



**INBOUND LOGISTICS OPERATION IN ANTIRETROVIRAL DRUGS: THE  
CASE OF ST. PAUL'S HOSPITAL MILLENNIUM MEDICAL COLLEGE, IN  
ADDIS ABABA, ETHIOPIA**

**By**

**RAEY YOHANNES ARAYA**

**(ID No. GSE 0165/08)**

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**Advisor: Tariku Jebena, PhD**

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LOGISTICS AND SUPPLY CHAIN MANAGEMENT UNIT**

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Millennium Medical College, in Addis Ababa, Ethiopia”**

**By**

**Raey Yohannes Araya, (ID No. GSE 0165/08)**

**APPROVED BY BOARD OF EXAMINERS AND ADVISOR**

<b>1.</b>	<b><u>Tariku Jebena (PhD)</u></b> Advisor	_____	_____
		<b>Signature</b>	<b>Date</b>
<b>3.</b>	<b><u>Shiferaw Mitiku (PhD)</u></b> Internal Examiner	_____	_____
		<b>Signature</b>	<b>Date</b>
<b>4.</b>	<b><u>Abebe Ejigu (PhD)</u></b> External Examiner	_____	_____
		<b>Signature</b>	<b>Date</b>
<b>5.</b>	_____	_____	_____
	<b>Chairman of Graduate Committee</b>	<b>Signature</b>	<b>Date</b>

## **DECLARATION**

I hereby declare that the work which is presented in this thesis entitled “Inbound Logistics Operation in Antiretroviral Drugs: The Case of St. Paul’s Hospital Millennium Medical College, in Addis Ababa, Ethiopia” is the original work of my own effort and done under the guidance of Tariku Jebena (PhD), and that all the sources of materials used for the study have been duly acknowledged. I further confirm that the thesis has not been submitted either in part or in full to any other university for the purpose of earning any degree.

Declared by:

Raey Yohannes	_____	_____
Student	Signature	Date

This is to certify that the above declaration made by the candidate is correct to the best of my knowledge.

Tariku Jebena (PhD)	_____	_____
Advisor	Signature	Date

## **Table of Contents**

DECLARATION .....	i
ACKNOWLEDGEMENTS .....	v
ACRONYMS AND ABBREVIATIONS .....	vi
LIST OF TABLES .....	vii
LIST OF FIGURES .....	viii
ABSTRACT.....	ix
CHAPTER ONE .....	1
1. INTRODUCTION .....	1
1.1. Background of the Study .....	1
1.2. Statement of the Problem.....	3
1.3. Research Questions.....	4
1.4. Objectives of the Study .....	5
1.5. Significance of the study.....	5
1.6. Scope of the Study .....	5
1.7. Limitation of the Study .....	6
1.8. Operational Definition .....	6
1.9. Organizations of the Study.....	7
CHAPTER TWO .....	8
2. RELATED LITERATURE REVIEW .....	8
2.1. Theoretical Literature Review .....	8
2.1.1. Supply Chain Management of Antiretroviral Drugs.....	8
2.1.2. Selection and Quantification of ARV Drugs .....	9
2.1.3. Procurement of ARV Drugs.....	10
2.1.4. Inventory Management of ARV Drugs.....	11
2.1.5. Storage and Distribution of ARV Drugs.....	11
2.1.6. Logistic Management Information System (LMIS).....	12

2.1.7.	Review of ART Supply Chain Performance Measurement tools .....	12
2.2.	Empirical Literature Review .....	13
2.3.	Identified Literature Gaps .....	16
2.4.	Conceptual Framework .....	17
CHAPTER THREE .....		19
3.	METHODOLOGY OF THE STUDY .....	19
3.1.	Description of the Study Area.....	19
3.2.	Research Approach .....	19
3.3.	Research Design .....	20
3.4.	Unit of Analysis .....	20
3.5.	Population of the Study.....	20
3.6.	Sampling Method.....	20
3.7.	Variables of the Study.....	20
3.8.	Data Type and Source.....	21
3.8.1.	Data Collection Tools .....	21
3.8.2.	Procedure of Data Collection.....	22
3.8.3.	Method of Data Analysis .....	22
3.9.	Ethical Consideration.....	22
CHAPTER FOUR.....		23
4.	RESULT, DISCUSSION AND INTERPRETATION .....	23
4.1.1.	The Logistic System Performance of SPHMMC for ARV Drugs.....	23
4.1.1.1.	The Logistics Knowledge Level of Personnel Involved in the ARV Drugs SCM .....	23
4.1.1.2.	Length of Resupply Period .....	27
4.1.1.3.	Order Fill Rate .....	28
4.1.1.4.	Emergency Order Placement .....	29
4.1.2.	Inventory Management System of ARV Drugs at SPHMMC .....	30
4.1.2.1.	Availability and Utilization of Stock Records .....	30

4.1.2.2. Accuracy of Logistics Data for Inventory Management.....	33
4.1.2.3. The Stock Availability of ARV Drugs at SPHMMC.....	35
4.1.2.3.1. Stock Availability of ARV Drugs on the Day of Assessment .....	35
4.1.2.3.2. Stock Availability for the Six-month Period Prior to the Assessment.....	36
4.1.2.3.3. Average Percentage of Time Out of Stock of ARV Drugs .....	36
4.1.3. Logistic Management Information System of ARV Drugs at SPHMMC .....	38
4.1.4. The Storage Conditions of ARV Drugs at SPHMMC .....	39
CHAPTER FIVE .....	41
5. SUMMARY, CONCLUSION AND RECOMMENDATION .....	41
5.1. SUMMARY OF MAJOR FINDINGS.....	41
5.2. CONCLUSION.....	41
5.3. RECOMMENDATIONS .....	42
5.4. FUTURE RESEARCH FORWARD .....	42
References.....	44
APPENDIX.....	48

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## **ACRONYMS AND ABBREVIATIONS**

<b>AIDS</b>	Acquired Immune Deficiency Syndrome
<b>ART</b>	Antiretroviral Therapy
<b>ARV</b>	Antiretroviral
<b>ASM</b>	Appointment Spacing Model
<b>EDHS</b>	Ethiopia Demographic Health Survey
<b>EPHI</b>	Ethiopian Public Health Institute
<b>FMOH</b>	Federal Ministry of Health
<b>FHAPCO</b>	Federal HIV/AIDS Prevention and Control Office
<b>HIV</b>	Human Immune Virus
<b>LMIS</b>	Logistics and Management Information System
<b>MSH</b>	Management Science for Health
<b>NGO</b>	Non-Government organization
<b>OIG</b>	Global fund Office of the Inspector General
<b>PFSA</b>	Pharmaceutical Fund Supply Agency
<b>PHC</b>	Primary Health Care
<b>PSM</b>	Pharmaceutical Supply Management
<b>RHBs</b>	Regional Health Bureaus
<b>SCMS</b>	Supply Chain Management System
<b>SDP</b>	Service Delivery Point
<b>SPHMMC</b>	St. Paul's Hospital Millennium Medical College
<b>WHO</b>	World Health Organization

## LIST OF TABLES

Table 1: Demographic Features of Respondents .....	23
Table 2: Summary of Participant Responses .....	24
Table 3: Grading of knowledge Level .....	27
Table 4: Pharmaceutical Logistics System Knowledge Level of Professionals .....	27
Table 5: List of ARV Medicines with Bin Card Available and Updated .....	30
Table 6: Stock Outs During the Recent 6 Months Prior to Visit for ARV Drugs.....	36

## **LIST OF FIGURES**

Figure 1: Logistics Cycle .....	9
Figure 2: A Conceptual Framework of ARV Drugs Supply Chain Management .....	18
Figure 3: List of drugs ordered during the recent order period Vs order fill rate .....	29
Figure 4: Bin Card Recording Practice .....	31
Figure 5: Bin Card Record Accuracy for ARV Drugs .....	33
Figure 6: Availability of ARV Drugs on the Day of Visit .....	35

## ABSTRACT

*A wide range of medicines and other pharmaceutical products are needed for diagnosis, treatment, care, and prevention of human immune deficiency virus. However, interrupted supplies and stock outs are the major challenges in the supply chain of antiretroviral drugs. The supply of medicines needs to be managed efficiently in order to prevent all types of wastage including overstocking, pilferage and expiry. To assess the supply chain management practices of antiretroviral drugs at Saint Paulo's Hospital Millennium Medical College. Cross sectional descriptive approach was used in the study whereby the logistics management and information system, the inventory control system, logistics knowledge of professional and the storage system of the hospital was assessed and examined against the requirements and standards. Census was used to collect data. In addition, check lists, interview guides and observations were some of the tools used in the data collection process. Detail results pertaining to availability and proper use of logistics management and information system, stock availability, logistics knowledge of professional, fulfillment of acceptable storage conditions for antiretroviral drugs store room, resupply period, order fill rate, emergency order trends and major challenges on antiretroviral drugs supply chain management are described and presented in the result section of this paper. Even though some encouraging practices are observed with respect to some measurements, certain gaps are observed on supply chain management of antiretroviral drugs in the hospital. In order to bring improvements, continuous efforts on providing on job training, regular supervision, regular and timely monitoring and feedback on logistics recording tools to maximize proper utilization and accuracy of logistics management information system tools needed. Receiving a good quality logistics management information system data from the hospital, the supplying pharmaceuticals fund and supply agency hub should maintain sufficient stock of all items at all times based on accurate forecast of future needs/demands. This would help to provide the exact perceived re-fill of items with respect to type and quantity as requested by the hospital.*

**Key words:** *human immune deficiency virus, antiretroviral drugs, supply chain Management, storage, resupply period, order fill rate and emergency order.*

# CHAPTER ONE

## 1. INTRODUCTION

This chapter contains background of the study, statement of the problem, research questions, objective of the study, significance of the study, scope of the study, limitation of the study definition of terms and the organization of the research report.

### 1.1. Background of the Study

Life saving drugs such as anti-retroviral therapy and other critical supplies are becoming more accessible to the millions of people living with HIV. This has been in part due to the concerted effort of the international community, national governments, private industry, non-governmental organizations and others to improve the availability of supplies (Sangeeta & Nadeem 2005).

Ethiopia has achieved exemplary successes in terms of HIV service expansion, and uptake, which impacted to a 90% decline of new HIV infection and 70 % reduction of AIDS deaths compared to the periods 2000 and 2004 respectively (FMOH, 2016). Based on EDHS report, the prevalence of HIV in Ethiopia is 0.9% (0.6% in men and 1.2% in women) and ranges from less than 0.1% in Somali to 4.8% in Gambela regions. HIV prevalence in urban and rural parts of the country is 2.9% and 0.4% respectively (EDHS, 2018).

According to EPHI HIV estimates, there are a total of 718,000 people living with HIV, of which 413,076 people are currently taking the antiretroviral medicines. The country's treatment programme is implemented in line with the latest WHO guidelines. The antiretroviral medicines procurement covered 100% by the Global Fund grants. (OIG, 2017).

The Pharmaceutical Fund and Supply Agency (PFSA) is responsible for the selection, quantification, procurement planning, procurement, storage, distribution, inventory management and rational drugs use of ARV drugs and delivery of this products to health facilities. (FMOH, 2014). Nationally 1,500 health facilities are giving ART services. Saint Paulo's Hospital Millennium Medical College (SPHMMC) is one of the facilities giving ART services.

Saint Paulo's Hospital Millennium Medical College (SPHMMC). SPHMMC is the second largest public hospital in the nation and provides ART services for huge number of people living with HIV. The hospital was established to serve the economically under privileged population, providing services free of charge to about 75% of its patients. In 2007 it became a medical college and its core services include the provision of medical care, teaching and research (Ministerial Leadership Initiative, 2012).

The success of these nationwide programs will depend on the ability of the host country and health systems to reliably and consistently supply the commodities to health facilities at all levels of the health system. Supply chain process is equally challenging most especially in developing countries leading to stock-outs and expired drugs. The deleterious implications of expired and counterfeit drugs are understood to be a central challenge to the integrity of public health systems around the globe, as well as a direct threat to individual health and welfare. (Finlay, 2011).

Supplies often get interrupted for many reasons, including intra and inter professional conflicts, industrial strike, poor availability of resources to manage logistics, non-availability of transportation means, lack of technical knowhow on the part of the health care workers, poor donor support among several others. The consequence of supply interruption can be dire, including anti-retroviral drug resistance, which could have a wider global impact on the availability of drugs for treatment. (Samson *et al.*, 2017)

The supply of medicines needs to be managed efficiently in order to prevent all types of wastage including overstocking, pilferage and expiry. This wastage reduces the quantity of medicines available to patients and therefore the quality of health care they receive. Both under stocking or overstocking and expiry of medicines highlight problems within the supply chain activities which include selection, quantification, procurement, storage, distribution and use (Kagashe & Massawe, 2012).

The objective of the study is to assess the supply chain management of ARV drugs and to identify the possible gaps that exist in the supply chain of these drugs. And the result of the study will help decision makers and other stakeholders to have an insight about the challenges of the supply chain of ARV medicines and make operational strategies to overcome those issues in the supply chain.

