, TB, FP program at public health facilities of Addis Ababa. The objective of the study is to assess the factors contributing to pharmaceuticals expiry the case of HIV, TB, and FP program from the previous 1 year Hamele 1/2011-sene 30/2012. The information you give me will be used to reduce resource (program pharmaceutical) expiry and to improve supply chain of pharmaceutical. Thereby contribute to improved care of HIV, TB patients and Family planning user and services. The study will isolate the problem and factors contributing to pharmaceuticals expiry the case of HIV, TB, and FP program 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.

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

Tel: 0913 06 48 42 or email: meronkifle2018@gmail.com and mkifle@efda.gov.et

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 _____

QUESTIONNAIRE

participant code _____

Research title: Factors contributing to pharmaceuticals expiry: The case of HIV, TB and FP
Programs at Public Health Facilities in Addis Ababa.

Questionnaire for Drug Store Managers

Part I: Background Information

1. Gender Male Female
2. Profession: Pharmacy Medical lab tech Nurse other

3. Age: _____

4. What is your level of education? Diploma BA/BSc

MBA/MSc others (specify) _____

5. How many years (months) have you been working in this capacity? _____

6. Have you ever received any training on integrated pharmaceuticals logistics system (IPLS)?

Yes No

7. Have you ever received any training on logistics management information system (HCMIS)?

Yes b) No

Part II: General Questions

Questions on factors contributing to pharmaceuticals expiry the case of HIV, TB, and FP program at the health facilities

In this section, I am asking your feeling about factors contributing to pharmaceuticals expiry the case of HIV, TB, and FP program in your facility.

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

SN	Factor	Five scale rating				
		Strongly Disagree = 1	Disagree = 2	Neutral = 3	Agree = 4	Strongly Agree = 5
Poor performance of supplying hubs						
1	Near expiry medicines (< 6months) are being delivered to the health					

	Facility					
2	Donation received irrespective of need					
Improper forecasting and quantification						
1	Absence of functional DTC in the health facility					
2	Selection of medicines are not based on available essential medicines list in the health facility					
3	Nonparticipation of clinicians in medicine selection and quantification of the facility					
4	No accurate data available in the health facility to facilitate quantification of medicines					
5	Presence of over stocked medicines due to improper forecasting of need in the facility					
6	Standard treatment guideline violated in forecasting					
7	Quantified by vertical program					
8	Sellers incentive influence quantification					

Improper inventory management practices						
1	Poor stock management like using neither FIFO nor FEFO in stock management					
2	Lack of electronic stock management tools that automatically capture medicines expiry in the health facility					
3	Weak or no mechanisms for medicine expiry monitoring and evaluation in the health facility					
4	Lack of accountability for stock-outs and expiry of medicines in the facility					
5	No knowledge about FIFO and FEFO					
Over procurement						
1	Medicines are purchased without procurement plan/policy in the facility					
Improper implementation of health system						
1	Abrupt changes of treatment practices results medicines expiry					

	in the facility					
2	Poor communication and coordination with key stake holders (health bureau/office, suppliers, NGO"s)					
3	Lack of system to move nearly expired medicines facility to facility					
4	Lack of knowledge and skills of pharmacy professionals in medicine supply management					
5	The shortage of pharmacy human resources in the facility					

Interview Guide questions

Guidelines for semi-structured interviews with Pharmacy heads, Respondents from sub city logistic officer, RHB and EPSA. (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 in logistic management information system (HCMIS)?
a) Yes b) No

If yes When? _____

Part II: General Interview Guide Questions

Now I would like you to think about the past 1 year. Have you ever faced expiry of HIV/TB/FP pharmaceutical in the previous year (from Hamel 1/ 2011-Sene 30/ 2012)?

1. Which pharmaceuticals are expired in the research period?
2. How do you assess the current situation of pharmaceutical expiry in your health facility?
3. What are the factors contributing for expiry of pharmaceutical in your health facility?

(Need for further probing in associated with the variables etc.)

- Poor performance Supplying hub (EPSA)
- Improper implementation of health system
- Improper forecasting and quantification

- Over procurement
 - Improper Inventory management practice
4. How an expired pharmaceutical in your health facility is affecting service provision of your facility?
 5. Are there any efforts made so far by the facility to prevent/ reduced expiry of pharmaceutical? What do you recommend to minimize for the future too? What is your opinion?
 6. Is there anything else you would like to tell us or ask us?

Thank you very much for your participation in this interview.

