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ADDIS ABABA UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

SCHOOL OF COMMERCE

DEPARTMENT OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT

Analysis of pharmaceutical supply chain performance in public health facilities in Addis Ababa, Ethiopia

By

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Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Arts in Logistics and Supply Chain Management School of commerce Faculty of Business and Economics Addis Ababa University

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MAY, 2018

ADDIS ABABA, ETHIOPIA

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Declaration

I, the under signed, declare that this thesis entitled "***Analysis of pharmaceutical supply chain performance in public health facilities in Addis Ababa, Ethiopia***", is my original work and to the best of my knowledge has not been presented for a degree by any other person, and that all the sources of material used for the thesis have been duly acknowledged.

Declared by:

Bezuayehu Woldehitsan Tessema

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Date & Signature

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This is to certify that the thesis carried out by **Bezuayehu Woldehitsan Tessema**, entitled: "***Analysis of pharmaceutical supply chain performance in public health facilities in Addis Ababa, Ethiopia***" and submitted in partial fulfillment of the requirements of the Degree of Master of Art in Logistics and Supply Chain Management complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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Acknowledgement

Foremost, I would like to acknowledge the extraordinary institutional support of Addis Ababa University School of Commerce authority and all staff of the department of Logistics and Supply Chain Management, who were involved in teaching throughout this three year master's program. Next, my gratitude goes to my advisor Dr. Mathios Ensermu for his support and unreserved effort in guiding me in all the time of the research and writing of this thesis.

Besides my advisor, I would like to thank my best friends Abdulhakim and Kassanesh for their encouragement, and insightful comments.

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Abbreviations and Acronyms

FMOH-Federal Ministry Of Health

KPI-Key Performance Indicators

LSAT-Logistics System Assessment Tool

MOH-Ministry Of Health

MPPD- Medicines Procurement and Planning Division

MSH-Management Science for Health

PFSA-Pharmaceutical Fund and Supply Agency

PLMP- Pharmaceutical Logistics Master Plan

PSCM-Pharmaceutical Supply Chain Management

SCM-Supply Chain Management

SCMS-Supply Chain Management System

SCPMS- Supply chain performance management system

SC-Supply Chains

WHO- World Health Organization

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Abstract

Back ground: pharmaceutical Supply chain management is the backbone of healthcare delivery. It arises from the fact that health care is dependent on the availability of drugs and other medical supplies at the right time and in the right quantities for the management of patients. Public health facilities are facing challenges in assuring uninterrupted pharmaceuticals that are efficacious and have good quality, physically and financially accessible and used rationally. Developing a framework for assessing the performance of the supply chain requires certain assumptions, including the ones related the areas of its measurement. Several types of indicators have been developed to measure many supply chain and logistics activities.

Objective: study aimed at analysis of the performance of pharmaceutical supply chain management practices and the strength and weakness at public health facilities in Addis Ababa

Methodology: a quantitative and qualitative study approaches were employed to analyze the pharmaceutical performance of public health facility. The data was collected by using performance indicator analysis check list from 41 health facilities (2 referral hospitals, 2 regional hospitals and 37 health centers) questionnaire was used to collect data from Medical director, Store Manager and Pharmacy and key personnel from PFSA were interviewed and data collection check list was used to collect past performance of the health facilities. The health facilities were classified into their sub cities and type of facility and each facility was selected by using lottery method. Each individual to be studied were selected purposely.

Result: A total of 41 Health facilities were observed and all the observed health facilities have their own facility specific drug list, low warehouse accident rate, most of the facilities have a supply planning but 58.54% of the surveyed health facilities encountered stock out of essential medicines. 64% of the pharmaceuticals price is below the average international price. Wastage rate range from 1.04-10.21% and the average inventory turnover rate was 0.82. The pharmaceutical supply chain performance of the public health facilities with respect to quality, responsiveness, cost and roductivity were found moderate.

Conclusion: From this study we can conclude that the public health facility supply chain performance using different measuring indicators showed that the performance was moderate and poor availability of essential medicines, poor order fill rate, long lead time, high rate of expiry and low inventory turnover rate was seen.

Recommendations: Public health facilities should revise their specific drug list, improve quantification, reduce rate of expiry in addition to this PFSA should consider the cost effectiveness of the producs, improve transportation and improve lead time.

Key words: Public health facility, Pharmaceutical, Pharmaceutical supply chain performance

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Chapter one

Introduction

1.1. Background of the study

High proportion of health budgets spent on drugs in many countries, particularly in developing countries, thereby limiting the remaining funds available for the provision of adequate health care to the whole population through primary health care; (WHO, 1987). Pharmaceutical Expenditures, in low-income countries total pharmaceutical expenditure constituted around 30% on average of total health expenditure (range 7.7% to 62.9%) *(WHO,1987).*

Pharmaceutical supply chain management is the backbone of healthcare delivery. This arises from the fact that health care is so dependent on the availability of drugs and other medical supplies at the right time and in the right quantities for the management of patients. Lack of the pharmaceutical product at the point of need often leads to an unnecessary loss of lives which could otherwise have been prevented. Pharmaceutical Supply Chain Management (PSCM) practices play a major role in the availability of the pharmaceutical and non-pharmaceuticals.

Efficient public health supply chain performance is essential for assuring access to health supplies, and thus for positive health outcomes. This is particularly important in most countries in sub- Saharan Africa where large proportion of the population is served by the public and mission health sectors. The public/mission health supply chain manager therefore has an essential role in the realization of global public health goals, for improving maternal health, reducing child mortality, and combating HIV/AIDS, malaria and other diseases. Rapidly increasing health assistance from multilateral and bilateral donors has significantly benefited health programs, but has also resulted in huge increases in the quantity and value of commodities flowing through public health supply chains — a trend that will continue as newly developed products (many with demanding supply chain requirements) continue to be introduced into developing countries health systems.

In order to achieve these goals, there should be adequate supply of logistics which are needed for efficient and effective service delivery. There should also be proper management of logistics in order to achieve these goals. Logistics bridges the physical and temporal gaps in a

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global supply chain. Efficient logistics makes a global economy possible, lowering the cost of living for the people of the world. In the name of efficiency, information technology has been adopted to support logistics for many years *(John Frimpong, 2013).*

In health logistics system, the supply chain partners are the manufacturers who are the pharmaceutical companies which supply raw materials, the procurement agents such us the ministries of health, health administrative units, United Nations agencies and others. Distributors are composed of the transporters, the central, the regional and the district medical stores. Financiers are donors or funding agencies.

Measuring supply chain performance might lead to a greater understanding of the supply chain and helps to test and reveal the viability of a firm's strategies. In addition, Ramaa et al. (2009) state that measuring supply chain performance provides important feedback information, helps to reveal progress, increase employers' motivation and communication, and helps to diagnose problems. The measures that help a company measure their progress on performance objectives in everyday work are often referred to as key performance indicators (KPIs).

Garcia et al. (2012) proposed four performance attributes within which they defined specific KPIs related to each level of the whole logistics process. In particular, following the approach proposed by Frazelle (2002), which provided for the introduction of cost/financial, productivity, quality and responsiveness. The quality attribute (product selection, procurement plan, stock out rate, product availability and warehouse accident rate) is related to both the quality of the processes and service along the supply chain. WHO defines essential medicines are those satisfy the needs of the majority population. Therefore should be available all the time. Selection of medicines should be from national essential medicine list *(MSH, 2012).* The responsiveness attribute is related to the response of the supply chain, required to meet the needs of customers. It aims at providing the requested type of products with a short lead time. It may include order fill rate, customer response time and on time delivery. The logistics costs attribute is related to the financial logistics performance and affordability. The KPI for the procurement functional area is the percentage of international reference price paid, which indicates how efficiently public money is spent for the procurement of medicines (International Drug Price Indicator Guide, 2014). Productivity is related to the efficiency of the use of the resources

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KPIs can therefore be used to measure the performance of a specific process of the supply chain, to supervise the progress of its performance over time and, through the implementation of benchmarking techniques, compare the performance of the supply chain with those of the supply chain of the other competing companies (benchmarking) and improve customer satisfaction *(MSH, 1997).*

1.2. Public Health Facility Supply Management System in Ethiopia

In order to study the business process in the health facility supply chain, the structure of the supply chain must first be explored. Pharmaceutical Supply chain of health facility can be considered more complex than other supply chains. The ultimate customer of the health facility supply chain is patients who visit the health facility seeking diagnosis and treatment *(Parnaby &Towill,, 2009)*

In 1993 Ethiopia has issued National Drug Policy which is part and parcel of the health policy which has served as an umbrella for pharmaceutical services in Ethiopia *(MOH, 1993).* Since the start of HSDP I, the government of Ethiopia was committed to ensuring community's access to the essential medicines that are safe, effective and of assured quality including rational drug prescription and use. Moreover, since HSDP III a number of reforms have been employed that have significant impact on quality of pharmaceutical service.

One of the reforms is the Pharmaceutical Logistics Master Plan (PLMP) which was introduced in 2009 with the aim of ensuring the uninterrupted supply of essential, quality and cost-effective pharmaceuticals at all health facilities *(FMOH, 2009).* To achieve this, the Pharmaceutical Fund and Supply Agency (PFSA) was created with mandates: to supply the entire country with both Program and Essential pharmaceuticals, as well as serve as the distribution entity for vaccines, other health facility supplies, and laboratory equipment *(The World Bank, 2009).* So as to execute its mandate in the area of pharmaceuticals supply in an efficient and effective manner, PFSA developed the integrated pharmaceuticals logistics system that integrates the drug requisition, distribution, and reporting of essential pharmaceuticals that used to be managed vertically into a single mechanism *(FMOH, 2009).* Public health facilities mainly procure pharmaceuticals from PFSA but also they procure Pharmaceuticals from different private pharmaceuticals importers and wholesalers.

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To satitfy the needs of customers and improve of the quality of care, Federal Ministry of Health (FMoH) has prepared a Health Sector Transformation Plan (HSTP) for the years (2015/16 - 2019/20) where ensuring availability and affordability of health commodities is identified as key startegies *(FMOH, 2015a).*

However, little is known how well the pharmaceutical supply chain in public health facilities is performing. Studying this helps to explain the processes along the entire supply chain, compare the performance and provides a basis for how to improve those processes to satisfy a customer's demands.

1.3. Statement of the problem

Pharmaceuticals are one of the vital tools needed to improve and maintain health, for too many people throughout the world pharmaceuticals still unaffordable, unavailable, unsafe and improperly used. An estimated one third of the world's population lacks to regular access to essential drugs, with this figure rising to over half of the poorest parts of Africa and Asia *(Chetley et al 2007).*

Efficient Pharmaceutical Management Systems are increasingly becoming more important, even critical, in the performance of the healthcare sector. In a broader context, Supply Chain Management (SCM) systems are gaining an increasing importance due to globalization and strong competitive pressures. They represent a paradigm shift in conducting business in the modern era, where collaboration rather than conflict seems more important and rewarding among the firms operating in a networking environment. Therefore, it seems that researching and analyzing SCM systems in the healthcare industry is a promising and fruitful area of research today having major practical consequences *(Bialas, 2014).*

Many studies recognize that an effective SCM is a powerful tool to achieve cost advantage and a more profitable outcome for all parties within and beyond any organization *(Avis, 2008).* In the health sector an effective SCM management will contribute considerably to constant availability of medical supplies, more so medicines in particular, which are important items in health service delivery. Well-organized pharmaceutical service ensures the continuous availability of all pharmaceuticals *(FMoH, 2010).* In opposite poor pharmaceutical supply management results in unreliable availability of pharmaceuticals that leads to stock out, shortage and treatment failure. It could also result in significant wastage of

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resources due to deterioration and expiration, which leads not only to the morbidity or mortality of a patient but also have socioeconomic impacts *(USAID, 2011).*

Currently public health facilities are facing challenges in assuring uninterrupted pharmaceuticals that are efficacious and good quality, physically and financially accessible and used rationally. According to Dukes and colleagues (2007), described some of the factors that impede drug supply management: Lack of infrastructure for storage and distribution of Pharmaceuticals, lack of dedicated transport to ensure constant supply of pharmaceuticals, losses from expiration, theft, fraud and inappropriate storage and inaccurate forecasting of pharmaceuticals requirements due to non-adherence to drug reorder levels.

The rapidly expanding number of health facilities in the country and training of medical professionals is creating a huge demand for health commodities. Inaccessibility of medicines is major cause for high morbidity, mortality and poor adherence among patients. Poor supply chain performance (i.e. poor quantification practice; lack of transparent and accountable financial transaction and services; inadequately trained staff for supply chain and high attrition of experienced staff) presumed to be the major cause for this *(FMOH, 2015b).* It also erodes public confident on health professionals and the health care system *(Yan and Addo-Atuh, 2014).*

Evaluation of the performance of hospitals is of paramount importance because of the hospitals' impact on the efficacy of health systems *(Bahadori M, 2011).* There are a number of reasons why health care industries needs to look at how they manage their supply chain *(Bradley,P (2000).* The main reasons are cost and risk. Since the two reasons are critical for all members across the supply chain, performance measurement is important to understand how they are performing

Different perspective of supply chain performance measures are operational and economic performance. Measuring supply chain performance might lead to a greater understanding of the supply chain and helps to test and reveal the viability of a firm's strategies. In addition, Ramaa et al. (2009) and charan et al (2008). State that measuring supply chain performance provides important feedback information, helps to reveal progress, increase employers' motivation and communication, and helps to diagnose problems. The measures that help a

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company measure their progress on performance objectives in everyday work are often referred to as key performance indicators (KPIs).

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In my literature review most of the studies conducted measuring supply chain performance was on manufacturing, one specific area and only on a single facility only. There is no insight on the performance of pharmaceutical supply chain management with respect to quality, productivity, cost and responsiveness in public health facilities at large with that of its supplier. The intention of this research study is to evaluate the performance pharmaceutical supply chain in public health facilities focusing on the cost, productivity, quality and responsiveness and efficiency of the supply chain management practices as well as best practices based on Key performance indicator method.

1.4. Research question

This study addressed the following major questions:-

a. What is the level of pharmaceutical supply chain performance of the public health facilities measured in terms of the four key performance indicators?
b. What is the level of performance of Pharmaceutics Fund and Supply Agency in supplying the public health facilities?
c. On which key performance indicator the public health facilities perform better?
d. What is the strength and weakness of the pharmaceutical supply chain in public health facilities?

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1.5. Research objectives

1.5.1. General Objective

The study aimed at evaluating the performance of pharmaceutical supply chain management practices of public health facilities and their supplier

1.5.2. Specific Objective

1. To analyze the pharmaceutical supply chain performance of public health facilities in terms of quality, financial/cost, responsiveness and productivity dimension
2. To analyze the performance capability of PFSA in supplying public health facilities
3. To determine which dimensions of pharmaceutical supply chain performance measurement better performed by health facilities
4. To determine the strength and weakness of the pharmaceutical supply chain in public health facilities

1.6. Scope of the Study

This study is meant to analyze the pharmaceutical supply chain performance of public health facilities. The operationalization and measurement of pharmaceutical supply chain performance is made on the bases of four dimensions, namely Quality, Responsiveness, cost/financial, and productivity. As such, the findings of this particular study are to be to public health facilities and pharmaceutical Fund and Supply Agency.

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1.7. Significance of the study

The objective of the study is to critically analyze and investigate the supply chain performance of public health facilities in Addis Ababa and to identify and address the areas of weakness that may affect organizational performance. Based on the analysis the overall performance of the health facilities was assessed and this would help the management and other stakeholder to identify potential pharmaceutical supply chain problems and to take corrective actions and devise improvement strategies in order to improve their pharmaceutical supply chain performance. It tries to explore the supply chain performance in different areas in the supply chain including product selection/ forecasting/procurement, warehousing/storage, inventory management/logistics management information system/customer response and distribution/transport.

1.8. Definition of terms

Pharmaceuticals: are all medicines, laboratory reagents, medical supplies and medical Equipment.

Public Health Facilities: are hospitals and health centers owned by government

Supply chain Performance: Supply chain performances is the entire chain's ability to meet end customer needs through planning and management of all activities related to material, information, financial flows, and co-ordination and collaboration with supply chain members

1.9. Organization of the study

To introduce and develop the arguments summarized here in detail, the proposal comprises the chapters. These chapters are constituted as follows.

