Addis Ababa University College of Business and Economics School of Commerce

Assessment of Supply Chain Management of Anti Retroviral Drugs in Public Hospitals in Addis Ababa, Ethiopia

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DECLARATION

I Meskerem Adugna the undersigned, declare that this is my original work and has never been presented for the degree in this or any other university and all the source materials used for this research has duly acknowledged.

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List of Abbrivations

AIDS	Acquired Immune Deficiency Syndrome
ARV's	anti-retroviral viral
ART	anti-retroviral therapy
EDT	electronic dispencing tool
HAART	Highly active antiretroviral therapy
HIV	human immune deficiency virus
LMIS	logistics management information system
NRTIs	nucleoside analogue reverse transcriptase inhibitors
NNRTIs	non-nucleoside analogue reverse transcriptase inhibitors
PIs	Protease inhibitors
SCM	Supply chain management
SPSS	Statistical Package for Social Sciences
RRF	Reporting resupply form
UNAIDS	united nation of Acquired Immune Deficiency Syndrome
WHO	World Health Organization

Definition of Terms

Antiretroviral drugs: refer to the medicines used to treat HIV (WHO, 2015).

Antiretroviral therapy: refers to the use of a combination of three or more ARV drugs for treating HIV infection. ART involves lifelong treatment (WHO, 2015).

Health facility: a building, where medicine is practiced (includes dispensaries, health centers and hospitals).

First-line ARV: is the initial regimen prescribed for a patient who fulfills national clinical and laboratory criteria to start ART

Second-line ARV : is the next regimen used in sequence immediately after first line therapy has failed (clinically and/or immunologically and/or virologically).

EDT: is electronic dispencing tool which enables pharmacy staff at the facility level to manage patients, plan follow- ups and monitor stock levels.

Supply chain management: Management of material and information flow in a supply chain to provide the highest degree of customer satisfaction at the lowest possible cost (Business dictiionary.com, 2012).

Pharmaceuticals: means any substance or mixture of substances used in the diagnosis, treatment, mitigation or prevention of a disease, and include medical instruments and medical supplies (Proclamation No 553/2007).

Abstract

Acquired Immune Deficiency Syndrome (AIDS) is a disease caused by a retrovirus known as human immune deficiency virus (HIV). The virus attacks the immune system and weakens the body's natural defense system to fight against infection. Highly active antiretroviral therapy (HAART) is the cornerstone of management of patients with HIV infection. This study therefore sought to assess supply chain management of ARV drugs in all public hospitals in Addis Ababa, Ethiopia. The study employed a facility based cross-sectional descriptive quantitative study and retrospective document review. The total sample size for the study was all public hospitals (censes). The study included heads of the pharmacy; ART dispenser and ART store manager/general store manager of the public hospitals as a target population of the study. The study specifically gathered data on quantification, ordering and receiving of ARV drugs, inventory management procedures, storage conditions and distribution of ARV drugs within all the public hospitals in Addis Ababa. Both structured questionnaires and observation check lists were used to gather these data and analysis were done using words, graphs, tables and statistics.

Statistical Package for Social Sciences (SPSS) version 20 was used for analysis. Overall, the mean age of public hospitals had an experience on ART service provision 15.6 years. The study revealed that 20(86.95%) of federal hospital and 14(82.5%) regional hospitals pharmacies properly report and have the record of patients by regimen data. And 25 (62.5%) of the hospitals were using a compensation of electronic dispensing tool (EDT) data, ART pharmacy data and ART clinic data for reporting. EDT: enables pharmacy staff at the facility level to manage patients, plan follow- ups and monitor stock levels; however among the respondents 16(69.56%) from federal hospitals and 14(82.35%) from regional hospitals have EDT tool but among this only 13(56.52%) federal hospitals and 11(64.7%) of regional hospitals electronic dispensing tools functional. 24(60%) used EDT for recording daily dispensing drugs, for trucking patients by regimen & following patient treatment. Almost above half 24(60%) of the hospitals used EDT for recording daily dispensing drugs, for trucking patients by regimen & following patient treatment. Of all the participants only 12(52%) of the respondents from federal hospitals and 10(58.82%) of the respondents from regional hospitals had ART training. The majority of the federal hospitals 5 (45.5%) and regional hospitals 6(54.55%) were able to submit the requisition and report of ARV drugs to Pharmaceutical Fund and Supply Agency according to the schedule.

An emergency order would be needed to avoid reaching a stock out before the end of the review period 20% of the federal hospitals and 15% of the regional hospitals had more than three emergency order of ARV drugs were placed on the past 6 months. 5(50%) of stock out of ARV drugs occurred in the hospitals due to not receiving the exact quantity they have ordered. Stock out was high for Nvp240ml in federal hospitals 3(60.0%). A well-organized storeroom will simplify a facility's work; time will not be wasted trying to find needed supplies among ten hospitals 5(50%) of the hospitals have separated store for ARV drug and also 3(30%) of them have expiry date trucking chart. Logistics Management Information System (LMIS) is to support the management of essential pharmaceuticals like ARV drugs 5(21.5%) of federal hospitals and 6(35.3%) of regional hospitals have computer based LMIS. The remaining 18(78.3%) of federal hospitals and 11(64.7%) of regional hospitals have paper based LMIS; they used computerized EDT at dispensary and Health Commodities Management Information System (HCMIS) in the store. The study concludes that there were stock outs of ARV drugs which are an indicator of weak supply chain and also inadequate data on patient by regimen and stock status of ARV drugs. It was also noted that in majority of the cases the professionals were unable to handle the computerized LMIS, as desired. It was recommended for the hospitals handling ARV drugs to have adequate and reliable patient information and drug utilization data on hand and improve their storage conditions and prevent expiry and wastage of expensive ARV drugs.

Key words: ARV drugs, ART, LMIS, EDT, supply chain Management, pharmaceutical storage

CHAPTER ONE

INTRODUCTION

1.1. Background of the study

Acquired Immune Deficiency Syndrome (AIDS) is a disease caused by a retrovirus known as human immune deficiency virus (HIV). It is the most advanced stage of HIV infection and it takes 10-15 years for an HIV infection person to develop AIDS (WHO, 2014a). The virus attacks the immune system and weakens the body's natural defense system to fight against infection (UNAIDS, *2008)*. Highly active antiretroviral therapy (HAART) is the cornerstone of management of patients with HIV infection (Kumarasamy, et al, 2011). Although important progress has been achieved in preventing new HIV infections and in lowering the annual number of AIDS related deaths (UNAIDS, 2008). Due to anti-retroviral therapy (ART) and other critical supplies are becoming more accessible to the millions of people living with HIV (Alagaw et al, 2014).

A total of 36.7 million [34.0 million–39.8 million] people globally were living with HIV at the end 2015. As of UNADIS, June 2016, 18.2 million [16.1 million–19.0 million] people living with HIV were accessing antiretroviral therapy, up from 15.8 million in June 2015 and 7.5 million in 2010. In 2015, there were 19 million [17.7 million–20.5 million] people living with HIV in eastern and southern Africa. In eastern and southern Africa, 10.3 million people were accessing antiretroviral therapy, 54% [50–58%] of all people living with HIV in the region (UNADIS, November 2016). Increased access to anti-retroviral viral (ARV's) drugs has brought hope to millions of people living with HIV/AIDS, especially in sub-Saharan Africa (Michel Sidibé, 2013). From the 2010 to 2015, the number of AIDS-related deaths in eastern and southern Africa fell by 38% (UNADIS, November 2016). An intensified scaling-up of treatment programs has caused a substantial reduction in HIV/AIDS-related deaths as well as a significant reduction in transmission rates. The global target is to ensure that 15 million people have been placed on treatment by 2015 (Michel, 2013).

Since the advent of the ART program, more than 200,000 people of have started on treatment in about 500 health facilities of Ethiopians. ART service expansion has been recent and fast from only four facilities in 2003 to 517 in 2009. Parallel with this, the number of people who have accessed ART has also increased substantially from 900 in 2003 to 211,000 in 2009 (USAID, 2010). Accessed to HIV treatment has been greatly expanded in Ethiopia thanks, in part, to the decentralization of site offering ART by the end of 2012, nearly 290,000 Ethiopians were receiving free ART 74% of eligible people as opposed to approximately 10,000 in 2005 (Michel, 2013)

Treatment for people living with HIV is life-long, and long-term survival depends on continuous access to newer and more potent ARVs (Sarah and Attapon, *2013).* Currently there are six categories of ARVs. Namely, nucleoside analogue reverse transcriptase inhibitors (NRTIs), non-nucleoside analogue reverse transcriptase inhibitors (NNRTIs), protease inhibitors (PIs), intigerase inhibitors (IIs), chemokine receptor 5 (CCR5) inhibitors and fusion inhibitors (FIs) (EFMHACA, 2013).The drugs suppress the multiplication of the virus through interfering with the life cycle of the virus (DACA, *2003).* According to standard treatment guideline (STG) 2010 for General Hospital of Ethiopia: ART naïve patients, treatment is initiated with a combination of three drugs (Triple Therapy) consist of two NRTI plus one NNRTI as first line drugs (Assefa et al, *2014* and (Chan, et al, 2014). When first line regimen failure occurs, the patient switches to astandard boosted protease inhibitor (PI) based second line regimen two NRTIs plus one PI (Wilsdon and Lilian, 2016).

Supply chain management of essential health commodities, including high-value medicines like ARV drugs, involves a series of activities to guarantee the continuous flow of products from the point of manufacture to the point where they are used by consumers (Chandani et al, 2006). The nature of ART and the specific characteristics of ARV drugs and how they are used pose particular challenges for managing the supply chain for ARV drugs (Allers and Yasmin, 2006). Ensuring an effective supply chain 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 infections (STIs); medicines to treat HIV-related cancers (Helena and Douglas, 2009); diagnostic test kits for HIV and other laboratory reagents; contraceptives; condoms; protective gear for infection prevention and health worker safety; and a host of consumable medical and laboratory supplies and equipment (Allers and Yasmin , 2006).

Procurement and supply management of drugs and other supplies is one of the key functions that needed attention. Treatment programs cannot be expanded without reliable, efficiently managed supplies of safe, effective and affordable ARV drugs and associated diagnostics and supplies (Habiyambere et al, 2005). The aim of this study to assess the supply chain of ARV drugs in public hospitals in Addis Ababa and to identify the possible gaps that exist in the supply chain of these commodities.

1.2. Statement of the problem

A major challenge to initiation and expansion of ART services in resource-poor countries that have been most affected by the HIV/AIDS epidemic is the limited capacity of health commodity supply chains to ensure a reliable supply of the products at service delivery sites to support HIV prevention, care, and treatment programs. Successful provision of ART services depends not only on the continuous availability of high-quality ARV drugs but also on the supply of a range of HIV/ AIDS-related commodities (Allers C and Yasmin C, 2006).

ART treatment with ARV drugs has several characteristics that affect the management of the commodities and that pose unique challenges in quantification of ARV drugs and supplies mainly in low and middle income countries. Data on ART services and ARV drug supply are still of limited quality and availability and tend to be unreliable or insufficient for forecasting ARV drug requirements. Consequently, many forecasts still rely heavily on assumptions or quantifying ARV drug requirements (USAID | DELIVER PROJECT, Task Order1, 2009).

