

ASSESSING THE EFFECTS OF SUPPLY CHAIN PERFORMANCE MEASUREMENT ON INTEGRATED PHARMACEUTICALS LOGISTICS SYSTEM OF THE ETHIOPIAN PHARMACEUTICALS SUPPLY AGENCY

BY

Endashaw Kifle Regassa

(GSE 0764/06)

A thesis submitted to Addis Ababa University, School of Commerce for partial fulfillment of Master of Arts Degree in Logistics and Supply Chain Management

Advisor: Shiferaw Mitiku, PhD

June 2020

Addis Ababa, Ethiopia

SCHOOL OF GRADUATE STUDIES

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SCHOOL OF COMMERCE

DEPARTMENT OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT

APPROVED BY THE COMMITTEE OF EXAMINERS

1.	_____	_____	_____
	Department Head	Signature	Date
2.	_____	_____	_____
	Advisor	Signature	Date
3.	_____	_____	_____
	Internal Examiner	Signature	Date
4.	_____	_____	_____
	External Examiner	Signature	Date

ACKNOWLEDGEMENTS

I would like to acknowledge and thank Ato Solomon Abebe and the whole staff of EPSA for their continuous support in responding to my questionnaire and their true and genuine feedback during my data collection times. Without each and every one of them, this study would not have been a reality.

I also would like to deeply thank Dr. Shiferaw Mitiku, my advisor for his amazing insights, guide and support to complete this study.

Endashaw Kifle Regassa

DECLARATION

I the undersigned herewith declare that this thesis is the result of my own independent research work on the topic entitled "THE EFFECTS OF SUPPLY CHAIN PERFORMANCE MEASUREMENT ON INTEGRATED PHARMACEUTICALS LOGISTICS SYSTEM OF THE ETHIOPIAN PHARMACEUTICAL SUPPLY AGENCY" for partial fulfilment of the requirements for the Degree of Masters of Arts in Logistics and Supply Chain Management at Addis Ababa University, School of Commerce. It is my original work and all the references used in the study are acknowledged as much as possible.

Declared by: Name: _____

Signature: _____

Date: _____

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List of acronyms and abbreviations

EPSA	Ethiopian Pharmaceuticals Supply Agency
SCM	Supply Chain Management
USAID	United States Agency for International Development
GOE	Government of Ethiopia
IPLS	Integrated Pharmaceuticals Logistics System
DHIS2	District of Health Information System (v.2)
LMIS	Logistics Management Information System
LIAT	Logistics System Assessment Tool
HSTP	Health Sector Transformation Plan
ART	Anti-retroviral
LSAT	Logistics System Assessment Tool
SOP	Standard Operating Procedure
FEFO	First to Expire First Out
SCPM	Supply Chain Performance Management
KII	Key Informant Interview
SC	Supply Chain

Abstract

There has been pressure to improve performance of public healthcare services and constraints on public budget, to innovate and improve coordination of information, material and financial flow in order to improve the traditional supply chain performance measures like cost, quality and customer service. The objective of this study is to assess relevance of supply chain performance measurement dimensions and test their effects on the performance of Ethiopian Pharmaceuticals Supply Agency's Integrated Pharmaceuticals Logistics System. Descriptive research design and Explanatory research have been used for the study. Results indicate that six of the twelve independent variables of the three dimensions (organization and process benefits, financial benefits and set up and operating costs), technological investment (95.8%), safety (95.7%), price trend (93%), standardization (91%), staff specialization (87.3%) and warehouse management (78.57%) are relevant and have statistically strong effect on performance measurement of Integrated Pharmaceutical Logistics System in their order of influence. The study concludes ESTAV is suitable framework for the agency's Logistics System performance measurement. The study recommended that EPSA should keep up rolling out IPLS to lowest level of facilities to improve overall supply chain performance. Moreover, safety issues to be considered as an important anchor of health system supply chain performance measures, cold chain issues and adequately qualified pharmacists and professionals are suggested to be addressed. Finally, the academia is also suggested to test relevance of the ESTAV framework from service delivery facilities side.

Key words: Integrated Pharmaceuticals Logistics System, Ethiopian Pharmaceuticals Supply Agency, Health Sector Development Plan, ESTAV

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CHAPTER ONE

INTRODUCTION

This chapter provides an introduction to objectives of the thesis. It explains the background and need for the research, research methodology and significance.

1.1. Background of the study

The Health Sector Transformation Plan (HSTP) of the Federal Ministry of Health of Ethiopia gives due attention to Pharmaceuticals Supply Chain and Logistics Management (HSTP 2014). Accordingly, the Ethiopia Pharmaceuticals Supply Agency (EPSA) which was formerly called Pharmaceuticals Fund and Supply Agency (PFSA) was established in 2007. EPSA is currently serving as the lead organization managing the healthcare supply chain of the country.

EPSA supported by its partners like USAID has designed and implemented various innovative programs, of which the Integrated Pharmaceuticals Logistics System (IPLS) is on the forefront. This major intervention is aimed at creating a strong and unified healthcare supply chain, to connect all levels of supply chain, and to provide accurate and timely data for decision making.

EPSA's Head Office coordinates the activities of its nineteen branches and the seven clusters offices. Acting as the epicenter of pharmaceutical affairs in the country, the head office procures and distributes pharmaceuticals, medical supplies, medical equipment and laboratory reagents from local and international manufacturers to its nineteen branches and hubs that in turn reach over 4,000 medical facilities located in all corners of the country.

Currently IPLS has become the primary mechanism to ensure un-interrupted supply and continuous availability of quality assured essential medicines, pharmaceuticals included to all public health facilities of Ethiopia at an affordable price (PFSA 2014).

Since IPLS has become live and operational in 2009 as a project at different public healthcare facilities, routine project implementation reports and surveys were undertaken. As a result, the project implementation and installation of the new system has profoundly improved supply chain performance of facilities, specifically information systems such as recording and reporting, storage

and distribution systems, as well as availability of pharmaceuticals at service delivery points. However, different USAID/Deliver and other project supervision reports reveal inconsistent and at times conflicting performance results, which calls for an objective and comprehensive performance measurement framework.

According to Beamon (1999), a supply chain performance measurement system must place emphasis on three separate types of performance measures viz. Resource measures (generally costs); Output measures (generally customer responsiveness); and Flexibility measures (Ability to respond to a changing environment). Each of these three types of performance measures has different goals and purposes and enable objective performance measures.

Recently, the concept of SCM has gained momentum in the field of healthcare as a tool for increasing productivity and improving quality (Jarret 1998, Radnor et al. 2006, Doerner and Reiman 2007), of which supply chain performance measurement is one of them.

Though the healthcare supply chain shares several similarities with other industry supply chains, not only in terms of processes (e.g. procurement, warehousing, distribution), but also in terms of discerning customers and management structures (Walters and Rainbird, 2007), there are also considerable differences in the chain that are associated to specific characteristics and requirements of the sector. In general, healthcare supply chains are very complex, fragmented, diverse and dynamic. The main reason for this is increasing level of complexity due to the participation of multiple organizations, who are involved across the entire value chain and it requires key competencies.

Lega *et al*. 2012 further argue that the public healthcare facilities have unique specificities of being "publicness" and "healthcare" nature which require a specific theoretical approach to identifying the appropriate dimensions of supply chain performance measurement initiatives. Therefore, it is important to identify those peculiar elements that influence supply chain performance in the public healthcare sector. Many related literatures in this area of study overlooked those peculiarities and extensively used other standard adapted from the manufacturing and service sector like the supply chain reference model (SCOR) developed by the Supply Chain Council and the popular Balanced Scorecard framework (Kaplan and Norton 1992) as a framework to measure of SC performance.