## **1.2. Statement of the Problem**

According to the Health Logistics Quarterly newsletter report in 2014, Ethiopia has been challenged in facing various public health pharmaceutical supply chain management system gaps where various multiple stakeholders involved were responsible for managing supply chain for various essential pharmaceutical items. (USAID/DELIVER PROJECT, 2014)

Managing supply chain for health commodities especially for ARV drugs has been a unique challenge given that HIV treatment requires lifelong therapy and few or no substitution can be made if stock out occurs or if drug resistance happens due to treatment failure as result of stock outs of existing treatment regimen started. (Bunting BA, 2013)

Since stock outs at health facilities can result in treatment interruption that can quickly lead to drug resistance or missed opportunities for diagnosis, significant resource for procurement and distribution of essential drugs especially ARV items is invested to prevent this stock outs. Hence, poor supply chain and logistics management of these items implies loss of significant resources. (Bunting BA, 2013)

Proper supply chain management of ARV drugs helps to reduce stock outs, delay in delivery, drugs expiry, and also improves product availability by ensuring continuous supply of ARV drugs fulfilling the six rights of supply chain management which are availing the right products to patients, in the right quantity, of the right quality, at the right place, at the right time and for the right cost and hence better service of ART treatment for HIV/AIDS patients. (PFSA IPLS SOP, 2015; USAID, LMIS M & E indicators, 2006)

With all its importance, unless its proper implementation is studied and gaps and challenges of implementation are identified and appropriate measures are taken, all the consequences of poor implementation such as stock outs, delay in delivery, drug expiry and wastage of finance and resources will result with an ultimate negative impact of poor health of the community. Such consequences are extremely severe and dire if the supply management is poorly implemented for ARV drugs supply chain management as these items are lifesaving and lifelong treatments for people living with HIV/AIDS and the negative consequences for these drugs will result to treatment failure due to missed dose, developments of resistant strains of the virus, quick deterioration of health and death of patients.

Therefore, focusing on the Anti-Retroviral (ARV) drugs supply chain management, doing this proposed research on inbound logistics operation in SPHMMC is justified based on the following reasons.

Firstly, inbound logistics is a big topic that encompasses three main components such as the Logistic Management Information System, the Inventory Control System and the Storage System of items and all these three components are addressed in this study.

Secondly, this topic is extremely important and sensitive as these drugs are very essential, costly, potentially lifesaving and poor implementation leads to death of patients and have significant impact on community/nations wellbeing.

Thirdly, with proper operation, there will be in placement and consistent use of mandatory requirements such as availability and proper utilization of various logistic data reporting and recoding tools, LMIS data quality and other facility requirements such as acceptable storage facility. And the study has addressed all these in a comprehensive way.

In addition to the above reasons, considering its importance, its impacts and contribution to promote health of individuals, community and nation at large, more researches on ARV drugs supply chain at health institution level need to be conducted to investigate bottle necks and challenges and identify further ingredients to take necessary and quick interventions.

Therefore, this study has tried to assess the inbound logistics operation of ARV drugs in SPHMMC using relevant indicators that helps to measure availability, proper use and functioning of the three components which are the logistic management information system, the inventory control system and the storage system.

### **1.3. Research Questions**

The following research questions are proposed.

1. How is logistic system performance of the hospital for ARV drugs?
2. How does the inventory management of ARV drugs at SPHMMC looks like?
3. What does the Logistics Management information system (LMIS) of ARV drugs at SPHMMC looks like?
4. What are the storage conditions practices of ARV drugs at SPHMMC?

## **1.4. Objectives of the Study**

### **1.4.1. General Objective of the Study**

The general objective of the study is to assess the supply chain management practices of ARV drugs at SPHMMC.

### **1.4.2. Specific Objectives of the Study**

The specific objectives of the study are:

- To assess the logistic system performance of the hospital for ARV drugs
- To assess the inventory management of ARV drugs at SPHMMC
- To assess the LMIS of ARV drugs at SPHMMC
- To assess the storage conditions of ARV drugs at SPHMMC

## **1.5. Significance of the study**

The study assessed the supply chain management of ARV drugs at SPHMMC and recommend proper corrective action measures to strengthen ARV supply chain management system. Public organizations, such as, Federal Ministry of Health (FMOH), FHAPCO, PFSA, SPHMMC and other interested organizations participating in the supply chain of ARV drugs will get important concepts on the supply chain of the ARV medicines and able to know the supply chain management challenges of ARV products and may take the recommendations to improve their system. This will develop awareness for the opportunities to meet the need of the customer.

In addition, the study will be useful to researchers to undertake further research into the area of supply chain management of ARV drugs.

## **1.6. Scope of the Study**

This study was focused on the assessment of ARV medicines supply chain management. The study was conducted at St. Paul's Hospital Millennium Medical College (SPHMMC) in Addis Ababa. Data was collected from SPHMMC pharmacy professionals responsible for acquiring and managing the hospital ARV stocks, ART stores and from LMIS tools.

## 1.7. Limitation of the Study

The study did not include ART clients.

## 1.8. Operational Definition

**Supply Chain Management:** in this document supply chain management refers to ordering, receiving, warehousing/storing, managing the logistics information system, the inventory management and the storage conditions of ARV drugs (USAID/Deliver, 2005).

**Inventory Management System:** is a system which enable store-keepers to manage their stock – know how much stock to hold, when to order and how much to order (Sangeeta and Nadeem 2005).

**Logistics Management Information System (LMIS):** is a system that generates basic logistics information, which is needed to make logistics decisions (PFSA, 2015).

**LMIS tools:** different tools such as IRRF, IFFR, bin cards and stock cards which are important for reporting and recording data related to ARV drugs supply and distribution. These tools are important for successful operation and implementation of LMIS (USAID/Deliver, 2005).

**Duration of stock outs:** the time period at which a given drug remains stock outs (completely not available) LMIS (PFSA, 2015).

**Frequency of stock outs:** How many times a given drug is reported stock outs with in a certain time interval (PFSA, 2015).

**Proper use of LMIS tools:** correct and timely recoding and reporting of drugs supply and distribution data using the LMIS tools. (USAID/Deliver, 2005).

**Stock out on the day of the visit:** Not having any available stock on the day that the data collector has arrived to check stock availability. (USAID/DELIVER, 2010).

**Stock refill:** The amount of stock of drugs refilled by PFSA hub up on the request of the hospital (USAID/DELIVER, 2010).

**Order fill rate:** The percentage of correct items that are actually filled according to ordered quantities (USAID/DELIVER, 2010).

**A physical count (Physical Inventory):** is an actual count of the quantity of each supply at any given time. (PFSA, 2015).

## **1.9. Organizations of the Study**

The research report organized in five chapters: Chapter one: Introduction – this chapter contains background of the study, statement of the problem, research questions, objective of the study, definition of terms, significance of the study and scope of the study. Chapter two contains review of related literature. Chapter three contains method of the study. Chapter four contains results and discussions. Finally, the last chapter contains summary, conclusions and recommendations.

## CHAPTER TWO

### 2. RELATED LITERATURE REVIEW

In this chapter theoretical literature review, empirical literature review, identified literature gaps and conceptual framework will be discussed.

#### 2.1. Theoretical Literature Review

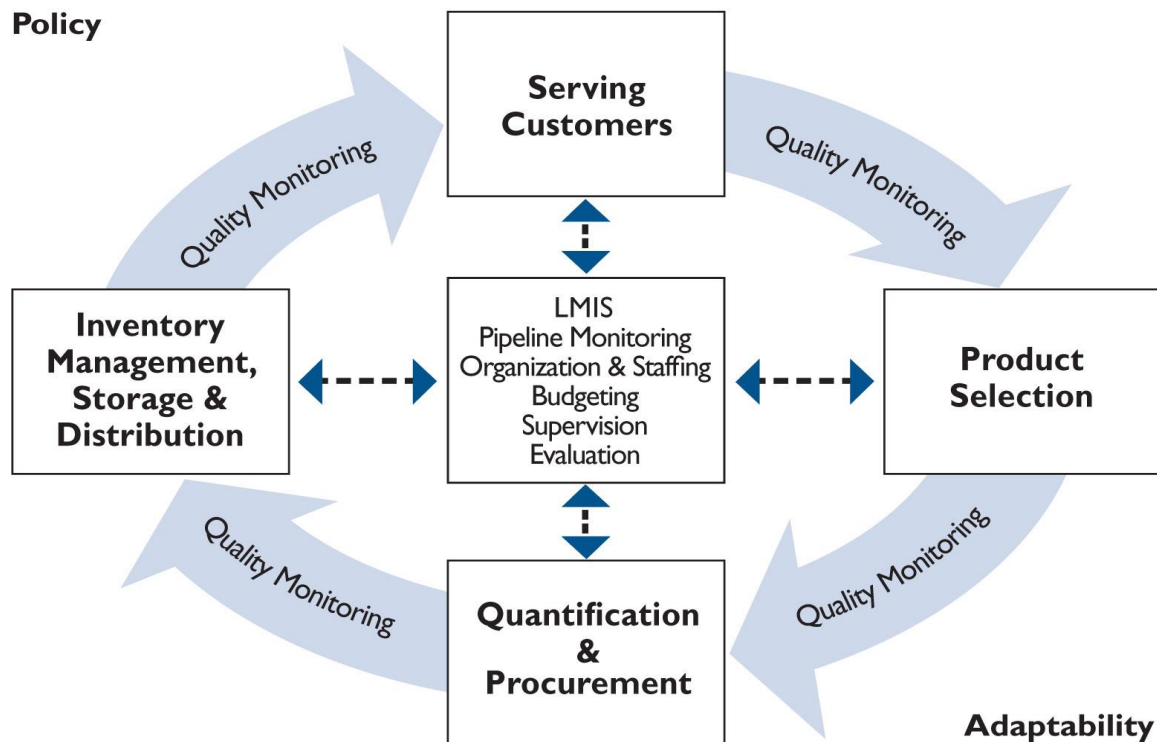
##### 2.1.1. Supply Chain Management of Antiretroviral Drugs

Kitsolutions (2003) defines Supply Chain management (SCM) as providing the right goods or services, to the right location, in the right quantity, at the right time and at the right cost.

According to Simchi-Levi, D., Kaminsky, P. & Simchi-Levi, E. (2003), Supply Chain management (SCM) refers to “a set of methods used to effectively coordinate suppliers, producers, depots, and stores, so that commodity is produced and distributed at the correct quantities, to the correct locations, and at the correct time, in order to reduce system costs while satisfying service level requirements. The fundamental notion of these definitions is that a Supply Chain must be controlled in order to be fast and trustworthy, cost-effective, and flexible enough to meet customers’ requirements.

Stevenson (2005) defines the supply chain as a sequence of organizations their facilities, functions, and activities that are involved in producing and delivering a product or service. Many studies have been carried out on the management of the drug supply system, particularly in developing countries (Chandani *et al.*, 2006; Jitta *et al.*, 2003; Pharasi, 2007), where strengths and weaknesses of the drug supply management system have been highlighted. A robust supply system is necessary to manage the massive amount of ARVs and related commodities.

According to JSI Deliver (2005) to manage a logistics system, a number of activities need to be continually executed and supported. Figure 1, the Logistics Cycle, shows the activities and resources that are required to operate an effective logistics system. As the cycle portrays, each of the activities in the logistics cycle are inter-dependent on each other. Customers will not be served if there is a breakdown in one of the activities. (JSI Deliver., 2005)



**Figure 1: Logistics Cycle**

Source: DELIVER/JSI., 2005

### 2.1.2. Selection and Quantification of ARV Drugs

JSI Deliver (2005) says in many of the HIV programs, development of standard treatment guidelines or essential drugs lists that include HIV drugs and supplies would be one of the first steps to product selection. (USAID/Deliver, 2005). The antiretroviral drugs and related supplies for use in Ethiopia described in the national/essential drug list and HIV/AIDS standard treatment guidelines (FMOH, 2014). As stated by WHO (2003), essential drug list simplifies systems of procurement by guiding the procurement and supply of medicines in the public sector. Moreover, it leads to better supply of drugs, to more rational prescribing, and consequently to lower costs, to better quality of care, and to better health outcomes. (WHO, 2003).

A study done in Tanzania showed that from 27 surveyed health facilities only 38% of them had essential drug list out of which only 52% of facilities procured medicines within the list (MOHSW, 2008).

Quantification is important for informing supply chain decisions on product selection, financing, procurement, and delivery. (PFSA, 2015). National quantification of pharmaceuticals need for the Ethiopian Antiretroviral Treatment program will be conducted by PFSA in collaboration with stakeholders such as HAPCO, FMOH, RHBs and development partners (FMOH, 2014).

As stated by Family Health International, an accurate quantification is essential for all health commodities but of very importance for HIV/AIDS related commodities because quantification of drug and health commodity requirements for HIV/AIDS programs is complex and uninterrupted access for patients must be ensured. (Family Health International 2008). When medicine quantification requirements are not estimated according to real needs, it could lead to mal quantification and may tie up a portion of the medicine budget – leaving insufficient funds for other important and perhaps life-saving medicines (Clark & Barraclough, 2010).