Even though it has been a decade since ART and VCT services were started in Ethiopia there was not adequate data on patient by regimen and stock status of ARV drugs and Test kits (Eyerusale and Teferi, 2014). In many low- and middle- income countries, the capacity of the procurement and supply management systems has always been weak (Paui et al, 2009).

Stock-outs of ARVs directly affect adherence to antiretroviral therapy (John Snow, 2009) which in turn increases the risks of resistance development, disease progression and mortality (Global AIDS Response Progress Reporting, January 2016).

Inventory management is a key step in ensuring a continuous supply of ARVs. It is crucial to know the levels of medicines in the store in order to maintain the availability of ARVs, to avoid stock outs, overstocking and expiries. These are challenges in public sector health institutions, and are to a large extent attributed to poor inventory control systems that do not provide an audit trail for medicines delivered from the provincial stores (Mahoro and Kim, 2013).

ARV drugs and HIV tests are both relative newcomers to public health logistics systems, and they have particular characteristics that often require making adaptations to the supply chain through which they are managed. The special nature of ARV drugs and HIV tests influences the design of the inventory control and logistics management information systems, the design of the storage and distribution networks, and the process for implementing upstream and downstream functions. Because the programs that use these commodities for example voluntary counseling and testing (VCT), prevention of mother to child transmission (PMTCT), and ART are still evolving in the way services are provided, assessment teams must have a basic understanding of how the special characteristics of HIV tests and ARV drugs affect supply chain performance, system design, and implementation (Aronovich et al, 2006).

Global coverage of antiretroviral therapy reached 46% [43–50%] at the end of 2015 (UNAIDS, 2016).World Health Organization (WHO) has recently recommended initiating ART with higher CD4 cell count, up to 500/µl for WHO stage 3 diseases. This is call for countries to identify context specific option for increasing access and utilization of ART (Asefa. A et al, 2014 and UNAIDS, 2014). Ethiopian STG 2010 recommend that ART should be initiated when the CD4 count falls below 350/µl for WHO stage 3 diseases and should be initiated irrespective of CD4 count for stage 4 disease. If CD4 count is not available it should be initiated irrespective of total lymphocyte count (DACA, 2010). So it may lead to a drastic increase of the number of patients who are eligible for ART. Thus it forces to increase ARVs and other HIV commodities, creating an enormous burden to national health care system and health facilities (Elke et al, 2012).

Gap analysis

A number of studies have been carried out in the field of supply chain management (SCM) targeting different component of SCM. For example, (Gizat and Samson, 2014) focus on assessment of pharmaceutical store management, west Hararghe zone in Ethiopia. Solomon Dawit, 2014 focuses on assessment of pharmaceutical inventory management in Addis Ababa health bureau hospitals. But to the extent of the researcher's literature review, no studies have focused on the assessment of supply chain management of ARV drugs in public hospitals particularly in Addis Ababa. Therefore, this research study will be conducted to assess the supply chain of ARV drugs in public hospitals in Addis Ababa and to identify the possible gaps that exist in the supply chain of ARV drugs.

1.3. Research Questions

1. How are the selection, quantification, ordering and receiving of ARV drugs carried out in public hospitals?
2. What is the storage condition of ARV drugs in the public hospitals?
3. How do Inventory Management of ARV drugs in the public hospitals look like?
4. Which ARV drugs are in short supply and why?

1.4. Research Objective

1.4.1. General Objective

The general objective of this study is to assess the supply chain management of ARV drugs in public hospitals in Addis Ababa, Ethiopia.

1.4.2. Specific Objective

1. To assess selection, quantification, ordering and receiving of ARV drugs in selected public hospitals in Addis Ababa.
2. To assess inventory management procedures, storage conditions and distribution of ARV drugs within the public hospitals in Addis Ababa.
3. To assess the utilization of ARV drugs in public hospitals in Addis Ababa.

1.5. Significance of the Study

This study will help decision makers and other stakeholders to have an insight about the supply chain of ARV drugs in public hospitals in Addis Ababa and in other parts of the country. The result of the study will believe to have significance in reduction of resource wastage and emergency of drug resistance which intern increases the quality of life of the patient. Finally, the study will be used as base line information for future studies related to the specific topic.

According to David and Scott, UNAIDS announced bold new targets for the global response to HIV, aptly named the 90-90-90 strategy, that 90% of people living with HIV (PLHIV) know their status, 90% of diagnosed PLHIV are on treatment and 90% of PLHIV on treatment achieve an undetectable viral load, by 2020. To realizing this there must be uninterrupted supply chain management of HIV/ADIS related commodity (Jamieson D and Kellerman S, 2016).

1.6. Scope of the Study

The research was conducted in public hospitals in Addis Ababa, Ethiopia, that provide ART services. The study included heads of the pharmacy; ART dispenser and ART store manager/general store manager of the selected health facility as a target population of the study. The study specifically gathered data on quantification, ordering and receiving of ARV drugs, inventory management procedures, storage conditions and distribution of ARV drugs within the public hospitals in Addis Ababa. The study was conducted during the time period of October 2016 to June, 2017.

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1.7. Organization of the Study

This paper has five chapters.

Chapter one is the introductory chapter that covers the background of the study, statement of the problem, objectives of the study, scope of the study & significance of the study.

Chapter two presents, the review of related literature. It covers concepts and theoretical framework and empirical studies on supply chain management ARV drugs.

Chapter three presents discussion and explanation of the research methodology of the study. Discussion of the research design, population of the study, sampling techniques, sample size, data collection instruments, the data collection procedures, the ethical consideration and data analysis approach.

Chapter four presents the data presentation, data analysis and result of the study.

Chapter five finally present the discussion, conclusions, and recommendations of the study.

CHAPTER TWO

Literature Review

2.1. Introduction

This chapter discusses the literature review of the study; it cover Concept of Supply Chain Management, Supply Chain Management Activity in Health Facility, Pharmaceutical Supply Chain Management Activity in Health Facility and Supply Chain Management of ARV drugs in Ethiopia. The information covered in the literature review was obtained from past reference materials like magazines, newspapers articles and other published materials. This contributed towards broadening the scope of the research study and concludes with a summary of the chapter.

2.1. Understanding of Supply Chain

2.2.1 Concept of Supply Chain Management

The best companies around the world are discovering a powerful new source of competitive advantage, it's called supply-chain management and it encompasses all of those integrated activities that bring product to market and create satisfied customers (Sotiris, 2000). According to the Council of Supply Chain Management Professionals (CSCMP) "Supply chain management encompasses the planning and management of all activities involved in sourcing and procurement and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies" (Kumurya, A. S, 2015).

The term supply chain describes the links and the interrelationships among the many organizations, people, resources, and procedures involved in getting commodities to the health care consumers. A typical health supply chain would include partners from manufacturing, Procurement Agents, Distributors, Financiers and service delivery. Together, these organizations the flow of products to the end consumer, information for better planning and, finances to cover

the transaction costs (Daweil Lu, 2011). A key ingredient of a successful supply chain is that partners are focused on improved coordination, information sharing and, serving the end customers (Sangeeta, et al, 2004).

Traditionally, marketing, distribution, planning, manufacturing, and the purchasing of organizations along the supply chain operate independently. These organizations have their own objectives and they are often conflicting. For these reasons, there is a need for companies to manage not only their own organizations but also their relationships with other companies in the same supply chain (Dag & Sweden, 2010) or supply integration. SCM is a strategy through which integration can be achieved. SCM is typically viewed to lie between fully vertically integrated firms, where the entire material flow is owned by a single firm, and where each channel member operates independently. Therefore, coordination between the various players to the chain is a key in its effective management (Shah, 2003).

The strategic supply chain continues to be adopted by organizations as the medium for creating and sustaining a competitive advantage. Such a displacement is understandable considering the potential benefits of successful SCM. These benefits include inventory reduction, improved delivery service, and shorter product development cycles (Stanley, et al, 2008).

2.2.2. Supply Chain Management Activity in Health Facility

SCM is core component of health sector for health programs and services (Dessalegn and Tiruneh 2015). It is correctly applied in public Health Institutions can contribute greatly assuring access to health supplies public health institutions and thus for positive health outcomes. This is particularly important in most countries in sub Saharan Africa where large proportion of the population is served by the public and mission health sectors. The public/mission health supply chain manager 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 (Simon and Gerald, 2013).

Supply chains underpin the entire health system and are essential for providing consistent availability of affordable, high-quality diagnostic and treatment products in locations that are geographically accessible to the target population (Jody, et al, 2011). In addition, supply chains carry information about supply and demand for products back to planners and policymakers and

handle financial flows so that the system is adequately resourced. A broken supply chain can cripple the health system and undermine positive health outcomes (Dalberg Global Development Advisors and the MIT-Zaragoza International Logistics Program, 2008).

An effective public health supply chain requires motivated and skilled people with competencies in various essential supply chain functions. Staff must be empowered to make decisions that positively impact health supplies and supply chains. In many countries, a lack of trained staff and poor supply chain practices are frequent causes of poor performance, resulting in weak information systems, poor vaccine management, and ultimately stock-outs and wastage (Steele, 2014).

Access to affordable medicines, including HIV treatment, is of central importance in healthcare and in improving health outcomes. It is also a fundamental element in achieving the full realization of the right of everyone to the enjoyment of the highest attainable standard of physical and mental health that is enshrined in global legally binding treaties. The right to health is recognized in the 1948 Universal Declaration of Human Rights and the 1966 International Covenant on Economic, Social, and Cultural Rights, the Convention on the Elimination of All Forms of Racial Discrimination (1965), by the constitution of the World Health Organization (WHO) (1946) and several other documents protecting specific groups such as workers and migrant workers, prisoners, the disabled and mentally ill, Over 100 countries also include health provisions in their constitutions(Sarah & Attapon, 2013).

The scale-up of antiretroviral therapy (ART) has been one of the success stories of sub-Saharan Africa, where coverage has increased from about 2% in 2003 to more than 40% 5 years later. However, tempering this success is a growing concern about patient retention (the proportion of patients who are alive and remaining on ART in the health system) (Anthony D. Harries, Rony Zachariah, Stephen D. Lawn and Sydney Rosen, 2010). Ethiopia is committed to improving access to HIV care and ART. In May 2005, some private hospitals in Addis Ababa City Administration received accreditation to provide ART services to eligible patients (Omar, et al, 2011)

2.2.3. **Pharmaceutical Supply Chain Management Activity in Health Facility**

The pharmaceutical industry can be defined as a complex of processes, operations and organizations involved in the discovery, development and manufacture of drugs and medications. The World Health organization defined a drug or pharmaceutical preparation as: any substance or mixture of substances manufactured, sold, offered for sale or represented for use in the diagnosis, treatment, mitigation or prevention of disease, abnormal physical state or the symptoms there of in man or animal and for use in restoring, correcting or modifying organic functions in man or animal (Nilay, 2003).

The complexity of the pharmaceutical supply chain results from the involvement of multiple large independent organizations of very diverse nature. The key stakeholders in this supply chain include multiple government agencies, hospitals, clinics, drug manufacturers, drug distributors, pharmacy chains, retailers, and the research organizations and the food and drug administration (Mahender, et al, 2005). The goals of the pharmaceutical supply chain obviously emphasize regulatory compliance and safety of products, but also include leveraging information to be more responsive to the needs of consumers (Simon and Nikoi, 2014).