As mentioned above, the Federal Ministry of Health (FMOH) in Ethiopia in collaboration with partners like USAID are investing resources to strengthen the healthcare commodity including the pharmaceuticals supply chain and improve availability of essential health commodities for its citizens with the instrumentality of IPLS. As part of this support, the USAID/Deliver project has developed Logistics System Assessment Tool (LSAT), which is a comprehensive system-level assessment of the performance of logistics systems for health facilities and pharmaceuticals supply chain. EPSA is the focal firm in Ethiopian public healthcare delivery supply chain. Its decision and leadership impact how care is coordinated and delivered, which influences outcome (Butler et al. 1996).

1.2. Statement of the Problem

There are pressures to improve performance of public healthcare services and constraints on public budget which have attracted increasing attention. Mc Cue and Gianakis (2001), Matthews (2005), Rendon (2005). These actions are aimed at lowering cost and improving quality of healthcare services (HSTP, 2015). According to Van de Ven, Delbecq & Koenig (1976); Cater, Rogers & Choi (2015) and Dobrzykowski, Callaway & Vonderembse (2015) the pressure on public healthcare is even more intense to innovate and improve coordination of information, material and financial flow in order to improve the traditional SC performance measures; namely cost, quality, and customer services.

McKone-Sweet et al 2006, argue that implementation of effective supply chain management practices is not always a straightforward venture. Often times, it is characterized by lack of top management support, suitable performance measurement systems and awareness on the performance and function of a supply chain. Thus, lack of effective supply chain performance measurement framework and dimensions of the focal firm of healthcare industry in Ethiopia are serious barriers in implementing effective supply chain management systems. Albeit significant improvements recorded after implementation of IPLS by EPSA across different public healthcare facilities of Ethiopia, the challenges mentioned specifically in relation to effective performance measurement system is still concerning (MoH, Good Dispensing Practice and Pharmaceuticals Supply Chain Management, 2019). Moreover, project supervision visit results reveal inconsistent and at times conflicting performance results, which calls for an objective, comprehensive and

integrated SC performance measurement framework. Despite these anomalies, quite handful of researches such as Tilahun (2016), Kefale and Shebo (2019), Nenad Stefanovic (2014), Molalign (2019), Mekuanint (2017) did not addressed peculiarities of the sector specifically its "publicness" into account.

Literatures on supply chain performance on the other hand distinguish the public healthcare sector from those of private sector and other industries Lega *et al* (2012). Specificities of healthcare and the effect of 'publicness' on the organizational environment have not been duly conceptualized in models like SCOR and Balanced Score Card models which were largely used as framework of analysis for many of available studies. Authors like Lai *et al*. (2002), Sharahi and Abedian (2009) maintain that one of the major problems of SCM in the healthcare sector is a lack of relevant performance measures. This is because healthcare production processes and supply chain systems are characterized by a series of specificities that inevitably influence the range of available SCM strategies Balaraman Rajan (2017). Similarly, Liga *et al* (2012) argue that the public nature of healthcare and the specific nature and context of the healthcare industry require a specific theoretical approach in identifying and evaluating appropriate dimensions of SC performance measurement initiatives. Therefore, it is imperative to identify and evaluate effects of these unique performance dimensions on the public healthcare supply chain.

Given its characterizing feature of public healthcare sector and integrated nature of the IPLS, its SC performance measurement requires a very focused and integrated supply chain performance measure. As Tarasewicz (2016) said, modern and advanced measurement systems should analyze both the performance of individual organizations in the supply chains and the performance of a supply chain as a whole (integrated approach). However, the adoption of an integrated approach in healthcare sector supply chain performance measurement is still far from common. Nachtmann and Pohl (2009), Villa *et al*. (2009). Therefore, to reliably evaluate the supply chain performance of IPLS, it is deemed important to understand peculiarities of the sector and evaluate SC performance dimensions of the system in light of existing relevant literatures and scholarly works.

The problem statement in this study is therefore as follows:

What are the relevant supply chain performance measurement dimensions peculiar to the public healthcare sector of Ethiopia and their effects on performance of IPLS?

1.3. Research Questions

In order to achieve objective of this study, two major research questions were aimed to be addressed:

1. How are the Pharmaceuticals supply chain performance dimensions namely, organization and process benefits, financial benefits and set up and operating costs are relevant in the EPSA's IPLS?
2. What are the effects of the three supply chain performance dimensions (organization and process benefits, financial benefits and set up and operating costs) on the EPSA's IPLS supply chain performance?

1.4. Research Objectives

The main objective of this study is to identify and understand the effects of public healthcare pharmaceuticals supply chain performance dimensions towards the endeavor of evaluating the existing supply chain system of the public healthcare sector.

The specific objectives in this study are as follows:

i. To assess relevance of the three pharmaceuticals supply chain performance evaluation dimensions namely organization and process benefits, financial benefits and set up and operating costs in the EPSA's IPLS
ii. To determine the effects of the three pharmaceuticals supply chain performance dimensions (organization and process benefits, financial benefits and set up and operating costs) on EPSA's IPLS supply chain performance

1.5. Significance of the Study

As it emerged from the theoretical study, effective performance measurement plays an important role in the improvement of supply chains and organizations at large (Elrod *et al*, 2013). Performance measures are important to the effectiveness of supply chains. Because such measures have a capacity to serve as an indicator of how well the supply chain system is functioning. Moreover, according to Charan *et al* (2008) measuring Supply Chain performance can facilitate a

greater understanding of the supply chain and improve its overall performance. Ittner and Larcker (2003) identified the importance of supply chain performance in helping to direct the allocation of resources, assessing and communicating progress towards strategic objectives and evaluate managerial performance. As Franzelle & Edward (2002) said people behave and systems act based on the way they are measured. Thus, performance measurement is key to direct resources.

Despite the current importance given to supply chain performance measurement systems, several shortcomings are still extant Pedersen *et al* (2012). Since public SCM has important socio-economic implications and peculiarities; it is essential to ensure that its processes are both efficient and effective Ambe & Badenhorst-Weiss (2012).

Various literatures pointed out that the Healthcare industry is increasingly looking into specific applications of supply chain measurement concepts, tools, and techniques to eliminate waste and achieve efficiency in healthcare networks Balaraman Rajan (2017). However, as mentioned above there are only a small number of performance measurement systems exist, which can help to understand and improve a supply chain's overall performance Chan *et al*. (2006). Therefore, this study will be significant in filling gaps in the study area.

On top of existing EPSA's effort to improve sustainable availability of quality assured pharmaceuticals at an affordable price to the public, the agency can take advantage of research findings of this study to reliably measure supply chain performance and identify gaps to improve performance.

Therefore, the study is believed to be significant in terms of making contribution by identifying relevant supply chain performance measurement dimensions and their effects on performance of IPLS performance at large and provide insights to the agency and the academia in improving supply chain performance measurement practices and suggest future research directions.

1.6. Scope of the Study

The scope of this study had been limited to pharmaceuticals supply chain performance measurement from EPSA perspective only. Moreover, of the essential drugs and available medical supplies, this study focuses on pharmaceuticals supply chain only.

1.7. Limitation of the Study

The study used primary data collected from EPSA specialists and secondary data from the existing public health sector information management system and successive surveys undertaken by EPSA. Better result would have been obtained by conducting an in-depth interview of the different regional health bureau, HEWs and service providers working at Primary Hospitals and Health Centers. Due to accessibility and other considerations no primary data have been collected from health facilities. To compensate that the study heavily relied on use of District Health Information System (DHIS2), periodic reports and other pertinent secondary source of data coming from facilities. The findings of the study cannot be extended to the entire public health sector of Ethiopia. Thus, generalization to wider areas is not warranted.

1.8. Definition of terms

Essential medicine: are the medicines that "satisfy the priority health care needs of the population". These are the medications to which people should have access at all times in sufficient amounts.