Chapter -1 Introduction: In the first chapter all introductory parts of the study like background of the study, problem statement, research question, objective of the study, conceptual frame work, significant of the study, delimitation and limitation of the study, as well as conceptual definitions are included.

Chapter -2 Literature review: The second chapter of the study comprises the theoretical framework, which is a compilation of other author‘s journals and articles, literature about the

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supply chain performance. This section also includes a review of various empirical studies that have been made on supply chain performances.

Chapter -3 Research methodologies: The methodology part of the proposal represents the processes to mapping out the study area, research design, target Population, method of data collection and research instruments, , methods of data analysis and ethical consideration.

Chapter-4 Result and Discussion: finding on the supply chain performance of pharmaceutical supply chain performance at public health facilities in Addis

Chapter-5 Summaryof Findings, Conclusions and Recommendations: the conclusions drawn from the research findings and recommendations to enhance organizational supply chain performance efficiency.

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Chapter Two

Literature review

2. 1 Theoretical Review

2.1.1. Supply chain management

The term “Supply Chain Management” (SCM) was introduced in 1982, and according to the Council of Supply Chain Management Professionals, it is described as an integrating function with primary responsibility for linking major business functions and business processes, within and across companies, into a cohesive and high-performing business model. It includes the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities as well as manufacturing operations and it drives coordination of processes and activities with and across marketing, sales, product design, and finance and information technology. SCM also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers *(Bialas et al, 2014).* Supply chains (SCs) are involved in the entire product life cycle, from material procurement to manufacturing to distribution, customer service and eventually the recycling and disposal of the product *(V.D.R. Guide et al, 2003)*

The objective of every supply chain should be to maximize the overall value generated. The value a supply chain generates is the difference between what the final product is worth to the customer and the costs the supply chain incurs in filling the customer's request. Successful supply chain management requires many decisions relating to the flow of information, product, and funds *(Sunil, 2007).*

2.2. Supply Chain Performance Capability

According to the research, SC capability can be measured by using different kinds of approaches:

- A Performance measurement matrix (Keegan,1989)
- Financial and/or non-financial metrics (Kaplan and Norton 1992; Lambert and Pohlen 1998; Lawrie and Cobbold 2004; Neely 2002; Tangen 2004; Thakkar et al. 2007)

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- Qualitative or quantitative approach (Beamon 1999; Chan 2003)
- Performance prism (Neely et al. 2002)
- Performance measurement questionnaire (Dixon 1990)
- Balanced scorecard approaches (Bigliardi and Bottani 2010; Chia, Goh and Hum 2009; Dror 2008; Xu and Li 2008; Bhagwat and Sharma 2007; Thakkar et al. 2007; Lawrie and Cobbold 2004; Kaplan and Norton 1992)
- Key Performance Indicators (Edward Frazelle, 2002)
- Six-sigma approaches (Lin and Li 2010; Ramaa, Rangaswamy and Subramanya 2009; Xu 2008)

2.3. Pharmaceutical supply chain management

The provision of healthcare involves many players: (1) payer (e.g., government, employer, and individual); (2) healthcare service provider (e.g., doctors, hospitals, pharmacies, and integrated delivery network); (3) healthcare product maker (e.g., drug manufacturers, medical device and equipment makers); (4) insurers (e.g., healthcare exchanges, health maintenance organization, and preferred provider organization); (5) channel intermediaries (e.g., distributors, wholesalers). The presence of these many players in the healthcare sector means a high likelihood of conflicts, miscommunication, overlap, and fragmentation that can create inefficiencies and thus offer low customer value (i.e., low quality but expensive healthcare services). To avoid these inefficiencies, we have to embrace the idea of supply chain management, which can help us break the hidden silos among different healthcare players and then harmonize their conflicting interests *(Hokey, 2014).*

Health supply Management is very important to the success of almost all health institutions as they all relay on pharmaceuticals, medical supplies, reagents and medical equipment. Health commodities management is an aspect of the bigger picture of commodities management. The goal of a health supply management system is much larger than simply making sure a product gets where it needs to go. Ultimately, the goal of every public health logistics system is to help ensure that every customer has commodity security. Commodity security exists when every person is able to obtain and use quality essential health supplies whenever he or she needs them. A properly functioning supply chain is a critical part of ensuring commodity security— financing, policies, and commitment are also necessary. Effective supply chains not only help ensure commodity security, they also help determine

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the success or failure of any public health program. Both in business and in the public sector, decision makers increasingly direct their attention to improving supply chains, because logistics improvements bring important, quantifiable benefits *(Kumurya, 2015).*

Raeeda and collegues assessed the effect of Supply Chain Management and Its Effect on Health Care Service Quality and found that a high performing supply chain management has significant effect of supply chain management dimensions (the relationship with suppliers, specifications and standards, and delivery, after-sales service) on the quality of health services *(Raeeda et al, 2013).* Effective health commodities management has a great impact on the efficiency and effectiveness of the service delivery of health facilities *(Emelia et al, 2014).*

2.4. Performance evaluation in supply chain management

Supply chain performance is defined as the ability of the supply chain to deliver the right product to the correct location at the appropriate time at the lowest cost of logistics *(Zhang & Okoroafo 2015).* Performance measurement is a management tool which is the process to evaluate the operation of the business or organization *(Kumar et al, 2005 & Neely et al 1996).* Performance measurement is the process of quantifying the effectiveness and efficiency of past actions. Effectiveness is the extent to which customers' requirements are met and efficiency measures how economically a firm's resources are utilized when providing a pre-specified level of customer satisfaction. Also, they highlight that a performance measurement system should enable informed decisions to be made and actions to be taken because it quantifies the efficiency and effectiveness of past actions *(Neely, Adams, & Kennerley, 2002).* General benefits of evaluating performance include assessing and controlling progress, highlighting accomplishments, improving understanding of key processes, identifying potential problems and providing insight about possible future improvement actions, among others *(Ahi & Searcy, 2015).*

Ramdas et al Proposed that performance be defined as the efficiency and effectiveness of action, which leads to the following definitions: (i). Performance measurement is defined as the process of quantifying the efficiency and effectiveness of action; (ii). A performance measure is defined as a metric used to quantify the efficiency and/or effectiveness of an action; and (iii). Performance Management System is defined as the set of metrics used to

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quantify the efficiency and effectiveness of an action. Effective supply chain management (SCM) has been associated with a variety of advantages including increased customer value, increased profitability, reduced cycle times and average inventory levels and even better product design *(Shingo, 1988).*

The objective of SCPM therefore has to facilitate and enhance the efficiency and effectiveness of SCM. The main goal of SCPM models and frameworks is to support management by helping them to measure business performance, analyze and improve business operational efficiency through better decision-making processes *(Ramdas, & Spekman, 2000).*

Hasnan and colleagues reviewed the articles published in performance measurement systems in the supply management and found that that SC performance measurement remains a fertile research area as distinctive affirmations have been traced in the study. A comprehensive supply chain performance management system (SCPMS) that incorporates the specific needs of organizations has yet to be realized *(Hasan et al.2016).* Performance measures to evaluate a supply chain should cover the financial and operational domains since the goal is to provide customer satisfaction at low cost and to guarantee competitiveness over the long term. In other words, performance measures should be useful not only to continuously improve the efficiency of the supply chain but also to help run a strategic policy. Performance measures should be easy to define, simple to apply, and easy to understand in order for the manager to be able to react accordingly in real time in day-to-day *situations (Manish and Jean-Marie, 2002).*

The relevance of effective performance measures in achieving sustained business progress in a dynamic environment cannot be understated *(Roshan, & Jenson, 2014).* Evaluating the effectiveness and efficiency of a supply chain involves using metrics related to various performance objectives such as cost, quality, responsiveness, flexibility, productivity, and others *(Webster, 2002).* Performance measures are created from a single or several indicators of a process. The measures can be a single indicator, a sum of indicators or a ratio of them depending on the information wanted from the measure *(Franceschini, et al, 2007).*

Performance indicator is a verifiable measurement associated with a performance object. A measurement is verifiable if it is based on an estimation process specifying the data and

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calculation methods required to obtain the indicator. The performance object refers to what is being evaluated. It depends on where we are looking (forward or backward), on what we are trying to do (control, improve or communicate), and on the level of the responsibility centers that it affects. An indicator must elucidate what allows the responsibility center to create value for the company and its customers. As such, it should ideally be tied to value drivers that are, to factors affecting the value added by the center *(Alain & Walid , 2016)*

Indicators are variables that measure change. They may be numerical and expressed in terms of numbers, percentages, or averages. They may also be expressed as binomials such as "yes" and "no." Indicators are useful tools for managers to track the performance of particular aspects or activities of the pharmaceutical supply system as well as the performance of the overall system. A well-defined indicator is clearly linked to an important input, process, or outcome. A well-selected indicator will help managers quickly identify potential problems in critical areas. Indicators are extremely helpful to communicate important performance gains and losses to other stakeholders of the pharmaceutical supply system. Indicators can be developed for different levels of the supply system. When used to make measurements at one point in time, indicators allow a manager to compare a program's performance with a target level of performance (or with another program's performance) and to identify areas of relative strength and weakness *(MSH, 2012)*

2.5. Categories of supply chain performance indicators

Developing a framework for assessing the performance of the supply chain requires certain assumptions, including the ones related the areas of its measurement. 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. Edward (2002) has discussed different types of indicators to measure supply chain management performance. These are financial, productivity, quality, and response-time metrics Neely et al. (1995) cost, quality, Ganga & Carpinetti (2011) responsiveness and related to Hho et al related to productivity. The Authors described quantitative measures to measure supply chain performance associated with the customer: fill rate and lead time.

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2.5.1. Financial Measures Of Supply chain Performance

Supply chain is playing an increasingly important role in value creation, revenue enhancement, capital consumption, and expense control. As a result, logistics financial performance is playing a bigger role in corporate financial performance. Measuring and improving logistics financial performance is increasingly important in measuring and improving corporate financial performance. In addition, since supply chain is often in competition with other business processes for capital projects, the better the overall financial reporting we do in logistics, the better chance we have to justify our logistics projects. The most important principal to remember in developing and implementing logistics financial performance measures is that nearly every generally accepted corporate financial measure has a corresponding logistics financial measure *(Edward H. Frazelle, 2002)*

2.5.2. Productivity Measures Of supply chain Performance

A danger in focusing too much attention on overall supply chain costs is that certain cost elements cannot be controlled by logistics managers and engineers. For example, logistics managers have limited control over some of the major cost, including wage rates, fuel costs, occupancy cost, inventory carrying rates, and systems capitalization rates. Instead, logistics managers have direct control over the amount of inventory in the system, the amount of working hours expended, the amount of occupied space, and the number of transportation miles traveled. Essentially, logistics managers and analysts have influence over the amount of logistics resources consumed in providing performance indicators will include measures of logistics resource utilization and productivity *(Edward H. Frazelle (2002).*

2.5.3. Quality Measures Of Supply chain Performance

How do you measure logistics quality? Unfortunately, no industry standard exists for doing so. In fact, so many different measures are available that many managers have given up trying. The issue is so complex that universities around the country have entire research projects devoted to identifying the right set of logistics accuracy indicators. The most effective indicator of logistics accuracy or quality is the *perfect order percentage* (POP), which ties together the indices for logistics quality in each of the logistics activities. *(Edward H. Frazelle, 2002).*

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2.5.4. Responsiveness Measures Of supply chain Performance

The responsiveness indicators include supplier lead time variability, order lead time and average delivery time *(Edward H. Frazelle, 2002).*

2.5. Empirical Review

Positive health outcomes are highly dependent on how well the health delivery system—health information, financing, personnel and supply chain (including supplies)—is performing. The importance of having medicines and other supplies available at health facility cannot be overstated, and their availability depends on how well or how poorly the supply chain is performing. But, to improve supply chain performance must understand how it is currently performing, e.g., it needs to be measured *(Aronovich et al, 2010).*

Healthcare SCM includes business activities and operations that integrate a continuous, seamless flow of materials and services for healthcare delivery. The health facility supply chain is implemented in different areas of the chain. To ensure the success of supply chain implementation requires performance measurement. *(Lee, 2014)* Performance measurement of supply chain should be measured from supply chain perspective which can be investigated through business process of the supply chain to ensure coverage and completeness and to create efficiency to the supply chain as a whole *(Beamon, 1999).*

Healthcare SCM processes have three types of flows: physical product flow, information flow, and financial flow. The physical product flow manages customized products and services for the treatment of patients and their needs. Information and financial flows are related to supply chain design decisions for effective product flow and improved organizational performance *(Lee, D. Lee & M.J. , 2011)*

Fedrico et al (2013) evaluated framework for measuring supply chain performance in the public healthcare sector: evidence from the Italian NHS discuss that public healthcare organizations view SC performance evaluation as a means of decreasing costs and improving quality levels, the framework developed in this research may provide a useful guide for managers and policymakers and enhance the current knowledge of SCM in the public healthcare sector *(Federico, Marta & Stefano, 2013).*

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Karthikeyan Lenin assessed supply chain performance in health care industry in U.A.E showed that Order forecasting was not given much of importance thus leading to inventory stock outs. The cash conversion cycle for the two years shows a decrease from 91.28 days in 2013 to 76.95 days in 2014, *(Karthikeyan, 2014)*

A study conducted in Rwanda to assess the Key Performance Indicators (KPIs) of a supply chain and its functional areas at the national, district and facility level. Data was collected at each facility for a set of 13 indicators that measured the performance of product selection, procurement, warehousing & inventory management, transportation and SC human resources. Overall, the capability and performance of the pharmaceutical supply chain in Rwanda varied by functional area. Capability ranged from 70 percent (product selection) to 24 percent (waste management). Performance varied at the national level, with some successful indicators of on-time facility reporting rates to Medicines Procurement and Planning Division (MPPD) (94%) and percentage of products passing quality testing (96%) and stock out rates for tracer commodities (12%). Others presented challenges such as order fill rate (47%) and on-time delivery (54%) from MPPD to the district pharmacies *(SCMS/Rwanda Ministry of Health. 2013).*

Product selection capability in Rwanda is slightly above average with an overall score of 60%. Forecasting and supply planning capability overall is 40%, but within the functional area the different enablers vary significantly. Although human resources are adequate at 80% processes and tools are in the middle of the capability spectrum at 52%. Overall procurement capability in Rwanda is relatively high at 70%. Order fill rate from MPPD to the district pharmacies was 47% overall but varied by district ranging from 36.3 to 54.4%. Only 54% of active distribution orders from MPPD to DPs were delivered within 5 days of the scheduled delivery date. Although the active distribution system is in place and a delivery schedule is produced there seemed to be issues with adherence to this schedule. Facility reporting rates were high across all program products and all health facilities had reporting rates of over 90% for the entire assessment period. When analyzing the district pharmacies, data revealed that there were gaps with timeliness of reporting with only 63% of reports submitted on time from January-June 2013. While reports were not always timely, the submitted reports were complete, with 92% of district pharmacy reports submitted fully completed.2 (Only one of 15

district pharmacies failed to submit a complete report each month *(SCMS/Rwanda Ministry of Health. 2013).*

A report to Exploring New Distribution Models for Vaccines and other Health Commodities Adapted to the on the Ground Realities of the Equateur and Tshuapa Provinces, Democratic Republic of Congo showed that Stock outs of many commodities (vaccines, family planning, malaria and HIV treatment, essential medicines) were systematic at health facilities and warehouses at all levels, resulting in health workers having to travel up to 170 km to the provincial main town to purchase commodities of questionable quality from private pharmacies. The supply chains for vertical health programs work independently and with little coordination, resulting in duplication of effort and resources. Cursory reviews of health facility documentation show poor data quality and lack of supervision from higher levels. At all levels of the health system, human resource capacity for managing logistics activities (cold chain, warehouse, transport, distribution, data collection/validation and use, etc.) is highly questionable. Supervision and activity monitoring from the higher level down is mostly inexistent *(Democratic Republic of Congo. 2015)*