The pharmaceutical industry supply chain covers drug research, development, manufacture; distribution and application through a range of healthcare services, together with all the ancillary businesses that help these different stages function effectively. Fundamentally, the pharmaceutical industry is a business that is about health and therefore about people. The pharmaceutical and healthcare industry is hugely complex because it involves so many markets, products, processes and intermediaries. It is also globally heavily regulated and used by everyone in life. Changes in one area impact upon the others and environmental factors such as pricing, regulatory change or actions by competitors, impact the whole supply chain in ways that are not easily understood or properly managed (Simon and Nikoi, 2014).

Pharmaceutical supply management involves four basic functions: selection, procurement, distribution, and use. At the center of the pharmaceutical management cycle is the core of related management support systems including the planning and organization of services, financing and financial management, information management and human resource management. These management support systems hold the management cycle together. The entire cycle rests on a policy and legal framework that establishes and supports the public commitment to supply

essential medicines (SIAPS, 2015). The Pharmaceutical Management Cycle is illustrated in Figure below.

Figure one: - Pharmaceutical Management Cycle.

Source: - Management science for health (MSH), 2010

The success of the drug supply management (DSM) cycle will depend upon the ability to reliably and consistently supply the drugs to health facilities at all levels of the health system. The consequence of supply interruption can be dire, including antibiotic and ARV drug resistance, which could have a wider global impact on the availability of drugs for treatment. Medical health drug supply chains are different because they usually have large, extended global pipelines, require high levels of product availability and have a high uncertainty in supply and demand. It is therefore paramount that supply chain or logistics systems are treated as an important and critical function in getting the drugs to their destination. In fact, in order to sustain and expand the successful interventions experienced to date, the supply chains will need to be made more robust, agile and flexible through better management and increased investment of resources to achieve supply chain optimization (Mohammad & Raja, 2004).

Although medicines are one of the vital tools needed to improve and maintain health, for too many people throughout the world medicines are still unaffordable, unavailable, unsafe and improperly used. An estimated one third of the world's population lacks regular access to essential drugs, with this figure rising to over half in the poorest parts of Africa and Asia. The lack of infrastructure for storage and distribution of drugs. The lack of dedicated transport to

ensure constant drug supply Losses from expiration, theft, fraud and inappropriate storage Inaccurate forecasting of drug requirements due to non adherence to drug re-order levels (ROL) (Shamima et al, 2012).

As countries scale up ART services, it is important to ensure ARVs are there for those who need them. ART is a long-term treatment strategy for people living with advanced HIV infection (Global AIDS Response Progress Reporting, 2016) and placed strong demands on health systems (Patrick, et al, 2005). The interruptions ARVs supply may lead to treatment failure and HIV drug resistance. Efficient supply management is needed for an uninterrupted supply of ARVs (Global AIDS Response Progress Reporting, 2016).

The successful provision of VCT, PMTCT and ART service depends on the continuous availability of HIV/AIDS supplies and commodities (USAID, 2006). But Supply Chain Management of HIV/AIDS in many low- and middle- income countries are challenging and weak. The management of supplies for what is essentially a chronic disease needing lifelong therapy is becoming increasingly difficult. The ARV supply chain management has become increasingly difficult due to increasing number of people on ART, increasing number of sites providing ART, a greater diversity of different ARV regimen (Erik, et al, 2011), weak supply chain infrastructure and a lack of human capacity to ensure that essential products reach ART points of service (PEPFAR, 2006).

A study done by Eyerusalem and Teferi, in Addis Ababa, Ethiopia, on the assessment of HIV/ADIS related commodities. The study was included 4 public hospitals and 20 government Health Centers. The result reviled that 14(70%) of Health Centers and 2(50%) of the hospitals stopped VCT service due to lack of adequate supply (Eyerusale and Teferi, 2014).

Another study done by Daniel et al in Kilombero and Ulanga districts in southern Tanzania. He Conclude that access to ART in Kilombero and Ulanga districts has some critical imbalances in the supply chain and management for HIV/AIDS care and treatment. Potential strategies to overcome the barriers are discussed in relation to routine health management information system, investments into mobile health and human resource capacity strengthening (Daniel et al, April 2015). supply chain management for ARV drugs and HIV test kits depends on (Allers, et al, 2007): product selection and quantification, inventory management; registration and use;

facility ordering procedures; distribution and transport; storage conditions and stock keeping practices and logistics management information system (including monitoring and evaluation) (Jon, et al, 2005).

- **Selection and Quantification**

Rational selection of essential drugs for the treatment of HIV/AIDS is the first and most important step in achieving effective therapy against HIV and related illnesses. The cornerstone of any public health approach to combating these diseases is an efficient and effective drug supply system based on the selection of a standard list of essential drugs (World Bank, 2004).

Selection is the process of deciding which medicines a health system should include in its pharmaceutical strategy to improve access (Brandon E. Whitney and Deborah A. McFarland, (2014)) such as ART (Jeffrey et al, 2015). In a health logistics system, product selection may be the responsibility of a national formulary and therapeutics committee, pharmaceutical board, board of physicians, or other government appointed group. Selection may start at national level and cascaded to the specific place where the care is going to be provided. It involves establishing a list of commodities at national and facility levels. Therefore, the list should be developed based on the prevailing health care needs and should address the essential health package of the country (Dessalegn and Tiruneh, 2015). Most countries have developed their essential drug lists patterned from the World Health Organization Model List (Emelia et al, 2014).

A study done in Lesotho on Assessment of the HIV/AIDS Medical Supplies and Laboratory Commodities Supply Chain, in ten hospitals, one filter clinic, and four health centers which providing ART services. The selection of ART drugs process in Lesotho intended by National Pharmacy and Therapeutics Committee (NPTC) (which is not yet in place), in collaboration with the Hospital Pharmacy and Therapeutics Committees (HPTCs). At the time of the assessment, 46 percent of the hospitals had established pharmacy and therapeutics committees, but the majority was not yet functional (Pharasi, 2007).

The challenge experienced in ARV selection in many low income countries. The policy makers overlook certain supply chain factors such as formulations and cold chain requirements, ignoring

the fact that the supply of electricity is unreliable and even absent in many areas. This jeopardizes the quality of ARVs which are temperature sensitive. In addition, meetings among ART stakeholders such as product selection committees and ART managers from all levels should be more frequent so as to review the ARVs on the national essential medicines list, based on growing evidence and experience with treatment in resource limited settings (Kamuzora, 2011).

A good selection process facilitates access to treatments and ensures the efficient use of funding. A wrong specification list may result in receiving a product which meets all the stated requirements but which is wrong for the intended application. It may put at risk the entire programme implementation (Jeffrey et al, 2015).

After products have been selected, the required quantity and cost of each product must be determined. Quantification is the process of estimating the quantity and cost of the products required for a specific health program (or service), and, to ensure an uninterrupted supply for the program, determining when the products should be procured and distributed (John Snow, 2011)..Quantification consists of four distinct steps: forecasting demand, estimating requirements, calculating the costs for procuring the requirements, and, if needed, adjusting the final quantities to procure according to the amount of funding available (Allers C and Yasmin C, 2006). Quantification of HIV/AIDS commodities should be information driven, using logistics data such as current consumption, stock currently available in country, and losses and wastage, when possible.

Quantification is a critical supply chain activity that links information on services and commodities from the facility level with the program policies and plans at the national level; it is then used to inform higher-level decision-making on the financing and procurement of commodities (John Snow, 2010). The results from quantification can be used to help maximize the use of available resources for procurement; advocate for mobilization of additional resources, when needed; and inform manufacturer production cycles and supplier shipment schedules (John Snow, 2014).

Quantification is important to realize that in situations where the HIV/AIDS epidemic or responses to it are expanding, careful judgment will be necessary to arrive at the correct quantities of each commodity needed for procurement and to decide how much to buy.

Underestimates will deprive people of necessary treatments or tests. Overestimates may waste resources if limited-shelf-life products expire unused, especially as treatment protocols and diagnostic preferences change (Jean-Louis and James, 2004).

Moreover, there are certain common challenges associated with the quantification of ARV drugs and supplies mainly in low and middle income countries. Data on ART services and ARV drug supply are still of limited quality and availability and tend to be unreliable or insufficient for forecasting ARV drug requirements. Consequently, many forecasts still rely heavily on assumptions or quantifying ARV drug requirements (John Snow, 2009).

- **Inventory Management and Storage**

Inventory management is concerned with ensuring that all activities involved in storekeeping and stock control are carried out efficiently and economically by those employed in the store (Elema et al, 2014). Aarti and Dhawa, also stated inventory management system provides information to efficiently manage the flow of materials, effectively utilize people and equipment, coordinate internal activities and communicate with customers. Inventory Management does not make decisions or manage operations but provides the information to managers who make more accurate and timely decisions to manage their operations (Aarti and Dhawal, 2010).

According to the Deliver logistics handbook (2006, p. 123) proper inventory management avoids overstocking, under stocking and stock out, minimizes wastage of product from damage and expiry of the pharmaceuticals, simplifies inventory control decision making and it aids forecasting when there is a consistency of stock levels.

For many organizations, there is no doubt that inventory management enhances their operations. Organizations with high levels of finished goods inventory can offer a wide range of products and make quick delivery from their backwards to the customers Stanton. There has been a question for management about the efficiency of inventory management procedures in place resulting from inconsistencies of inventory levels leading to various weaknesses like losses that come as a result of over, under-stocking, expiry inventory, failure to meet targets and low morale of the company members. As a result the company's stores are overcrowded making the work of a store-keeper difficult, late issue of materials to the department and these in turn result into poor inventory service delivery (Godana, B. E. & Ngugi, K, 2014).

Increasing the frequency of deliveries from the central warehouse to ART sites would further decrease pressure on storage capacity in ART sites. These two measures would not only improve supply management of ARVs, but would also mitigate the effects of delays in grant disbursement (Erik et al, 2011).

According to Ethiopian Health Sector Development Program IV IV 2010/11 – 2014/15,(2010) . The Ethiopian pharmaceutical supply & services Targets are majorly to decrease procurement lead time from 240 days to 120 days, to decrease proportion of health facilities with stock-out for essential drugs from 35% to 0%. And to reduce percentage of stock wasted due to expiry from 8.24% to 2%.

A WHO survey in 2009 revealed that 36 (38%) out of 94 reporting countries had documented at least one stock out of ARV drugs in health facilities. Interrupted supply of ARVs puts individual patients at risk of disease progression and death, jeopardizes public health due to development of ARV drug resistance, hampers progress towards universal access, and diminishes the credibility of ART programs in the eyes of patients, the community and healthcare providers. An increase and spread of HIV drug resistance will necessitate a change of first-line ARV regimens, and these are without exception more expensive and increase the costs of national ART programs (Erik et al, 2011).

A study done by Armelle et al., in Abidjanin, showed that 1,554 adults initiated Combnation ART and were followed for a mean of 13.2 months. During this time, 72 patients discontinued treatment and 98 modified their regimen due to drug stock-outs (Armelle et al, 2010)

Similar study conducted by Alemwork and Bineyam in addis ababa,Ethiopia. A total of 33 public health facilities included in their study, the result showed that 24(96%) of facilities experienced stocked out for HIV/AIDs and TB laboratory commodities in the last six months (Alemwork and Bineyam, 2014).