Health facility: are places that provide health care. They include hospitals, clinics, outpatient care centers, and specialized care centers, such as birthing centers and psychiatric care centers.

Pharmaceuticals: A substance or mixture of a substance used in diagnosis treatment, mitigation or prevention of disease and medical equipment and supplies

Public Health center: an institution that gives health service for the community and governed by the Federal Ministry of Health in primary health activities

ESTAV: A public hospital network developed in Tuscany (a region in central Italy)

1.9. Organization of the study

This thesis report is organized in five chapters. Chapter one, presents a general introduction to the problem and includes the objectives of the research along with the significance and scope of the study. Chapter two is devoted to literature review. It discusses literatures and concepts from local and international sources on supply chain performance measurement and the IPLS. In chapter three, the research methodology is described. Data presentation, analysis and discussions are

presented in chapter four. Finally, chapter 5 presented general conclusions and recommendations along with future research directions based on observations and results from the study.

CHAPTER TWO

Related Literature Review

Introduction

In this chapter, the theoretical background of supply chain performance evaluation is discussed based on the availability of previous scientific researches. The literature review was aimed at searching for previous scholarly works, priority was given for more recent sources to understand the theoretical background of performance measurement with specific focus of health sector, its peculiarities supply chain performance.

2.1. Theoretical Literature Review

2.1.1. The Concept Performance Measurement

Neely *et al*. (2002) defined Performance Measurement system (PMS) as a balanced and dynamic system that enables support of decision-making processes by gathering, elaborating and analyzing information. Performance measurement, as asserted by Dobroszek (2012), assist decision makers providing information about the weak links, to look for operational improvement and potential opportunities. This in turn could enable the supply chain performance and linkages between upstream and downstream chain members. As Shepherd, Günter (2012) asserted the performance measuring system should be understood as a set of indicators used to quantify the efficiency and effectiveness of operations.

Thus, performance measurement's aim is to quantify the effectiveness and efficiency of actions taken and results achieved. The degree to which a customers' requirements are met is defined as effectiveness. The economical utilization of a firm's resources to meet the pre-specified level of customer satisfaction is termed as efficiency.

According to different authors, the design, implementation and use of the performance measures and metrics are not a one-time effort but instead organizations must provide processes ensuring continuous review of the system. For example, Gopal and Thakkar (2012) pointed out the importance of maintaining the PMS over time in order for organizations remain aligned with dynamic environments and changing strategies.

According to Yuliansyah, Y. and Jermias, J. (2018), the performance measurement system is described by six characteristics. They are: (1) Comprehensive/ all inclusive: if it captures all constituents and stakeholders of the process; (2) cause-effect oriented: if it tracks activities and indicators which influence each other in the current or future performance; (3) vertically integrated: if it interprets overall strategy of the firm to all major actors of the organization; (4) horizontally integrated: if it includes relevant activities, functions and departments along the process; (5) internally comparable: if it takes into account and allows for tradeoff between the different dimensions of performance; and (6) useful or relevant: if it is readily understandable by the decision makers and provides a guide for action to be taken.

2.1.2. Characteristics of performance measurement systems

Typical performance measurement systems need to fulfill a number of desirable characteristics. According to different authors a number of characteristics can be identified as desirable characteristics of performance measurement system. Inclusiveness (measurement of all pertinent aspects), universality (allow for comparison under various operating conditions), measurability and consistency which refers to alignment with organizational goals.

The best known and most popular performance measurement framework is the balanced scorecard as developed by Kaplan Norton in 1992 identified four different perspectives in terms of measuring performance: financial, customer, internal business and innovation and learning. According to Kaplan all four of the perspectives have equal weighting. Balanced scorecard links measurement to the organization's strategy more explicit than predecessor models (Neely *et al*, 2007). However, it is generic and not industry specific.

2.1.3. Supply Chain Performance Measurement

Supply chain performance is the ability (of the entire supply chain) to meet end-customer needs, associated with ensuring the availability of product, deliver it on time in the right way and ensure appropriate inventory levels. It also exceeds the functional boundaries of organizations, i.e. production, distribution, marketing and sales, research and development.

The literature on supply chain performance measurement provides useful insights to the study of supply chain performance measurement. However, most of the studies were designed primarily

for use in manufacturing supply chains: (2011). Therefore, it is important to develop an appropriate performance measurement in the context of healthcare sector.

The concept of SCM requires measuring overall supply chain performance rather than just the performance of the individual chain members. It is the combined performance of the supply chain, the final outcome of the efforts of all integrated members that is of greatest importance from a measurement perspective. Although measures of supply chain performance differ in terms of individual indicators employed, according to Tarasewicz, Rafal (2016) almost all have one overriding focus which is continuous improvement of the final customer service.

To satisfactorily meet final customer's need, the functioning of the supply chains should be constantly improved and be customer focused. As Chan *et al* (2006) asserted SC performance measures to support the improvement of the performance of the supply chain, they must relate to the individual companies and their functions.

As described by Folan & Browne (2005), historically as well the performance measurement process has evolved since the mid-eighties of the last century when its foundations were formalized and integrated into the management of organizations, have developed various models of performance measurement structures to reach metrics intra-organizational or inter-organizational performance interorganizational system focuses on measuring the performance of SC.
Performance measurement system may be analyzed on three different fronts:

- Individual performance indicators;
- A set of performance indicators (as a whole);
- The relationship between the performance measurement system and the environment in which it operates.

2.1.4. Objectives of Performance measurement in Supply Chain

The fundamental objectives of performance measurement systems include (Akyuz, Erkan 2010; Parker 2000):

- Identification of success;
- Monitoring of the degree of meeting customer expectations;
- Better understanding of the processes taking place in the company and its environment;
- Identification of bottlenecks, wastage, problems and opportunities for development;

- Making decisions based on facts, not on assumptions or emotions;
- Creating conditions for development;
- Tracking the progress of the introduction of improvements;
- Facilitation of open communication and cooperation.

The development of a performance measurement system of the supply chain requires the proper selection of indicators. An important practical problem is the analysis of too many indicators (sometimes hundreds), which greatly hinders their interpretation. Furthermore, it stresses the lack of their relationship with the organization's and the supply chain's strategies (Shaw, Grant 2010). Supply chain performance management (SCPM) has become one of the key ways of achieving perfection. SCPM aims to provide information and insight into the functioning of the supply chain by tracking key indicators, for example product quality, inventory levels etc. according to Louw, Goedhals-Gerber (2014).

Characteristics of good measures can be depicted from the below figure

A good measure :	Description :
• Is quantatative	• The measure can be expressed as an objective value
• Is easy to understand	• The measure conveys at a glance what it is measuring, and how it is derived
• Encourages appropriate behavior	• The measure is balanced to reward productive behavior and discourage "game playing"
• Is visible	• The effects of the measure are readily apparent to all involved in the process being measured
• Is defined and mutually understood	• The measure has been defined by and/or agreed to by all key process participants (internally and externally)
• Encompasses both outputs and inputs	• The measure integrates factors from all aspects of the process measured
• Measures only what is important	• The measure focuses on a key performance indicator that is of real value to managing the process
• Is multidimensional	• The measure is properly balanced between utilization, productivity, and performance, and shows the trade-offs
• Uses economies of effort	• The benefits of the measure outweigh the costs of collection and analysis
• Facilitates trust	• The measure validates the participation among the various parties

Figure 1. Characteristics of Good Measures (source: Dobroszek (2012))

Dobroszek (2012) asserted that, a well-organized system for measuring the performance of the supply chain is crucial for better supply chain management. It is necessary to identify problems,

areas of measurement, and relationships between economic operators. In addition, the right tools and measurement methods should be chosen.

Performance measurement as part of supply chain management has an impact on the effective planning, controlling, monitoring and conducting analyses of logistics processes. It provides relevant information on costs, profits and results presented in the form of appropriate reports useful in decision-making.