As said by Chris *et al.* (2014), producing accurate national demand forecast is challenging, which can result in orders that may not reflect the country's actual need. On the one hand, under-forecasting can result in product scarcity, increasing the likelihood of stock-outs and creating the need for costly emergency orders. It also substantially increases the use of high-cost air shipping the normal transportation mode for emergency orders. In contrast, orders placed sufficiently in advance of their desired delivery date can be shipped via ocean, with savings of more than 60% when compared with the cost of air freight. To ensure on-time delivery of the most common fixed-dosed combination and single-dose formulation ARVs shipped via ocean, a minimum lead time of 6 months is needed. This lead time can extend up to 9 months, as supply constraints and demand variations come into play (Chris *et al.*, 2014).

### **2.1.3. Procurement of ARV Drugs**

After a supply plan has been developed as part of the quantification process, quantities of products must be procured (Kumurya., 2015).

According to FMOH (2014) HIV/AIDS treatment guidelines, in Ethiopia, all antiretroviral drugs procured at affordable prices, with assured quality and adequate shelf life, from a reliable supply by PFSA. It follows the national and international procurement regulation. It is a competitive approach through international bidding or tender system on an annual basis and technical evaluation of bidders that it selects supplies and awards contracts. (FMOH., 2014)

David *et al.* (2014) stated that some of the key procurement and supply chain issues that challenge timely and reliable delivery of ARVs includes supply risks, fragmentation of demand, forecasting inaccuracy, product registration, shelf life requirement challenges and cost risks.

#### **2.1.4. Inventory Management of ARV Drugs**

In Ethiopian Integrated Pharmaceutical logistics system the purpose of an inventory control system is explained as to inform personnel when and how much of ARV drugs to order and to maintain an appropriate stock level to meet the needs of clients. A well designed and well operated inventory control system helps to prevent shortages, oversupply, and expiry of pharmaceuticals. (PFSA, 2015). According to MSH (2012), poor inventory management in public health institutions results in wastage of financial resources, poor availability of some essential medicines, stock outs, stock losses and consequently, failure to ameliorate patients' health outcomes (MSH, 2012). Poor inventory management mechanisms affect the availability of medicines, as proven by the poor availability of ARVs reported in Tanzania, where stock outs have been recorded in hospitals that depended on the Medical Stores Department (MSD) for their supply – lack of logistics skills in ordering was associated with observed stock outs. In Lesotho stock outs have been associated with poor record-keeping practice (Kagashe & Massawe, 2012). As per Clark & Barraclough (2010), a failure to monitor stock levels regularly could have fatal consequences; disruption of or delay in a course of treatment may worsen a patient's condition and lead to death if a lifesaving medicine is out of stock (Clark & Barraclough, 2010). The lack of a standardized inventory control system with procedures for monitoring and managing stock levels of ARV drugs is a challenge to emerging logistic systems; as is the case in Lesotho where stock levels were not monitored, resulting in over-stocking of certain medicines (Pharasi, 2007).

#### **2.1.5. Storage and Distribution of ARV Drugs**

DELIVER (2011) says after an item has been procured and received by the health system or program, it must be transported to the service delivery level where the client will receive the products. During this process, the products must be stored until they are sent to the next lower level, or until the customer needs them (USAID | DELIVER., 2011). Storage conditions for medicines are critical and it is, therefore, important to maintain the temperature at the required levels (SAPC, 2010). In the Ethiopian IPLS document, proper storage of ARVs, including refrigeration, mentioned as a critical element to maintain the quality of the drugs and related

supplies. Adequate space and facilities for proper handling must be ensured at various levels. (PFSA, 2015).

In the PFSA IPLS document it is explained that, ARV drugs distribution will follow the existing delivery system and it extends from the central level to the facility. PFSA will be the main system that will be used to deliver the products to its hubs; subsequently the hubs distribute the product to health facilities. (PFSA, 2015).

#### **2.1.6. Logistic Management Information System (LMIS)**

Logistics management information system (LMIS) is the collection, processing and utilization of logistics information for decision making (DELIVER, 2011). There are only three activities that happen to pharmaceuticals within a logistics system: they are stored, moved between facilities, and used to provide health services to patients. A well- designed logistics management information system will include records and forms that collect and report the three essential data items as they relate to these three activities. (PFSA, 2015). According to Kagashe & Massawe (2012), LMIS is an important tool in inventory management, therefore accurate record keeping is essential. A study in Tanzania reported 8% and 72% recorded balance that was less and greater than the physical count respectively. (Kagashe & Massawe 2012). Another study done in Tanzania showed that often neither minimum nor maximum levels were defined. (MOHSW, 2008).

#### **2.1.7. Review of ART Supply Chain Performance Measurement tools**

Several types of indicators have been developed to measure many supply chain and logistics activities. Choosing the type of indicator to measure can be daunting, and it could be dangerous to simply focus attention on one area. For example, focusing only on cost containment could improve one area but not affect the overall performance of the supply chain. (USAID/DELIVER, 2010).

The Logistics Indicators Assessment Tool (LIAT), a quantitative data collection instrument developed by the DELIVER project, is used to conduct a facility-based survey to assess health commodity logistics system performance and commodity availability at health facilities. This tool has been adapted from the original version specifically to assess antiretroviral drugs logistics system performance and availability at health facilities. The LIAT can be used to monitor the

performance of certain processes involved in the logistics management of health commodities over time, to evaluate certain outcomes of logistics interventions, to provide ongoing supervision and performance monitoring, and to monitor commodity availability. (USAID/DELIVER, 2009). For the assessment of the SCM of ARVs, the Logistics Indicators Assessment Tool (LIAT) was used to collect quantitative data from St. Paul's hospital millennium medical college.

The Logistics System Assessment Tool (LSAT), one of two data-gathering tools (with the Logistics Indicators Assessment Tool) developed by the DELIVER project, is used to assess a logistics system and the system's environment. (USAID/DELIVER, 2009). LSAT is a comprehensive, qualitative diagnostic and monitoring tool by which strengths and weaknesses of the logistics system will be identified.

## **2.2. Empirical Literature Review**

Related studies have been conducted by different researchers on ARV drugs supply chain management, some of the studies are briefly reviewed as below.

The findings from an assessment of the Central Medical Store in four countries of West Africa (Ghana, Nigeria, Cote d'Ivoire and Burkina Faso) showed that the forecasting of ARV drugs suffer from the lack of data drug use. Standard treatment guidelines orient the choices of drugs and quantification committees are established in most countries. However, validation of the data used in the quantification process is not always carried out. All this contributes to the lack of reliability of the quantification of needs and thus increase the risk of stock-outs or expiration of drugs. (Samuel & Gerard 2013).

According to a study made on the inventory management of ARV drugs at community health centers in the Cape Metropole in western Cape town in 2015, 86.7% of CHCs utilized a logistics tool (either manual or electronic) to manage ARV drugs. About 82.7 % of ARV drugs have logistics recording tools out of which only 21.9 % are accurately used. Out of the total available logistic tools in use only 32.9% had up-to-date records. In addition, the variation between stock records and physical counts for the ARV drugs assessed was 51.6% and 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 M,2015).

In a study undertaken by Mori and Owenya (2014), on ARV distribution in Tanzania, they found that stock-outs of ARVs due to inefficient supply systems, quantification problems and short expiry duration, caused patients to change their ART regimens, thereby increasing the risk of the emergence of drug-resistant HIV strains. (Mori & Owenya 2014).

A study done by David *et al*, in 2014 on Antiretroviral procurement and supply chain management specified that with hundreds of ART centers in operation in many countries, often with limited data training and support, accurately forecasting and ordering at the ART center level for each product is a difficult task. Moreover, the time required for replenishment of stocks from a central warehouse to ART center can stretch to many months. These factors often lead to either stock-outs or expired products at ART sites, despite having stock at the central warehouse. At the central level, it is likewise difficult to estimate demand accurately given low site-level visibility and frequent switches between regimens and unpredictable scale-up rates. This results in lack of storage space, sub-optimal storage, risk of expiry as well risk of stock-outs. Some countries compensate poor forecasting accuracy with large safety stock levels. Although this works well to prevent stock-outs, it can contribute to product expirations or the costly efforts to relocate stocks from one center or country to another. (David *et al.*, 2014).

An assessment done in Sierra Leone on ARV drugs indicated that, 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 limited and, when available, are often unreliable or insufficient to be used for quantifying ARV drug requirements. Multiple sources of funding, procurement mechanisms, and distribution channels used for ARV drugs are also posing a problem on quantification of ARVs and other commodities. Communication and coordination are lacking among key stakeholders and implementers (i.e., policymakers, program managers, service providers, funding sources, procurement agents, and suppliers) on issues related to the selection, quantification, and procurement of ARV drug. (Allers & Yasmin 2006).

A supply chain assessment for ARVs done in Sierra Leone showed that estimates did not take into account monthly consumption, lead time, safety stock, re-order levels, stock on hand and the procurement period, when ordering quantities of ARV drugs needed for adults, pediatric ART and ARV prophylaxis during pregnancy, post-partum, and for post-exposure prophylaxis – the

ordering process did not clearly describe the sources of data, the basis for the assumptions, or how the actual quantities of product were arrived at. However, the study suggested that the forecasting methodology should include assumptions about the number of patients expected to continue treatment during the forecast period; the expected rates of drug substitution within regimens and switches from first- to second-line regimens, and the number of new patients expected to initiate treatment during the forecast period according to scale-up plans and service delivery capacity (Allers *et al.*, 2007).

A study conducted in three countries in East Africa (Tanzania, Uganda and Rwanda) highlighted that, despite the efforts of initiatives to increase the availability of and access to ARVs – the pharmaceutical supply management in the aforementioned countries was found to be deficient. The weakness was underlined by the incapacity to adequately quantify needs, place orders, and adequately keep records (Matowe *et al.*, 2008).

A case study done in QwaQwa district of South Africa on Supply chain solutions to improve the distribution of antiretroviral drugs (ARVs) revealed that distributing the ARVs between the pharmaceutical warehouse, the Manapo hospital and the peripheral clinics, causing patients to be without medication. The hospital claimed the warehouse maintained inadequate stock-keeping practices and was therefore unreliable in the timely delivery of the drugs. On the other hand, the hospital was accused of lacking sufficient and suitable warehousing facilities; that the staff did not have proper inventory management procedures in place; and that the transport system between the hospital and the peripheral clinics was unreliable. All these supply chain issues resulted in an unsatisfied eventual patient in need of treatment. (Mamolise *et al.*, 2017).

A lack of awareness of the methods of inventory control was found in public hospitals in Tanzania; most of the staff (65%) in Dar es Salaam hospitals did not know any of the inventory control methods used in inventory management. Consequently, there was a poor estimation of needs resulting in over-stocking of medicines (Kagashe & Massawe, 2012).

A study conducted in Darbhanga district in India found that no inventory control techniques were used for the maintenance of the stock in public hospitals, resulting in frequent stock-outs (Roy *et al.*, 2009).

In a study on medicine stock outs and inventory management in Tanzanian public hospitals, Kagashe and Massawe (2012) reported discrepancies between recorded quantities on stock cards and physical count. Mwananyamala hospital had 72% of recorded balance on stock cards that

was greater than the physical count, while Mwananyamala hospital had 8% of recorded balance on stock cards that was less than the physical count. These discrepancies were due to poor logistics skills. Kagashe and Massawe (2012).

In a study carried out by Muyingo *et al.* (2000) in Uganda, it was found that major challenges in store management at the PHC facilities, were a lack of adequate space, shelves, ventilation and sanitation. At one PHC there was no separate space for the storage of medicines, and at some centers medicines were found scattered around the table in the storeroom. (Muyingo *et al.*, 2000)

An evaluation done on ART sites of Ethiopia showed that, there were large quantities of ARV drugs which expire shortly. There were also some expired second line drugs. Expired ARV drugs were kept together with active drugs at one study site. There were inadequate storage facilities, management, capacity, and temperature monitoring, especially for the cold chain in the selected health facilities. It also showed that the ART pharmacy stores were managed by using stock cards, generally manual, but it was computerized in some places. (RPM., 2006).

A research done on the supply chain management of HIV/AIDS commodities in selected Health facilities of Addis Ababa, Ethiopia, explored that, there were frequent stock outs of ARV drugs, which are an indicator of weak supply chain. (Eyerusalem &Teferi., 2014).

Tesfaye & Tadesse (2017) in their study of supply chain management of antiretroviral drugs in public health facilities in Eastern Ethiopia, found out that only thirty percent of the health facilities had received all the ordered quantities of ARV drugs. The health facilities will not receive all the quantities of ARV drugs that they have ordered. (Tesfaye & Tadesse., 2017)

### **2.3. Identified Literature Gaps**

Almost all of the reviewed literature above revealed that poor forecasting and quantification, inefficient procurement, inventory management and distribution leads to ARV stock out and causes risk of emergence of drug resistance of HIV strains. Hence efficient ARV SCM is important to achieve consistent and uninterrupted supply of ARV drugs.