The Guideline for storage of essential medicines and health commodities by Deliver project in collaboration with WHO, states maintaining proper storage conditions for health commodities is vital to ensure their quality and product expiration dates are also based on ideal storage conditions, and protecting product quality until their expiration date is important for serving customers and conserving resources(WHO, 2003). ARV drugs should be stored in accordance

with storage condition mentioned on their label and for those drugs and diagnostics which require cold storage a cold chain storage facilities should be made available in the store and during transportation. ARV drugs should be kept in a separate and secured lockable store or cabinet in a store and dispensary and the key should be kept in the hand of authorized pharmacist or other pharmacy personnel (DACA, 2003).

According to MSH, assessment; Ethiopia warehousing and distribution systems of PMTCT products at the central level were lacking. Pharmaceutical and laboratory structure at facility level were limited in terms of space, storage and handling capacity, thereby compromising security and safety and patient confidentiality (MSH, 2012).

A study done by Gizat and Samson, in Harargy zone Ethiopia, out of 5 study store 3(60%) of them had no sufficient storage and reception area and 4(80%) had no adequate space for movement of goods. And also all of them had no separate store for ARVs (Gizat and Samson, 2014).

- **Drug use and Registration**

Drug use is a complex subject involving the physician, the patient, and pharmaceutical institutions. Each of these is influenced by many factors that are often difficult to measure and quantify (Otoom et al, 2002). Rational use of drugs requires that patients receive medications appropriate to their clinical needs, in doses that meet their own individual requirements for an adequate period of time, and at the lowest cost to them and their community (MSH, 2012). Irrational or non-rational use is the use of medicines in a way that is not compliant with rational use of drug (WHO, 2002).

Bin Cards and Stock Record Cards are used to record or account a products held in storage, including their receipt and issue. In the SCM of ARV drugs valuable information used to make re-supply decisions is recorded on the Bin Card and Stock Record Card; data from these records are used in reporting, calculating reorder quantities and for monitoring stock levels. It is essential that personnel responsible for the management of pharmaceuticals maintain up to date and accurate Bin Cards and Stock Record Cards for each product and individual units of issues for products having more than one units of issue.

A study done by Erik et al. showed that 91% of the patients were on standard first line regimen in Malawi by the end of 2010, which indicate good drug use pattern in country (Erik et al, 2011).

One of the persistent obstacles to ARV access is the maintenance of complete drug registration requirements in individual countries. It was evident from discussions that the extensive registration process is often the rate-limiting factor in the introduction of ARVs to a population. Robert Webster of Gilead Sciences mentioned the slowness of the registration process in some countries and asked for simplified registration requirements, especially for drugs that have already been approved by the FDA, such as fast-track registration(WHO / UNAIDS Meeting, 2005).

According to Susan and Michael, (2000) accuracy of inventory records is necessary to provide satisfactory customer service, determine replenishment of individual items, ensure that material availability and meets projected demand. And a research done by Adino et al, 2012 in Addis Ababa's health facility, 50% of the assessed hospitals and 54% of health centers were using stock/bin cards for all HIV/AIDS and TB laboratory commodities in main pharmacy store(Susan and Michael, 2000).

- **Logistics Management Information System**

In most developing countries, local levels of the supply chains are managed through paper records. Missing data at the lowest rungs of the chain create significant challenges at the ministry level. This can lead to a system of irrational allocation of resources proving costly to health infrastructure and outcomes. Paper-based data collection makes it difficult for local governments to capture a timely picture of their health needs and it becomes virtually impossible for health ministry's to build supply chains based on supply and demand (Jody et al, 2011).

All effective supply chains are driven by accurate and timely logistics data related to demand, inventory, and pipeline information. Without quality logistics data, supply systems are more likely to have problems, such as stock outs, which make the system unresponsive to health facility and patient needs; and imbalances, which undermine facility services to patients and the accountability of the supply system (Wright et al, 2013).

Information is the engine that drives the logistics cycle; without information, the logistics system would not run smoothly. In the beginning of the cycle, managers gather information about each activity in the system and analyze that information to make decisions and coordinate future actions (Kumurya, A. S, 2015). LMIS is the system of records and reports that you use to collect, organize, and present logistics/ supply chain data gathered across all levels of the system (John Snow, 2011).

The LMIS can be manual (paper based) or partly or wholly computerized. For any supply chain system, the three essential LMIS data items are quantity of stock on hand, quantity of stock consumed (dispensed to users), and losses and adjustments (Chandani et al, 2006 and John Snow, 2005). Currently most LMIS are computer based since HIV/AIDS programs are complex and manage a broad range of commodities so paper-based systems for collecting, aggregating and analyzing data are burdensome (John Snow, 2008). But all the United States Government (USG) partners like DELIVER, SCMS, MSH and PEPFAR agree that 70% of the data collection should be done paper based even at location that had been using computerized ADT sometime (USAID, 2009).

LMIS is important for all public health commodity distribution systems. It is especially critical for Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS) commodities that have high value and requires special handling procedures (Takang et al, 2006)). Without LMIS implementation, programs will inevitably waste valuable resources through prolonged and frequent stock outs, overstocks and losses. A well implemented LMIS reduces the likely hood of stock outs and overstocks that can waste scarce resources and lead to product expiration, especially given the short shelf life of HIV test kits (Adino et al, 2012).

A study done in Addis Ababa, Ethiopia on Assessment of supply chain management of HIV/AIDS related commodity, in 4 government hospitals and 20 health centers which providing ART services. The result show that 16(80%) of Health Center and 1(25%) of hospital pharmacies properly report and have the record of patients by regimen data. Almost all facilities had Electronic Dispensing Tool and used it for recording patient information on daily bases. Only, 14(70%) of the Health Centers used paper based ARV drugs dispensing register as a backup (Eyerisalem and Tefery, 2014).

Another study done by Alice and Kim L in Western Cape South Africa reveled that 86.7% of community health centre (CHCs) utilized a logistics tool (either manual or electronic) to manage ARVs. The average number of adult ARV drugs with a logistics tool available in all CHCs was 82.7% of which 21.9% met the criteria for accuracy. Only 32.9% of all logistics tools had records that were up to date. The average percentage of total variation between stock records and physical counts for the ARV drugs assessed was 51.6%. No historical data on stock outs and monthly usage (monthly consumption) could be retrieved in any of the CHCs, although there were no actual stock outs on the day of the fieldwork (Mahoro and Kim, 2013).

2.2.4. Supply Chain Management of ARV drugs in Ethiopia.

It has been almost a decade since ART and VCT services started in Ethiopia. VCT and ART services were first initiated at Zewditu memorial hospital in 2002 and 2003 respectively. ART service was then started at St. Peter (2004) and ALERT (2005) hospitals. Since then all governmental hospitals and HCs, some private hospitals and some NGO owned facilities started to provide VCT and ART and PMTCT service jointly or separately (Eyerusalem and Tefery, 2014).

The Government of Ethiopia established a multi-sectorial program coordinated by National and Regional HIV/AIDS Council Secretariats. In 2003, the ministry of health (MOH), drug administration and control authority (DACA) the current food medicine and health care administration and control office (FMHACA) and HIV/AIDS Prevention and Control Office (HAPCO) developed the National Guidelines on ARV and began providing ART training to teams of healthcare providers (MOH, 2005). HIV/AIDS related commodities supply chain management in Ethiopia is vertical approach, dominated by partners with little government ownership. In most of the cases centralized procurement, distribution and LMIS activities had been managed by huge involvement of partners than the government (Alemayehu, 2009).

The provision of complete health care necessitates the availability of safe, effective and affordable drugs and related supplies of the required quality, in adequate quantity at all times. Despite this fact, in the past, the pharmaceutical supply chain management system of the country had several problems including non-availability, unaffordability, poor storage and stock management and irrational use. To solve this problem in public health facilities, Pharmaceuticals

Fund and Supply Agency (PFSA) were established in 2007 by proclamation No 553/2007 based on the pharmaceuticals logistic master plan (PLMP) (SOP manual for the IPLS, 2015).

PFSA is a governmental pharmaceutical importer and distributor which is mainly involved in the supply of ARV drugs and test kits to the health facilities. PFSA had 11 hubs in the country and 7 additional hubs are reported under construction in different parts of the country (Pharmaceutical fund Supply Agency, 2012).

PFSA distribution of ARV drugs to Hospitals and Health Centers which have submitted a completed and approved report and requisition format (RRF) on time. Each hospital and health centre shall prepare a requisition of ARV drugs every two month using RRF and submit to PFSA. Then PFSA shall issues two month's stock of the requested ARV drugs after reviewing the quantity. Each hospital and health centers shall collect the ARV drugs from PFSA. At the time of delivery, PFSA trucks will wait while products are counted and verified, to take note of any discrepancies, to obtain proof of delivery (Model 19), to collect signed and sealed PFSA Delivery for the pharmaceuticals shipment. Pharmaceuticals are delivered with two copies of PFSA Delivery Invoices. But, the facility will use the RRF copy in the facility to check if they are receiving the quantity Ordered (FMHACA, 2011).

Figure 2.1: The flow of ARV drugs and, information between PFSA and health facilities.

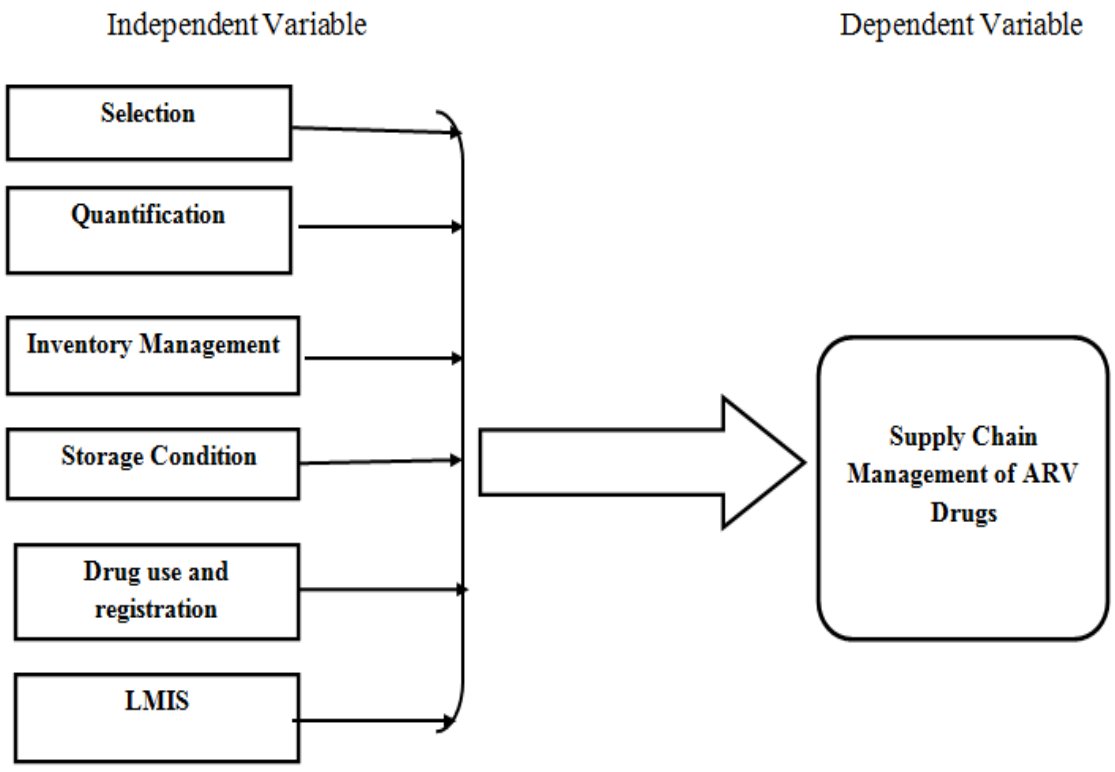
***Source**: - Eyob, 2013*

2.3. Conceptual Frame Work of the study

A conceptual framework is very important in any research study being undertaken. It shows the relationship between the dependent variables and the independent variable. The figure below shows the study's conceptual framework which illustrates the relationship between the variables of the study (Kotter, 1995).