As Dobroszek (2012) clearly identified supply chain performance measurement can be analyzed at three levels. These levels are at strategic, tactical and operational dimensions. These performance dimension take input from tools and methods coming from financial accounting, controlling/logistics controlling and logistics. Basically these tools and methods are derivatives of different levels of supply chain such as objects like resources and business entities, processes and tasks at different levels of supply chain performance measurement area including but not limited to time, quality, productivity, flexibility, reliability, capacity, cost, results and ultimately customer satisfaction. These whole considerations enables to view supply chain as logistic network within which supply chain performance measurement can be conceptualized.

An adequate performance measurement system helps to identify problem areas. Performance measurement is crucial in managing the organization in a turbulent environment and competitive global markets. An appropriate set of metrics enable companies to observe the progress in implementing the strategy, identify areas that need improvement, as well as compare themselves with competitors and leaders. They provide the necessary information for managers so they can take the right decisions at the right time.

One of the most important problems associated with performance measuring according to Shaw, Grant (2010) is an attempt to analyze too many indicators, hundreds of them which, however, are not related to the company's strategy. Performance measurement should be performed and analyzed in a context and dimensions of indicators resulting from the purpose and focus of the measurement should be determined.

2.1.5. Health Sector Supply Chain

The healthcare supply chain shares a number of similarities with other chains, not only in terms of processes (like Procurement, warehousing, distribution), but also in terms of discerning customers and management structures (Waters and Rainbirds, 2007).

However, there are also remarkable differences in the chain that are associated to the specific characteristics and requirements of the sector. In general, according to Lenin (2014), healthcare supply chains are very complex, fragmented, diverse, and dynamic. The main reason for this increasing level of complexity is due to the participation of multiple organizations, who are involved across the entire value chain and it requires key competencies.

The healthcare supply chain according to Medina *et al*. (2014) generally consists of four main components: producers, purchasers, providers and patients. Arrowsmith *et al* (1995) presented the illustration in figure 2 to represent the supply of the healthcare system.

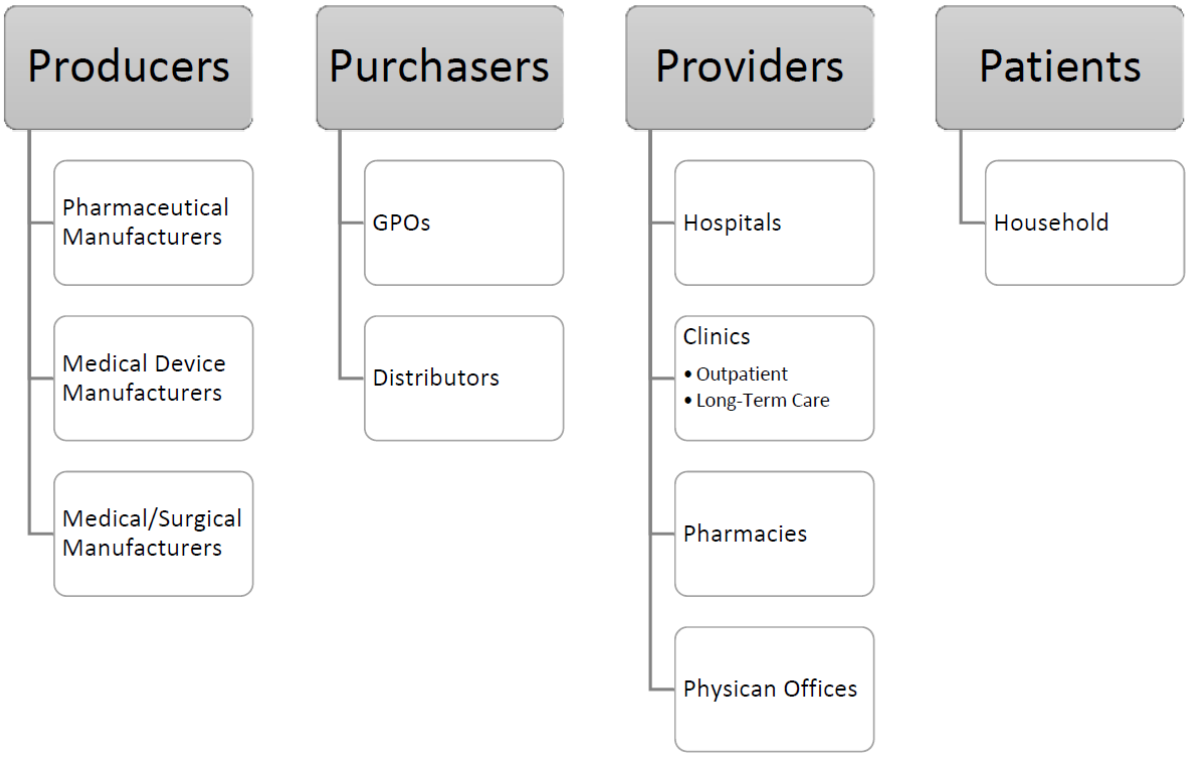


Figure 2: Components of the Healthcare Supply Chain

Although, many health care systems in general have recognized the importance of adopting supply chain management practices as pointed out by Jan de Vries and *et al* (2011), the application of techniques, methods and practices which were originally developed in an industrial setting is causing alignment challenges.

Unlike other industries supply chain, Beier (1995) argue that the application of supply chain management practices in the healthcare sector not only related to physical goods like drugs, pharmaceutical, medical devices and health aids but also the flow of patients.

2.1.6. Performance metrices and measurement in the public health sector

2.1.6.1. Public sector peculiarities

According to Eskildsen, Kristensen and Juhl (2004), private and public organizations do not achieve excellent results or outcome in identical manner. Private companies put higher emphasis on the systems dimension whereas public organizations put higher emphasis on the people dimension.

Golrizgashti (2014) pointed out five structural constraints that distinguish public sector:
(1) Public organizations have an "iron quadrangle" of inputs into the different government legislative decision-making process commonly referred to as the executive branch, legislative sub-groups, judicial and the mass media. (2) Public organizations contrary to the private sector have a variety of interests and reward structures, making it difficult to identify precise needs of the public for change and to satisfy all relevant stakeholders. (3) Government bureaucracies lack centralized power, being responsive to state and local pressures in decision making. (4) In addition, overseeing each level of government are bevies of short tenured political appointees of varying skills, interests, and goals, and having weak relationships with long-term career professionals. This complicates communications and coordinating policies, but also greatly limits decentralized decisional flexibility. (5) Lastly, the legalistic foundation of public administration produces a narrowly - focused span of control, emphasizes procedural regularity rather than openness in solving problems, and intermixes politics and management.

2.1.7. Public sector Supply Chain

Public sector supply chain is not different from the above-mentioned structural constraints. Proponents of the view that 'public management is different' (Boyne 2002, Borgonovi 2005) have drawn attention to several aspects of the public sector that make it distinct from the private one.
First, the range of actions available to public managers is limited by a series of political constraints. Political dynamics result in frequent policy changes and the imposition of short time horizons on public managers. Furthermore, politics is characterized by ambiguity, which is an asset in building and maintaining consensus. Clear goals may well prove unacceptable to some members of a political coalition. As a result, strategic goals tend to be fuzzy and to change frequently. As has been concurred by Zanjirani *et al*. (2009), developing sound long-term and sustainable SC strategies and innovation projects is therefore more difficult in public sector context.