A study conducted in south Sudan to assess the Pharmaceutical logistics in South Sudan in 102 facilities using Logistic System Assessment Tool (LSAT) and Logistics indicator assessment tool. The finding showed that 54% health facilities surveyed receive medicines and supplies from the CMS through the predominantly "push" system of the South Sudan pharmaceutical supply chain system. The LMIS is weak at all levels and does not capture all essential logistics data; as a result, such data are not used for pragmatic decision-making on supply chain management. Findings showed the gradual decrease in percentages of assessed health facilities having forms (39%), to facilities also filling those forms accurately (27%). outline forecasting of national requirements for essential medicines is historically done manually. Consumption data are received at South Sudan's CMS on an infrequent basis, and are generally too incomplete and late to be used for systematic quantification and forecasting. There was no evidence of use of other types of quantification (e.g., demographic or morbidity methods). The inventory control system is not clearly understood by all health care workers; as a result, there is no standardized method of calculating resupply quantities for health facilities. Twenty-seven percent of stores, health facilities, and pharmacies assessed had experienced a stock-out in the last three months prior to the assessment visit. 6. Only

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35% of the assessed health facilities and stores maintain minimally acceptable storage conditions *(Dick et al, 2011)*

A study conducted in Namibia to assess the capability and performance of the supply chain through a series of key informant interviews and collection of supply chain data from electronic system and manual sources sing the National Supply Chain Assessment tool showed that a sense of declining capability at the CMS, evidenced in the average levels of capability of key supply chain functions such as forecasting, procurement, warehousing and transportation. Although capability is average, performance remains high indicated by several strategic key performance indicators including Stock Out Rate 25%, Product Selection 90%, National Essential Medicines List Adherence 96%, Forecasting and Supply Planning 46%, Procurement 56%, Tender Procurements 53%, Vendor On Time Delivery 61%, Warehousing & Inventory Management 50%, Expiry (Qty) 1% , Order Fill Rate 80%, Transportation 55%, On-time delivery (OTD) 85%, Data and Information Reporting Rate 93% and Waste Management 40% *(Levenger et al, 2013)*

Another study conducted in Cameroon to assess Medicine prices, availability, and affordability in 36 developing and middle-income countries: Average public sector availability of generic medicines ranged from 29·4% to 54·4% across WHO regions. Median government procurement prices for 15 generic medicines were1·11 times corresponding international reference prices, although purchasing efficiency ranged from 0·09 to 5·37 times international reference prices *(Cameroon A., 2009).*

As a part of its commitment to make low-cost, quality medicines regularly available, the government exempts the CMS from profit tax, VAT and Zakat(c). However, CMS does not always pass on low procurement prices to patients, which can significantly affect the affordability of treatment. From the assessment it was found that the price paid by the patients range from 70-123% from the international reference price *(Gamal Khalafall, 2010).*

Abigael Achieng (2014) assessed effects of management of supply chain on performance of public health institutions in Migori County in Kenya**.** It was noted that stock outs were very common in the facilities and that it in turn lead to poor performance in the hospitals. 74.1% of the respondents strongly agreed that indeed there were stock outs in their institutions, whereas nobody was of a contrary opinion hence 0% could disagree with this. Frequency of

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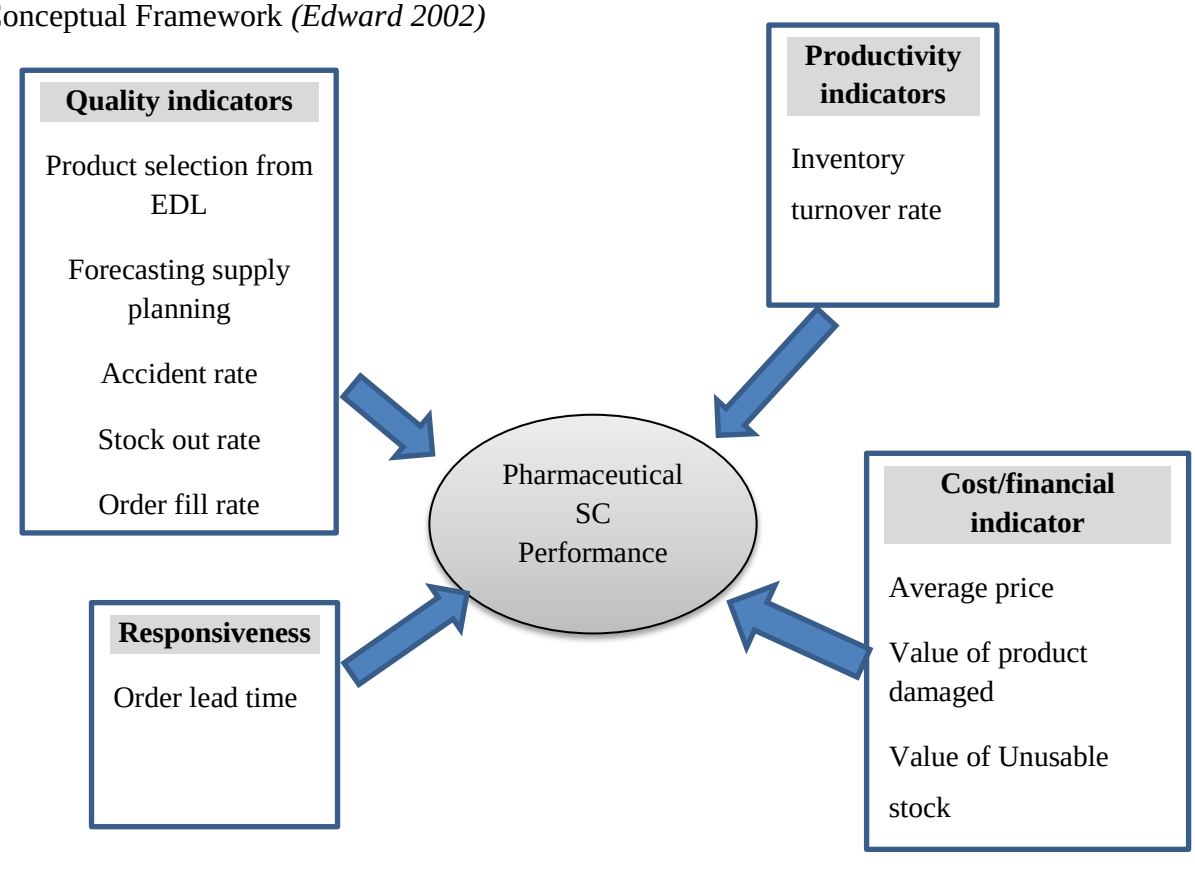
the stock outs was also found to be significant as 37% and 48.1% of the respondents agreed and strongly agreed respectively that there was high rate of stock outs.

A study conducted in to assess Inventory management performance of key essential medicines in health facilities of East Shewa Zone shwd that the inventory management practice of the study Facilities was found to e weak which was confirmed by poor record accuracy, high stock out rates and medicinens wastage with loos of money *(Tadesse G. & Awol J. , 2017).*

2.6. Conceptual Framework

Based on literature review of the existing performance indicators for supply chains, a conceptual frame work for measuring the performance of health facility pharmaceutical supply chains has been developed. Health facility pharmaceutical supply chain performance indicators are grouped in four main categories. Quality, cost, responsiveness and productivity are the pharmaceutical supply chain indicators. Each of these main indicators contains more detailed performance indicators.

Fig 2.1 Conceptual Framework *(Edward 2002)*



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Chapter Three

Methodology

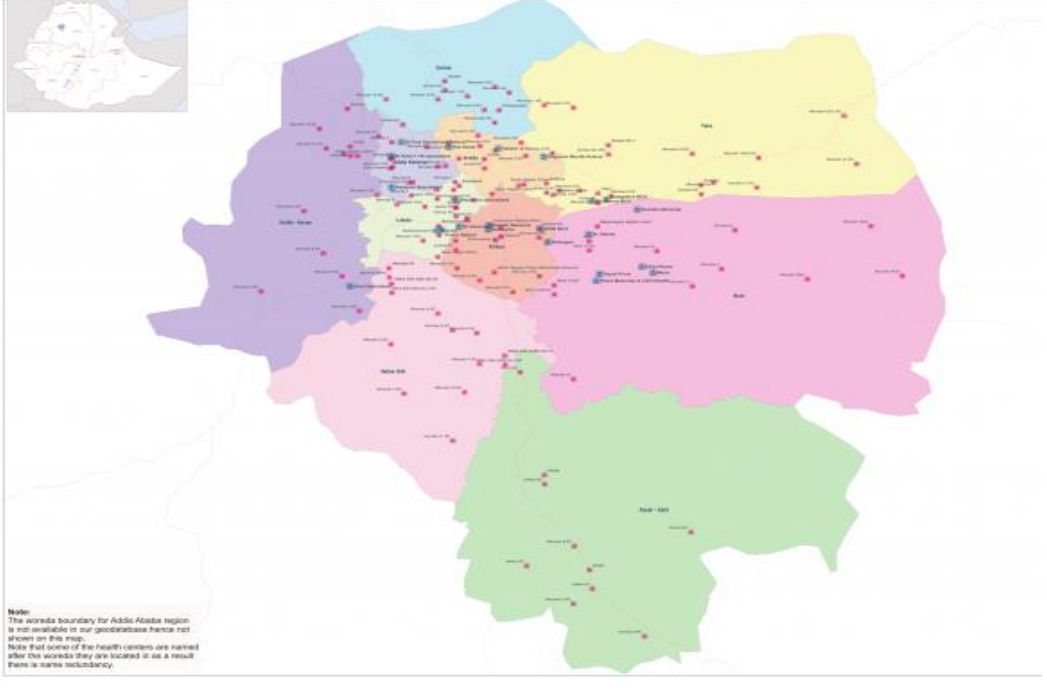
3.1. Introduction

This chapter presents the methodology applied to conduct the proposed research work, the research design, the nature and source of data collected and details about the research instrument used for the research. Moreover, description of the tests employed to establish reliability and validity of the collected data for further analysis and ethical issues are discussed in this chapter.

3.2. Description of the study area

Addis Ababa, the capital city of Ethiopia covers an area of 540 km^2 with a total with an estimated Population of 3.2 Million. It is administratively sub-divided into 10 sub-cities According to 2015 health and health related indicator there are 11 public hospitals, and 91 HCs, *(FMOH, 2015).* This study will be conducted in Addis Ababa public hospitals, health centers and Central PFSA.

Figure 3.1. Map of Addis Ababa Health Facility



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3.3. Research design

Ghauri & Gronhang (2005) defines research method as a systematic, focused and orderly collection of data for the purpose of obtaining information from them to solve/answer a particular research problem or question. The purpose of this research is to analyze the performance of pharmaceutical supply chain management with using key performance indicators.

This study utilized both quantitative and qualitative research methods through the facility based cross-sectional descriptive study of the past 12 months (2009 E.C.) data were reviewed. This study design followed essentially ensures that the data acquired for the study was quantitatively evaluated, compared and measured so that quantitative postulations were made. Furthermore, a descriptive approach was followed so that the data acquired was analyzed systematic manner with the use of tables, figures, and graphs.

3.4. Population and Sample

3.4.1. Population

The study populations were all public health facilities providing health care services to the community that are found in the Addis Ababa and PFSA head office. PFSA is established to supply public health facilities with efficacious and quality pharmaceuticals. The public health facilities were the 11 hospitals and 91 health centers found in Addis Ababa *(FMOH, 2015).*

3.4.2. Sampling Methodology

Sample Size determination

Sample size was calculated according to the guide for conducting supply chain assessments using the LSAT and LIAT (USAID | DELIVER PROJECT, 2011) To generate representative sample for LIAT survey, an assumption that 50% of the public health facilities would poorly pharmaceutical supply chain performance was considered as similar studies in Ethiopia were not available. In addition, a confidence level of 90% with a margin of error of 10% was used. The sample size was then calculated using formula for calculating sample sizes in finite population bases. With this formula, sample size of 42 was obtained.

The general formula for calculating a sample size is:

$$n = \frac{z^2 * p\,(1-p)}{}$$

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$$n = \frac{(1.64)^2 \times 0.5(1-0.5)}{(0.1)^2}$$

$$n = 67$$

where: n = required sample size

Z = Z value (e.g. 1.64. for 90% confidence level) p = estimated prevalence of the indicator. Unknown performance was used, 0.5)

m = margin of error you wish to allow in estimating the prevalence, at 10 percent m = 0.1)

However, there is a predetermined population (e.g., total number of public health facilities in Addis Ababa 102), the sample size generated from the above equation needs to be multiplied by the Finite Population Correction (FPC) factor. For our purposes, the formula can be expressed as:

$$\text{New } n = \frac{n}{1+[(n-1)/N]}$$

Where: New n = the adjusted new sample size N = the population size n = the sample size obtained from the general formula

$$\text{New } n = \frac{67}{1+[(67-1)/102]}$$

New n= 41.6 ~ 42

Sampling design

Stratified sampling method was used to select 41 public health facilities comprising of hospitals and health centers.

Sampling procedures

A total of 102 public health facilities that are providing health care service were used as a study population from which 41 selected facilities were drawn. For selection of the sample population, first the health facilities were categorized into three different strata as per their type. The strata include 5 regional hospitals, 6 specialized hospitals and 91 health centers. The number of facilities to be included into the calculated sample of 41 facilities from each of the stratum was determined by using proportionate sampling respective sizes. Once the sample size per stratum was determined, individual facilities were identified using lottery method. A total of 2 regional hospitals, 2 specialized hospitals and 37 health center were

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included in the study. In addition PFSA head office purposively included. Since PFSA is the sole supplier of pharmaceuticals to public health facilities.

S. No	Type of Facility	Total No	Sample size
1	Specialized Hospital	5	2
2	Regional Hospital	6	2
3	Health Centers	91	37
4	PFSA Central	1	1
		Total	**42**

Selection of respondents for the study was guided by non-probability purposive sampling procedure wherein respondents were selected on the basis of being able to provide an in-depth understanding on the topics being assessed.

In addition a questionnaire was administered to Facility Managers, Pharmacy head and warehouse manager. A total of 123 questionnaires were administered. A total of 6 personnel from forecasting and marketing, warehouse and inventory management, customer service and fleet management, fund management, planning, monitoring and evaluation officer, and quality management officer were interviewed.

3.4.3. Data sources and type

- Collect data using data collecting check list
- Administer questionnaire to key personnel from PFSA and health facilities
- Interview key informants from PFSA
- Collect data required to inform KPIs by questionnaire, physically counting stock, reviewing paper and electronic records, etc.
- List of essential drugs developed by Federal Ministry of Health of Ethiopia was used to check the performance of the supply chain. The essential drugs are representatives of therapeutic category used to treat diseases important in the health system that should be expected to be available all the time at the at health facilities.

3.5. Data collection

The data collection and observation was conducted by trained 5 trained pharmacists. Health facilities were assigned for the data collectors and conducted site visits at the facilities within that sub city identified. At each facility the data collector undertook the observation using the relevant checklist. Data was collected relevant KPI data using source data such as bin cards,

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LMIS reports, Health commodity Management Information System(HCMIS), proformas, orders, invoices and delivery notes. The PFSA key informants were interviewed by the investigator by using interview guide.

3.6. Data analysis

The quantitative and qualitative data were entered into Microsoft Excel 2010, tools of analysis proposed to be employed in the analysis are SPSS (version 20) and the result was presented in the form of tables and graphs. The findings were grouped according to key themes; and positions that emerged under each key theme. In particular, descriptive statistics were used to describe data behavior in a study. By providing simple summaries about the sample and the measures achieved, which represent the foundation of a quantitative analysis. Statistics can also help to identify the existing relations among variables. In particular, within the SC performance each of the different positions was summarized and the extent each variable was assessed.

3.7. Pre-testing of tools

The data collection tools were pilot tested on two health facilities i.e. one hospital and one health center, in order to check the clarity ambiguity of the data collection form. This helped the researcher to get a feedback on leading applicability of the instrument used.

3.8. Ethical consideration

Before commencing data collection, ethical approval was obtained from the Ethics Review Committee of the School of commerce, Addis Ababa University. Then, the selected public health facilities were communicated with formal letters from the School of commerce, Addis Ababa University. The study was conducted in the selected health facilities after permission from the higher officials of respective public health facilities were obtained. Participants of the study were asked for consent before participating in the study. During the consent process, they were provided with information regarding the purpose of the study, why and how they are selected to be involved in the study, and what were expected of them and that they can withdraw from the study at any time. Participants were also assured about confidentiality of the information obtained in the course of the study by not using personal identifiers and analyzing the data in aggregates. The name for whom a questionnaire was administered and the public facility in which they work will not appear in data analysis.