In those studies, done in Ethiopia they found out that stock outs of ARV drugs in some health facilities, poor storage conditions and some health facilities were not receiving the quantities of ARV drugs that they have ordered. The studies done in Addis Ababa health facilities was not up-

to-date and St Paul's hospital was not included. Hence this study assessed the supply chain management of ARV's drug by taking the case of St. Paul's Hospital.

Recently the country implemented new strategies on the ART program. One of the strategy is the test and start strategy and it was started on August 2016, ART should be initiated for all HIV positive clients irrespective of their WHO clinical stage and/or CD4 count. This strategy will leads to an increase in the number of patients taking ARV drugs. (FMOH, 2016). The other strategy is the appointment spacing model, transitioning ART patients from short (2-3 months) to longer (6 months) dispensing appointments. (FMOH, 2017).

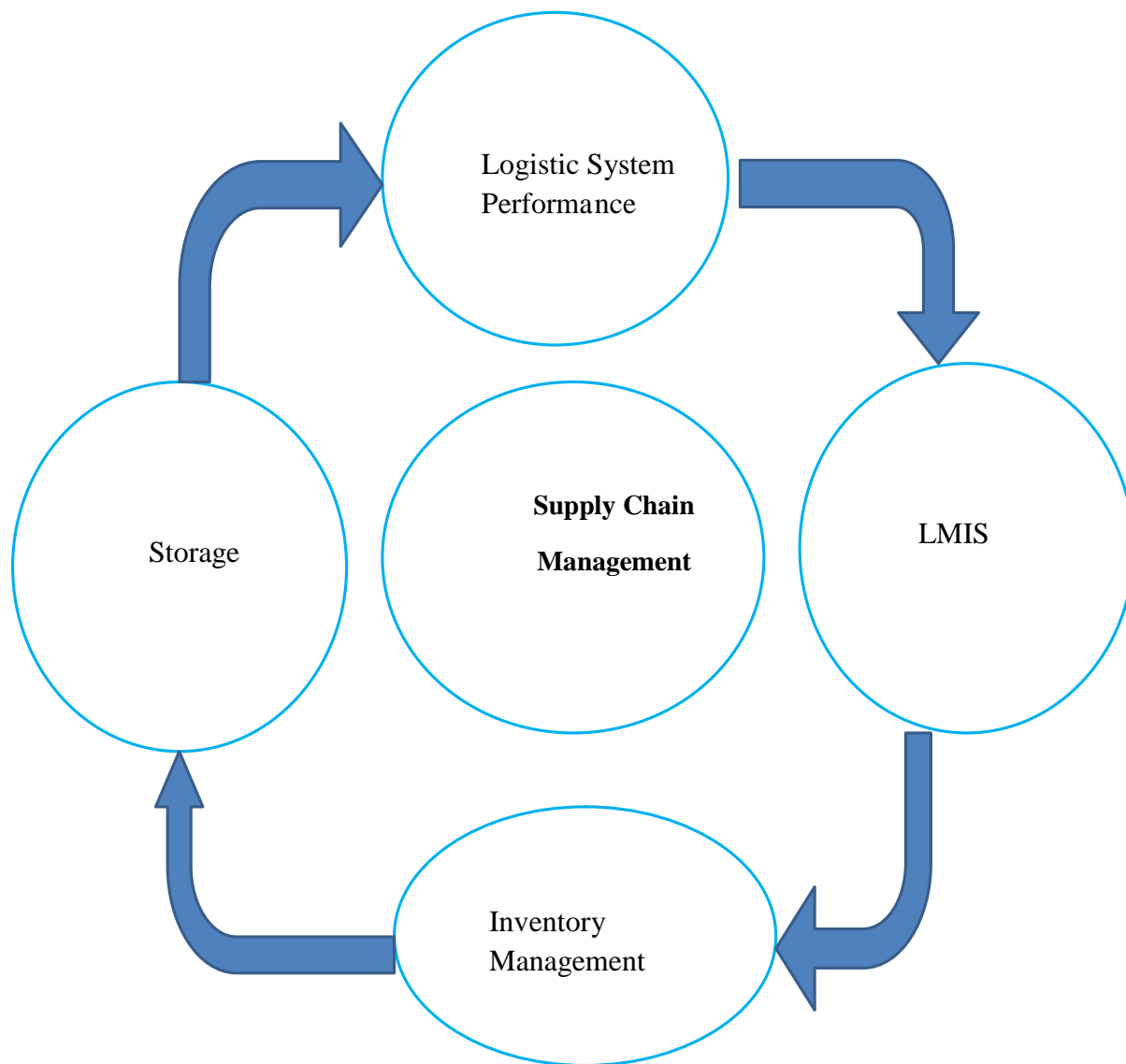
The above assessments done in Ethiopia were performed before those strategy changes on the ART program. The test and start strategy will increase the number of people taking the ARV medicines (FMOH, 2016) and this obviously affecting the supply chain of the ARV drugs (FMOH & PFSA, 2017). As stated by Erik *et al* (2011), as the ART program has grown (increasing numbers of people on ART, increasing numbers of sites providing ART) it has become clear that the ARV PSM system has become increasingly difficult to manage. (Erik *et al.*, 2011). The appointment spacing model (ASM) has an implication on storage, distribution, reporting, requisition and inventory management of ARV drugs. For instance, a faster-than-planned introduction of stable clients in to ASM will exhaust stocks and cause an increased risk of stock out; a slower-than-planned enrolment results in overstocking and wastage due to expiry of medications. (FMOH & PFSA, 2017)

Since this study assessed the recent ARV supply chain management, it will show for the policy makers if those ART program changes affecting the supply chain of ARV drugs by taking the case of St Paul's hospital.

#### **2.4. Conceptual Framework**

Supply chain management is a system that integrates activities to closely align supply and demand. Zooming in, it can be considered as logistics activities as the operational component of supply chain management. Figure 2 shows, a framework to illustrate the activities for inbound logistics operation system, each of the activities are inter-dependent on each other. Each activity; logistics system performance, LMIS, inventory management and storage of ARV drugs depends on and is affected by the other activities. The activities in the center of the framework represent

the supply chain management which is affected and impacted by the other elements around it. (DELIVER/JSI., 2017).



**Figure 2: A Conceptual Framework of ARV Drugs Supply Chain Management (DELIVER/JSI., 2017)**

## **CHAPTER THREE**

### **3. METHODOLOGY OF THE STUDY**

In this chapter; description of the study area, the research approaches, design of the research, unit of analysis, study population, sampling method, variables of the study, source of data and method of data analysis will be described.

#### **3.1. Description of the Study Area**

The study is conducted at St. Paul's Hospital Millennium Medical College (SPHMMC). It is a referral hospital in Addis Ababa under the Ethiopian Federal Ministry of Health (FMOH). It is the second largest public hospital in the nation, built by the Emperor Haile Selassie in 1961 with the help of the German Evangelical Church. The hospital was established to serve the economically under privileged population, providing services free of charge to about 75% of its patients. In 2007 it became a medical college and its core services include the provision of medical care, teaching and research (Ministerial Leadership Initiative, 2012).

SPHMMC selected for this study since this hospital is the second largest public hospital in the nation and provides ART services for huge number of people living with HIV.

#### **3.2. Research Approach**

The study used primarily quantitative research approach complimented by qualitative approach. Data was collected by using LIAT to answer questions on completeness of stock records, order fill rates, historical stock outs and for describing the inventory management practices of ARV drugs, the storage conditions, the logistics management information systems of the ARV drugs, logistics system performance and knowledge. The USAID/DELIVER project used quantitative method to conduct a facility based survey to assess ARV logistics system performance and commodity availability at facility. (USAID/DELIVER, 2009) and this study followed the same approach with the USAID/DELIVER project to conduct the assessment at SPHMMC.

### **3.3. Research Design**

To closely examine the ARV drugs supply chain management practices and challenges within a specific context a case study method was selected and SPHMMC was the subject of the study. The descriptive study design using cross sectional data was conducted to assess the ARV drugs supply chain management. Inventory records over a period of six month, from October 2017 to March 2018, were reviewed. Questionnaire and storage observation check list were used to collect information on logistics knowledge of the professionals involved in ARV drug supply chain management and ARV drugs storage condition respectively.

### **3.4. Unit of Analysis**

The unit of analysis were St Paul's Hospital Millennium Medical College ART pharmacy section and ARV Drug store.

### **3.5. Population of the Study**

As per the interview made with the ART pharmacy coordinator it was explained that, ART services have been offered in St. Paul's Hospital Millennium Medical College (SPHMMC) for fifteen years. There are 9302 (Adult, 9152 & Pediatrics 150) clients taking their ARV medicines from this hospital. The hospital have 60 pharmacists, 9 pharmacy technicians and 800 nurses. From these 35 pharmacists, 3 pharmacy technicians and 2 nurses are responsible for ARV drugs ordering, receiving, storing, securing, dispensing and reporting on stock status and consumption. All these health professionals responsible for ARV drugs ordering, receiving, storing, securing, dispensing and reporting on stock status and consumption were involved in the study.

### **3.6. Sampling Method**

Census method of sampling was used since every unit and everyone in a population was included in the study.

### **3.7. Variables of the Study**

- ARV drugs logistic system performance
- Stock availability of ARV drugs
- Inventory management of ARV drugs
- LMIS of ARV drugs

- Storage conditions of ARV drugs

### 3.8. Data Type and Source

Both Quantitative data and qualitative data was collected. Both primary and secondary data were used, mainly health care professionals and documents were used to assess the supply chain management of ARV drugs. Primary data was collected by using questionnaires, interviews and observations and secondary data was obtained from external sources such as internet, Journals and other documentations. The purpose of sourcing for secondary data is to help in the formation of problems and literature review.

#### 3.8.1. Data Collection Tools

In this survey data were collected through review of records, observation, self-administered questionnaire and key informant interview questionnaire. The tools were adopted from LIAT, which is developed by the DELIVER project (USAID/DELIVER, 2009).

Tools used in the record review were: (*see APPENDIX*)

**List of ARV products:** This list was used to guide the review and they are seventeen (17). The list included all ARV products available in the standard treatment Guidelines. (FMOH, 2014).

**Inventory data collection form:** to gather data that is used to assess the stock availability of ARV drugs for the past 6 months (October 2017 to March 2018), bin card availability, bin card utilization & accuracy of bin cards.

**Stock out data collection form:** to gather data on stock status on the day of visit.

**Order Fill Rate data collection form:** is used to collect data that will help to assess the order fill rate by examining the percentage difference between quantity ordered and quantity received.

**Facility storage condition observation checklist:** a tool that was used to collect data on the general pharmaceutical storage condition in the health facilities.

**Self-administered questionnaire:** was used to collect data on ARV drugs logistics knowledge of professionals involved in pharmaceutical management. Apart from questions to inquire on demographic features of the workers, there were seven questions to assess the knowledge.

**Key informant interview questionnaire:** was used to collect ART service and general data on ARV drugs

### 3.8.2. Procedure of Data Collection

All data were collected by the principal investigator. Data on days out of stock were collected by review of store ledger and/or bin cards and day out of stock was counted from when a stock record was recorded zero to when the stock record showed the stock was in. Data on availability on the day of visit was collected based on observation in the store and at the dispensing area. Data on accuracy of stock of stock record was collected by review of store ledger and/or bin card and adjusting for recent issues and receipts that were within seven days to the day of visit and comparing with the physical counts. Data on pharmaceutical logistics knowledge of the professionals was collected by first obtaining consent of the health workers and then giving them a self administered questionnaire which after filling they were returned to the principal investigator. Data on storage condition was collected though observing the general storage condition in the facilities" store area and marking against the specific storage criterion on the check list. General data's obtained from ART pharmacy coordinator with structured interviews.

### 3.8.3. Method of Data Analysis

Data collected were checked for completeness and entered into computer software SPSS. Availability of ARV drugs were assessed based on average percentage of time that products were out of stock for the last six month period and percentage of products in stock on the day of assessment. Calculations for these two indicators were based on the formulas developed by the Management Sciences for Health. (MSH, 2013).

Average percentage of time out of stock of the ARV drugs is calculated using the following formula;

$$\text{Average \% of time that ARV Drugs were out of stock} = \frac{\text{Total number of stock out days for all ARV Drugs}}{180 \times \text{Total number of ARV drugs in the study}} \times 100$$

### 3.9. Ethical Consideration

Ethical clearance was obtained from the Addis Ababa University, School of Commerce. Permission was obtained from SPHMMC. The necessary explanation about the purpose of the study and its procedure was given to respondents to obtain verbal consent. To assure confidentiality, anonymous questioners was given to the respondents.

## CHAPTER FOUR

### 4. RESULT, DISCUSSION AND INTERPRETATION

This chapter provides a summary of the findings obtained from the survey conducted from mid April to early May 2018 in SPHMMC, discussion and interpretation of the results. This chapter categorized into ARV drugs logistic system performance, inventory management, LMIS and storage conditions of ARV drugs.