Secondly, public organizations face disproportionately higher and diverse stakeholders who place demands and constraints on their managers. The presence of different stakeholders (e.g., taxpayers and recipients of services or industrial groups) requires public organizations to pursue different and sometimes conflicting objectives. Furthermore, as Flynn (2007) said, it has frequently been argued that public agencies have distinctive goals, such as ethics, equity or accountability, that do not vividly exist in the private sector

However, as has been claimed by several important authors like Moore (2000) the institutional mission of public organizations requires that they meet stakeholder expectations. All of these broad considerations have a direct and significant impact on SC strategies and innovation projects within public-sector organizations and may necessitate the evaluation of broader dimensions that are typically related to the achievement of public interest goals and that can affect an organization's overall performance. For instance, as Arrowsmith (1995) and Harland *et al*. (2007) governments often use procurement as a tool to promote a variety of important, broader public policy objectives (such as economic goals, social goals, environmental goals. Furthermore, in some cases, these goals may conflict. In the case of logistics, outsourcing strategies, justified on the basis of efficiency reasons, raise issues of equity and ethics when employees cease to be civil servants and become employees of a private external contractor Moschuri and Kondylis (2006), Bensa *et al*. (2010).

Thirdly, public organizations are often designed and structured around the principles of the hierarchical or bureaucratic model. Public sector organizations have more formal, less flexible and more risk-averse decision-making procedures than do their counterparts in the private sector. For example, public contracts are often awarded subject to rules and principles that are intended to ensure equal supplier treatment, nondiscrimination, and transparency and to reduce the risk of corruption. In this sense, as outlined by Moore (Moore, 1995), often in the case of publicly owned organizations the value addition has nothing to do with the actual result accomplished, but it is linked on how the process itself is configured and executed. With respect to laws and regulations of public entities such as in the area of execution of the procurement process, it is essential in order to accomplish relevant public goals (such as equity, accountability and legality). However, the bureaucratic model of public entities may reduce efficiency and increase overall advertising tendering costs (Doerner and Reiman 2007).

2.1.7.1. Public Healthcare sector supply chain

According to Schneller and Smeltzer (2006), the healthcare supply chain is frequently described as highly fragmented and relatively inefficient. This is because in healthcare service supply chain put patients and people who seek medical service into the clinical pathways which combines the processes to treat and cure them. Within the healthcare industry, the supply chain associated with pharmaceutical products is very important in ensuring a high standard of care for patients and providing adequate supplies of medication for pharmacies. In terms of cost, as estimated by Rorak (2005) that supply accounts for 25-30 percent of operational costs for hospitals in many of healthcare systems.

Comparatively public healthcare organizations have remarkable advantages over private organizations, such as the following: (1) Public organizations are expected to collaborate and to share their knowledge and best practices. Therefore, collaborative purchasing and network creation is expected to be stronger within these organizations as asserted by Schotanus and Telgen (2007). (2) Public organizations can impose regulations on suppliers that influence their willingness to collaborate, thus improving the supply chain. Such influence can be direct (through specific norms) or indirect (through moral suasion) as identified by Dimitri *et al*. (2006). (3) Dimitri *et al* (2006) further identified Public organizations, unlike private companies, are typically more willing to introduce drastic changes because they do not fear losing their market share and cannot file for

bankruptcy as identified by Dimitri *et al* (2006). All in all, the above mentioned clear differences between the public and private sectors impact respective supply chain practices which include SC performance measurement and priorities.

2.2.Empirical Literature Review

2.2.1. Pharmaceuticals Supply Chain Process in Ethiopian Public Health facilities

Ethiopia has a number of health programs that require efficient pharmaceuticals supply chain system for their effective and efficient implementation (USAID, 2011). The national assessment conducted on the public health pharmaceutical supply system in 2004 identified a number of vertical programs involving multiple stakeholders were responsible for managing supply chain for ART, TB, Family Health, EPI, etc., and other essential medicines (USAID, 2011, Nigatu *et al*, 2009).

To avert historical problems associated with the pharmaceutical supply chain system, Ethiopian Pharmaceutical Supply Agency (EPSA, the then PFSA), a semi-autonomous agency under Federal Ministry of Health, was nationally established by the House of People's Representatives with a mandate to run and coordinate the whole pharmaceutical supply chain operations for public health system (MOH, 2010).

This national pharmaceutical supply system reform has gave rise to the designing of an Integrated Pharmaceutical Logistics System (IPLS) as primary mechanism to ensure un-interrupted supply and continuous availability of quality-assured essential medicines at all public health facilities at affordable prices (Nigatu *et al*. 2009 and PFSA 2014).

IPLS is the term applied to a single pharmaceutical reporting and distribution system. It integrates the supply chain management of all types of pharmaceuticals (medicines, medical supplies and equipment, and laboratory chemicals and reagents) in the public health sector. The IPLS has three main components including the policies and guidelines for LMIS, inventory control and storage of pharmaceuticals at all levels of the supply chain system throughout the country (PFSA 2014). Each component (sub-system) has its own set of indicators for measuring progresses and performances (PFSA 2014 and MoH 2010). These indicators can also be used to check for: system leakages, to track the availability and utilization of records (e.g. bin card records), and to determine the extent to which facility laboratories complete and submit LMIS reports (MoH 2010 and USAID 2006).

Routine monitoring reports show that the implementation of IPLS has improved the performance information system (recording and reporting), storage and distribution systems, as well as the availability of essential commodities at service delivery points. However, no objective measurement so far was made to assess IPLS implementation status and performance of supply chain system in general and for laboratory commodities specifically (PFSA 2014).

IPLS, particularly LMIS and inventory control, focuses on the exchange of information and pharmaceuticals within hospitals and health centers and between health centers and health posts. These are parts of the overall system that then connect with EPSA through the EPSA hub warehouses.

IPLS has SOP Manual, which simplifies and standardizes the work in implementing the IPLS; it also serves as a reference for the health supply chain workforce as well as for managers and supervisors who support the supply chain workforce implementing IPLS.

The SOP guides implementation in the following tasks. (I) Recording and reporting on stock levels: There are different job aids in the SOP Manual that help facilitate the recording and reporting of stock levels and use of pharmaceuticals. (ii) The SOP Manual also has step-by-step guides that explain how pharmaceuticals are ordered from EPSA. (iii) Receiving and storing are also some of the topics that the SOP Manual covers. (iv) The SOP Manual also helps to standardize the work that health facilities do in issuing pharmaceuticals to their dispensing units, and finally (v) The SOP Manual also guides how health facilities can maintain optimum stock level at all times.

The IPLS aims to ensure that patients always get pharmaceuticals they need. To be successful, the system must fulfill the six rights of supply chain management: by ensuring the right products, in the right quantity, of the right quality, at the right place, at the right time, and for the right cost.

The products that alleviate health issues based on the prevention, diagnosis, or treatment protocol of a particular area should be in the appropriate quantity so that they can meet the demand of a particular situation. Products should also be of proven quality, safety, and efficacy. They need to arrive at the place and in the time for when they are most needed. Products should also be available at an affordable price.

IPLS system and product flow within the supply chain is designed to work together in accordance with the below depicted diagram.