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CHAPTER FOUR
DATA ANALYSIS, RESULT AND DISSCUSION

4.1 Result

4.1.1. Introduction

The data analysis, presentation and discussion focused on presenting the finding from the observation and answers to the research questions. The result of observation is presented in descriptive statistics. The questionnaire was analyzed using SPSS version 20 and the result found from the observation and interview was used to triangulate with the finding from the respondents. Emphasis was given to answer the research questions and finally summary of the analysis was presented.

4.1.1.1 Instrument Reliability Test

Internal consistency of the items constituting the items of the dimensions was checked by using Cronbach's alpha. Accordingly, the reliability of the study instrument has been determined by evaluating the average correlation among items in the scales of the respective dimensions suggested by *(Cronbach, L.J., 1951).* The resulting Cronbach's alpha values of the dimensions are presented in the subsequent table.

Reliability Statistics

Cronbach's Alpha	N of Items
.783	4

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Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Cost indicator	11.0935	2.222	.766	.632
Quality Indicator	11.2381	2.672	.539	.755
responsivness Indicator	10.9939	2.757	.561	.745
inventy turnover rate	11.0719	2.533	.512	.774

A scan at the above table implies that all alpha values for the respective dimensions were well above the suggested cut-off value of 0.7 *(Cronbach, L.J., (1951),* hence implying the reliability of the instrument that measures the study constructs, i.e. the items under the respective scales could properly measure the dimension of concern.

4.1.2 Facility type and Respondents' Demographic Information

As inferred in the preceding part of this study, selected public health facilities, employees working in drug supply chain management and Pharmaceutical Fund and Supply different directors and manger were included. A total of 41 public health facilities (37 health center, two regional hospitals and two specialized hospital) were included. From these facilities key personnel's that have direct relation with the pharmaceutical supply chain i.e. Store managers, pharmacy head and Medical Director/Clinical service director from each facility were included. For the qualitative part 6 personnel from PFSA were interviewed (Forecasting and marketing, Warehousing and inventory management, customer service and fleet management, fund management, planning, monitoring and evaluation officer and quality management officer). From the health facilities 98 respondents have filled and returned the questionnaire, which essentially made the response rate about 81.6%. The type of facility, demographic information of the respondents who have filled and returned the questionnaire is presented on table 4.1.

As depicted on the below table, males dominate the respondents' list registering about 70.1% of the total respondent with females taking the remaining 29.9% of the respondents from the public Facilities. From the supplier side all the interviewed were male.

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As far as respondents' age is concerned, the majority of the respondents from the public health facilities (61%) were aged between 26 to33 years followed by the age categories of 34 to 41 years, 18 to 25 years, age 50 to 57 and 42 to 49 years respectively with percentage scores of 23.4%, 11.7%, 2.6% and 1.3% in that order respectively. The age distribution of the from the supplier side 33.33% were from 26-33 category and 66.67% from 34-41 age category.

Table 4.1 Demographic characteristics of respondents of Public Health facility and type of facility April 2018, Addis Ababa

Variable		Frequency	Percent
Sex	Male	67	68.4
	Female	31	31.6
	Total	98	100
Age	18-25	11	11.2
	26-33	57	58.2
	34-41	26	26.5
	42-49	2	2
	50-57	2	2
	Total	98	100
Current Position	store Manager	30	30.6
	Pharmacy Head	36	36.7
	Medical Director/CSD	32	32.7
	Total	98	100
Educational Qualification	college diploma	18	18.4
	First degree	52	53.1
	Masters degree	25	25.5
	PhD and Above	3	3.1
	Total	98	100

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	Variable	Frequency	Percentage
Year Of Service in current position	below one year	17	17.3
	one to two years	45	45.9
	Three to four years	22	22.4
	greater than five years	14	14.3
	Total	98	100
Type of Facility	Regional Hospital	2	4.88
	Federal Specialized Hospital	2	4.88
	Health Centers	37	90.24
	Total	41	100

Source: *Survey Result*, 2016

With regard to educational qualification, significantly higher percentage of the respondents (53.1%) were first degree holders, whereas those having postgraduate degree and diploma stand Second and third in the ladder of educational qualification accounting for 25.5% and 18.4% of the total number of respondents and 3.1% PhD and above from the service delivery. From the supplier side the educational qualification of the respondents were 83.33 % Master's degree, and 16.67% first degree. On the other hand, being an important element of the profile of the respondents, years of service under the relevant job positions was also assessed and it has been revealed that those who have served 1 to 2 years in the public health facility dominate the list by taking 45.9% of the entire respondents. Those who have served three to four years on the positions of concern came second on the ladder followed by the category of respondents who have served less than one year respectively with the

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corresponding percentage scores of about 22.4% and 17.3% in the public facilities. In the supplier side those who has served in current position for more than five years was only 16.67%. Those who have served for three to four years and below one year were found 33.33%, and 50.0% respectively. Considering the fact that respondents' relative work experience in the job positions of concern has a direct bearing on the quality of response that might be provided.

4.1.2 Descriptive Analysis

I. Quantitative Result and qua

The quantitative and observation result of the survey is presented below. The weighted average performance of each indicator is also presented on each table for each key performance indicator. An average score of 0.5-1.5 equals 'very low', 1.5-2.5 equals 'low', 2.5-3.75 equals 'moderate', 3.75-4.5 equals 'high' and above 4.5 equals 'very high'(Hair et al (2010).

Table 4.2 Quality indicator measurement items mean and standard deviation of respondents at Public Health facility April 2018, Addis Ababa

Measurement Items (Quality Indicator)	Mean	Std. Deviation
Products selected for the facility are procured only from facility specific drug list/national medicine list	4.0306	0.81802
The facility has procurement plan and adheres to it	3.7551	0.81305
The facility encounters frequently stock out of essential medicines	3.1429	0.70345
The customers get product that they need from the facility	3.2041	0.74556
Most of the time accidents are not are not occurred in the institution/facility warehouse like physical accident on daily laborer, warehouse personnel, also on equipment	3.9796	0.83702
Weighted average performance of quality Indicator	**3.62246**	**0.78342**

Source: own Survey**,** 2018

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4.1.4. Quality Indicator

i. Respondents Perception on quality indicators

The mean values of each of the measurement items of quality indicator were calculated between 3.14 and 4.03 with standard deviations that range between 0.70 and 0.83. The lowest mean value is registered in the case of the facility encounters frequently of stock out of essential medicines and in the second place followed by availability of essential medicines with a comparable mean value of 3.14 and 3.42 respectively; while product selection from facility specific drug list recorded with the largest mean value of 4.03.

The mean scores of the measurement items of quality indicator suggest that respondents in the public facility believe that there is a problem in stock out of essential medicines in the facility. Likewise the respondents also perceive that the public health facilities have problem in the availability of essential medicines. Contrary to this respondents perceive that most of the selection of the products is made from the facility specific drug list which is prepared by the team of experts considering the disease prevalence, availability of diagnostic facility and availability of trained man power. Over all the average value for quality indicators were calculated with a mean value of 3.62246 and with a standard deviation of 0.78342. The public health facilities pharmaceutical supply chain performance with regard to quality indicators can be taken as moderate.

ii. Result from direct observation on quality indicators

A. Product selection based on facility specific approved drug list

Facilities are expected to procure products from facility specific drug list. This helps to restrict procurements of products from the approved list. The items listed in the facility specific drug list satisfy the basic health care requirements of the facility. All public health facilities 41(100%) were found to have their own essential facility specific drug list. The mean score of product selection from facility specific drug list had the largest mean value in which the respondents agree that selection is made from facility specific drug list.

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Table 4.3 **Percentage of facilities having their own specific drug list, commitment of the to establish supply planning and warehouse accident rate April 2018, Addis Ababa**

Variables	No of responses	Frequencies yes N (%)
Availability of Approved essential drug list to the facility	41	41(100)
Commitment to establish procurement plan	41	36(87.80)
Warehouse accident rate	41	2(4.87)

Source: *own survey*, 2018

B. Commitment to establish supply plan

The survey showed that majority 36(87.80%) of the public health facilities had a procurment plan with budget breakdown prepared annually which is communicated to public health facility supplier. From the table 4.2 the mean score recorded in perception of the respondents in commitment of the public facility in establishing supply planning and adherence to it shows some what a moderate value.

C. Warehouse accident rate

Total number of accidents occurred in the facility warehouse/storage area during the review period was found to be 2(6.4.87%). A few warehouse accident rates were recorded in the surveyed public health facility. The observation result supports the perception of respondents from the survey result which shows that a lower warehouse accident rate with the second largest mean value was recorded. A lower warehouse accident rate in the warehouse shows a practice of good warehouse management, trained staffs, clear safety guidelines and good storage conditions.

D. Pharmaceutical availability

In this study, availability was assessed based on stock out duration during the twelve months of the year 2009 E.C. *Average days out of stock of essential pharmaceuticals* within the twelve months period of the year 2009 E.C. was expressed as the average days of that products were out of stock in a particular facility. The study has found that greater than half of the health facilities 24(58.54%) visited had experienced stock out of essential pharmaceuticals within the twelve months period of the year 2009 E.C. Table 4.4 shows the

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number of health facilities encountered stock out with minimum and maximum days of stock out duration. The result from the survey result also shows that the lowest mean and standard deviation with a value of 3.14 and 0.70 was recorded in facilities encounter frequent stock out of essential medicines. In addition to this the respondents perceive that availability of essential pharmaceuticals is not good in which the average mean value was comparable with that of the facility encounters stock out of essential medicines. The respondents agree with a small variation that the health facilities encounter frequent stock out of essential medicines

The survey and observation result of the study shows that availability of essential medicines was not satisfactory at public health facilities in which presented a considerable number of stock-out days. Some medicines were out of stock for the whole year in few facilities. The number of drugs stock out from the surveyed facilities was found that one drug was stock out in 6 health facilities, two drugs were stock out in 10 health facilities, three drugs stock out in 5 health facilities, four drug stock out in two health facilities and two drugs stock out in two health facilities. All the hospitals included in the survey encountered stock out of the products.

Among the selected 25 key essential medicines 13(52%) of them were stocked out at least once within the last one year with a different duration of times. Within the review period about 11 (28.63%) of the health facility had stock out of Co-trimoxazole and Glibenclamide with stock out duration of 32.72 and 57 days respectively, 8(19.51%) were stocked out of Oral rehydration salt with stock out duration of 168.75 days and Magnesium Sulphate with stock out duration of 70.71 days. Arthemeter + Lumefantrin (Coartem) tablet were stock out in five (20%) of the health facilities with a stock out duration of 67.2 days. Four (16%) of the facility were stocked out of Zinc dispersible tablet with stock out duration of 227.50 days. In addition Amoxicillin dispersible tablet and Tetanus Antitoxin with stock out duration of 146.6 and 51.33 days respectively. While 2(4.88%) of the facility had stock out of Dextrose in normal saline, Ferrous Sulphate + folic acid and Tetracycline eye ointment with stock out duration of 30, 120 & 45 days respectively. Oxytocin injection was stock out in only 1(2.44%) with a stock out duration of 30days. The rest 11(44%) of the essential medicines were available throughout the year.

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Table 4.4 **Number of facilities stock out and the average stock out duration public health facilities April 2018, Addis Ababa, Ethiopia**

	N	Number of health Facilities with any Stock-out N (%)	**Stock out days**	**Frequency of stock outs**
Non Program Drugs			**Min(max) days of stock out**	**Mean(SD) days of stock out**
Oral Rehydration Salt	41	8(19.51)	30(365)	168.75(163.02)
Cotrimoxazole	41	11(26.83)	30(45)	32.72(6.067)
Glibenclamide tablet	41	9(21.95)	23(210)	57(58.18)
Dextrose in normal Saline	41	2(4.88)	30(30)	30
Ferrous Sulphate + Folic Acid	41	2(4.88)	60(180)	120(84.85)
Hydralazine injection	41	3(7.32)	40(60)	53.33(11.54)
Tetanus Anti Toxin	41	3(7.32)	44(60)	51.33(8.08)
Tetracycline eye ointment	41	2(4.88)	45(45)	45
			Average stock out days	**69.76days**
Program Drugs				
Amoxicillin Dispersible tablet	41	3(7.32)	15(365)	146.6(190.41)
Zinc Dispersible tablet	41	4(9.76)	90(365)	227.50(158.77)
Magnesium Sulphate injection	41	6(14.63)	30(180)	70.71(57.91)
Oxytocin injection	41	1(2.44)	30(30)	30
Arthemeter + Lumefantrin (Coartem) tablet	41	5(12.20)	10(180)	67.2(69)
			Average stock out days for program drugs	**108.40**
			Average stock out days for all essential medicines	**84.86days**

Source: *own survey*, 2018

As per the interview all agree that product selection is a major step in commodity management cycle. They told that as Pharmaceutical Fund and Supply Agency has its own procurement list which is derived from the national essential drug list. From the interview the

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researcher understood that PFSA selects products for annual procurement based on facility forecasted needs. From the interview they told to the researcher that PFSA has supported public health facilities through capacity building to have their own facility specific drug list adopted from the national formulary but customized to each facility. In the interview they discussed problem related to the use of facility specific drug list i.e. poor adherence of facilities in using facility specific drug list in selection process; sometime facilities select products out of the facility specific list. From the interview they discussed the practice of using facility specific drug list is encouraging suggest that procurement of non-approved medicines could not be condoned. They also told that a problem was identified misalignment on vital pharmaceutical list between facility specific drug lists with that of the agency list.

The forecasting and marketing officer told to the researcher that PFSA prepares a procurment plan that is revised periodically and it gives a clear picture how the procurement could be organized. The procurment plan is the basis for initiating and implementing the procurement process and also creating the necessary coordinating mechanisms of ensuring the provision of pharmaceuticals the facility needed in a more organized manner. The major challenge discussed was lack of adherence to the procurment plan.

As per the interview PFSA is working to maximum of its capacity to ensure the availability of pharmaceuticals at the public health facilities. They also discussed the procedure of procurement of pharmaceuticals is based on the facility order forecast. The following problems were identified in the interview which hinders availability of pharmaceuticals; misleading information flow from the facilities, most of the facilities forecast the amount through approximation without having the relevant data; problem with timely reporting and requisition, even though most facilities have their own essential drug lacks frequent updating of the facility specific drug list and shortage of foreign currency. They told to the researcher the inventory level of the agency is often not in a good level. The consequences of the above problems were also discussed; agency has to pay extra cost for renting the large warehouse to keep the products and sometimes products expiry with large volume, product stock out and source of good governance problem.

The warehouse and inventory management officer discussed the incident of ware house accidents rate which is not common. The officer discussed that continuous training are

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provided to employees working in warehouse about warehouse management and safe storage practice.

4.1.5 Responsiveness indicator

i. Respondents' perception on Responsiveness indicator

The mean values of each of the measurement items of responsiveness indicator respondents from public health facility were calculated between 3.63 and 3.78 with standard deviations that range between 0.7 and 0.99. The lowest mean value was registered in the case of on time delivery of pharmaceuticals to its customers. The scores of the scale of responsiveness indicator in public health facility for facility receives the right type and quantity of products, the facilities receives pharmaceuticals on time, and the facility serves the customers on time was found with very comparably close mean values of 3.63, 3.75 and 3.78 respectively, the result is depicted on the table below. The weighted average value of responsiveness indicators on supply chain performance were calculate with a mean value of 3.59306 and standard deviation of 0.9150 result shows that the perception of the respondents on the pharmaceutical supply chain performance of the health facilities on responsiveness indicator was moderate with a minimum variation among the respondents.