#### 4.1.1. The Logistic System Performance of SPHMMC for ARV Drugs

The logistics system performance of SPHMMC for ARV drugs was assessed with respect to the logistics knowledge level of personnel involved in the ARV drugs supply chain management, resupply period, order fill rate and emergency order. The findings are depicted below.

##### 4.1.1.1. The Logistics Knowledge Level of Personnel Involved in the ARV Drugs SCM

To assess the logistics knowledge of personnel involved in the ARV drugs supply chain, forty professionals were requested. Majority of the respondents were males 24 (60%), age of the respondents was somehow equally distributed. As far as profession is concerned, majority was pharmacist. The demographic features of the respondents are depicted in table 1.

**Table 1: Demographic Features of Respondents**

<b>Demographic features</b>	<b>Frequency (n= 40)</b>	<b>Percent (%)</b>
<b>Age</b>		
25-34	26	65%
35-44	12	30%
45-54	2	5%
<b>Sex</b>		
Male	24	60%
Female	16	40%
<b>Profession</b>		
Pharmacist	35	88%

Pharmacy Technician	3	8%
Nurse	2	5%
<b>Work experience</b>		
<1 year	5	13%
1-5 years	13	33%
6-10 years	16	40%
>10 years	6	15%

The study focused on the understanding of the following criteria to assess knowledge; the supply system that the hospital was using to receive ARV drugs, methods that can be used to estimate ARV drugs need in the hospital, best practice to follow when managing ARV drugs in a store; first expiry first out (FEFO). It also looked on the understanding of; the meaning of physical inventory, the importance of doing physical inventory, the meaning of safety stock and the essential data for ARV drugs report for the hospital. Table 2 summarizes the participant's responses to the questions.

**Table 2: Summary of Participant Responses**

<b>Response</b>	<b>Frequency (n=40)</b>
<u>Supply system of ARV drugs</u>	
Pull system	40
<u>Methods that can be used to estimate ARV drugs need in a hospital</u>	
Consumption method	23
Morbidity method	5
Consumption and morbidity methods	10
Do not know	2
<u>Best practice in managing products in a store</u>	
First in first out	5
First expiry first out	35
<u>Meaning of physical inventory</u>	
Hand counting of inventory	30
Know expired products	1

Know quantity available	8
Know requirements	1
<b>Importance of doing physical inventory</b>	
Knows actual stock available	25
Know consumption	7
Auditor to verify stock	8
<b>Meaning of safety stock</b>	
Medicines for emergency situations	10
Additional supply from PFSA	2
Reserve stock to prevent out of stock	28
<b>Essential data for ARV drugs report</b>	
Stock on hand	3
Stock on hand+ Consumption rate + Losses/Adjustment	37

#### *Supply system of ARV drugs*

The above results show that, 40 (100%) respondents knew the supply system in which their hospital were operating, which is a pull system.

#### *Methods that can be used to estimate ARV needs*

Results show that 10 professionals were able to mention both morbidity method and consumption method as the methods that the hospital can use to estimate ARV drugs need. On the other hand 2 professionals could not mention any method.

#### *Best practice in managing products in a store.*

Results show that 35 respondents were able to correctly mention first expiry first out as the best practice to observe when managing ARV drugs in a store.

#### *Meaning and importance of doing physical inventory*

The study findings show that 30 respondents were able to correctly explain the meaning of physical inventory as the process of counting by hand all units of products available at that particular time. On the other hand 25 respondents were able to mention the importance of doing physical inventory as is to know the actual stock available on the shelves in a hospital.

#### *Safety stock*

The study findings show that 28 respondents were able to explain on safety stock as that reserve stock kept on hand preventing against stock outs due to delayed deliveries and unprecedented increase in demand.

#### *Essential data for ARV drugs report*

Results show that 38 respondents were able to mention both stock on hand, consumption rate and losses/adjustment as essential data for ARV drugs report at the hospital. The findings of this study indicate that they have enough understanding of the basics of pharmaceutical logistics among professionals who were involved in ARV drugs SCM. All of them know the supply system which was used in their hospitals to obtain the needed ARV drugs.

It is important for the people at the last step of the supply system to understand their responsibilities so that ARV drugs can reach patients (Norman *et al.*, 2007). Results also show that two personnel did not able to mention any method used in estimation of ARV drugs need, while 28 personnel (70%) were able to mention only one method. This shows that quantification methods and procedures were not very well known to the professionals. Furthermore, the study shows that five professionals were not able to identify the use of “First Expiry First Out” (FEFO) as the best practice while managing ARV drugs in store. Regarding the concepts of physical inventory and safety stock, this study has revealed that, these concepts were known to majority of the personnel. The findings indicate that the basic principles were properly followed, and products will not expire simply because of failing to implement the “FEFO” principle. Also by keeping safety stock and regularly doing physical stock could help to reduce unnecessary stock outs. Lack of enough knowledge in the pharmaceutical logistics has been reported in a study that was done in Dar es Salaam to assess medicines stock out and inventory management problems in public hospitals. The study found that 65% of the personnel did not know the methods used in estimating pharmaceutical needs (Kagashe & Massawe, 2012).

In addition, the study assessed logistics knowledge of professionals involved in the ARV drugs supply chain management. To assess their logistics knowledge: the knowledge of staff was categorized as poor, average and good. Grading was based on the knowledge scale provided on table 3.

**Table 3: Grading of knowledge Level**

Category	Knowledge Level
Answered 5 to 7 questions correctly	Good
Answered 3 to 4 questions correctly	Average
Answered 0 to 2 questions correctly	Poor

Table 4 shows the knowledge level of professionals who were involved in ARV drugs supply chain management. The proportion of professionals who had good knowledge was 70%. This indicates that in general the professionals have enough knowledge in logistics.

**Table 4: Pharmaceutical Logistics System Knowledge Level of Professionals**

Level of knowledge	Frequency	Percent
Good	28	70%
Average	7	18%
Poor	5	13%

#### **4.1.1.2. Length of Resupply Period**

The assessment tried to assess the length of the resupply period by examining the perception of the facility key staff on the timelines on the resupply period for products requested by the hospital. Accordingly, the result showed that on average, for a normal order, it will take, approximately two weeks to one months between sending an order and receiving products from PFSA. This result is encouraging in that the supplying PFSA hub has maintained the resupply period which within the one month's period of request as it is recommended on the IPLS SOP.

To help maintain adequate stock levels, the maximum months of stock, minimum months of stock and an emergency order point have been established for each health facility in the system. Hospitals are required to report and order every two months. Hospitals calculate their own order quantities, ordering sufficient quantities of all pharmaceuticals to bring stock levels up to the maximum level. (PFSA, 2015).

As per the recommendation of the Standard Operation Procedure (SOP) designed by PFSA, PFSA is responsible to resupply health facilities with the requested quantity within one month of receiving resupply request from health facilities. (PFSA, 2015).

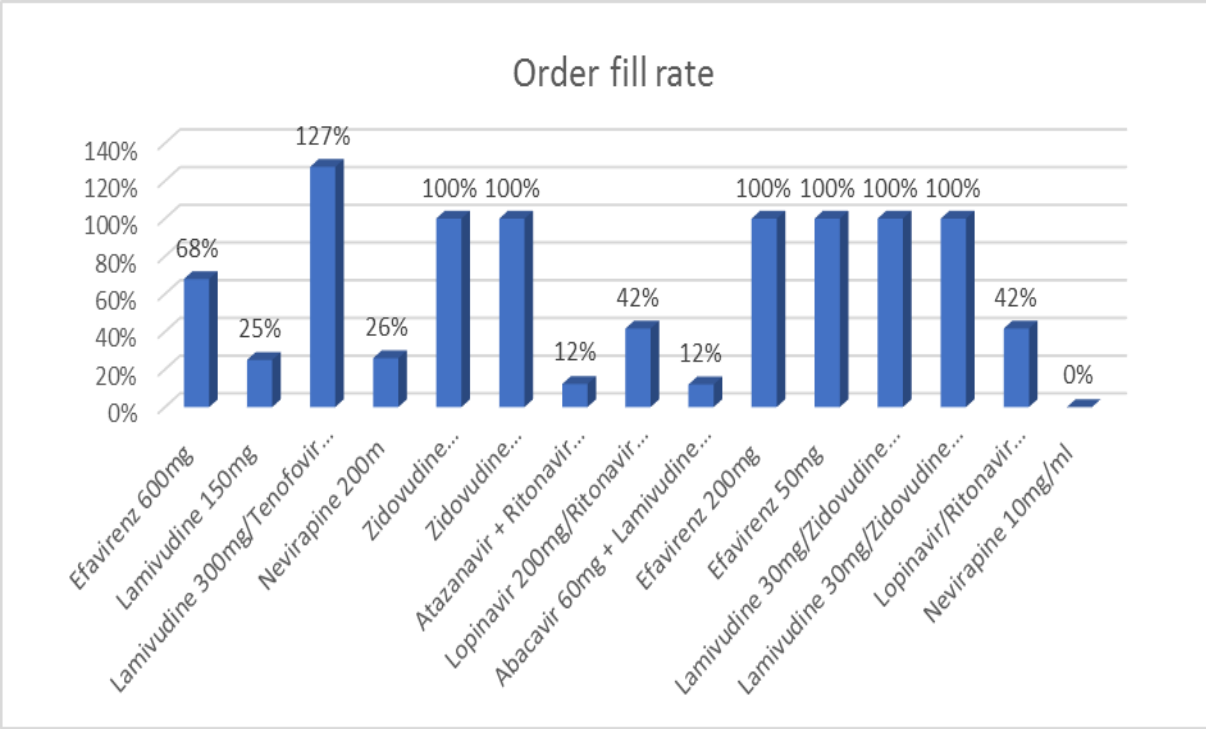
#### **4.1.1.3. Order Fill Rate**

In this research, the order fill rate which is percentage difference between quantity ordered by the hospital and quantity received from the higher supplying unit (PFSA hub) is assessed. Hence, as it can be shown from the figure 3 below, out of the 17 types of ARV drugs, the hospital has recently placed order (request of resupply) for 15 products, out of which for 6 products, same quantity is received as per requested (100 % order fill rate), for 7 products the hospital received with less quantity (68 – 12%), for one product the hospital received more than the requested quantity, while one items was not totally delivered (0% order fill rate) even though requested by the hospital. This result shows that among the total of 15 drugs requested only 6 of them (61.5%) had a perfect fill rate (100%).

Such gaps in order fill rate performance is also observed in other studies. For example, in a pharmaceutical logistic assessment conducted in Sudan in 2011, it is reported that only 24 % of health facilities received the quantity of the RDF drugs they ordered (Dick M., Farai C. & Joseph N., 2011)

Further assessment was done on the reason for not having the perceived order fill rate by the hospital. Hence, the result obtained from the respondent interview showed that the two reasons for not having the exact amount of items requested by the hospital are absence of adequate stock at the resupplying PFSA hub and sock out of items during the resupply period at the resupplying PFSA hub.

Combined request resupply with the previous request were the reason explained for one of the product received more than the hospital request.



**Figure 3: List of drugs ordered during the recent order period Vs order fill rate**

**4.1.1.4. Emergency Order Placement**

This assessment also tried to see the emergency order trend. As per the result obtained from interviewing of the key personnel, in addition to using the RRF and IFRR, the hospital places emergency orders. The assessment further showed that for the last six months the hospital made three emergency orders of ARV drugs from the PFSA supplying hub. Having an emergency order of three times within six months period is not considered frequent and hence the trend is encouraging.

According to IPLS SOP manual facilities should always be able to maintain the maximum-minimum inventory stock level so that they can always have enough amount of stock in their store in order to serve their clients and bring the desired health outcome. This maximum-minimum inventory stock helps to avoid emergency orders, and stock outs. If the stock on hand for any product at a facility falls below a set emergency order point before the end of the reporting period, an emergency order should be placed. (PFSA, 2015).

As per the requirement of IPLS and under normal condition hospitals are expected to request refill by sending their RRF report to PFSA every two months and it is only under rare condition when their stock fall below two weeks consumption should they request emergency order so that they can avoid stock outs. Hence, as per the IPLS recommendation frequent emergency order is not encouraged. (PFSA, 2015).

#### 4.1.2. Inventory Management System of ARV Drugs at SPHMMC

SPHMMC is managing the inventory of seventeen ARV products and these products are managed by pharmacists. During the assessment the availability of inventory recording tools, the utilization of this tools and the accuracy of the recording practices were evaluated. Also ARV drugs stock availability on the day of assessment and with the previous six month period was assessed. The findings are indicated below.