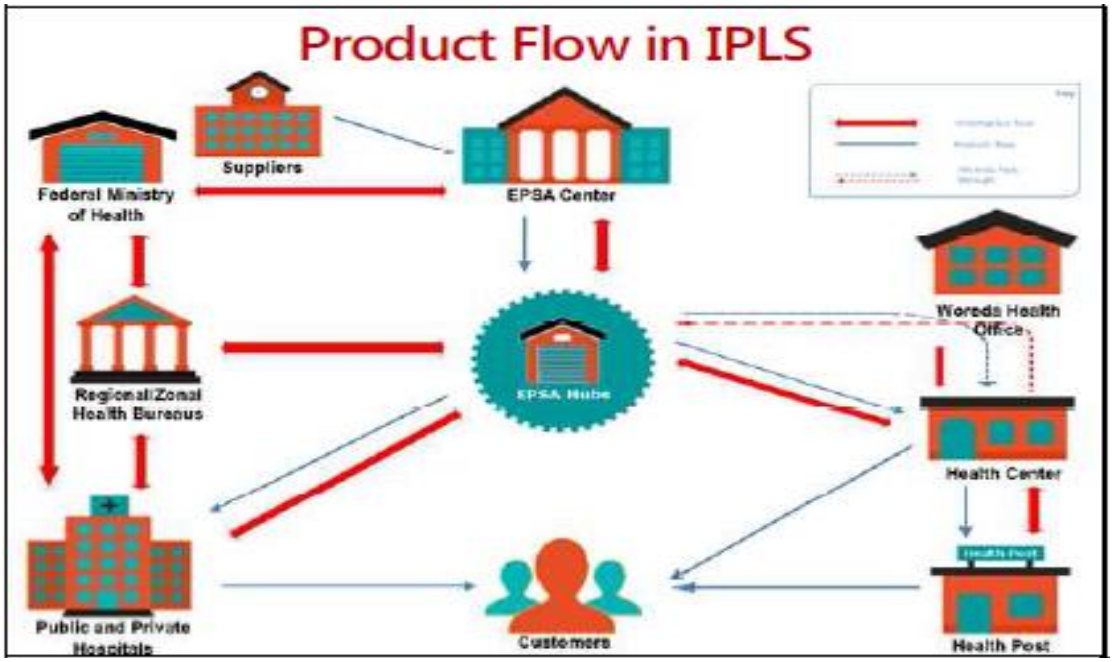


Figure 3. Product flow in IPLS (Source: EPSA)

Since 2001 the USAID/DELIVER project has developed and introduced Logistics System Assessment Tool (LSAT) and Logistics Indicators Assessment Tool (LIAT) as standard methods for conducting evaluation of health commodity supply chains in the developing world. After IPLS implementation in 2009 these same tools refocused and being used for IPLS as well.

The purpose of these standard tools is to periodically conduct and support routine management and strengthening of logistics and supply chain systems. In Ethiopia as well, the standards are part of overall logistics management to lead the assessment process.

USAID/Deliver's Logistics System Assessment Tool (LSAT) embraces 11 key parameters. These include:

1. Organization and Staffing
2. Logistics management information systems (LMIS)
3. Product selection
4. Forecasting

5. Procurement
6. Inventory control procedures
7. Warehousing and storage
8. Transport and distribution
9. Organizational support
10. Product use
11. Finance, donor coordination, and commodity security planning

2.2.2. Issues and Challenges of Pharmaceuticals Supply Chain in the public sector

The barriers and issues raised in supply chain management will effect to the success of healthcare supply chain. According to Mustaffa & Potter, 2009 there are two main issues exist that affect the customer service performance which are urgent orders and stock availability at the wholesaler. Urgent orders happened when the product in inventory reaches to critical level. This issue occurs because the order done by manual and it relies on the experience of the individual at the clinics. Previously, the product delivery on order have the lead time about five days, this will increase the risk of stock out (Mustaffa & Potter, 2009). Other than that, some customer also purchase service for other alternative and this will be the critical issue in providing patient care as the supply chain may not reach to the best quality in terms of service performance. Thus, urgent orders need to deliver immediately. However, there are barriers that will affect the process in service delivery. Transportation cost is increased because some of the places to be delivered is scattered and this make the delivery provided in shipment.

Stock problem is also a common challenge in many public sector healthcare facilities. Inventory management at the wholesaler and EPSA is based on the orders made by different facilities. As supply chain always dealing with a lot of decision especially to the hospitals or clinics organization, wholesaler and EPSA find it difficult to forecast their requirement. Most problems occur when many clinics make same product order as the same time and cause out of stock at the wholesaler. The result to the clinics is some clinics get the product ordered on time while others need to wait until the new stock arrives. Not only issues in ordering and stock availability become the problem that affects the successful in-service performance, the issues in internal of the organization also may affect the supply chain in providing patient care.

Meijboom *et al*. (2011) has distinguished four challenges categories in internal organization of public sector healthcare facilities that affect the performance of inpatient care such as communication, patient safety, waiting times and integration.

Shortell & Conrad (2007) asserted that ineffective cooperation in internal communication and coordination will lead into complaints. This barrier may come from lack of well-developed, flexible and timely information systems able to manage and direct information

In addition, Ovretveit (2000) pointed out that inefficiencies in healthcare delivery may come from different departments because they may not communicate or coordinate about their work Incomplete information about the risks, waiting times and delays of the patient with duplication of test will drag into increase in costs.

Customer care is another common impediment in public healthcare facilities. Schoen *et al* (2005) identified patient safety are not usually included in public healthcare system. As a result, high physicians assigned to a patient care could produce high errors within and outside the hospital in laboratory and diagnostic care. Problems in work coordination to different professional like physician with different patients occur between curative and public health service and between specialties with particular sub-sectors lead to deviation from the optimal, planned path for patients. This could cause the patient safety not to be assured.

Quality in healthcare services can be measured in patient waiting times Shah and *et al* (2008). Putting customer or patients in longer waiting times may worsen and may put customer into risks when waiting to receive treatment. Some issues that requires customers to wait for a long time and being hospitalized is because may be there are not enough professionals and medical products. Some of the patient may assign to appointment when frequent checks is needed by supplying medicals to the patients. However, high frequent appointment by hospitals may be too demanding for some patients.

Integration in decision making between health system leaders and support staff may not be strong because they felt uncomfortable to make centralized changes just for their patient (Shah *et al*. 2008).

2.3. Conceptual framework of the study

In this sub-section the ESTAV case analysis for evaluating supply chain performance in the public health care sector is presented as conceptual framework of the study.

The ESTAV case analysis was developed as an attempt to fill a gap by proposing an evaluation framework for assessing the performance of integrated supply chain models in the public healthcare sector. As indicated by F. Lega et al, 2012, their research draws from the literatures on supply chain performance an don specificities that distinguish the public healthcare sector from those of other industries.

The ESTAV framework has been developed based on inductive case study research. The organization selected (the ESTAV Centro) has developed one of the most mature Supply Chain Management operating in the Italian healthcare sector and is representative of the current overall trend in Europe toward the creation of centralized supply chain platform for networked healthcare delivery organization (Dimitri et al. 2006).

The ESTAV framework was very influential in helping the researchers to define and operationalize the evaluation dimensions of the model. Particularly the series of interviews and direct observations replicated over a seven years period were essential in the definition of the different theoretical categories included in the framework. The final version of the model has been defined through a series of meetings where the model has been discussed and validated by all the interviewees.

Therefore, this study attempts to measure performance of the Ethiopia Ministry of Health's (EPSA) IPLS product flow and supply chain performance measurement evaluation with the use of the framework developed by ESTAV case analysis. As Flea *et al* (2012) dictated this evaluation framework included three broad dimensions specifically designed for Public healthcare sector supply chain measurement. These dimensions were set-up and operating costs, financial benefits and organizational and process benefits.

Set up and operating costs as indicated in the SCOR model, refers to the development and management of a SC system that entails a series of set-up and operating costs as performance evaluation indicators. Researchers like F. Lega *et al, (2012)* classified costs according to different cost drivers. These drivers include technology infrastructure, human resources, warehouse

management costs, outsourced services and advertisement tendering costs. Under the financial benefits in general two broad financial benefits could be identified. These are reductions in purchasing prices and reductions in volume of supplies stocked internally (either those stocked at central warehouses or those stocked at medical department warehouse such as health facility pharmacies. Finally, under the organizational and process benefits product and process standardization, staff specialization, quality service levels, safety and supplier relationships was used as performance parameters.

2.4. Identified Literature Gap

The literature in this chapter showed the concept and importance of performance measurement in general and in public healthcare sector in particular.

The existing published researches on SC performance measurement examined with the use of generic frameworks like SCOR and Balanced Score Card. However, there is no one unified framework that comprehensively measures public healthcare supply chain performance.