Table 4.5 **Responsiveness Indicator measurement items mean and standard deviation at public health facilities April 2018, Addis Ababa, Ethiopia.**

	Public health facility Respondents	
Variable	**Mean**	**Std. Deviation**
The facility receives the right type and quantity of products	3.7792	.92656
The Facility receives pharmaceuticals on time	3.4416	.78629
The facility serve the customer on reasonable time i.e. from the moment an order is received until the time the order is responded clients	3.5584	1.03229
Weighted average for Responsiveness indicators	**3.59306**	**0.9150**

Source: *own survey*, 2018

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ii. **Direct Observation result on Responsiveness indicator**

a. Order Fill Rate

Percentage of items ordered that are actually received to determine whether an order is filled in the correct quantities with the correct products. This can help the facilities to determine how the supplier is effective in satisfying orders in correct quantities and correct items. The survey evaluated the order fill rate of the public health facilities in addition to assess their perception of the staffs. To calculate this, the quantity ordered was compared with the same period quantity received for essential pharmaceuticals during the review period. Note that this indicator is calculated only for facilities with information on both quantities ordered and received for the products assessed. For most products assessed, the percentage of facilities resupplied with the quantity ordered was about 74.67 percent for program items and 62.46 percent for non-program items. The order fill rate helps to gauge the PFSA response to facility needs when making orders (figure 4.1). The ideal order fill rate is 100%, which means that a facility receives the exact quantity that was requested for a particular product when placing its order with PFSA.

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Table 4.6 **Average order Fill rate of Public Health Facilities for program and Non program pharmaceuticals April 2018, Addis Ababa, Ethiopia.**

Program Drug average order Fill rate	
Name of the Item	Order Fill rate
Amoxicillin Dispersible tablet	82.50
Oral Rehydration Salt	67.70
Zinc Dispersible tablet	84.38
Magnesium Sulphate injection	69.40
Medroxy Progestron Acetate injection	64.83
Pentavalent Vaccine	79.11
TDF/3TC/EFV adult	78.43
RHZE/RH	75.33
Arthemeter + Lumefantrin (Coartem) tablet	65.40
Artesunate injection	77.44
Implanol	76.87
Average Refill Rate	**74.67**
Non-Program drugs order fill Rate	
Gentamycin Sulphate injection	80.93
Co-trimoxazole	68.64
Oxytocin injection	69.98
Enalapril tablet	90.08
Glienclamide tablet	79.64
Adrenaline injection	79.07
Glucose 40%	62.25
Dextrose in normal Saline	48.19
Ferrous Sulphate + Folic Acid	75.25
Ciprofloxacin tablet	70.57
Ceftriaxone injection	60.83
Hydralazine injection	58.63
Tetanus Anti Toxin	49.71
Tetracycline eye ointment	43.15
Average Order Fill rate	**62.46**

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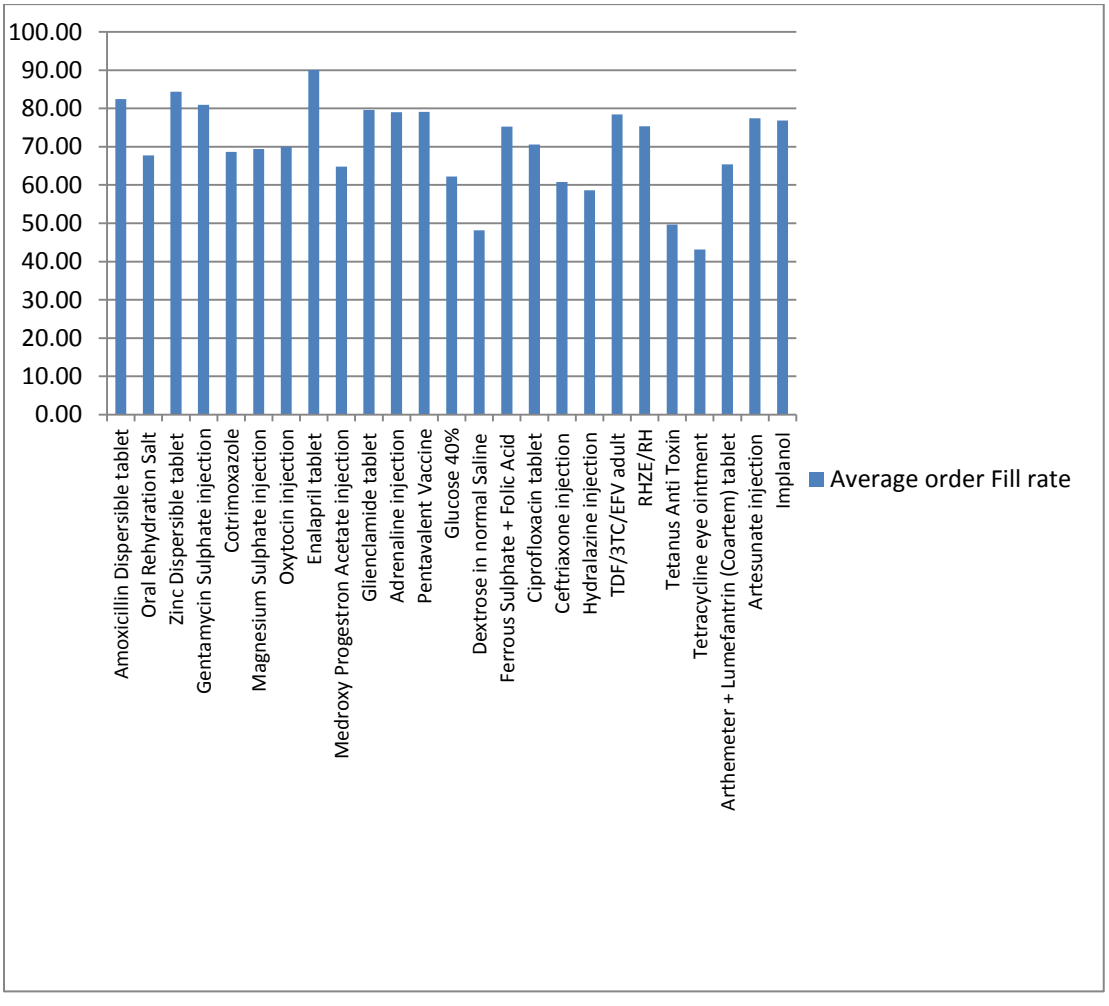
Fig 4.1 Average order Fill rate Facilities Resupplied Based on Their Request by Product April 2018, Addis Ababa, Ethiopia



b. **Lead-time**

Public Health facilities are supposed to maintain a minimum stock level of two months and maximum of four months for essential medicines. It is important for the facility to receive their fresh supplies before they run out of stock. Therefore, minimum stock is 2 month or 60 days and thus new supplies should reach within 60 days that is the maximum lead-time allowed. Any lead-time > 60 might lead to out of stock situation. For program commodities, PFSA expected to resupply facilities with the requested quantities within one month of receiving the request. For products procured for non-program items if the product is not available at the PFSA store, facilities can buy products from PFSA or other vendors anytime without a specific resupply schedule.

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The survey evaluated the timeliness and the resupply of products, as per their request. Data related to time of order placed and received was found in 16(47.06%) public health facilities. The result showed that all of the public health facilities usually receive available non-program products requested within two weeks. But the result showed that 87 % of public facilities are supplied by PFSA for program items within two weeks to one month. Only 12.5% of the facilities reported waiting for more than one month to receive products after placing orders.

Fig 4.2 **Percentage of Facilities with delivery Time of Resupply for program items, public health facilities April 2018, Addis Abba, Ethiopia**

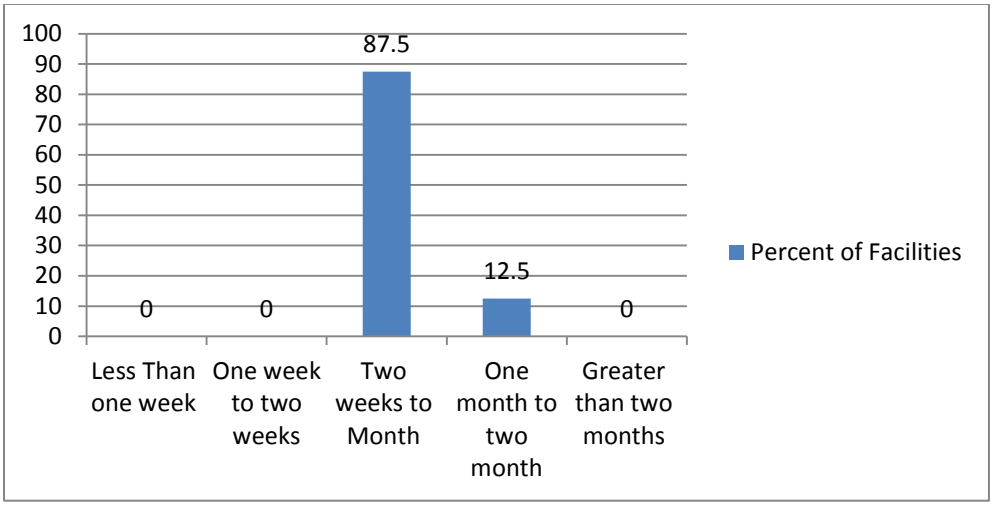
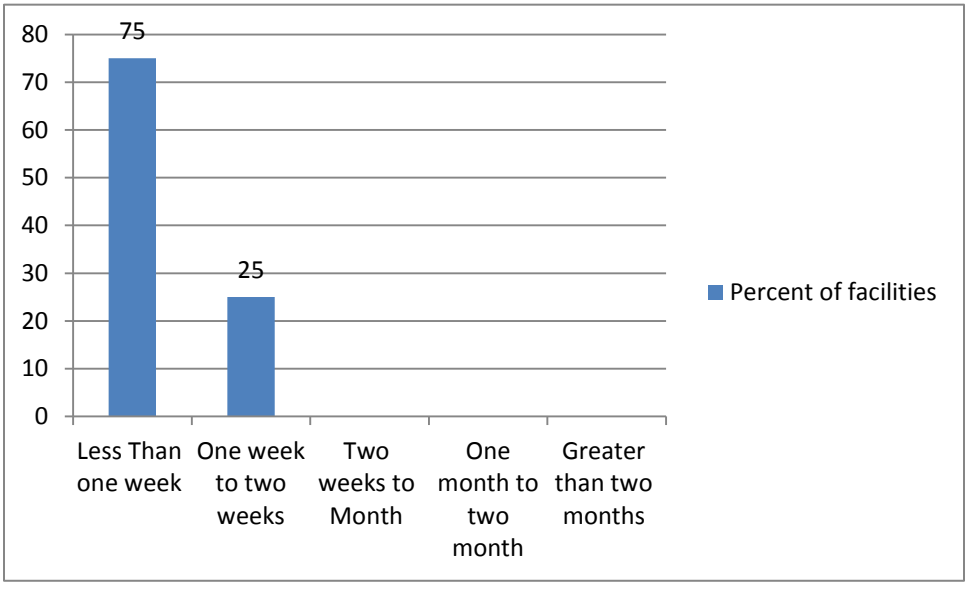


Fig. 4.3 Percentage of Facilities with delivery Time of Resupply for non-program items, public health facilities April 2018, Addis Abba, Ethiopia



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c. Time to serve customers

The perception of the respondents on the time to serve the customers was found to be with a mean value of 3.5 and standard deviation of 1.03. This shows that some time elapse before the customers get the service**.**

As per the interview order lead-time of PFSA supply chain the agency's order lead- time vary from time to time. Large amount of pharmaceuticals are procured for national consumption and most of the time the suppliers are unable to supply within the agreed time period.

Participants in the interview discussed that most of public facilities experience with the late delivery of items. The main reasons of the late delivery were explained by the participants; shortage of transportation service, inaccurate reporting of their consumption and late reporting from public facilities. In addition to this they raised that there are a large number of catchment health facilities to address with the available transportation service with short delivery time.

The participant rose that the agency encounters frequently stock out of the pharmaceuticals and unable to supply the quantity and type of pharmaceuticals needed by the facility. Sometimes the stock out lasts for long days. The major problem for the stock out rose was problem with the practice of inventory management concept on placing an order when the minimum level was reached. This is the only way the agency can trigger and initiate the necessary activity that would lead to stock replenishment. The solution for decreasing stock out rate was better forecasting would obviate the situation where stock out becomes common.

4.1.6 Cost/Financial Indicators

i. Respondents' Perception on Cost\Financial Indicator

The mean values of the measurement items of cost indicator which are price of products, expiry/damage of pharmaceuticals and availability of unusable product in the facility warehouse were calculated and found that with mean value of 4.08, 3.37 and 3.40 with Standard deviations of 0.78, 0.80 and 1.05 respectively. The largest mean value was observed in the affordability of price to the customers. The respondents believe that the price of the products is affordable to the customers. The mean value of the performance of the facilities in minimizing total product wastage was and availability of unusable stock in the warehouse was moderate. The weighted average values for the cost/financial indicator were calculated

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with a mean value of 3.6181 and standard deviation of 0.88046. The average result shows that pharmaceutical supply chain performance on cost/financial indicator of public health facilities was moderate.

Table 4.7 Cost/financial indicator measurement items mean and standard deviation public health facilities April 2018, Addis Ababa Ethiopia.

Variables	Mean	Std. Deviation
The price of products are reasonable to our customers	4.0816	0.78219
The facility is successful in minimize total product expired/damage in the warehouse like product deterioration, breakage, leakage etc	3.3747	0.80656
The facility has low stock of unusable product in the warehouse	3.3980	1.05263
The weighted average value for cost/financial indicator	**3.6181**	**0.88046**

ii. Direct Observational result of the cost/Financial indicator

a. Percentage of Average Int'l Price Paid:

Overall, the prices paid by public health facilities for more than half of essential medicines were close to the international reference price in the MSH International Drug Price Indicator Guide. Prices paid range from 18.36% of the international reference price to 395.80% of the international reference price. Although the prices paid for the essential pharmaceuticals were relatively close the international reference price, analysis of a sample of products procured 64% (16 of 25) of essential medicines procured were purchased at the international reference price or below.

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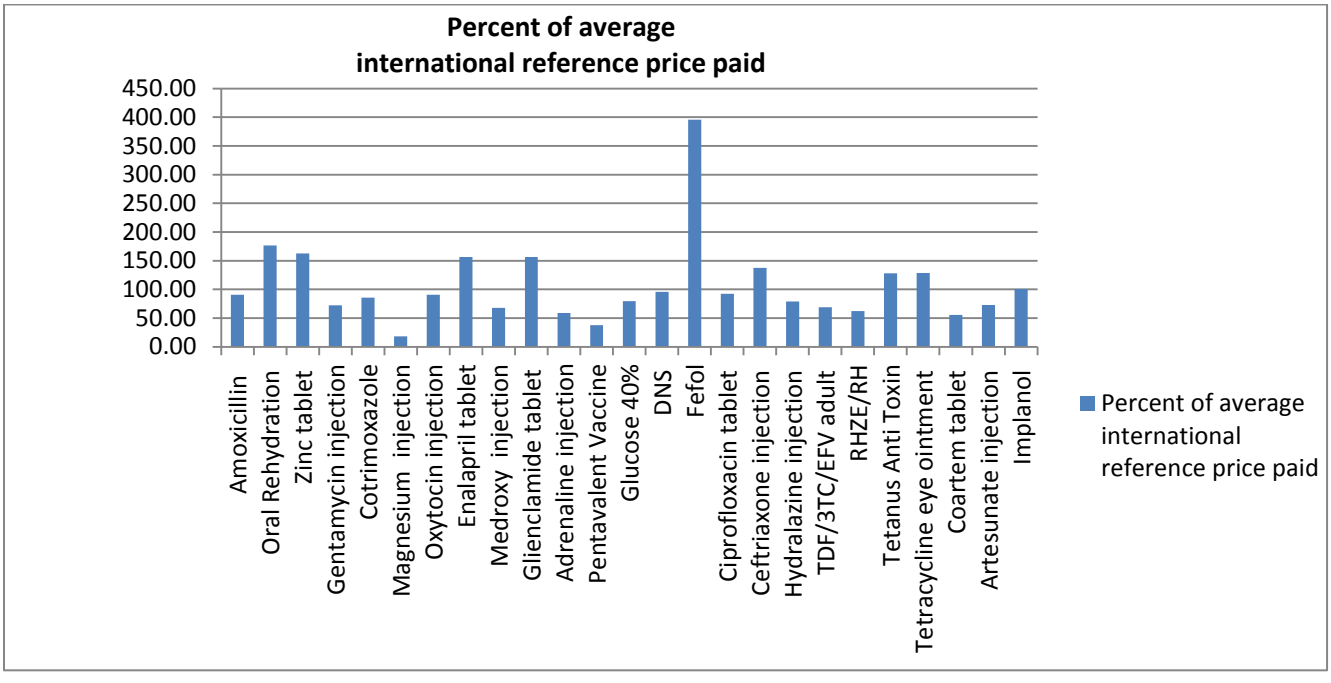
Fig.4.4 **Percentage of average international reference price paid by public health facilities April 2018, Addis Ababa Ethiopia**



b. Rate of expiry

The rate of expiry in the public health facilities indicates the ability of the public health facilities in minimizing wastage rate of pharmaceuticals. From the survey result rate of expiry range from the smallest 1.04% to the largest 10.21%

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Table 4.8 **Expiry rate of public health facilities April 2018, Addis Ababa, Ethiopia.**

Facility code	value of Shipped product	Total Value of damaged product within the review Period	Wastage Rate
Facility 41	10,394,631.28	1061448.57	10.21
Facility 17	35002104.05	2691948.8	7.69
Facility 30	1555385.47	96456.2	6.20
Facility 16	15423074.75	671225.7	4.35
Facility 31	211679583	2201683.25	1.04
Facility 34	1369853.21	89235.66	6.51
Facility 02	1126935.88	92658.33	8.22
Facility 06	1563698.31	64596.3	4.13
Facility 09	1256986.5	43698.34	3.48
Facility 12	1896597.43	71298.22	3.76
Facility 32	1363529.2	94256.89	6.91
Facility 27	1456983.79	78965.93	5.42
Facility 35	1352986.23	34563.21	2.55
Facility 39	14896583.55	562986.33	3.78
Facility 05	1789253.51	67529.35	3.77
Facility 01	1563254.46	89378.55	5.72
Facility 08	1223659.38	43259.88	3.54
Facility 03	1659658.22	67965.69	4.10
Facility 19	1569856.33	51698.19	3.29
	Average wastage rate of Public health Facilities		4.98

c. Percentage of unusable products

It was difficult to find information on the value of unusable products. The perception of the respondents on the availability of unusable products in the public health facilities was found with a mean value of 3.4 and standard deviation of 1.05.