The independent variables are factors which influence supply chain management of ARV drugs. The dependent variable is supply chain management of ARV drugs and the independent variables are selection; quantification; Inventory Management functions; storage condition; drug use and registration and logistics management information system (Jon song et al, 2005 and pharmaceutical supply chain management (PSCM), 2011). The figure below shows the conceptual frame works of the study.

Figure two: conceptual frame work of the study



Source: - Developed by the researcher based on literature (2016).

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Introduction

Leedy and ormrod (2010) described methodology as a means or method of doing something. Zikmund et al.; (2009) also explained methodology as the process of following the steps, procedures and strategies for gathering and analyzing data in a research. The role of the methodology is to carry on the research work in a scientific and valid manner**.**

3.2. Study Area

The study was conducted in Addis Ababa which is the capital city of Ethiopia, seat of African Union and Economic Commission. It is located in the geographic center of the country and covers a landmass of 540 sq. km. It is administratively sub-divided into 10 sub cities and 116 weredas.

The cities have 11 public hospitals, 77 health centers, 8 health facilities owned by non-governmental organizations and 19 private hospitals were reported providing ART and VCT services in Addis Ababa. Reports showed that as of may, 2016 PFAS, more than 1, 701, 406 patients had been enrolled in HIV/AIDS care, 1, 60048 patients had ever started ART and 88,272 patients were currently on ART (pharmaceutical fund supply agency (PFSA, May, 2016).

The study area is selected for the following reasons. Firstly, the city has more health facilities than any other cities in the country (FMOH, 2001). Secondly, the poor functioning of the system in such area will enable us to see how severe the problem will be in the rural areas of the country. For these reasons the study focused on Addis Ababa.

3.3. Research Approach and Design

A research design, as defined by Kothari (2004) is "the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure." In fact, it is the conceptual structure within which research is conducted; it constitutes the blueprint for the collection, measurement and analysis of data. Research design

stands for advance planning of the methods to be adopted for collecting the relevant data and the techniques to be used in their analysis, keeping in view the objective of the research and availability of staff, time and money.

The study employed a facility based cross-sectional descriptive study and retrospective document review. It used both quantitative and qualitative data collection techniques to gather the required information. According to Koul (1992) descriptive survey is the only means through which views, opinions, attitudes, and suggestions for improvement of practices can be collected. Both quantitative and qualitative data of this study was collected by structured questionnaire. A standardized questionnaire was adapted from Eyerusalem, (2014) and Alice Mahoro, 2013. The study focused on the supply chain management of ARV drugs in all public hospitals in Addis Ababa.

3.4. Source of Population

According to Burns and Grove (2005) a study population is an aggregate of elements sharing some common set of criteria. Target Population is the set of all elements that belong to a certain defined group to be studied to which the investigator wants to generalize his/her results. A population (a universe). The source populations in this study are all available health facilities in Addis Ababa will be the source facilities. The study was carried out in all public hospitals in Addis Ababa that providing ART services as a target populations.

3.5. Sampling Techniques and Research Participant

A sample is a smaller group obtained from the accessible population to represent the whole population while sampling is the process of selecting the individuals for the study from the population (Mugenda and Mugenda, 2003). The purpose of sampling is to gain an understanding about some features or attributes of the whole population based on the characteristics of the sample.

A total of 11 public hospitals in Addis Ababa that provide ART services were used as a study population. All the public hospitals provide first and second line pediatrics and adults dose of ARV drugs, have high patient load and found in near geographical location from the researcher.

Due to this reasons private hospitals, health facilities owned by non-governmental organizations and all public health centers were excluded.

All pharmacists that work in ART dispensary, heads of the pharmacy and ART store manager/ general store managers of the public hospitals were included in the study for the assessment of supply chain management of ARV drugs they are 49 in number. The table below show that the number of pharmacists who are directly working in the management ARV drugs in public hospitals in Addis Ababa.

Table 3.1: Number of Respondents in the Target Public Hospitals.

Level of hospitals	**Name of health facilities**	**Number of pharmacist working in the management of ART drugs**
Addis Ababa Federal hospitals	Alert hospital St-Paul hospital Petirose hospital Amanuel hospital Tikur anbesa hospital	5 5 5 4 4
Addis Ababa City Administration Regional Health Biro(AARHB) hospitals	*Zewditu Memorial Hospital* Yekatit 12 hospital medical college *Millik II Hospital* referral hospital *Ras Desta Memorial Hospital* *Gandi Memorial Hospital* *Tirunesh-Beijing hospital*	5 5 4 4 4 4
Total	11 public hospitals	49

Soures: - from the HR managers of the hospitals, (2017).

3.6. Data sources and Type

Primary data was collected by semi-structured questionnaires in combination with observation check lists. It was used to collect data on quantification, receiving and distribution, drugs use and storage and inventory control procedures of ARV drugs from the different respondents including the heads of the pharmacy, ART dispensers and ART store managers/general store managers. The secondary data was collected from journals, research papers, articles and facility file and reports. They were collected from the library, target facilities and through internet.

3.7. Data collection Instrument

The researcher adopted questioners, from Eyerusalem, (2014) and Alice Mahoro, 2013. A combination of semi-structured questionnaire and observation check list was used to collect data on the supply management of ARV drugs. The questionnaires were modified to address the objective of the study and also tailored to the level of understanding of participants. The data collection tool was pretested prior to the data collection. The principal investigator (PI) discussed with the research assistants on regular basis and reviewed the collected data for completeness.

The semi-structured questionnaires was used to collect quantitative data on quantification, receiving and distribution, use and inventory control procedures of ARV drugs from the different respondents including the head of the pharmacy, ART dispenser, and ART store manager/general store manager. Qualitative data was collected by observation check lists in ART store and ART dispensing area.

A total of 12 ARV drugs from first and second line regimen ARV drugs of adults and pediatrics doses were selected for this assessment. A six month data back to the study was taken from bin card to see the pattern of stock status in health facilities.

3.6. Validity and Reliability

Before administrating the instruments of data collection, the questionnaire was tested for validity and reliability. Conforming this Wilkinson and Birmingham, (2003), have stated that usually mistakes are quickly spotted through piloting; ambiguous questions can be restated or redeveloped

Validity refers to the extent to which an instrument measures what is supposed to measure. Data need not only to be reliable but also true and accurate. If a measurement is valid, it is also reliable (Joppe, 2000). The questionnaire is developed on the basis of standard questioner from from Eyerusalem, (2014) and Alice Mahoro, 2013. In order to ensures the Validity of the methodology for obtaining answers to the research quotations accurately and objectively (Kumar, 2011)

Reliability refers to the consistency or dependability of a measurement technique, and it is concerned with the consistency or stability of the score obtained from a measure or assessment

over time and across settings or conditions. If the measurement is reliable, then there is less chance that the obtained score is due to random factors and measurement error (Geoffrey et al, 2005). To measure the reliability of the data collection instruments, an internal consistency technique using Cronbach's alpha will have used in this study. Cronbach's alpha is a coefficient of reliability that gives an unbiased estimate of data generalization. An alpha coefficient of 0.75 or higher indicated that the gathered data are reliable as they have a relatively high internal consistency and can be generalized to reflect opinions of all respondents in the target population (Zinbarg2005).

3.7. Data Analysis and Presentation

The collected data was manually checked for completeness and consistencies before being entered into the computer. The quantitative data was entered and analyzed by using a data processing tool, Statistical Package for Social Sciences (SPSS) version 20 was used to present in the form of tables, percentage and graphs. A descriptive approach was followed on the analysis of the data and figures and possible recommendations were made.

3.8. Ethical Consideration

The study was done after the school has approved it for its ethical acceptability and the study was performed after the researcher asked each public hospital by the official letter from the School and through the willingness of the health facilities staff.

CHAPTER FOUR

DATA ANALYSIS *and* PRESENTATION

4.1. Introduction

This chapter gives a summary of key findings of the study. The finding of the study was presented according to the objectives of the study. The data that was collected using interview (questionnaires) made to the staffs, document review and observation of the ten public hospitals store room. Questionnaires were used to collect the data from different public hospitals that dispense ARV drugs to HIV client. Observation cheek list was used to collect data on the ART drugs storage condition of the hospitals. In addition, document was reviewed to assess some of the ARV drugs stock status of the hospitals. SPSS version 20 was used to perform the analysis.

For this study 59 questionnaires were administered from these 48 questionnaires and 11 observations check list were administered to pharmacists or druggists who were currently working in the management of ARV drugs during the study period. Of the entire 59 questionnaire administered, 50 were obtained, checked for completeness and were valid for analysis while nine were discarded as a result of improper or incomplete responses. The response rate of this study was 84.14%. The reliability of the data in this study was tested by Cronbach's which measure the internal scale consistency. For this study the internal scale consistency was 0.834 which is above the standard threshold level 0.7(Nunnally, 1978).

4.2. Demographic characteristics of respondents

A total of 10 public hospitals were investigated in this study, of which 5(50%) were federal hospitals and 50(50%) AACARHB hospitals. A total of 40 pharmacy professionals were interviewed in this study of which 7 were diploma level, 28 were at degree level and the remaining 5 of respondents were post graduate. They accounted 25 male respondents representing 62.5% and the remaining 15 of respondents which accounted 37.5% were female. Majority of the respondents had been working in hospitals, 26(65%) of respondents have more than five years experience, and the rest have been between two to five years experience. The

mean age and standard deviation of the respondents were 28 and 6.2 respectively. A percentage and frequency characteristic of the respondents response were presented in tables 4.1, below.

Table 4.1: Demographic characteristics of the respondents.

Item	Value	Frequency	Percent
Gender	Male	25	62.5
	Female	15	37.5
Age of Respondent	20-30 years	11	27.5
	31-40 years	21	52.5
	41-50 years	8	20.0
Educational Level	Diploma	7	17.5
	Degree	28	70.0
	Postgraduate	5	12.5
Experience	2 to 5 years	14	35.0
	more than 5years	26	65.0

***Source**: Survey of April, 2017*

4.3. ART services

A total of 10 public hospitals were visited during this assessment; of which 5 were Addis Ababa federal hospitals and 5 were AACARHB hospitals located in Addis Ababa. The hospitals had an experience on ART service provision for (15.6± 3.11). Based on the results obtained from SPSS software the percentage of respondents who respond the availability of a copy of the updated standard treatment guideline and use RRF form for report is 100%. And the percentage of respondents who respond on the availability of a document that lists all the recommended ARV drug regimens in dispensing room is 87.5% the remaining 22.5% they didn't have the document. Looking at patient by regimen data, 20 (86.95%) of federal hospital and 14(82.5%) regional hospitals were reported their patient by regimen data. The 25 (62.5%) of the respondents response the hospitals were using EDT, ART pharmacy and ART clinic data for reporting to higher level and the rest 15(37.5%) using EDT. The table below showed that frequency and

Percentage of the data on total numbers of patient and number of patient on ART by regimen reported to higher.