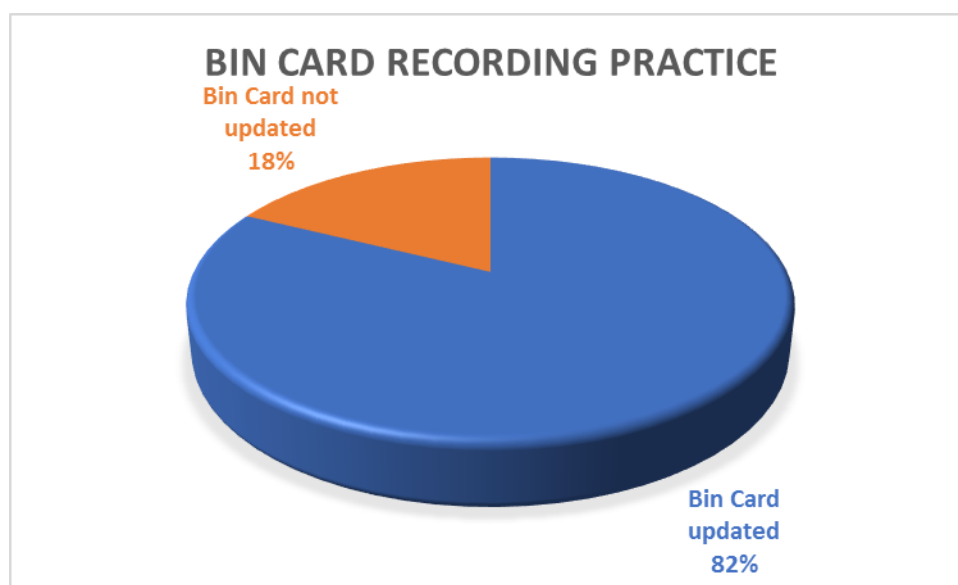
##### 4.1.2.1. Availability and Utilization of Stock Records

The assessment recorded whether the hospital pharmacy store managers were keeping bin cards for the medicines they managed and whether those bin cards were up-to-date on the day of visit (defined as bin card updated with last transaction or bin card last updated with the balance of 0 and the facility has not received any product since the date of entry). As it can be shown from the below table (Table 5), 17 ARV drugs are managed in the hospital and all of them have bin cards. As it can be shown in the figure 4 below, the bin card is updated for 82% of ARV products.

**Table 5: List of ARV Medicines with Bin Card Available and Updated**

S.No	Product	Units of count	Bin card available	Bin card updated
1	Abacavir 300mg	Tablet	Yes	Yes
2	Efavirenz 600mg	Tablet	Yes	Yes
3	Lamivudine 150mg	Tablet	Yes	No
4	Lamivudine 300mg/Tenofovir 300mg	Tablet	Yes	Yes
5	Lamivudine 300mg/Tenofovir 300mg / Efavirenz 600mg	Tablet	Yes	Yes
6	Nevirapine 200m	Tablet	Yes	Yes
7	Zidovudine 300mg/Lamivudine 150mg	Tablet	Yes	Yes
8	Zidovudine 300mg/Lamivudine 150mg /Nevirapine 200mg	Tablet	Yes	Yes
9	Atazanavir + Ritonavir (300+100) mg	Tablet	Yes	No

10	Lopinavir 200mg/Ritonavir 50mg	Tablet	Yes	Yes
11	Abacavir 60mg + Lamivudine 30mg	Tablet	Yes	Yes
12	Efavirenz 200mg	Caps	Yes	Yes
13	Efavirenz 50mg	Caps	Yes	Yes
14	Lamivudine 30mg/Zidovudine 60mg /Nevirapine 50mg	Tablet	Yes	Yes
15	Lamivudine 30mg/Zidovudine 60mg	Tablet	Yes	Yes
16	Lopinavir/Ritonavir 80/20mg/ml	Soln	Yes	Yes
17	Nevirapine 10mg/ml	Susp	Yes	No



**Figure 4: Bin Card Recording Practice**

According to IPLS SOP Manual, the purpose of an inventory control system is to inform personnel when and how much of a pharmaceutical to order and to maintain an appropriate stock level to meet the needs of patients. A well designed and well operated inventory control system helps to prevent shortages, oversupply, and expiry of pharmaceuticals. (PFSA, 2015).

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. Bin cards and stock record cards are used to account for products held in store, including their receipt and issue. The bin card is used at all public health facilities. In collaboration of its partners, PFSA introduced by printing and distributing these important

recording and reporting tools to health facilities like SPHMMC. These tools and formats include bin cards, Stock cards, Internal Facility Report and Resupply Form (IFRR). (PFSA, 2015).

As per the result obtained in this study during the day of visit, this assessment showed that all (100% of) the required inventory management blank logistics recording and reporting tools such as bin cards, RRF Formats and IFRR formats are available in the hospital.

In a Pharmaceutical Logistics System Assessment using LIAT done in Sudan in 2011 showed that the availability of blank logistics recording and reporting tools in health facilities was only 39%. (Dick M. ,Farai C. & Joseph N. ,2011)

In addition, according to an assessment of IPLS for the management of HIV/AIDS and TB laboratory diagnostic commodity in public health facilities in Addis Ababa in 2016, availability of IPLS formats for recording and reporting such as bin cards, internal facility report and requests (IFRR), and report and request forms (RRF) was reported in majority of facilities (92.6%). (Tilahun *et al.*,2016).

When compared to the above two studies done in Sudan and in Addis Ababa, 100 % availability of blank inventory recording and reporting tools such as bin cards, RRF Formats and IFRR formats for use at SPHMMC is highly encouraging which needs continued attention, effort and commitment so that consistent and continuous availability of these tools are maintained every time.

As it can be shown from the result part (Table-5), even though bin card is available for all the 17 ARV drugs, bin cards are updated for 82 %. This is a significant gap in the hospital and much has to be done to improve this gap so that regular update of bin cards can be maintained at full scale.

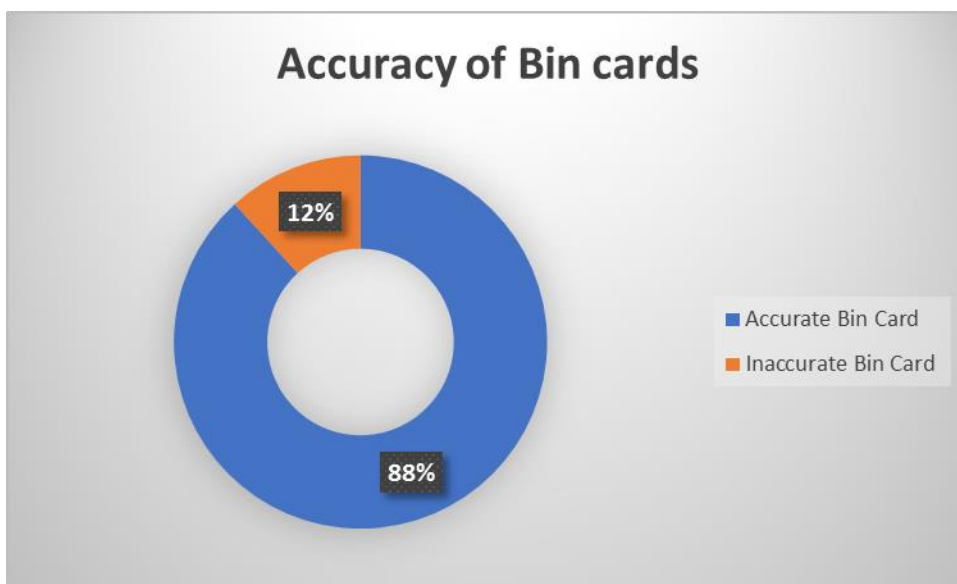
Such gap of failing to regularly update bin cards are also observed in other studies among which are; in a study with assessment of the practice for HIV/AIDs and TB laboratory commodities done in selected public health facilities in Addis Ababa, only in 25% of the Hospitals and 20.8% of the Health Centers exhibited accurate update of bin cads. (Adino et al, 2013)

Also in similar studies of assessing IPLS for the management of HIV/AIDS and TB laboratory diagnostic commodity in public health facilities in Addis Ababa in 2016, regular update of bin

cards was reported to be in 61.5% of health facilities. (Tilahun A, Geleta DA, Abeshu MA, Geleta B, Taye B,2016)

#### 4.1.2.2. Accuracy of Logistics Data for Inventory Management

To check whether the balance recorded on the bin card is accurate or not, physical count was taken during the day of visit and two of the products (12%) showed inaccurate balance record on the bin card while for the other types of items (88 %) the record balanced with the physical count of the stock on the day of visit. See Figure 5 below.



**Figure 5: Bin Card Record Accuracy for ARV Drugs**

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. (PFSA, 2015).

A given bin card is considered up to date, if it is updated with in the previous 30 days or if the bin card was last updated with the balance of zero for a given product and the facility has not received any amount of that given product since then.

In addition to checking timely update of bin cards, the quality of updated data on bin card was cross checked by comparing the accuracy of bin card balance with the physical count for all the 17 ARV drugs available in the hospital store. The comparison was done at two levels of accuracy in such a way that a bin card balance with perfect accuracy (no discrepancy) with the physical

count is considered accurate while a bin card having a less than 10 % discrepancy in value between the bin card balance and the physical count is considered near to accurate.

Logistics records serve as the primary framework for every logistics system. Accurate inventory keeping records are essential for proper inventory management. This survey has shown that, 88% of them showed accurate bin card balance recording when compared with the physical balance.

In another study made on the inventory management of ARV drugs at community health centers in the Cape Metropole in Western Cape town in 2015 showed that the variation between stock records and physical counts for the ARV drugs assessed was 51.6%, (Mahoro M,2015), which shows that the percentage of inaccuracy is higher than the one observed in SPHMMC). In a national survey conducted by PFSA in 2015, the accuracy of balances on bin cards by facility level showed that at hospitals, accurate balances ranged from 29 percent to 71 percent per different items with an average of 49 percent.

Such gap of data accuracy in updating bin cards which are the fundamental logistic records that help to capture essential inventory data across the supply chain need special attention otherwise will result in poor inventory management practice of ARV drugs.

Proper utilization of RRF and IFRR formats is important to report the previous consumption of items and as the same time requesting the reasonable amount of stock for the next period use which is crucial to avoid stock out and expiry. As it can be shown from the result part, in this study, it is observed that the Hospital store uses RRF and the dispensing unit uses IFRR formats for reporting of previous consumption and requisition of resupply for the next period consumption. While utilizing the RRF and IFRR formats by the hospital store and IFRR by the dispensing unit is an encouraging practice, it is also observed that there is still some gap in that some columns of the IFRR and RRF remains unfilled which may contribute to provide incomplete information for decision making. This gap may be caused due to the work load and limited man power available in the hospital which is evidenced at the time of visit by the principal investigator and the response of key informants for questions related to challenges in supply chain management of ARV drugs the hospital.

The average percentage of stock records that correspond with physical counts provides a measure of the quality of the stock record-keeping system. The ideal target for this indicator is

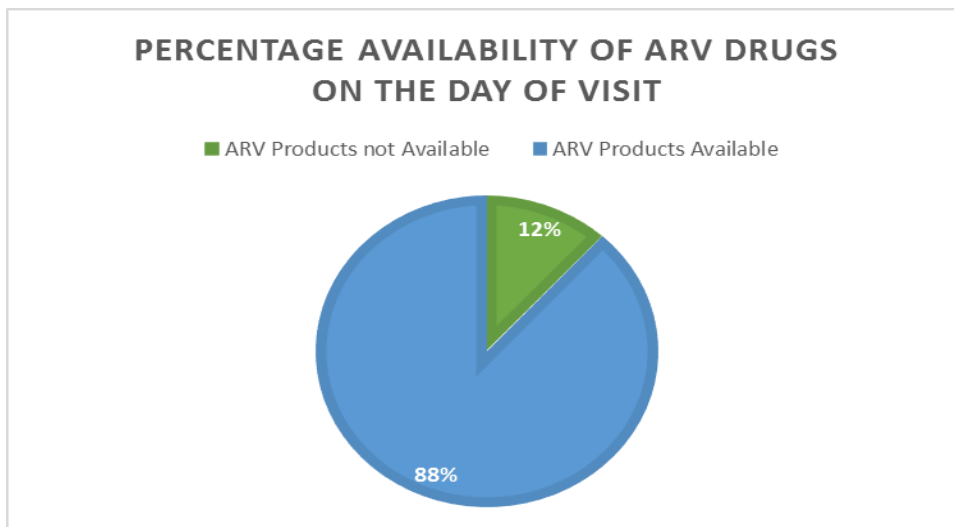
100%. Record keeping in this hospitals was both manual and electronic tools called Health commodity management information system (HCMIS). Stock records serve as a key source of information that is used by health facilities in estimating their needs for pharmaceuticals. Inaccurate records pose increased risk for problems of stock outs, leaks and expiry (Tetteh, G., J. Mwangi., 2004) Findings in this study about the inaccuracy of record keeping practices in health facilities, underscores the need for the Government to strengthen the record keeping system in this hospital.

#### **4.1.2.3. The Stock Availability of ARV Drugs at SPHMMC**

In this study, stock availability was assessed based on; stock out duration during the six-month period prior to the assessment (October 1, 2017 to March 31, 2018) and availability on the day of assessment. The survey collected data on both stock on hand, stock outs on the day of visit and stock outs during the previous six months period.