In the interview they discussed the procurement process of the agency start by floating international bids to receive competitive prices and quality products. Many multinational

companies participate in the bidding process. The agency evaluated that the majority of the prices quoted are affordable to our community. Sometimes higher prices are given by supplier especially for products that are requested in small volume like specialty medicines (e.g. Cancer Medications). The suppliers lack interest to supply products with low volume which results in higher price. As per the interview the major challenge raised was higher price for specialty products which cannot be procured in large volume.

As per the interview the agency was working to decrease the rate of expiry of by increasing the capability of the facilities on forecasting, use of inventory management tools and providing training for pharmacy professionals working at facility level. In addition to these redistribution of stocks from branch to branch and facility to facility where the items are needed. As a rule currently the agency does not receive products with shelf life less than one year. All the above efforts were points raised during the interview made by the agency to decrease the rate of expiry and the accumulation of unusable products.

4.1.7 Productivity indicator

i. Respondents' Perception on Productivity Indicator

One indicator was assessed in the productivity indicator. The mean values of the measurement items of productivity indicator i.e. inventory turnover rate was calculated with a mean value of 3.72 and standard deviation of 0.72. Respondents are rating their respective facility performance as moderate, as in the case of their evaluation regarding the inventory turnover rate of pharmaceuticals.

Table 4.9 Respondents perception on inventory turnover rate of Public Health Facilities April 2018, Addis Ababa, Ethiopia.

Indicator	Mean	Std. Deviation
The inventory turnover rate of the facility is optimal	3.7449	0.76403

Source: *own survey*, 2018

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ii. Direct Observation Result of Productivity Indicator

Inventory turnover rate

Inventory turnover rate is calculated using data on value of commodity movement for the year 2009 E.C. Table 4.10 shows inventory turnover rate of pharmaceuticals from public health facilities during the review period. Data for calculating inventory turnover rate was obtained from 16 facilities. The finding shows that the minimum inventory rate was 0.59 and the maximum inventory rate was 0.94. Only one variable was seen in productivity indicator. The value of the productivity indicator shows that the pharmaceutical supply chain performance of the performance of public health facilities was moderate.

Table 4.10 **Inventory Turnover rate of public health facilities April 2018, Addis Ababa, Ethiopia.**

Name of the facility	Amount of Pharmaceuticals cost sold within the review Period	Average cost of Inventory	Inventory Turnover rate
Facility 30	3256202.826	5443209.316	0.60
Facility 16	56067787	69927522.81	0.80
Facility 17	28905346.75	39531599.24	0.73
Facility 41	14538079.48	22248046.59	0.65
Facility 31	263606051.7	308573266.9	0.85
Facility 29	1,413,550.50	1,541,666.70	0.92
Facility 24	1893245.29	2005468.62	0.94
Facility 21	3254791.73	3394521.66	0.96
Facility 01	1434336.12	1789524.89	0.80
Facility 09	945682.38	1365921.82	0.69
Facility 11	1345698.12	1689264.33	0.80
Facility 39	2453651.95	2965321.23	0.83
Facility 18	196253.65	212986.74	0.92
Facility 19	2695352.56	3005698.29	0.90
Facility 10	1639545.11	1795436.72	0.91
Facility 32	1896542.39	2256986.57	0.84
	Average Inventory Turnover rate in Public Health Facilities		**0.82**

Own Survey, 2018

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From the interview the researcher understood that the inventory turnover rate of the agency is dependent on the inventory turnover rate of public health facilities. The warehouse and inventory management officer discussed those large volumes of pharmaceuticals greater than their maximum stock levels are stored in the agency warehouse which decreases the inventory turnover rate. The cause for low inventory rate raised was poor forecast accuracy from the facilities.

Finally, in the end of the interview for key informants, the researcher asked the key informants to give their idea how to improve the pharmaceutical supply chain performance of the case the agency. Most of them noticed the information flow is the most critical issue that the agency needs to improve. The investment on new technology and training sections of using technology for the public health facility was suggested.

Strength and weakness of public health facilities

The researcher conducted to analyses the performance of public health facilities questionnaires administered to public health facilities staffs, direct observation of the public health facilities and interview of key informants of PFSA staffs. The respondents and the direct observation provided mixed response on key performance indicators. The researcher tried to analyze the strength and weakness of the public health.

One of the strength seen in all of the public health facilities was the existence of facility approved specific essential medicines list. Majority agreed that most of the time product selection is done from facility specific drug list. This is the result of the existence of a capacity-building support program from PFSA. The most important thing in the procurement process in the in supply management cycle is supply planning. Most facilities annually prepare supply planning and reconcile with the available budget. Warehouse accident rate is not common in public health facilities as well as in PFSA.

Weaknesses from the observation, questionnaire and interview in the public health facilities include: frequent and long stock out days some of the essential pharmaceuticals; problem of buying few medicines that is not on an approved medicines list, the absence of adequate information flows between different levels, poor procurement forecasting accuracy

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(Unreliable consumption data, Quantification exercise inherently imprecise because of variable, poor Availability of medicines), lacking which increases stock out rates and increase shortage of pharmaceuticals and problem with reporting and time of reporting of the public health facilities,

Product availability may not necessarily attributes to the performance of PFSA systems or supply chain activities as such as there are multiple factors that affect product availability. However, essential medicine availability for selected public health programs low to moderate which is the ultimate output of SCM both from the majority of the key informants and desktop reviews.

Performance of Public health facilities with regard to the key performance indicators

The finding of the study shows that; from the questionnaire the perception of the respondents of the public health facilities on the four key performance indicators vary in all indicators. The overall performance of the pharmaceutical supply chain performance of the health facilities was found moderate. From the finding of the study the four key performance indicators can be ranked based on the weighted average mean value from the largest to the smallest Productivity indicator, Quality indicator, cost/financial indicator and responsiveness indicator. The result of the observations also support the result found from the questionnaire.

With regard to supplier pharmaceutical supply chain performance the interview results showed the strength and problems associated which hinders the performance of the agency.

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4.2 Discussion

The findings of this study emphasized on pharmaceutical supply chain performance of public health facilities using key performance indicators related to quality, responsiveness, cost and productivity including drug selection from facility specific drug list, procurement planning, warehouse accident rate, stock out rate of key essential medicines, availability of pharmaceuticals, time to serve customers, Stock wastage due to expiration/damage/loss, order fill rate, order lead time, value of unusable pharmaceuticals, average international reference price, international stock & storage condition of medicines and challenges associated with the performance of public health facilities.

Quality Indicators

The finding of this study showed that the performance of the public health facilities with respect to quality indicators was moderate. All of the surveyed public health facilities have their own facility specific drug list. The selection of products for the public health facility is made from the facility specific drug list. From the survey 69% of the respondent's agree and strongly agree that the selection of products the facility is made from the facility specific drugs list. All the surveyed health facilities had facility specific drug list. The result of this study is similar with that of a study conducted in Rwanda in which the selection of pharmaceutical products is made from the national list of essential drugs (NLED) and higher than that of a study conducted in a study conducted eastern Ethiopia which was found 92% of public health facilities make selection from facility specific drug list *(Kenza et al. 2016 & Bilal et al. (2016)).*

The rationale for selection of limited list of essential drugs is to improve the supply of drugs, intriguing balanced usage, and lowering cost associated with the supply of drugs. Essential drugs are those that are deemed to placate the healthcare needs of the population and available at appropriate dosage forms and strength. Selection of vital drugs has a considerable impact on the quality of healthcare services provided and cost related to the treatment provided. The essential drug lists are composed in such a way that it indicates the level of healthcare facility where each medicine can be used *(MSH, 2012).*

Forecasting and procurment planning are essential for ensuring product availability within the supply chain. Forecasts are used to determine supply, inform procurement decisions, and help

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plan the shipment and distribution of commodities to ultimately ensure consistent product availability within a supply chain while minimizing costs. Good forecasting and supply planning is prerequisite for efficient accessibility to appropriate and good quality drugs. The main objectives of the supply planning system is to Purchase of right quantities of drugs in a cost-effective way, Selection of reliable suppliers of higher quality goods, Assuring timely delivery and distribution of drugs and other requirements and Achieving the lowest possible total cost associated with the transaction in the procurement system (*Management Science for Health, 2012).* It is embarked to avoid shortage of drugs, assure credible healthcare services, to evade excessive stocking and wastage of limited drug resources and incorporate better financial management. In most of the surveyed health facilities have a procurement plan which is prepared annually. From the survey result it was found that 87.80% of the public health facilities have a forecasting and procurement plan.

The result of this study indicated that about 58.54% of the health facilities were stocked out at least on one of the key essential medicines with an average stock out duration of 84.86 days. Among the selected 25 key essential medicines 13 (52%) of them were stocked out at least once within the last one year with a different duration of times. However this finding is lower than the study conducted Tanzania and higher than survey conducted in west Showa Ethiopia where the average stock out rate was reported to 69% and 24% respectively *(Wales et al, 2013. & Tadesse Gudeta et al 2017).* This significant difference between the result of this study and that of Tanzania might be the geographical coverage where that of Tanzania was national survey involving around 923 public and private health facilities where as this study was conducted in a Addis Ababa town involving only 41 public health facilities. The other possible reason could be the number of medicines selected for the study. The present study involved 25 key essential medicines where the significant stock out rate of specific medicines can be masked by the product with no stock out rate. Only 14 tracer medicines were selected to be studied in 923 health facilities in case of the Tanzania survey. The difference in result between this study and that of the west shewa Ethiopia could be because of the types of medicines involved in the survey.

The perception of the respondents regarding the stock out rates of essential medicines 11.2% of the respondents strongly agree that the health facilities encounter frequently stock out of essential medicines. In addition 32.7 % of the respondents agree, 45.9% neutral, 10.2%

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disagree that health facilities frequently encounter stock out of essential medicines. But the finding of this study is different from a study conducted in Kenya to assess effects of management of supply chain on performance of public health institutions in Migori County was found 74.1% of the respondents strongly agreed that the health facilities encounter stock out of essential medicines. This shows that the result of this study is better than the one studied in Kenya in which the frequency of stock out is higher *(Abigael Achieng, 2014).*

Responsiveness Indicators

The ideal order fill rate is 100%, which means that a facility receives the exact quantity that was requested for a particular product when placing its order with the PFSA. For most products assessed, the percentage of facilities resupplied with the quantity ordered was about 74.67 percent for program items and 62.46 percent for non-program items. The order fill rate was assessed to gauge the PFSA response to facility needs when making orders. The result of this finding is lower than that from a study conducted in Namibia which was found to be fairly high at 80% *(Levenger, et al 2013).* The reason for a lower order fill rate related to delay in reporting, forecast inaccuracy, and shortage of currency in the country. Regarding the perception of the respondents about quantity and item type delivery only 71.5% of the respondents perceive that they can get type and quantity of ordered quantity.

In the other side the order lead time for program and non-program products vary significantly. It was found that the all of the public health facilities usually receive available non program products requested within two weeks. This finding showed that 87.5 % of public facilities are supplied by PFSA for program items within two weeks to one month. Only 12.5% of the facilities reported waiting for more than one month to receive products after placing orders. For non-program products 75% of the facilities receive their products in less than 1week period. A study conducted in Namibia showed that On-time delivery performance for scheduled deliveries is high, with 85% of deliveries arriving within 7 days of the scheduled delivery date *(Levenger et al 2013).* The finding of this study is lower than for the program products from that of the Namibia and non-program items. This is because program items are directly supplied by PFSA based on report from the facilities. The reason could be delay in reporting from facilities to PFSA and shortage of delivery trucks. The respondents from the facility perceive that 45.1% agree and strongly agree with the onetime

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delivery of products. Generally pharmaceutical supply chain performance of the public health facilities is moderate with respect to responsiveness indicators.

Cost/financial indicators

Prices paid for the essential medicines range from 18.36% of the international reference price to 395.80%. Although the majority of prices paid for the essential pharmaceuticals are relatively close the international reference price, analysis of a sample of products procured 64% (16 of 25) of essential medicines procured were purchased at the international reference price. A study conducted in Namibia Prices paid range from 40% of the international reference price to 119% of the international reference price. Only 21% of the commodities were purchased below the average international reference price paid which is lower than that of this study. This indicates that the health facilities in this study were not receiving competitive price for some of the pharmaceuticals. The perception of our respondents in this study was found that the price of the commodities is somewhat affordable with a mean value of 4.08 and with a standard deviation of 0.78. This shows that the price of the commodities is fair but needs competitive price for those pharmaceuticals paid above the international reference price *(Levenger, M. et al 2013).*

From the survey it was found that the rate of expiry in public health facility was found 1.04-10.21%, with an average expiry rate of 4.98%. A study conducted in Tanzania to assess procurement of medicines and supply management system amount of medicines and supplies that expired in 2006 was 3.7% of sales for the year 2006 and the value of expired products varied from 0.02-6% of annual sales for the *year (Ministry of Health and Social Welfare, T., 2008)***.** The finding from this study the rate of expiry of pharmaceuticals is greater than that of the Tanzania. This can be due to overstocking of pharmaceuticals and purchase of drug with near expiry date. The public health facilities need a great effort to reduce the rate of expiry by improving quantification. The cost/financial indicator performance of the health facilities is moderate.

Productivity indicator

Inventory turnover rate is a metrics selected to measure the productivity indicator that describes the ability to efficiently utilize assets. Inventory turns, referred to as average annual inventory turns, measures the degree to which inventory held by public health facilities to

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fulfill customer orders is appropriately sized to buffer for uncertain demand. The indicator assesses cost-effectiveness by evaluating the degree to which inventoried pharmaceuticals are not stocking for too long in the facilities controlled inventory stocks. The finding showed that the average pharmaceutical inventory turnover rate of 0.82. A study conducted in Addis Ababa Amanuel Specialized hospital to assess laboratory supply chain performance inventory was found to be 0.72. The average inventory turnover of this is study higher than that of the Amanuel Specialized hospital study but the turnover rate is low. It tells inventory was not moving in the supply chain. This implies that there a risk of expiry *(Banchirega Mekuria, 2017).*

The roles of the PFSA have generally included the national procurement of healthcare commodities, storage and handling of inventory commodities, and distribution to various sections of the national public health system; and, in some cases, the private-sector health system. In addition to it also provides capacity building on the supply chain.