Table 4.2: The data on total number of patient and number of patient on ART by regimen reported to higher.

Variable	Data on the total number of patients on ART reported to a higher level		data on the number of patient on ART by regimen reported to higher	
	Frequency	**Percent**	**Frequency**	**Percent**
Yes	35	87.5	34	85.0
No	5	12.5	6	15.0
Total	40	100.0	40	100.0

***Source**: Survey of April, 2017*

4.4. ART pharmacy

Regarding the ART training, majority of 12(52%) of the respondents from federal hospitals and 10(58.82%) of the respondents from regional hospitals had ART training. Regarding the duration of drugs dispensed, 18(45%) responded for two months, 11(27.5%) for one month and 11(27.5%) for three month. And 'stock on hand' registration of the ARV drugs, 27(67.5%) recorded on bin Card, 4(10%) recorded on other and 9(22.5%) do not record. Majority; of 75% the facility had EDT which used to register patients by regimen, the quantity dispensed to the client and to follow patient treatment. 16(69.56%) of federal hospitals and 14(82.35%) of regional hospitals have EDT but among this only 13(56.52%) federal hospitals and11 (64.7%) of regional hospitals EDT functional. Almost above half 24(60%) of the hospitals used electronic dispensing tool for recording daily dispensing drugs, for trucking patients by regimen & following patient treatment. The 24(60%) of the respondents using EDT for registering daily dispensing drugs, for trucking patients by regimen & following patient treatment, 8(20%) of the respondent response using EDT only for registering daily dispensing drugs and the remaining percent of respondents using EDT for trucking patients by regimen. 34(85%) first line ARV drugs regimen and 6(15%) second line ARV drugs regimen were prescribed/ dispensed. The

table below show that the tool used for recording patient by regimen and quantities of ARV drugs dispensed daily.

Table 4.3: The recording tool patient by regimen and quantities of ARV drugs dispensed daily

	Recording tools for patient by regimen		Recording tools for the quantities of ARV drugs dispensed daily	
	Frequency	**Percent**	**Frequency**	**Percent**
Daily ART Register	20	50	20	50.0
EDT	11	27.5	10	25.0
Daily ART Register , yellow card & EDT	9	22.5	10	25.0

***Source**: Survey of April, 2017*

4.5. Reporting and Ordering

In this study 29(72.5) the LMIS were Paper based and 11(27.5) were Computerized. All of the facilities were using RRF as LMIS for reporting to high level. 40(100%) of the respondents responds essential data items that is required to run the logistic system and which must be captured data about received, issues, consumption and stock on hand from RRF and only 26(65%) respondents captured data about on lose and adjustment from RRF. 11(27.5%) the hospitals LMIS given data on the total number of patients on ART and 19(47.5%) of the LMIS give data on patients on each ARV drug regimen.

Table 4.4: Prepare order and report

Item	**Value**	**Frequency**	**Percent**
Order and report prepare	Head of the pharmacy	6	15.0
	Store manage	20	50.0
	Head of the pharmacy and store manager	14	35.0

Source: *Survey of May, 2017*

In half of the hospital 20 (50%) of RRF was prepared and reported by the store manager, 14(35%) were prepared and reported by head of the pharmacy and store manager and the remaining 6(15%) reported by head of the pharmacy. The table below shows that the respondents learn how to full fill RRF form.

Table 4.5: The training how to full fill RRF

Item	Value	Frequency	Percent
Learn to complete the forms	During a training workshop	14	35.0
	On-the-job training	11	27.5
	Never been trained	15	37.5

***Source**: Survey of April, 2017*

Different job related trainings were given to pharmacy staffs; about 14(35%) of the respondents learn to complete the RRF forms during a training workshop, 11(27.5%) of respondents learn to complete the RRF forms on-the-job training and the remaining 15(37.5%) of respondents never been trained. The table below shows the ability of the respondents to submit the report on time between the federal and regional hospitals. The table below shows the ability to submit the report on time.

Table 4.6: Ability to submit the report on time

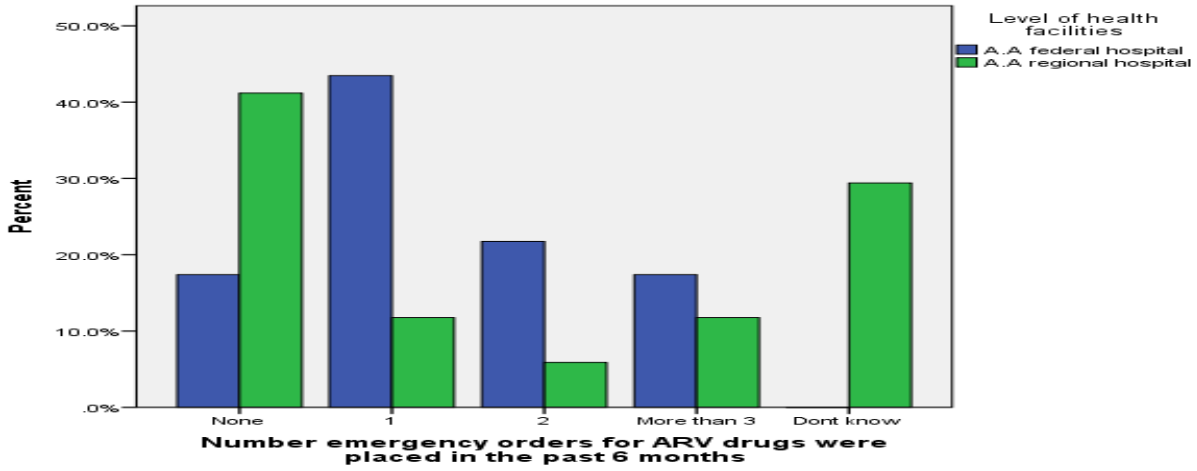
Item	value	Ability to submit the report on time	
		Always	Most of the time
Level of health facilities	Federal hospitals	5 (45.5%)	18(62.1%)
	Regional hospitals	6(54.55%)	11(37.9%)

Source: ***Source**: Survey of April, 2017*

5 (45.5%) federal hospitals and 6(54.55%) regional hospitals have ability to submit the report on time. But 18(62.1%) federal hospitals and 6(54.55) regional hospitals were most of the time they submit the report on time.45.5% of the respondent of the federal hospitals and 10% 0f the respondent of the regional hospitals have one emergency order were placed on the past 6 months and 20% of the federal hospitals and 15% of the respondent of the hospitals more than three

emergency order were placed on the past 6 months. The fining shows that federal hospital placed higher number of emergency order than the regional hospitals on the past 6 months.

Figure4.1: Number of emergency orders



***Source**: Survey of April, 2017*

The graph above showed that the number of emergency order in the hospital and the present of the respondent responses on emergency order between federal and regional hospital.

4.6. Inventory management

All Pharmacists in the public hospitals responsible for inventory management of ARV drugs. The mean lead time and standard division between ordering and receiving of ARVs drugs 1.95 and 0.389 respectively. Majority of 34(85%) the respondents' response lead time between ordering and receiving of ARVs drugs within weeks, 4(10%) respondents response it take a days and 2(5%) respondents response it take an hours.

Table 4.7: Frequency of physical inventory carried out

Item	Value	Frequency	Percent
Frequency of physical inventory carried out	Once per month	5	12.5
	Once every six months	8	20.0
	Once a year	19	47.5
	Other	8	20.0

Source: *Survey of April, 2017*

The table above shows frequency of physical inventory carried out 19(47.5%) once a year, 8(20%) once every six months, 8(12.5%), once per month and 8(12.5%) other. The table below shows that stock out of ARV drugs on the day of visit.

Table 4.8: ARV drugs stock out on the day of visit.

List of drugs	Value	Level of health facilities	
		Federal hospitals	AACARHB hospitals
AZT/3TC, 300/300mg	No	5(100%)	5(100%)
NVP 200 mg	No	5(100.0%)	5(100.0%)
EFV 600mg	Yes No	5(100.0%)	5(100.0%)
LPV/RTV20mg/5ml	Yes No	_ 5(100.0%)	2(40%) 3(60%)
LPV200mg /RTV50mg	Yes No	1(20%) 4(80%)	_ 5(100.0%)
3TC 30mg	Yes No	_ 5(100.0%)	_ 5(100.0%)
NVP 50 mg	Yes No	_ 5(100.0%)	_ 5(100.0%)
EVP 50 mg	Yes No	_ 5(100.0%)	_ 5(100.0%)
AZV300mg/RTV100mg	Yes No	_ 5(100.0%)	3(60%) 2(40%)
ABC 60mg	No	5(100.0%)	5(100.0%)
NVP 200ml syrup	Yes No	3(60.0%) 2(40%)	1(20%) 4(80%)

***Source**: Survey of April, 2017*

4.7. Storage condition

Regarding the Storage condition from ten public hospital store 6(60%) of the ART drugs are arranged on shelves with arrows pointing up, and with identification labels, expiry dates, and manufacturing dates clearly visible. 5(50%) ARV drugs are stored and organized to FEFO procedures and are accessible for counting and general stock management. Almost all 8(80%) of the hospitals have separate store for expired and damaged products, and procedures exist for removing them from inventory. 5(50%) of the hospitals Storeroom are clean, with all trash removed, no evidence of food and drinks, products stored on sturdy shelves/bins, and boxes organized during the time of visit. Majority the hospitals 7(70%) of the store roof are maintained in good condition to avoid sunlight and water penetration the remaining 3(70%) of the store roof are not maintained in good condition to avoid sunlight and water penetration. when looking the storage space of the hospital 5(50%) have sufficient storage space for existing products. During

the time of visit 6(60%) of the stored ARV drugs are stored in a good condition or the outer cartons are not crushed, perforated, stained, or otherwise visibly damaged. The expiry date tracking chart and a separated stored room for ARV drugs are described by table below.

Table 4.9: Determined quantity of ARV drugs

Item	Value	Frequency	Percent
A responsible party to determines the quantities of ARV drugs to order	The facility itself	40	100.0
The way to determine the order resupply quantity	Formula	40	100.0
Factors affect the quantities you order	No of patients on ARV	40	100.0

***Source**: Survey of April, 2017*

As the above table shows all respondents agreed on the A responsible party to determines the quantities of ARV drugs to order, the way to determine the order resupply quantity and Factors affect the quantities you order.

Table 4.10: The availability of expiry date tracking chart and separated stored room for ARV drugs.

Item	Value	Frequency	Percent
Separated stored room for ARV	YES	5	50.0
	NO	5	50.0
Expiry date tracking chart	YES	3	30.0
	NO	7	70.0

***Source**: Survey of April, 2017*

The above table show that 5(50%) of the hospitals have separated store for ARV drug and 3(30%) them have expiry date tracking chart.

Table 4.10: The common reason for stock out

	Value	Frequency	Percent
Valid	didn't receive order	3	30.0
	didn't receive the quantity ordered	5	50.0
	stock out at the central level,	2	20.0

***Source**: Survey of April, 2017*

The above table show that 5(50%) of stock out occurred due to didn't receive the quantity ordered, 3(30%) of stock out occurred due to didn't receive order and the remaining 2(20%) occurred due to stock out at the central level.