Moreover, specific issues of public healthcare industry such as safety as a performance measure was not sufficiently covered in many publications. Finally, peculiarities of the public sector, specifically “publicness” has not been adequately researched. Therefore, the motivation behind this study is aimed at filling literature gaps observed in the aforementioned issues.

CHAPTER THREE

Research Methodology

This section of the study describes the research methodology deployed to investigate the stated problems in systematic and scientific manner. The conceptual framework, description of the study area, research approach, research design, data type and sources, data collection procedure, population and sampling, ethical considerations, data analysis in view of validity and reliability of the instrument have been discussed.

3.1. Conceptual Framework

The review of literature presented in chapter 2, highlighted the issues related to supply chain performance measurement of public healthcare supply chain, IPLS from Ethiopian Pharmaceuticals Supply Agency's perspective. In this context, the problem investigated in this study addressed the gaps identified in the literature review and discussed the needs for appropriate performance measurement of IPLS. The focus of the research was to identify appropriate supply chain performance measurement evaluation dimensions and evaluate the effects of each on IPLS performance.

To come up with comprehensive / integrated approach to evaluate the effects of identified broad dimensions, analysis of each followed by contextual presentation and mapping with USAID/Deliver's standard metrices viz. LIAT (Logistics Indicator Assessment Tool) and LSAT (Logistics System Assessment Tools) were adopted with modification.

In accordance with the ESTAV Centro's public healthcare supply chain performance evaluation framework, the three broad dimensions of pharmaceuticals included set-up and operating costs, financial benefits and organizational / process benefits.

Bringing together the two frameworks and mapping yielded interesting insights.

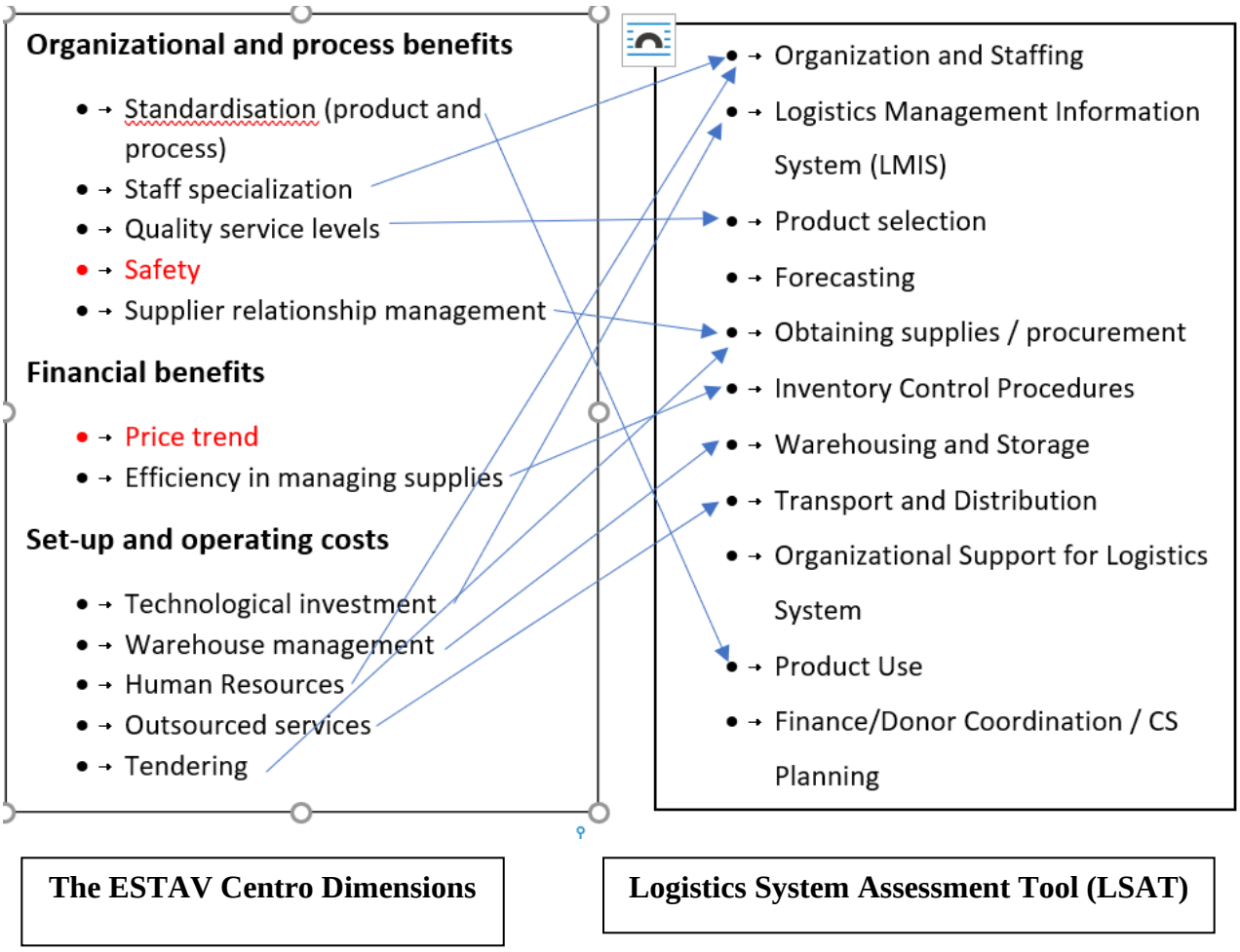


Figure 4: ESTAV vs LSAT Mapping (Source: Own study)

ESTAV Centro dimensions identified two key peculiar variables viz. safety and price trend which are very relevant in the public healthcare sector. Otherwise, all other variables of ETSAV are also included in USAID/DELIVER's LSAT framework in one way or another.

The authors and developer of the ESTAV Centro framework argued that the public nature of healthcare and the specificities of the healthcare context required a specific theoretical approach in identifying the appropriate dimensions of evaluating SC performance measurement. As previously mentioned, the framework was developed based on the evidence emerged from the ESTAV case analysis, which was very influential in helping the researchers to define and operationalize the evaluation dimensions of the model. Particularly the series of interviews and direct observations replicated over a seven years period were essential in the definition of the different theoretical categories included in the framework. The final version of the model has been

defined through a series of meetings where the model has been discussed and validated by all the interviewees. So, the researcher has become convinced to use this framework as appropriate theoretical framework for measuring and assessing supply chain performance of the Integrated Pharmaceutical Logistics System, IPLS that is being implemented by EPSA of the Ethiopian Federal Ministry of Health, within different public healthcare facilities.

Taking into account this evidence, the evaluation framework includes three broad dimensions namely Set-up and operating costs; Financial benefits; Organizational and process benefits as illustrated in Figure 1.