Through the interview, the researcher notices that the pharmaceutical supply chain performance of PFSA is not satisfactory. The performance of pharmaceutical Fund and Supply Agency directly affects the performance of public health facility. The use of performance metrics is needed in this case in order to have the overall performance of picture of the agency's supply chain. Moreover, KPIs help to access the accuracy of demand plan and the execution performance hence they offer the opportunities to identify and correct potential problems. The author assessed the case agency's supply chain performance. The performance metrics that were gathered under four core supply chain performance attributes: quality, responsiveness, costs and productivity.

PFSA selects pharmaceuticals for procurement based on needs from health facilities. PFSA aggregates the demand of the health facilities and ensures the presence of the requested items in National drug list. Central Medical store procures pharmaceuticals from approved national drug list. All medicines on the Central Medical Store are selected from the Sudan National list of Essential Medicines (NLEM*)(Gamal Khalafalla. 2010)*

Appropriate forecasting and procurment planning improves the overall performance of the supply chain. The Mozambique central medical store found that performance continually

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improved over baseline and that central medical store achieved many of its performance targets *(Spisak C et al 2016).*

The stock level of supply of medicines and medical supplies at PFSA was Moderate. It was earlier pointed out that ensuring a sustained availability of these health products in the health service delivery points in the country requires proper quantification, forecasting, procurement process, appropriate warehousing and effective distribution strategies.

The most common challenge was lack of accuracy of quantification—ordering the right amount of products—is necessary to prevent stock-outs at the PFSA and hence to prevent incomplete filling of customers' orders. A study conducted in Burkina Faso, Senegal and Cameroon to assess the Market Mechanisms of Central Medical store Medical store managers was interviewed. All the interviewed managers agree that quantification Forecasting accuracy in all three countries was extremely weak *(Ramesh Govindaraj et al, 2010).* This indicates that there is a problem in forecasting is a major problem in most countries.

The supply of medicines and medical supplies is very crucial in achieving health for all. When the question was posed to participants on how the lack of supply had affected the care provided the majority the PFSA key personnel agree that PFSA was not supplying the units with the required quantities and sometimes not supplied at all. Inadequate planning and forecasting, use of archaic procurement methods, and tendering yearly or multiple times a year contribute to high commodity costs, long lead times, stock imbalances, and, overall, commodity insecurity *(WHO,2011).* Indeed, across all WHO regions, the mean availability of selected medicines is consistently lower in the public sector than in the private sector (Cameron A, 2009)

In reality, most the records available in the Public health facilities are not systematically maintained and number of days of drug stock-outs is not gauged accurately. There are no such standard formulas used to identify stock-out periods or estimate the demand. Quantification is based on previous year's consumption pattern, adjustments, and addition put forth by the senior staffs of the facility. Since in actuality the forecasting is completely based on individual perception and lack of systematic method, it leads to inappropriateness of the past records of medicine consumption. Finally, perpetuation of irrational usage of drugs

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that is under stocking or over stocking of drugs due to under estimating and over-estimating respectively of the requirements. Capturing of real and actual demand poses a vital move for executing consumption based drug quantification.

The finding from the interview shows that the order fill rate is not satisfactory. A study conducted in central medical store in Cameron was found that order fill rate was 69.5 percent of the time (*Ramesh et al, 2008).* This shows that the capability of the central medical stores in fulfilling the demand of health facilities is limited.

Then, according to Lapukeni (2012), the supply chain showed serious flaw, leading to intermittent supply to delivery sites. Quantification, forecasting, lead times and other activities are crucial in making sure those medicines and medical supplies are available in public health facilities. However, as mentioned by the interviewees it is clear that PFSA continues to have problems which meant lack of availability of medicines and medical supplies in hospitals and health centers. From the observation of it shows that PFSA was still finding problems in trying to gain confidence from the public health facilities in terms of supply of medicines and medical supplies. Some other participants have pointed out that good procurement systems gains confidence and that good procurement would ensure constant availability of medicines. Besides, when products are not overstocked expiry is avoided and then losses are reduced.

From the survey it is difficult to predict PFSA has enough quantity of medicines and medical supplies to supply to hospitals and health centers as shown by fluctuating percentages in the order fill rate. Moreover, when the question asked to ascertain the time it takes for them to deliver the medicines and medical supplies to health facilities the majority of participants mentioned some indicated less than one week for non-program items and between two weeks and one month for program items.

Most of the participants agree that the price of the pharmaceuticals is affordable to the community except for some items. The result of the observation also shows that majority of the pharmaceuticals are below the international reference price for public health facilities. A study conducted in Sudan showed that the prices selling price averaged 70% and 123% for central medical stores which is lower than that of this finding *(Gamal Khalafalla 2010)*

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Chapter Five

Summary of Findings, Conclusions and Recommendations

5.1. Summary of Finding

Based on presentation of the results, the findings of the study are summarized as follows. To measure the pharmaceutical supply chain performance of the public health facility the researcher looked for Key Performance Indicators and to enrich the measurement researcher have used observation and supplier interview.

In order to achieve these objectives, data were collected from 41 public health facilities through direct physical observation and questionnaire was administered to each health facility store manager, Pharmacy head and Medical director. During the direct physical observation review of invoices, bin cards, Health commodity management information system, and request papers. Key informants in PFSA from major departments (Forecasting and marketing, warehousing and inventory management, Customer service and fleet management, fund management, Planning, Monitoring and Evaluation officer and Quality management officer)were also interviewed. The data were processed in qualitative and quantitative approaches and presented through description.

From the demographic characteristics of respondents the dominant percentage was male (70.1%) and the remaining (29.9%) were female respondents in public health facilities. All the interviewed key informants from the supplier side was male. The minimum educational background of respondents was college diploma from the public health facilities and from the supplier side only one person was first degree holder and the rest was Master‘s degree holders. Work experience on the current position 45.9% of the respondents had served for 1 to 2 years from the public health facilities. Work experience of the key informants from the PFSA showed that greater than 50% of the served below one year on current position. Both from the public health facilities as well as at PFSA most of the respondents have short experience in current position. This indicates that there is a high turnover rate of employees.

From the questionnaire, interview and physical observation the researcher observed that the pharmaceutical supply chain performance of public health facility with respect to quality, responsiveness, cost/financial and productivity indicator was moderate. The findings of the

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analysis shows the average mean values of the KPI were from 3.14 to 4.03 and this indicates the average pharmaceutical supply chain performance was moderate. This result is also supported by the result from the direct physical observation. Selection from facility specific drug list, low warehouse accident rate, procurement planning and forecasting showed good performance in the public health facilities where as late delivery, low order fill rate high price for some products, high wastage rate, long lead time and low inventory turnover rate was observed.

On the other hand the analysis of the external survey interview of the supplier shows that the supply chain performance of PFSA was Moderate. Some of the challenges raised was lack of updating of facility specific drug list, transportation shortage, shortage of foreign currency, low forecasting practice, poor reporting and requisition practice and lack of adherence to supply planning.

5.2. Conclusion

The research sought to analyze the performance of pharmaceutical supply chain management using key performance indicators of public health facilities, the performance of PFSA in supplying public health facilities and identify the major strength and weakness which can bring effectiveness and efficiency in the health supply system and ensure health commodity availability in order to maintain high service level in the health sector. From this study I can conclude that the pharmaceutical supply chin performance of the public health facilities is moderate with respect to quality, responsiveness, cost/financial and productivity indicators.

Public health facility supply chain performance using different measuring indicators showed that poor availability of essential medicines, poor order fill rate, long lead time, high rate of expiry and low inventory turnover rate was seen. The study revealed that product selection from facility specific drug list, forecasting and commitment to establish supply planning and price of pharmaceuticals was found that the public health facilities showed good performance. The main cause for the underperformance in the supply chain was problem with quantification, problem with communication, lack of frequent update of the facility specific drug list, problem with on time reporting and currency shortage.

The performance of the pharmaceutical supply Agency is not satisfactory which has problem with on time delivery, shortage of transportation, poor adherence to supply planning, high

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rate of expiry, low order fill rate etc. Irrespective of the level of strategies adopted in the various health facility under study, there is still more room for improvement. The importance of this service industry grows stronger every day and the way forward for an improved service delivery is by making sure that health commodities are managed and delivered effectively for those of in need. It is therefore worth stating that the use managing health commodities in health facilities has a positive effect on health service delivery.

5.3 Recommendations

Based on the finding the following recommendations are forwarded:

- Annual reviewing of the essential drug list of each public health facilities with grouping of medicines and other pharmaceutical needs based on the health facility level and real-time based requirements.
- Review the system of drug quantification and stock control of the public health facilities. Standard methods or formulas can be incorporated to exercise scientific methods in forecasting the future requirements considering the stock-out periods, buffer stocks and the stock on hand
- PFSA should consider evaluating the cost effectiveness with their current pharmaceutical prices to ensure they are receiving competitive pricing and high quality service. Consider using forecasts to develop supply plans, ensuring better medium-long term planning for procurements which can help ensure better prices on pharmaceuticals and commodities
- Public health facilities should consider improvement of management of unusable of pharmaceutical products before disposal
- Strengthening collaborative planning, forecasting and replenishment between public health facilities and supplier.
- There is a need for long term supplier agreement between PFSA and supplier to PFSA to obtain competitive price.
- PFSA should Improve transportation management system to ensure on time delivery of pharmaceuticals
- The problem of stock-out duration in both in public health facilities and PFSA is very significant and has to be tackled while making sure that medicines are appropriately quantified.

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5.4 Limitation of the study

As supply chain performance for pharmaceuticals is often overlooked, findings of this study are believed to shade light on existing situation and gaps for improving the system. Despite these facts, however, the following limitations should also be noted. First, the study only focused on public health facilities in Addis Ababa and focused on essential medicines only. As such, it lacked to see the supply chain performance of the private sector studied for comparison and full product coverage. It also, fails to look into potential regional variations of pharmaceutical supply chain performance. The investigators thus call for assessment private sector and regional inclusion.

Further Studies

Further study should be conducted in order to investigate the pharmaceutical supply chain performance of private suppliers. In addition the cause for the high rate of expiry should be investigated.

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Annex I: Data Collection Check list

Data collection Tool

Code of The facility ---------- Type of Facility-Sp. Hop/General hosp./Health Center

1. Does the health center have its own Essential Medical List a. yes b. No
2. Product selection is made from Fcility Specif list a. yes b. no
3. Commitment to establish Supply plan (product selection, forecasting, and procurement)
   a. Yes b. No
4. Warehouse accident rate
   a. yes b. no

5. Stock out rate (Inventory Management/LMIS customer response)

S.No	Essential Drugs for Hospital/Health Center	Unit of count	Stock out most recent 12 months (Y/N)	Number of stock out	Total number of days	Remark
1.	Amoxicillin Dispersible tablet					
2.	Oral Rehydration Salt					
3.	Zinc Dispersible tablet					
4.	Gentamycin Sulphate injection					
5.	Cotrimoxazole					
6.	Magnesium Sulphate injection					
7.	Oxytocin injection					
8.	Enalapril tablet					
9.	Medroxy Progestron Acetate injection					
10.	Glienclamide tablet					
11.	Adrenaline injection					
12.	Pentavalent Vaccine					
13.	Glucose 40%					
14.	Dextrose in normal Saline					
15.	Ferrous Sulphate + Folic Acid					
16.	Ciprofloxacin tablet					

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17.	Ceftriaxone injection					
18.	Hydralazine injection					
19.	TDF/3TC/EFV adult					
20.	RHZE/RH					
21.	Tetanus Anti Toxin					
22.	Tetracycline eye ointment					
23.	Arthemeter + Lumefantrin (Coartem) tablet					
24.	Artesunate injection					
25.	Implanol					

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6. Order fill rate (Inventory Management/LMIS customer response):

S.No	Essential Drugs for Hospital/Health Center	Name of the facility											
		Month 1		Month 2		Month 3		Month4		Month 5		Month 6	
		Qty Ord.	Qty Rec.	Qty Ord.	Qty Rec.	Qty Ord.	Qty Rec.	Qty Ord.	Qty Rec.	Qty Ord.	Qty Rec.	Qty Ord.	Qty Rec.
1.	Amoxicillin Dispersible tablet												
2.	Oral Rehydration Salt												
3.	Zinc Dispersible tablet												
4.	Gentamycin Sulphate injection												
5.	Cotrimoxazole												
6.	Magnesium Sulphate injection												
7.	Oxytocin injection												
8.	Enalapril tablet												
9.	Medroxy Progestron Acetate injection												
10.	Glienclamide tablet												
11.	Adrenaline injection												
12.	Pentavalent Vaccine												
13.	Glucose 40%												
14.	Dextrose in normal Saline												
15.	Ferrous Sulphate + Folic Acid												
16.	Ciprofloxacin tablet												
17.	Ceftriaxone injection												
18.	Hydralazine injection												
19.	TDF/3TC/EFV adult												
20.	RHZE/RH												
21.	Tetanus Anti Toxin												
22.	Tetracycline eye ointment												
23.	Arthemeter + Lumefantrin (Coartem) tablet												
24.	Artesunate injection												
25.	Implanol												

7. Stock wastage due to expiration or damage (Inventory Management/LMIS customer response)
   a. Quantity of unusable physical stock

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b. Total quantity of Usable and Unusable stock

8. Order lead time (Inventory Management)

S.No	Essential Drugs for Hospital/Health Center	Name of the facility											
		Month 1		Month 2		Month 3		Month4		Month 5		Month 6	
		Date order Placed	Date Order Received	Date order Placed	Date Order Received	Date order Placed	Date Order Received	Date order Placed	Date Order Received	Date order Placed	Date Order Received	Date order Placed	Date Order Received
1.	Amoxicillin Dispersible tablet												
2.	Oral Rehydration Salt												
3.	Zinc Dispersible tablet												
4.	Gentamycin Sulphate injection												
5.	Cotrimoxazole												
6.	Magnesium Sulphate injection												
7.	Oxytocin injection												
8.	Enalapril tablet												
9.	Medroxy Progestron Acetate injection												
10.	Glienclamide tablet												
11.	Adrenaline injection												
12.	Pentavalent Vaccine												
13.	Glucose 40%												
14.	Dextrose in normal Saline												
15.	Ferrous Sulphate + Folic Acid												
16.	Ciprofloxacin tablet												
17.	Ceftriaxone injection												
18.	Hydralazine injection												
19.	TDF/3TC/EFV adult												
20.	RHZE/RH												
21.	Tetanus Anti Toxin												
22.	Tetracycline eye ointment												
23.	Arthemeter + Lumefantrin (Coartem) tablet												
24.	Artesunate injection												
25.	Implanol												

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9. Percent of average international reference price paid (product selection, forecasting, and procurement)

S.NO	Name of the item	Pack size	Pack price	Median international supplier unit price	Remark
1.	Amoxicillin Dispersible tablet				
2.	Oral Rehydration Salt				
3.	Zinc Dispersible tablet				
4.	Gentamycin Sulphate injection				
5.	Cotrimoxazole				
6.	Magnesium Sulphate injection				
7.	Oxytocin injection				
8.	Enalapril tablet				
9.	Medroxy Progestron Acetate injection				
10.	Glienclamide tablet				
11.	Adrenaline injection				
12.	Pentavalent Vaccine				
13.	Glucose 40%				
14.	Dextrose in normal Saline				
15.	Ferrous Sulphate + Folic Acid				
16.	Ciprofloxacin tablet				
17.	Ceftriaxone injection				
18.	Hydralazine injection				
19.	TDF/3TC/EFV adult				
20.	RHZE/RH				
21.	Tetanus Anti Toxin				
22.	Tetracycline eye ointment				
23.	Arthemeter + Lumefantrin (Coartem) tablet				

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24.	Artesunate injection				
25.	Implanol				

10. Value of product damaged in the warehouse (warehousing/Storage):

    Total value of damaged products within the review Period

    Value of shipped products

11. Value of unusable stock (Inventory Management/LMIS/Customer response)

S.NO	**Name of the item**	**Value of wasted Units**	**Value of total units purchased/Received**	**Remark**
1.	Amoxicillin Dispersible tablet			
2.	Oral Rehydration Salt			
3.	Zinc Dispersible tablet			
4.	Gentamycin Sulphate injection			
5.	Cotrimoxazole			
6.	Magnesium Sulphate injection			
7.	Oxytocin injection			
8.	Enalapril tablet			
9.	Medroxy Progestron Acetate injection			
10.	Glienclamide tablet			
11.	Adrenaline injection			
12.	Pentavalent Vaccine			
13.	Glucose 40%			
14.	Dextrose in normal Saline			
15.	Ferrous Sulphate + Folic Acid			

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16.	Ciprofloxacin tablet			
17.	Ceftriaxone injection			
18.	Hydralazine injection			
19.	TDF/3TC/EFV adult			
20.	RHZE/RH			
21.	Tetanus Anti Toxin			
22.	Tetracycline eye ointment			
23.	Arthemeter + Lumefantrin (Coartem) tablet			
24.	Artesunate injection			
25.	Implanol			

12. Inventory turnover rate (Inventory Management/LMIS/Customer response)

    Total value of items distributed or sold

    Average value of inventory

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ANNEX II: Questionnaire

QUESTIONNAIRE

ADDIS ABABA UNIVERSITY

SCHOOL OF BUSINESS & ECONOMICS GRADUATE STUDIES

DEPARTMENT OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT

Dear respondents:

I'm a graduate student at Addis Ababa University School of Commerce in the Department of Logistics and Supply Chain Management. Currently, I'm conducting a research entitled *'Evaluating pharmaceutical supply chain performance of public health facilities*' as a partial requirement for the award of Masters of Art Degree in Logistics and Supply Chain Management.