CHAPTER FIVE

Summary of Finding, Conclusion and Recommendation

5.1. Summary of the findings

Since the beginning of the ART program in Ethiopia, both ART and VCT services were provided for free in all governmental health facilities. The HIV/AIDS service was integrated with other service in the health facilities. A total of 10 public hospitals were visited during this assessment; of which 5 were federal hospitals and 5 were AACARB hospitals. The hospitals had an experience on ART service provision for an average of 15.6± 3.11, years.

The ultimate goal of the SCM of ARV drugs is to ensure ARV drugs availability at the service delivery points so that clients will receive the necessary ARV drugs. Individuals responsible for managing ARV drugs need to be trained in timely keeping of records on essential logistics data, analyzing the collected information to make the right decisions and submission of reports to the next higher level.

Knowing patient taking ARV by regimen data is crucial for the supply chain of ARV drugs, this finding showed that 20 (86.95%) of federal hospital and 14(82.5%) of regional hospitals pharmacies were supposed to report patient by regimen data for MOH and AARHB respectively also they knew their patient by regimen. Most of them use EDT data, ART pharmacy data or ART clinic data as an alternatively for reporting. The remaining percent of 3(13%) of federal hospital and 3(17.6.5%) of regional hospitals didn't report patient by regimen to higher level. The reasons they mentioned were that there is no access of EDT and operational problem with the EDT as a main factor. So this lack of adequate and accurate data would affect the decision of national ARV drugs selection and quantifiers.

The principal persons responsible for managing ARV drugs were found to be different from facility to facility. From the total of 10 public hospitals visited 8 (80%) were pharmacists and 2 (20%) were druggists managing ARV drugs in the store. In most of the assessed hospitals their LMIS 29(72.5%) were Paper based and 11(27.5) were Computerized. A similar study done by

Alice and Kim L in Western Cape South Africa reveled that 86.7% of community health centre (CHCs) utilized a logistics tool (either manual or electronic) to manage ARVs.

All the assessed hospitals pharmacy departments, RRF were currently using standardized LMIS forms for ordering ARV drugs from PFSA. In majority of the hospital 20 (50%) of RRF was prepared and reported by the store manager. Despite the fact that they were supposed to submit the report every two months; between the 1st and the 10th day of the reporting month, there were few facilities which failed to do so. They had mentioned negligence as a main reason for not being able to submit their RRF on time. In line with this; they had recalled lack of the RRF and work load as additional factors for the delay in submitting the RRF. Majority of the facilities 6(54.5%) of regional hospital and 5(45.5%) of federal hospitals were always able to submit their last report according to the schedule while 18(62.1%) federal hospitals and 6(54.55) regional hospitals were most of the time they submit the report on time. 13(32%) of the respondents responded the factor for the dalliance on the report was due to shortage of time between reports. The others mentioned reasons like, it takes too long, don't have the form and other. Timely report is crucial because it determines the quantity of the stock.

From a total of 40 pharmacy professionals involved in ARV drugs management, 12(52%) of the respondents from federal hospitals and 10(58.82%) of the respondents from regional hospitals were trained in basic ART training. The stock on hand' registration practices on the ARV drugs, 27(67.5%) recorded on bin Card. This study showed that, majority of bin cards were not updated with accurate information matching with the physical count done at the time of visit. And all most all of the hospitals didn't using stock card for stock recording. This cause wastage of medicines or expired without anyone noticing that the shelf life date was approaching this led to facilities stock out of certain ARV drugs. A similar study done by Adino et al, 2012 in Addis Ababa's health facility, 50% of the assessed hospitals and 54% of health centers were using stock/bin cards for all HIV/AIDS and TB laboratory commodities in main pharmacy store.

Majority;75% of the hospital had EDT which used to register patients by regimen, the quantity dispensed to the client and to follow patient treatment.15(37.5%) of the respondent never been trained how to complete the RRF forms and all hospitals were using RRF for reporting consumption and to order ARV drugs need. They submit the report to PFSA regional hub. They used facility personnel and vehicle to submit their report and request. The reporting resupply

form (RRF) is a pre-prepared format containing different logistic data which were classified as (Beginning balance, Quantity received, Loss/adjustment, Ending balance, Calculated consumption and Days of stock out) and requisition part (Maximum stock, Quantity needed to reach maximum and Quantity ordered). 25% of the data used for ARV drugs reporting gathered from EDT, ART pharmacy & ART clinic.

LMIS is important for all public health commodity distribution systems. It is especially critical for HIV/AIDS commodities that have high value and requires special handling procedures (Takang et al, May 2006). Without LMIS implementation, programs will inevitably waste valuable resources through prolonged and frequent stock outs, overstocks and losses. A well implemented LMIS reduces the likely hood of stock outs and overstocks that can waste scarce resources and lead to product expiration, especially given the short shelf life of HIV test kits (Adino et al, 2012).

EDT is one of the LMIS, 75% of the hospitals had EDT on time of visit which they used to register patients by regimen, the quantity dispensed to the client and to follow patient treatment. Among this 60% were actively operating during the time of visit. But the majority of public hospitals (24%) which have EDT tool used it only for registering daily dispensing drugs, for trucking patients by regimen & following patient treatments. since it also provides beginning balance, quantities received, and stock on hand and loss and adjustment when using it properly. And it also enhances the accuracy of data for reporting, reducing the time to complete the RRF report by avoiding physical counting. Stock out problems frequently happen due to poor information communication technology (ICT) practice between the public hospitals and central hub of the PFSA. The mean time and standard deviation for completing and preparing the RRF were 5.58 and 2.171 respectively.

The inventory control system enables staff at warehouses and stores to know when to order, how much to order, and how to maintain an appropriate stock level (between established minimum and maximum levels) to avoid shortages and oversupply. Inventory control procedure was established at all ART monitoring pharmacy or store and actually existed in the national standard operating procedure manual for national ARV drugs SCM. A well designed and well operated inventory control system helps to prevent shortages, oversupply, and expiry. *Most* Of the respondents respond about frequency of physical inventory carried out, 19(47.5%) said once a

year. physical inventory the essential component to determine the quantity of ARV drugs to be order and to know the actual stock on hand of ARV drugs. One of the unique characteristics of ARV drugs they have short shelf life due to this they need frequent physical inventory.

In this study the result showed that from 10 hospitals, 3(60.0%) of federal hospitals and 2(40.0%) Of AACARHB hospitals were stock out for NVP 200ml syrup on the day of visit. And also 1(20%) of the federal hospitals were stock out for LPV200mg /RTV50mg, 2(40%) and 3(60%) of the AACARHB hospitals were stock out for LPV/RTV20mg/5ml syrup and AZV 300mg/RTV100mg respectively on the day of visit. The data gets from PFSA show that the stock out were occurs six month back to the study only NVP 200ml syrup was stock out for 45 days the other ARV drugs they had sufficient amount ARV drugs. A similar study done by Armelle et al, 2010 in Abidjanin, showed that 1,554 adults initiated Combnation ART and were followed for a mean of 13.2 months. During this time, 72 patients discontinued treatment and 98 modified their regimen due to drug stock-outs

Strategies to cope with stock-outs included lending and borrowing of ARV drugs among facilities, emergency purpose and decreasing the amount of drugs dispensed were the major one. 20% of the federal hospitals and 15% of the regional hospitals had more than three emergency order of ARV drugs were placed on the past 6 months. 5(50%) of stock out of ARV drugs occurred in the facility due to not receiving the exact quantity they have ordered. This is an indicative for the interruption of the supply from the central level.

Storing is the safe keeping of pharmaceuticals to avoid damage, expiry, and theft. Proper storage procedures help to ensure that storage facilities protect the shelf life of products, that only high quality products are issued, and that there is little or no waste due to damage or expiry of products. If proper storage procedures are followed, customers can be assured that they have received a high quality product. 6 (60%) of the ART drugs are arranged on shelves with arrows pointing up, and with identification labels, expiry dates, and manufacturing dates clearly visible. One of the special characteristics of ARV drugs have short shelf life (expiry) due to this they need special attention.

When storing pharmaceutical there are two procedures that should be followed. First in first out (FIFO) and the other one is the FEFO procedure which is first expiry first out. 5(50%) of the

ARV drugs are stored and organized to FEFO procedures and are accessible for counting and general stock management. Almost all 8(80%) of the hospitals have separate store for expired and damaged products, and procedures exist for removing them from inventory. 5(50%) of the hospitals Store room were clean, with all trash removed, no evidence of food and drinks, products stored on shelves/bins, and boxes organized during the time of visit. Majority of the hospitals 7(70%) of the store roof are maintained in good condition to avoid sunlight and water penetration and.

When looking the storage space of the hospitals 5(50%) of them have sufficient storage space for existing products. During the time of visit 6(60%) of the stored ARV drugs are stored in a good condition or the outer cartons were not crushed, perforated, stained, or otherwise visibly damaged. From ten of public hospital 5(50%) of the hospitals have separated store for ARV drug and also 3(30%) from ten hospitals have expiry date trucking chart. A study done by Gizat and Samson, in Harargy zone Ethiopia, out of 5 study store 3(60%) of them had no sufficient storage and reception area and 4(80%) had no adequate space for movement of goods. And also all of them had no separate store for ARVs.

5.2. Conclusions and Recommendations

- The reporting and receiving system of ART drugs well organized in the study hospitals but the time of reporting not regular.
- Most of the hospitals reporting patient by regimen to higher level but some of the hospitals do not reporting patient by regimen to higher level.
- Most of the hospitals were used ether paper based or computerized LMIS.
- All of the hospitals didn't use the full package of EDT for day to day activities.
- Majority of the respondents who are responsible in managing ARV were not trained in basic ART training as well as how to complete RRF form.
- Some of the selected ART drugs were stock out at the day of the assessment.
- The supply chain of ART drugs was interrupted and not stable.
- Utilization of the logistics recording such as bin cards usage were higher, however most of the bin cards were not updated at the time of visit.
- Al most all of the hospitals didn't use stock card for stock recording.

- Most of the respondents cannot used EDT friendly, for instance they can't easily manipulate and fix when minor problem occurred by themselves.
- Most of the hospitals were under go physical inventory once per year.
- All facilities didn't have expiry tracking chart.
- Generally the storage condition was not good and regarding the computerized LMIS, in majority of the cases the professionals were unable to manipulate and operate as desired.

Based on the findings of this assessment the following recommendation can be forwarded for professionals, facilities, supplier and other concerned bodies.

- ART pharmacies hospitals should have full and reliable ARV patient information, which is the back bone of any supply chain that flow throughout the supply chain accordingly.
- Facilities should use both paper based and computerized LMIS to minimize loss of patient and drug information and to minimize wastage and shortage of resources.
- Facilities should use the full package of EDT tool to enhance accuracy of the data and the time of reporting.
- All public hospital should prepare and send reports regularly, since it is the main factor that affects the supply chain quantification of ARV drugs.
- Bin cards should be updated regularly in all facilities for all products
- All facilities should have expiry tracking chart to prevent and minimize expiry of very expensive ARV drugs.
- Storage condition of some of the public hospitals should be improved due to this the safety and efficacy of drugs can be maintained while damage and expiry of products can be minimized.
- All of the assessed hospitals should have frequent physical inventory.
- Thus all public hospital should use expire trucking chart to identify the near expiry drugs before they expiry and to take appropriate measures.
- Adequate training should be given to ART dispensers, data clerks and store manager regarding the computerized LMIS and how to fill the report format and on basic ART training.
- The EDT should be user friendly, easy to manipulate and fix in cases of minor problem by the professionals themselves.