##### **4.1.2.3.1. Stock Availability of ARV Drugs on the Day of Assessment**

Availability of ARV drugs on the day of assessment was expressed as the percentage of ARV drugs available on the day of assessment in the hospital. Figure 6 shows the average percentage of ARV drugs that were in stock on the day of assessment at SPHMMC.



**Figure 6: Availability of ARV Drugs on the Day of Visit**

#### 4.1.2.3.2. Stock Availability for the Six-month Period Prior to the Assessment

As clearly seen on table 6, as per the observation of bin card records, for a period of recent six months prior to the visit, the result shows that four products namely Lamivudine 150mg Tabs, Lamivudine 300mg/Tenofovir 300mg Tabs, Atazanavir + Ritonavir (300+100) mg Tabs and Abacavir 60mg + Lamivudine 30mg Tabs were found to be stock outs for five, three, one and five times and with a total number of days of stock outs of 60, 45, 15 and 50 days, respectively. The main reasons mentioned for stock out during those period was, not receiving the quantity ordered from PFSA and PFSA was stock out during those period.

**Table 6: Stock Outs During the Recent 6 Months Prior to Visit for ARV Drugs**

S.No	Product	Stock out during the recent 6 months, prior to visit (Yes/No)	Number of stock outs	Total number of days stock outs
1	Lamivudine 150mg	Yes	5	60 days
2	Lamivudine 300mg/Tenofovir 300mg	Yes	3	45 days
3	Atazanavir + Ritonavir (300+100) mg	Yes	1	15 days
4	Abacavir 60mg + Lamivudine 30mg	Yes	5	50 days

#### 4.1.2.3.3. Average Percentage of Time Out of Stock of ARV Drugs

Stock out within the last six months period was expressed as the average percentage of time that products were out of stock in the hospital. The study has found that 5.56% of the time the hospital had experienced stock out of ARV drugs within the last six months period.

The primary reason for holding stock in a pharmaceutical supply system is to ensure availability of essential items almost all the time (MSH, 2012). Stock outs and overstocks in any health system are important indicators of the logistics system lack of effectiveness and efficiency. Stock outs may result into unavailability of life saving medicines, disrupt course of treatment and ultimately patients and health workers may lose trust to the health system. Overstocking on the other hand puts products in increased risk of expiration or damage before they are distributed. (Bunde *et al.*, 2007)

This study found that the hospital had experienced stock out of a certain products for the previous six months and on the day of assessment. An indicator, average percent of time that

products are out of stock, indicate the capacity of a system to maintain constant supply of products over time by minimizing out of stock duration. (MSH, 2013). Average percent of time out of stock of ARV drugs in the hospital was 5.56%. These results show that logistics system in SPHMMC was not performing well. In an ideal situation the value should be zero.

In this study availability was also assessed based on percent of ARV drugs available on the day of visit. Percentage of products available help to measure the effectiveness of the system in maintaining the full list of products that need to be in stock at the day of assessment. (MSH, 2013). The study found that, the average percent of ARV drugs available on the day of assessment was 88%. These findings, again, shows the performance of the system was not good. For an ideal system availability on the day of visit should be 100%.

Different studies showed a record of stock out for certain items during an assessment. For example, in an assessment of pharmaceutical sector in Ethiopia in 2010, it was observed that the national average for availability of essential drugs in public health facilities was 70% (30 % stock outs) and the average duration for stock out is 99.2 % days which are higher figures when compared with the result of this study as discussed above. (WHO, 2010)

An assessment for stock status and logistics conducted in 2006, in Kenya, found that average percent of time out of stock for malaria products was 51.7% in district stores, 40% in health centres and 36% in dispensaries. (Bunde *et al.*, 2007). Also, an assessment that was done in Tanzania mainland found that average percent time out of stock of some medicines in the surveyed facilities was 33.3% (Bunde *et al.*, 2007). Another assessment which was done in Malawi found that the average percentage of time out of stock for medicines to manage malaria in the surveyed facilities was 33.3% (Norman *et al.*, 2007). All these studies highlight the fact that performance of many pharmaceutical logistics systems especially in sub-Saharan Africa is not good.

In this study, out of the 17 types of ARV drugs, 2 of them (Lamivudine 150mg tab and Abacavir 60mg + Lamivudine 30mg tab) are out of stock on the day of visit. The main reasons mentioned for stock out was, not receiving the quantity ordered from PFSA. For this purpose, PFSA key informants were interviewed and the stock status report of PFSA were reviewed and these products were stock out at central level. The reason mentioned by the key personnel for this stock out at central level was delay in procurement (Long procurement lead times). To solve the

issues of longer lead time PFSA is now embarking on framework contract procurement practice. And this will somehow resolve the stock out issues at facility level.

#### **4.1.3. Logistic Management Information System of ARV Drugs at SPHMMC**

SPHMMC used both computerized and paper based recording and reporting tools. The hospital used computerized EDT and HCMIS at dispensary and store respectively.

In addition to these, RRF and Internal Facility Reporting and Requisition (IFRR) were used to facilitate and control stock movement between PFSA and hospital and within the hospital itself respectively.

The study showed that EDT reduces the work load of the pharmacists and the data clerk at ART dispensary. The hospitals mainly used EDT to record patient information than paper based format like Daily ARV drug register even though there was risk of power interruption and risk of losing the patient data. EDT contains all the drugs currently dispensed at facilities unlike HCMIS. The EDT could mark the patient as lost or dropped if the data of the patient was not entering appropriately or the patient was actually missed. Since there is large number of HIV/AIDS patients this computerized software eases the work of the health professionals.

The other software was HCMIS, used in the store to control stock movement. The key respondent said that this software has many advantage. Firstly it was mentioned that it makes the job easy. This tool summarizes their data, preparing different reports, having its own expiry tracking chart and it helped them to understand the utilization pattern of the drug.

The purpose of a Logistics Management Information System (LMIS) is also mentioned in the SOP as to collect, organize, and report information to other levels in the system in order to make decisions that govern the logistics system. Stock on hand, consumption data and losses/adjustments are mentioned in the document as the three essential data required to run a logistics system and, therefore, must be captured by the LMIS. (PFSA, 2015).

SPHMMC used both computerized and paper based LMIS. It was reported that the computerized LMIS helps them to perform their day to day task in a facilitated manner. Similarly literature said that most LMIS related with HIV/AIDS 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. (USAID/DELIVER PROJECT, 2008).

RRF and IFRR were paper based format used to report, order and control stock movement. RRF was used to report and order ARV drugs from PFSA.

Instead IFRR was used to facilitate movement of products within the hospital itself.

#### **4.1.4. The Storage Conditions of ARV Drugs at SPHMMC**

In order to assess the storage condition of the hospital, 17 standard criteria (see APPENDIX) was considered and physical inspection with interviewing key hospital staff were used to evaluate compliance of the hospital store to these criteria.

Careful observation using check list during the day of visit showed that the most common storage conditions met by the store room. According to the observation drugs were protected from direct sunlight and high heat; cartoons and drugs were protected from water and humidity; drugs seems to be stored at appropriate temperature even though the store room lacks wall thermometer to verify this all the time; the store room was equipped (in separate room) with refrigerator for storage of drugs that require cold storage condition; storage was well secured with lock and key; roof was well maintained in good condition to avoid sunlight and water penetration; store room was well maintained in good condition (clean and tidy, all trash removed, equipped with well-organized shelves and boxes); storage area was visually free and protected from harmful insects and rodents; products were stacked at least 10 cm off the floor; fire safety equipment are in place and accessible; drugs were stored separately from insecticides and chemicals and there was separate room/ location to store or put expired and damaged items before they get disposed.

Storage Conditions that are not met by the store room of the facility was also observed by using the check list. In the store majority of the drugs were not arranged properly and professionally in such a way to enable that identification labels and expiry dates and/or manufacturing dates are visible; majority of drugs were not organized and arranged in a manner that is accessible for first- expire – first out (FEFO) stock rotation method; the current space of the store room was not sufficient for the existing products and reasonable expansion; some products were stacked with very much less than 30 cm away from the walls (even some products are arranged in a palate leaning the wall) and most products were stacked with more than 2.5 meter high with some piled

up nearest to the roof. In addition, the store room lacks implant equipment to regulate and monitor room temperature such as ventilator and room wall thermometer, respectively.

As it can be shown in the above paragraphs, it was observed that among the 17 standard criteria set to measure compliance of the storeroom with acceptable standard condition, it was observed that the store room fulfilled 12 of them (70.6%). Hence, since this figure is less than 80%, which is a minimum requirement for having acceptable storage condition for pharmaceuticals, the hospital store is considered that it didn't fulfil normal storage condition for pharmaceuticals storage as per the storage guideline.

Different studies also shows gaps of meeting storage condition requirements. For example, in a Pharmaceutical Logistics Assessment conducted in 2011 in Sudan, only 35% of the health facilities included in the study were able to meet the acceptable standard condition. (Dick M. ,Farai C. & Joseph N. ,2011)

Also in another study conducted in Lesotho, none of the facilities had a practice of separating damaged or expired items from usable ones which is one of a sign of poor storage management. (Pharasi B.2007).

Storage condition is important to maintain purity, potency, safety and effectiveness of pharmaceuticals for a longer period of time (USAID | DELIVER., 2011). Proper storage procedures help to ensure that storage facilities protect the shelf life of products, that only high-quality products are issued, and that there is little or no waste due to damaged or expired products. (PFSA, 2015)

## **CHAPTER FIVE**

### **5. SUMMARY, CONCLUSION AND RECOMMENDATION**

#### **5.1. SUMMARY OF MAJOR FINDINGS**

The study has revealed that availability of ARV drugs in SPHMMC was not perfect. The hospital had faced stock outs of certain ARV products. Stock outs being one of indicators for weak supply chain management system, hence the supply chain management system of ARV drugs was not effective. With respect to availability of logistics reporting and recording tools, and knowledge of health workers on the ARV drugs logistics management, the hospital had encouraging practice. But with respect to stock keeping records, SPHMMC was not perfectly accurate. There were incidences of some stock records counts to read more than what was actually available in stock and also there were incidences of some stock records count to read less than what was actually available in stock. This practice posed increased risk for stock outs, leak and expiry of ARV drugs. The hospital uses both computerized based and manual recording system. In addition, the study clearly showed a gap in perceived order fill rate and storage conditions of ARV drugs.

#### **5.2. CONCLUSION**

Detail results pertaining to the ARV drugs logistics system performance of SPHMMC with respect to logistics knowledge of professionals, resupply period, order fill rate, emergency order trends; the inventory management; proper use of logistics management information system; and fulfillment of acceptable storage conditions for antiretroviral drugs store room, were described and presented in the result section of this paper.

From the finding, this study concludes that even though some encouraging practices are observed with respect to some measurements, certain gaps are observed on supply chain management of ARV drugs in SPHMMC. With respect to logistics performance, it was concluded that in general the professionals have enough knowledge in logistics. The resupply period of the hospital was

within the one month's period of request as it is recommended on the IPLS SOP, this was encouraging practice but gaps were observed in the order fill rate performance of the hospital. With regard to the inventory management, in general there was good practices in availability and utilization of bin cards, but small gaps were observed in the accuracy of bin cards. The hospital uses both computerized based and manual recording system. With respect to the hospital store, it can be concluded that the hospital didn't fulfil normal storage condition for pharmaceuticals storage as per the storage guideline.

### **5.3. RECOMMENDATIONS**

In order to address the gaps observed in this study and to enable successful supply chain management of ARV drugs in SPHMMC, the following are recommended;

- Continuous efforts such as providing on job training, regular supervision, regular and timely monitoring and feedback on logistics recording tools to maximize proper utilization and accuracy of LMIS tools.
- Man power- work load assessment should be done by higher management to ensure adequate manpower is in place.
- Receiving a good quality LMIS data from the Hospital, the supplying PFSA hub should maintain sufficient stock of all items at all times based on accurate forecast of future needs/demands. This would help to provide the exact perceived re-fill of items with respect to type and quantity as requested by the Hospital.
- Renovation and expansion on the pharmacy store should be done and all the required storage conditions as per the storage condition requirement guideline should be fulfilled to avoid any gap with respect to the physical structure (e.g space) of the store room and fulfillment of necessary storage conditions.

### **5.4. FUTURE RESEARCH FORWARD**

This study only limited to ARV drugs supply chain management of hospital (SPHMMC), did not include pharmaceutical fund and supply agency (PFSA) and also didn't include the ARV supply chain management with clients perspective. Hence further research should be conducted on the

supply chain management of ARV drugs to triangulate the hospital supply chain management with PFSA and to see the ART clients satisfaction on the supply chain management of ARV drugs from customer service perception.