The purpose of this questionnaire is to gather data for the proposed study, and hence you are kindly requested to assist the successful completion of the study by providing the necessary information. Your participation is entirely voluntary and the questionnaire is completely anonymous. I confirm you that the information you share will stay confidential and only used for the aforementioned academic purpose, thus not affects you in any way rather it will may help you in improving the performance of your company warehouse. So, your genuine, frank and timely response is vital for the success of the study. I want to thank you in advance for your kind

cooperation and dedication of your precious time to fill this questionnaire.

Best Regards,

Bezuayehu Woldehitsan

Note:

1. No need of writing your name.
2. Indicate your answer with a check mark (**X**) on the appropriate cell both for Section I and part
3. If you need further explanation please do not hesitate to contact me through my personal phone

+251911803341 or in person.

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Questionnaire for Service Delivery

Part I. Socio Demographic

1. Age

18-25 ☐ 26-35 ☐ 36-45 ☐ 46-55 ☐ >55

2. Sex

Male Female ☐

3. Educational Qualification

College Diploma ☐ First Degree ☐

Master's Degree ☐ PhD and Above ☐

4. Current Position

Store manager ☐ Pharmacy Head ☐ Medical director/clinical service ☐ Director

5. Year of Service in Current Position

Below one Year ☐ one to two Years ☐

Three to four years ☐ Greater than five year ☐

Section II. Main Part of the questionnaire

Please indicate your coice by putting the check mark **x** on the appropriate cell

Where: 1 Strongly Disagree 2. Disagree 3. Neutral 4. Agree 5, Strongly Agree

6. Please indicate the degree to which you agree with the following statements regarding the pharmaceutical supply chain performance in four facility/institution(please take your key supply chain action in your mind while rating the statements)

S.No	Measurement Item	Score				
		1	2	3	4	5
Quality indicator						
6.1.	Products selected for the facility are procured only					

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	from facility specific drug list/national medicine list					
6.2.	The facility has procurement plan and adheres to it					
6.3.	The facility encounters frequently stock out of essential medicines					
6.4.	The customers get product that they need from the facility					
6.5.	Most of the time accidents are not are not occurred in the institution/facility warehouse like physical accident on daily laborer, warehouse personnel, also on equipment					
Responsiveness						
6.6.	Most of the time the institution/facility serve the customer on reasonable time i.e. from the moment an order is received until the time the order is responded clients					
6.7.	PFSA/supplier of pharmaceuticals deliver products on time					
6.8.	PFSA delivers the right quantity of products to the facility					
Cost/Financial Indicator						
6.9.	The price of products are reasonable to our customers					
6.10.	The institution/facility is successful in minimize total product expired/damage in the warehouse like product deterioration, breakage, leakage etc					
6.11.	The facility/institution has low stock of unusable product in the warehouse					
Productivity						
6.12.	The inventory turnover rate of the facility is optimal					

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Annex III. Interview Guide(for PFSA)

Part I. Socio Demographic

1. Age

18-25 ☐ 26-35 ☐ 36-45 ☐ 46-55 ☐ >55

2. Sex

   Male Female ☐

3. Educational Qualification

   College Diploma ☐ First Degree ☐

   Master's Degree ☐ PhD and Above ☐

4. Current Position --------
5. Year of Service in Current Position

   Below one Year ☐ one to two Years ☐

   Three to four years ☐ Greater than five year ☐

Interview Guide

1. How do you select products necessary for the procurement of products?
2. How do you determine the quantity of the pharmaceuticals, the budget needed for the facilities? Does the agency have supply plan?
3. PFSA in the major supplier of pharmaceuticals to public health facilities. The availability of pharmaceuticals at public health facility depends on the availability of the pharmaceuticals at PFSA. What is your opinion regarding the capacity of PFSA in supplying public health facilities with type and quantity needed timely?
4. Pharmaceutical fund Supply agency is the only supplier in the country for supplying of pharmaceuticals to public health facilities. How do you evaluate the availability of pharmaceuticals that are needed by facilities?
5. Facilities purchase non program pharmaceuticals and each facility collect the products. In other way for the program pharmaceuticals are directly delivered to the facility by the agency. How do you evaluate the lead time?
6. How do you rate the price of the pharmaceuticals products supplied to health facilities?

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7. The agency is providing supportive supervision and capacity building to health facilities to improve the supply chain management system. These include decrease the wastage rate and use of resources efficiently and effectively. How do you evaluate the rate of expiry and inventory turnover rate of pharmaceuticals at public health facilities? Do you think the price of the pharmaceuticals is affordable to the community?
8. What would you recommend to improve the pharmaceutical supply chain performance?

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I. Quality indicators

a. Product selection based on National medicine list (product selection, forecasting, and procurement) a. yes b. no

b. Commitment to establish procurement plan and availability of supply planning (product selection, forecasting, and procurement)

This indicator measures whether all stakeholders are committed to carry out an established procurement plan, by product; including a committed contribution of time, financial resources, or development of a mandate by stakeholders to develop regular, ongoing product-specific procurement plans.

Formula

Are all stakeholders committed to carrying out an established procurement plan by product? (yes/no)

Data requirement

-existing procurement plan

-List of stakeholders who attend procurement plan meetings

- List of products in the procurement plan
- Budget/financial commitments and disbursements by stakeholders.

c. Warehouse accident rate (Warehousing/Storage)

This indicator measures the total number of accidents occurring in a warehouse or other storage facility during a defined period of time.

Formula: number of accidents occurring at the storage location per hour/day/week/month/quarter

Data Requirement: All accident reports over a specified period of time

Defined security measures (Warehousing/Storage): This indicator measures whether there are guidelines or standard operating procedures (SOP) in place that provide instructions to prevent theft or leakage at a given storage location.

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Formula: are warehouse guidelines or standards in places that define the security measures? (Yes/no)

d. **Stock out rate (Inventory Management/LMIS customer response):** This indicator measures the percentage of facilities (e.g., service delivery points [SDP], warehouses) that experienced a stock out of a specific product that the site is expected to provide, at any point, within a defined period of time (e.g., the past six or 12 months). Stock out rates can be calculated for a single product across facilities or aggregated for all products carried by a certain type of facility, or with a certain region. It can be measured over any time but one year is typical.

$$\frac{\text{Number of facilities that experienced a stockout of a specific product}}{\text{Total number of facilities that are expected to offer that product}} * 100$$

Data requirement

Number of facilities that experienced a stock out of a specific product during a defined period of time

Total number of facilities that are expected to offer that product

e. **Order fill rate (Inventory Management/LMIS customer response):** This indicator measures the percentage of items ordered that are actually received to determine whether an order is filled in the correct quantities with the correct products. This indicator can be used to measure individual products(Line fill Rate) or for an entire order

1- $$\frac{\text{quantity and type of items ordered} - \text{quantity and type of items received}}{\text{Total quantity and type of items ordered}} * 100$$

Data requirement

Physical count of items received in the shipment

Quantity and type of items ordered

f. **Stock wastage due to expiration or damage (Inventory Management/LMIS customer response):** This indicator is defined as the percentage of stock for a product

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that is unusable because of expiration or damage out of the total quantity of stock on hand of that product, at a defined point in time (e.g., site visit, supervisory visit, physical inventory) This indicator can be calculated for any facility that manages the products of interest. It can be measured over any time period, but is usually calculated w physical inventory is taken.

Formula

$$\frac{\text{Unusable physical stock}}{\text{Total quantity of usable and unusable stock}} * 100$$

Data requirement

Quantity of product wasted due to expiry and damage

- Quantity of all stock.

II. Responsiveness

a. **Order lead time (Inventory Management) :** This indicator measures facility to the average amount of time it takes from when an order is placed from a lower-level facility to a higher level facility receives its shipment during a specified period of time. This indicator is usually recorded in days but can be calculated over any period of time.

Formula

$$\frac{\text{Sum of the number of days between when orders were placed and when orders were received}}{\text{total number of orders placed}}$$

- Dates when orders were placed
- Dates when orders were received
- Total number of orders placed during a specified period of time

III. Cost/financial indicator

a. Percent of average international reference price paid (product selection, forecasting, and procurement)

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This indicator measures the unit cost per item charged by an external supplier as a percentage of the average international price. This indicator can be calculated for any supplier that supplies products to a requesting facility. It can be measured over any time period, but one year is standard.

Formula

$$\frac{\text{Average unit cost of item}}{\text{Average international unit cost of item}} * 100$$

Data requirement

Invoices from the supplier showing unit price of items purchased (product selection, forecasting, and procurement)

b. **Value of product damaged in the warehouse (warehousing/Storage):** This indicator calculates the value of products damaged, during a defined period of time (usually one year), in the warehouse as a percentage of the value of all shipped products during that period.

$$\frac{\text{Total value of damaged products}}{\text{Value of shipped products}} *100$$

Data requirement

Value of damaged products

Value of shipped product

Ratio of Unit Prices Paid through an Emergency Procurement vs. Competitive Bidding Process(Product selection/Forecasting/Procurment)

c. **Value of unusable stock (Inventory Management/LMIS/Customer response) :** This indicator measures the total value of stock that was unusable, due to damage or expiry, as a percentage of total items purchased during a defined period of time. It takes the value of all wasted units of a certain products in a set period and divides that number by the value of all units of the same product purchased during the same period to determine the

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percentage of total items purchased that were not used during the defined period. It can be measured over any time period but is usually calculated when a physical inventory is taken.

Formula

$$\frac{\text{Value of wasted units per product}}{\text{Value of total units purchased of same product}} * 100$$

Data Requirements

Total Number of units damaged and expired products during a specified time period

- Total number of units purchased during a specified time period
- Cost per smallest unit.

IV. Productivity indicators

a. Inventory turnover rate (Inventory Management/LMIS/Customer response) : This indicator measures the number of inventory cycles or turnovers for a given product for a defined period of time, usually calculated annually. The total value of items distributed or sold during a specified time period (e.g., one year) is divided by the average value of inventory for that item period (i.e. average of beginning and ending inventory value). For example, if a facility distributes or sells USD 100,000 worth of an item in one year and carries, on average, USD10,000 worth of that item at any given time, the inventory of that item has turned over 10 times during that year

Formula

$$\frac{\text{Total value of items distributed or sold}}{\text{Average value of inventory}}$$

Data requirement

Prices paid for inventory

Value of products distributed or sold

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Key Performance Indicators

S.no	Indicator	Formula	Result
Quality	Product selection based on National medicine list (product selection, forecasting, and procurement)	Yes/No	
	Commitment to establish supply plan (product selection, forecasting, and procurement)	Yes/No	
	Warehouse accident rate (Warehousing/Storage)	Yes/No	
	Stock out rate (Inventory Management/LMIS customer response)	stock out of a tracer drugs _____*100 Total number of facilities that are expected to offer that product	Number of tracer drugs stock out Total number of tracer drugs
	Order fill rate (Inventory Management/LMIS customer response):	1- quantity and type of items ordered – quantity and type of items received _____ ___*100 Total quantity and type of items ordered	

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	Stock wastage due to expiration or damage (Inventory Management/LMIS customer response)	Unusable physical stock *100 Total quantity of usable and unusable stock	
	Order lead time (Inventory Management)	Sum of the number of days between when orders were placed and when orders were received total number of orders placed	
Cost/financial indicator	Percent of average international reference price paid (product selection, forecasting, and procurement)	Average unit cost of item * 100 Average international unit cost of item	
	Value of product damaged in the warehouse (warehousing/Storage):	Total value of damaged products *100 Value of shipped products	
	Value of unusable stock (Inventory Management/LMIS/Customer response)	Value of wasted units per product *100 Value of total units purchased of same product	
Productivity indicators	Inventory turnover rate (Inventory Management/LMIS/Customer response)	Total value of items distributed or sold Average value of inventory	

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List of Health Facilities

S.No	Facility Code	Name of the facility	Subcity
1	Facility 01	Addis Ketema HC	Addis Ketema Subcity
2	Facility 02	Kuas Meda HC	Addis Ketema Subcity
3	Facility 03	Abebe Bikila HC	Addis Ketema Subcity
4	Facility 04	Woreda10 HC	Addis Ketema Subcity
5	Facility 05	Akaki HC	Akaki Kality Subcity
6	Facility 06	Kality HC	Akaki Kality Subcity
7	Facility 07	Tulu Dimetu HC	Akaki Kality Subcity
8	Facility 08	Kilinto HC	Akaki Kality Subcity
9	Facility 09	cherchil HC	Arada Subcity
10	Facility 10	Beata Hc	Arada Subcity
11	Facility 11	Arada HC	Arada Subcity
12	Facility 12	Gerji HC	Bole Subcity
13	Facility 13	Bole Bulbula HC	Bole Subcity
14	Facility 14	BOle17HC	Bole Subcity
15	Facility 15	Sumit HC	Bole Subcity
16	Facility 16	Tirunesh Bejing Hospital	Akaki Kality Subcity
17	Facility 17	St.Paul hosp	Gulele Subcity
18	Facility 18	Addisu Gebeya HC	Gulele Subcity
19	Facility 19	Sheromeda HC	Gulele Subcity
20	Facility 20	Hidasse HC	Gulele Subcity
21	Facility 21	Maichew HC	Gulele Subcity
22	Facility 22	Meshalekia HC	Kirkos Subcity
23	Facility 23	Gotera Masalecha HC	Kirkos Subcity
24	Facility 24	Kassanchis HC	Kirkos Subcity
25	Facility 25	FelegeHiwot HC	Kirkos Subcity
26	Facility 26	Kolfe HC	Kolfe Subcity
27	Facility 27	KolfeW9HC	Kolfe Subcity
28	Facility 28	Keranyo Hc	Kolfe Subcity
29	Facility 29	Kolfe w3Hc	Kolfe Subcity
30	Facility 30	lideta Hc	Lideta Subcity
31	Facility 31	Black lion hosp	Lideta Subcity
32	Facility 32	Beletshachew HC	Lideta Subcity
33	Facility 33	Abnet HC	Lideta Subcity
34	Facility 34	NIfassilkw17Hc	Nifas Silk Lafto Subcity
35	Facility 35	Nifassilkw3Hc	Nifas Silk Lafto Subcity
36	Facility 36	Nifassilkw1 HC	Nifas Silk Lafto Subcity
37	Facility 37	Nifassilkw11 HC	Nifas Silk Lafto Subcity
38	Facility 38	Etot no1Hc	Yeka Subcity
39	Facility 39	Kotebe Hc	Yeka Subcity
40	Facility 40	Minilik HC	Yeka Subcity
41	Facility 41	Yekatit hosp	Arada Subcity
42		PFSA Head Office	

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