5.3. Strengths and limitations of the study

5.3.1. Strengths of the study

- The study has provided baseline information for interventions aiming to identify the weakness and improve the SCM of ARV drugs
- Combination of both qualitative and quantitative method helps to supplement the findings each other
- The study was include all public hospitals and all pharmacists who are involved the management first to be conducted with high number of facilities

5.3.2. Limitation of the study

- Lack of similar studies especially in Ethiopia made difficult for comparing results.
- The study was done only in Addis Ababa where distribution of commodities is relatively easy and good
- The study didn't include major stakeholders in the supply chain HIV/AIDS related commodities; PFSA, AACAHB and donors.
- There were lack and incomplete bin cards for ARV drugs.
- The health facilities do not have second line ARV drugs; they were excluded from the study. And also Tirunesh Beijing hospital excluded from the study due to unwilling to respond the questioners

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Annex I. ARV Drugs Questionnaire and Observation Check List

ADDIS ABABA UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

SCHOOL OF COMMERCE

DEPARTMENT OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT

Dear respondents, My name is Meskerem Adugna in the partial fulfillment of requirements for the degree of Masters of Arts (Logistics and Supply Chain Management), at AAUSC, I am carrying out a study which aims at assessing the supply chain management of ARV drugs in public hospitals in Addis Ababa that provide ART services. The study is entirely academic not a supervisory visit and the information provided shall be treated with greatest confidentiality and all your answers will be secret. You are therefore requested a kind cooperation in answering the questions as truthfully as possible. I would like to appreciate your assistance and support in this particular research endeavor. For other questions pertaining to this study, please you can contact me, via mobile 0913557150; e-mail Meskyzaq@gmail.com

First of all I would like to say thank you for your cooperation.

Part I. General information

1. Date: _____
2. Name of the hospital _____
3. Level of hospital: federal_____ regional: _____
4. Gender Male☐ Female ☐
5. Age _____
6. Level of education? 1. Diploma holder 2. Degree holder .
   3.Postgraduate
7. Your experience in the hospital? a. Less than 2 years b. 2 to 5 years
   c. More than 5 years

I	ART service	Answers with code	GoTo/comment
1	How long have free ART services been offered at this facility?	Years -------- Months ---------	
2	Is the copy of the updated standard treatment guideline available at this facility? If yes ask to see the copy of it.	Yes ----------1 No ----------0	
3	Is there a document that lists all the recommended ARV drug regimens to be prescribed and dispensed at this facility?	Yes ----------1 No ----------0	
4	Are the data on the total number of patients on ART at this facility reported to a higher level?	Yes ----------1 No ----------0	If your answer is no ➔go to number 10
5	Are the data on the number of patient on ART by regimen reported to higher level?	Yes ----------1 No ----------0	
6	From where did you get the patient on ART by regimen data?	EDT----------1 ART pharmacy ------2 ART clinic ----------3 EDT, ART pharmacy and ART clinic----------4 D0n't know----------5	
7	What report do you use for reporting ARV drugs stock status information to a higher level? ask to see a copy of the report		
8	Who is the principal person responsible for managing ARV drugs at this facility	Pharmacist ----------1 Druggist----------2 Pharmacy technician--------3 Other----------6	
II	**ART pharmacy**	**Answers with code**	**Goto/Comment**
9	Do you have ART training	Yes ----------1 No ----------0	
10	How much of a supply is dispensed to patients when they come for resupply? Most of the time	For one month:----------1 For two months: ----------2 For three months: ----------3 More than three months-----4	
11	There is a electronic dispensing tool (EDT)	Yes ----------1 No ----------0	If your answer is no➔go to number 13

12	Is EDT now functional	Yes ----------1 No ----------0	
13	Where do you record information on the quantities of ARV drugs dispensed daily (consumption)?	Daily ART Register --------1 Patient information sheet (yellow card----------2 EDT----------3 Daily ART Register, yellow card and EDT----------4 Not Recorded----- ----------5 Other ------ ----------6	
13	Where do you record information on the quantities of ARV drugs in stock (stock on hand)?	Stock Card ---------1 Bin Card ----------2 Not Recorded-------3 Other----------4	
14	Where do you record patient by regimen information?	Daily ART Register----------1 Patient information sheet (yellow card) ----------2 EDT----------3 Not Recorded----------4 Other ----------6	
15	Which drugs regimen more prescribed in this facility.	1st line 2nd line	
III	**Reporting and ordering**	**Answers with code**	**GoTo/comment**
16	What report do you use for reporting to higher level? Ask to see the copy of the report) write the name of logistic management information system (LMIS) here.		
17	LMIS this facility	Computer based----1 Paper based---------2 Bothe----------4	
18	Verify the type of data collected in the LMIS report. *(Look at the LMIS report toverify.)*		
a.	Received	Yes ----------1 No ----------0	
b.	Issues	Yes ----------1 No ----------0	
c.	Consumption	Yes ----------1 No ----------0	
d.	Stock on hand	Yes ----------1	

		No ----------0	
e.	Losses/adjustments	Yes ----------1 No ----------0	
f.	Total no. patients on ART at facility	Yes ----------1 No ----------0	
g.	No. patients on each ARV drug regimen	Yes ----------1 No ----------0	
I	others(specify)		
19	Who prepares the orders/reports for ARV drugs for this facility most of the time?	head of the pharmacy----------1 store manage----------2 head of the pharmacy and store manage ----------3 Other----------4	
20	When was the last time you submitted the report on consumption and stock on hand of ARV drugs at this facility?	Never ----------1 Within the last month ----------2 2 months ago----------3 3 months ago----------4 More than 3 months ago----------5	
21	How often are you supposed to submit reports to the higher level?	Monthly----------1 Every two months ---------2 Quarterly----------3 Semi-annually ----------4 Annually----------5 Other----------6	
22	Are you able to submit you report on time?	Always ----------1 Most of the time----------2 Sometimes ----------3 Never ----------4	
23	What factors influence not being able to submit your report on time?	Takes too long ----------1 Not enough time between reports--------2 Don't have the forms ----------3 Approval process is too long----------4 Difficulties in transmitting reports ------5 Other ----------6	
24	How long does it take you to complete your report/order?	Days: _____ Hours: _____	
25	How did you learn to complete the forms?	During a training workshop----------1 On-the-job training ----------2 Never been trained ----------3 Other *(specify)* ----------6	

26	Who determines the quantities of ARV drugs to order? *(Circle all that apply.)*	The facility itself ----------1 Higher-level facility ----------2 Other*(specify)* ----------6	
27	How are the order resupply quantities determined?	Formula----------1 Don't know ----------2 Other means (specify)----------6	
28	What factors affect the quantities you order?	No of patients on ARV----------1 Size of the store--------2 Other ----------6	
29	How many emergency orders for ARV drugs were placed in the past 6 months?	None ----------0 1 ----------1 2 ----------2 3 ----------3 More than 3 ----------4 Don't Know ----------7	
30	How do you transmit your report/order to the higher level?	By fax ----------1 By email ----------2 Send with courier or mail ----------3 Send by facility vehicle ----------4 Picked up by higher level ----------5 Other----------6	
IV	**Inventory management questionnaire**	**Answer with Code**	**GoTo/comment**
31	Who is responsible for inventory management of antiretroviral drugs?	Nurse.....1 Clinical officer.....2 Pharmacist .....5 Medical Assistant.....6 Other (Specify)…….…….....7	
32	How often is a physical inventory carried out?	Once per month?.....1 Once every six months?.....2 Once a year?.....3 Other……..…..…….....4	
33. Do you use and fill out the following logistics tools to manage antiretroviral drugs			
34	How do you determine the quantities you need to order?	Formula (specify)….....1 Don't know .....2 Other means.....3	
35	On average, what is the lag time between ordering and receiving ARVs drugs from the store?	……..Days ……..Weeks	
37. What are the most frequent problems faced during the inventory management?			

Storage condition

No	Description	Yes	No	Comments
1	Products are arranged on shelves with arrows pointing up, and with identification labels, expiry dates, and manufacturing dates clearly visible.			
2	ARV drugs are stored and organized to FEFO procedures and are accessible for counting and general stock management.			
3	Outer cartons are in good condition (not crushed, perforated, stained, or otherwise visibly damaged).			
4	There is separate store for expired and damaged products, and procedures exist for removing them from inventory			
5	Damaged and expired products are separated from usable products in the storeroom, and procedures exist for removing them from inventory.			
6	ARV drugs are stored in a dry, well-lit, well-ventilated storeroom. (Visually inspect roof, walls, and floor of storeroom.)			
7	Expired products are stored with other products haphazardly			
8	Cartons and products are protected from direct sunlight			
9	There is no evidence of rodents or insects in the storage area. (Visually inspect the storage area for evidence of rodents [droppings] or insects that can damage or contaminate the products.)			
10	Storage area is secured with a lock and key but is accessible during normal working hours; access is limited to authorized personnel.			
11	Roof is maintained in good condition to avoid sunlight and water penetration.			
12	Storeroom is clean, with all trash removed, no evidence of food and drinks, products stored on sturdy shelves/bins, and boxes organized neatly.			
13	Current storage space is sufficient for existing products.			
14	Expiry date tracking chart			

Table 2. Stock Data for ARV Drugs on the day of visit

INSTRUCTIONS

Column:

1. Name of each ARV drug that will be counted.
2. Whether or not the product is available, is this facility supposed to manage this product? Answer Y for yes or N for no. If the facility has been stocked out of a particular product for a long time, it may report as "not managing." Make sure to ask if the facility is actually supposed to manage the product.
3. Record if the facility is experiencing a stock out of the product on the day of the visit, according to the physical inventory; answer Y for yes or N for no.
4. Check if the stock card is available for each product; answer Y for yes or N for no. If another type of record is used (e.g., stores ledger), please note in column 4, and continue to gather stock information using another type of record.
5. Check if the bin card has been updated within the last 30 days; answer Y for yes or N for no. Note: If the balance was 0 the last time the bin card was updated and the facility has not received any resupply of ARV drugs, consider the bin card up-to-date. Record the balance on the stock card.

Product	**Managed at this facility? (Y/N)**	**Stock out today? (Y/N)**	**Bin card available? (Y/N)**	**Bin card update? (Y/N)**
TDF/3TC, 300/300mg				
AZT/3TC, 300/300mg				
NVP 200 mg				
EFV 600mg				
LPV/RTV20mg/5ml				
LPV200mg /RTV50mg				
3TC 30mg				
NVP 50 mg				
EVP 50 mg				
AZV300mg/RTV100mg				
ABC 60mg				
NVP 200ml syrup				

10* - Reason for stock out:

1, didn’t receive order,

2, did not order on time,

3, don’t know how to order,

4, didn’t receive the quantity ordered,

5, stock out at the central level,

6, transportation not available for delivery

Annex II: Standard Formula That All of the Professionals Used to Determine the Quantity to be Ordered (RRF)

Beginning Balance	Quantity Received	Loss/ Adjustment	Ending Balance	Calculated Consumption	Days of Stock Outs	Maximum Stock Quantity	Quantity Needed to Reach Max	Quantity Ordered
A	B	C	D	E (A+B) ± (C-D)	F	G $\frac{120*E}{(60-F)}$	H G-D	I