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## APPENDIX

### **APPENDIX I: List of Anti-Retroviral Drugs Being Used for Treatment** *(Source National Guideline for Comprehensive HIV prevention, care and treatment, 2014)*

No	Item Description	Unit
Adult 1 <sup>st</sup> line ARVs		
1.	Abacavir 300mg Tablet	60
2.	Efavirenz 600mg Tablet	30
3.	Lamivudine 150mg Tablet	60
4.	Lamivudine 300mg/Tenofovir 300mg Tablet	30
5.	Lamivudine 300mg/Tenofovir 300mg/Efavirenz 600mg Tablet	30
6.	Nevirapine 200mg Tablet	60
7.	Zidovudine 300mg/Lamivudine 150mg Tablet	60
8.	Zidovudine 300mg/Lamivudine 150mg/Nevirapine 200mg Tablet	60
Adult 2 <sup>nd</sup> line ARVs		
9.	Atazanavir + Ritonavir (300+100) mg Tablet	30
10.	Lopinavir 200mg/Ritonavir 50mg Tablet	120
Pediatric ARVs		
11.	Abacavir 60mg + Lamivudine 30mg Tablet	60
12.	Efavirenz 200mg Capsule	90
13.	Efavirenz 50mg Capsule	30
14.	Lamivudine 30mg/Zidovudine 60mg/Nevirapine 50mg Tablet	60
15.	Lamivudine 30mg/Zidovudine 60mg Tablet	60
16.	Lopinavir/Ritonavir 80/20mg/ml Solution	60ml
17.	Nevirapine 10mg/ml Suspension	240ml

## APPENDIX II: Data Collection Tool

### Section I. Product Availability, Bin Card Availability, Bin Card Utilization & Accuracy of Bin Cards

Table 1. This table helps to gather data that is used to assess the stock Availability of ARV Drugs (for the past 6 months), Bin Card Availability, Bin Card Utilization & Accuracy of Bin Cards

Description of each column:

1. Name of each ARV drug that will be counted.
  2. Unit of count for the product /commodity
- Note: Columns 1 and 2 will be filled out before questionnaires are printed for the survey.
3. Record whether or not the product is managed at this facility, answer Y for yes, or N for no.
  4. Check if the bin card is available, answer Y for yes, or N for no.
  5. Check if the bin card has been updated WITH THE LAST TRANSACTION, answer Y for yes, or N for no.

Note: If the bin card was last updated with the balance of 0 and the facility has not received any of that product since the date of that entry, consider the bin card up-to-date.

6. Record the balance on the bin card.
7. Record '1' for accurate balance and '0' for near accurate balance
8. Record if the facility has had any stockout of the product during the 6 month period from October 1/ 2017-March 30/2018, answer Y for yes, or N for no.
9. Record how many times the product was stocked out during the 6 month period, October 1/ 2017-March 30/2018, according to bin cards, if available.
10. Record the total number of days the product was stocked out during October 1/ 2017-March 30/2018, only.
11. Record the physical count in the storeroom.
12. Record if the facility has expired products.
13. Reason(s) for stockouts. For any product that experienced a stockout in the last six complete months before the survey, record the specific reason(s) for the stockout.

*\* Reason(s) for stockout: (1) did not receive order; (2) did not order on time; (3) do not know how to order; (4) did not receive the quantity ordered; (5) stockout at the central level; (6) transportation not available for delivery.*



**Table 2. Stock Status on the Day of Visit**

**Descriptions of the column:**

Column 1. Name of all authorized ARV drug products

Column 2. Unit of count for the product

Note: Column 1 & 2 are filled out before questionnaires are printed for the survey.

Column 3. Record if the hospital experiencing a stock out of the product on the day of visit. Answer Y for yes or N for no. Visually verify that usable products are in stock.

Column 4. Record reasons for stock out of the product on the day of visit.

*\* Reason(s) for stockout: (1) did not receive order; (2) did not order on time; (3) do not know how to order; (4) did not receive the quantity ordered; (5) stockout at the central level; (6) transportation not available for delivery.*

S.No	Product	Units of count	Stock out today? (Y/N)	Reasons for Stock out
	1	2	3	4
1	Abacavir 300mg	60 Tab		
2	Efavirenz 600mg	90 Tab		
3	Lamivudine 150mg	60 Tab		
4	Lamivudine 300mg/Tenofovir 300mg	30 Tab		
5	Lamivudine 300mg/Tenofovir 300mg / Efavirenz 600mg	30 Tab		
6	Nevirapine 200m	60 Tab		
7	Zidovudine 300mg/Lamivudine 150mg	60 Tab		
8	Zidovudine 300mg/Lamivudine 150mg /Nevirapine 200mg	60 Tab		

9	Atazanavir + Ritonavir (300+100) mg	30 Tab		
10	Lopinavir 200mg/Ritonavir 50mg	120 Tab		
11	Abacavir 60mg + Lamivudine 30mg	60 Tab		
12	Efavirenz 200mg	90 Caps		
13	Efavirenz 50mg	30 Caps		
14	Lamivudine 30mg/Zidovudine 60mg /Nevirapine 50mg	60 Tab		
15	Lamivudine 30mg/Zidovudine 60mg	60 Tab		
16	Lopinavir/Ritonavir 80/20mg/ml	1 bottle		
17	Nevirapine 10mg/ml	1 bottle		

## Section II. Order Fill Rate.

**Table 3. This table is used to collect data that will help to assess the order fill rate by examining the percentage difference between quantity ordered and quantity received.**

Descriptions of each column

Column 1. List of same products as in table 1.

Column 2. Check if RRF are available (answer Y for yes and N for no)

Column 3. Enter the quantity ordered for the last order period for which the product should have been received. (Don't include open orders whose expected receipt date has not arrived).

Column 4. Enter the quantity received in the last order.

Column 5: Enter **Reasons for discrepancy:** Reasons for discrepancy (1)The resupply point does not have adequate supply (2), the resupply point was stocked out, (3) Order amount was changed at the resupply point (4) Not sure/Don't know, (5) Other, specify.

<b>Product</b>	<b>Are RRFs available? No=0 Yes = 1 (If NO Skip to next item – only use acceptable data sources)</b>	<b>Quantity Ordered For Last Order Period</b>	<b>Quantity Received In Last Order/Procurement</b>	<b>Reasons for discrepancy</b>
1	2	3	4	5
Abacavir 300mg				
Efavirenz 600mg				
Lamivudine 150mg				
Lamivudine 300mg/Tenofovir 300mg				
Lamivudine 300mg/Tenofovir 300mg / Efavirenz 600mg				
Nevirapine 200mg				
Zidovudine 300mg/Lamivudine 150mg				
Zidovudine 300mg/Lamivudine 150mg /Nevirapine 200mg				
Atazanavir + Ritonavir (300+100) mg				
Lopinavir 200mg/Ritonavir 50mg				
Abacavir 60mg + Lamivudine 30mg				
Efavirenz 200mg				
Efavirenz 50mg				
Lamivudine 30mg/Zidovudine 60mg /Nevirapine 50mg				
Lamivudine 30mg/Zidovudine 60mg				
Lopinavir 100mg+ Ritonavir 25mg				
Lopinavir/Ritonavir 80/20mg/ml				
Nevirapine 10mg/ml				

**Section III.** Questionnaire for assessing the logistics knowledge level of professionals involved in the ARV drugs Supply Chain Management

ADDIS ABABA UNIVERSITY SCHOOL OF COMMERCE, ARV DRUGS SUPPLY CHAIN MANAGEMENT ASSESSMENT SURVEY QUESTIONNAIRE

*Dear Respondents,*

This questionnaire is part of a partial requirement for the award of a Master of Logistics & Supply chain management degree work, required by Addis Ababa University School of commerce. The questionnaire is designed to solicit your independent views on “Supply Chain Management Practices & Challenges of ARVs at St. Paul’s Hospital Millennium Medical College (SPHMMC), Ethiopia, Addis Ababa”. All information provided shall be treated as confidential and used strictly for academic purpose. Please answer the following questions freely without indicating your name. I am grateful for your cooperation in advance!

**I. INFORMATION ABOUT INTERVIEW**

Date:	DAY	MONTH	YEAR
	<input type="text"/>	<input type="text"/>	<input type="text"/>

1. Age.....
2. Sex                      a) Male      b) Female
3. Professional status: a) Pharmacist  
                                  b) Pharmaceutical Technician  
                                  c) Pharmaceutical Assistant  
                                  d) Others (specify).....
4. How long have you been working in your profession?  
                                  a) Less than one year  
                                  b) 1 to 5 years  
                                  c) 6 to 10 years  
                                  d) > 10 years
5. How long have you been working in this facility?  
                                  a) Less than one year  
                                  b) 1 to 5 years  
                                  c) 6 to 10 years  
                                  d) > 10 years
6. Have you attended any training on logistics management of ARV drugs?  
                                  a) Yes              b) No
7. What is a supply system you use to acquire ARV drugs needed in your hospital?

a) Push system

b) Pull system

If the answer above is “a” go to question 8 and 9 and skip question 10 and 11 AND if the answer above is “b” skip question 8 and 9 and proceed to question 10

8. If is by push system, how often do you receive the supplies?

a) Monthly

b) Quarterly

c) No specific period.

9. If you receive by push system, does the facility receive the supplies on planed schedule?

a) Yes

b) No

10. If is by pull system, how often do you order the supplies?

a) Monthly

b) Quarterly

c) No specific period

11. If the system is pull, how long does it take for a facility to receive supplies after placing an order? .....

12. What methods can be used to estimate ARV drugs needs in your hospital?

a) Consumption method

b) Morbidity method

c) All of the above

d) Do not know

13. When managing ARV drugs in a store, what is the best practice to follow?

a) Last in first out (LIFO)

b) First in first out (FIFO)

c) First expiry first out (FEFO)

d) Do not know

14. What is physical inventory? .....

15. What is the importance of doing physical inventory? .....

16. What is safety stock? .....

17. What are the essential data used to report ARV drugs?

a) Stock on hand

b) Consumption

c) Loss/adjustment

d) All of the above

e) Do not know

## Section IV. Storage Conditions

**Table 5.** This table is used as a check list to assess the storage condition of the Hospital which is used to store drugs. Place a check mark in the appropriate column based on visual inspection of the storage facility. Write any relevant observation noted in the comment's column.

N: B. to qualify as ‘‘yes’’ for each criteria, the store room must meet the requirement as per described per each criteria

No.	Description	No.	Yes	Comments
1	ARV drugs are arranged properly and professionally in such a way that identification labels and expiry dates and/or manufacturing dates are visible.			
2	ARV drugs are stored, organized and arranged in a manner that is accessible for first-expire – first-out (FEFO) stock rotation method			
3	Cartons and products are in good condition, not crushed, deteriorated, and spoiled due to mishandling. If cartons are open, determine if products are wet or cracked due to heat/radiation			
4	There is a separate location to store/put damaged and/or expired ARV drugs by removing from usable products before they get disposed using appropriate procedure.			
5	ARV drugs are protected from direct sunlight and high heat at all times of the day and during all seasons			
6	Cartons and drugs are protected from water and humidity during all seasons			
7	Storage area is visually free and protected from harmful insects and rodents (check the storage area for traces of bats and/or (dropping or insects)			
8	Storage area is well secured with a lock and key, but is accessible during normal working hours; access is limited to authorized personnel			
9	ARV Drugs are stored at the appropriate temperature during all seasons according to product temperature specifications			
10	Roof is always maintained in good condition to avoid sunlight and water penetration			
11	Storeroom is maintained in good condition (clean & tidy, all trash removed, sturdy shelves, well organized boxes).			
12	The current space of the store room is sufficient for existing products and reasonable expansion (i.e., receipt of expected product deliveries for foreseeable future).			
13	ARV Products are stacked at least 10 cm off the floor			
14	ARV Products are stacked at least 30 cm away from the walls and other stacks.			
15	ARV Products are stacked no more than 2.5 meters high.			
16	Fire safety equipment is available and accessible			
17	Drugs are stored separately from insecticides and chemicals			

## Section V. Interview with ART Pharmacy Coordinator

### Interview with the hospital ART pharmacy Coordinator

1.	Title, and mobile phone number of person interviewed for this section	Title: _____ Mobile Number: _____	
2.	Number of years and months worked in this hospital	Years: _____ Months: _____	
3.	How long have ART services been offered in this hospital?	Years: _____ Months: _____	
4.	<i>No of HIV clients in this hospital taking ARV drugs</i>		
5	What is the usual or most common source of ARV drugs		
6	For a normal order, how many days it will take for sending an order and receiving ARV products from PFSA		
7	How many emergency orders for ARV drugs were placed in the past 6 months?		
8	What are the forms/format used by the hospital to request and report ARV Medicines?		
9	Types of recording and reporting tools	Manual Computerized	
10	Is there a document that lists all the recommended ARV drug regimens to be prescribed and dispensed in this hospital?	Yes No	
11	Where do you record information on the quantities of ARV drugs dispensed (consumption)?	Daily ART Register Patient Information sheet EDT Not Recorded Other	
12	Where do you record information on the quantities of ARV drugs in stock (stock on hand)?	Stock Card Bin Card Not Recorded Other	
13	Where do you record patient by regimen information?		
14	Any challenges in supply chain management of ARV drugs the hospital.		