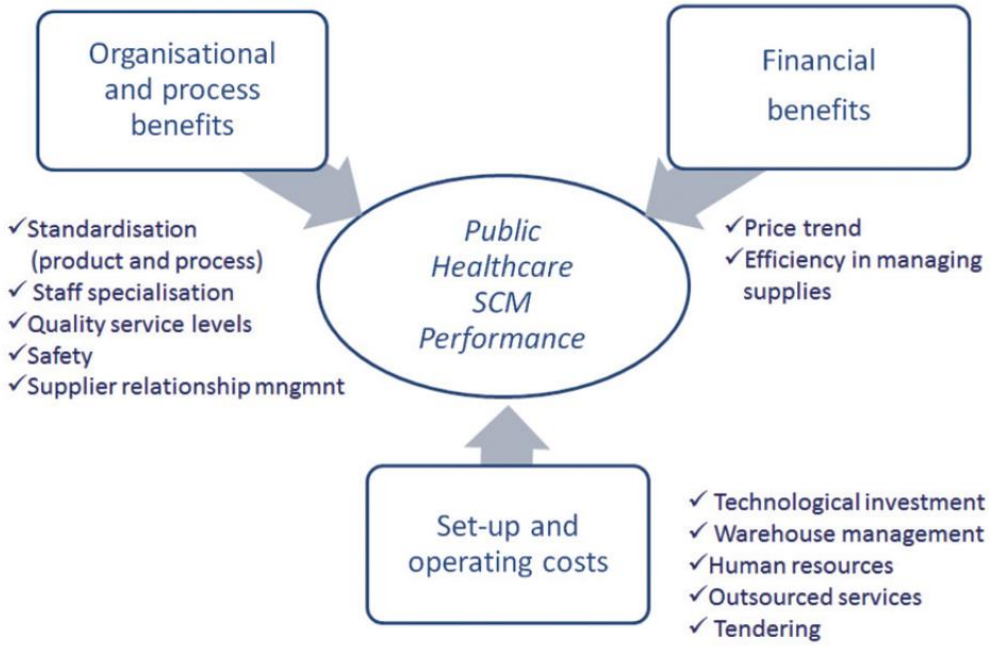


Figure 5. ESTAV's Model for evaluating supply chain performance in the public healthcare sector (Source: F. Lega *et al*, 2012).

The framework took into the three basic criteria of performance evaluation (Caplice and Sheffi 2018). These were:

- **Efficacy** – the relationship between the achieved results and the pursued objectives; it is related to the level of customer satisfaction with respect to the resources committed for this purpose;

- **Efficiency** – the relationship between efforts and resources involved in the operation and the actual utility value as a result of the action; it is linked to the achievement of objectives at a lower cost;
- **Effectiveness** – is related to the satisfaction with the results.

On the basis of literature review specifically, ESTAV's model was adopted as the research conceptual framework. The model illustrates IPLS supply chain performance: efficacy, efficiency and effectiveness shown at the center (as dependent variable) and the three dimensions namely organization and process benefits, financial benefits and set up and operating costs as independent factors. These factors were identified as dimensions that have an influence on the overall IPLS supply chain performance. Accordingly, figure xx illustrates the research model of this study which depicts the three performance dimensions of IPLS system.

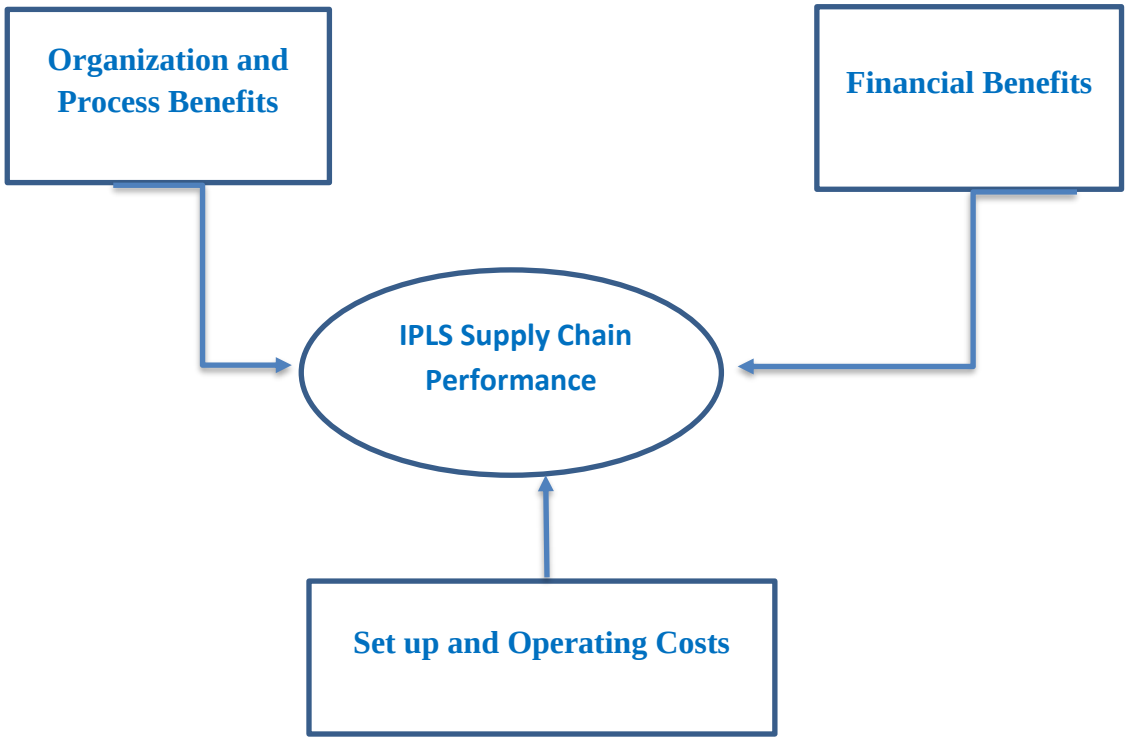


Figure 6: Conceptual framework (adapted from F. Lega *et al* (2012))

3.2. Description of the study area

Ethiopian Pharmaceuticals Supply Agency (EPSA) is a semi-autonomous agency under the Federal Ministry of Health. It has nineteen branches located throughout the country and anchored together by a head office based in the capital – Addis Ababa. As it supplies pharmaceuticals, chemical reagents, medical supplies and equipment to over 4,000 health facilities nationwide, it musters a big number of employees. It currently has 2,535 permanent employees and 314 contract employees. Of the permanent employees, 818 of them are pharmacists, 52 laboratory technicians, 28 bio-medical engineers, 76 in procurement, logistics and supply chain management and the remaining 1,247 administrative staff in Finance, Human Resources, IT and public relations staff other than 314 casual contractual employees.

3.3. Research Approach

This study largely utilized mixed research approach (qualitative and quantitative) data to meet the study objectives. In addition, qualitative data was collected from key informants and most recent survey undertaken by EPSA. As Croswell (2005) asserted quantitative research is a type of research in which the researcher describes what to ask specific, narrow questions, collects numeric (numbered) data from participants, analyze these numbers using statistics and conducts the inquiry in an unbiased and objective manner. The method had been used to make it easy for conversion of information obtained into statistical models for general analyses to be made and the research questions to be answered based on the statistical models. Qualitative approach, on the other hand was used to analyze data obtained from interview and open-ended questions to triangulate and substantiate the result obtained from the quantitative approach following content analysis protocols.

A well-organized and integrated system for measuring the performance of the supply chain is crucial for better supply chain management. It was deemed necessary to identify practices, problems, areas of measurement, and relationships between major actors from key informants at head office of EPSA.

3.4. Research Design

In this study, the researcher's used descriptive research design and causal/explanatory research design. Explanatory research aims to understand phenomena by discovering and measuring causal relations among them. Accordingly, the researcher largely used quantitative approach to test identified research questions.

Accordingly, the researcher used quantitative approach to test identified dimensions towards measurement of supply chain performance and supplement it with qualitative approach with the use of open-ended question to important actors and key informants (KII). Since the research objective was to examine effects of supply chain performance measurement dimensions the design geared towards those objectives.

3.5. Data types and sources

In this study, both primary and secondary data types were used. Primary data collected with the use of structured interview questionnaire. In addition to primary data, the DHIS2 system of public health facilities and data obtained from recent survey of IPLS used as key source of information for analysis.

3.6. Data Collection Procedures

The questionnaire used for this study was adopted, modified and developed from USAID/Deliver's LSAT/LIAT standard questionnaire and distributed to respondents via USAID PHC project offices. Moreover, the researcher accessed DHIS2, which the public sector is using for data management for this academic research purpose.

The effective measurement instrument should cover all content domains of constructs (Parasuraman, 1991). As in any empirical study, it is not be possible to test a relationship without valid and reliable measurement instruments for the constructs involved in the relationships. Thus, measurement instruments for the evaluation SC performance as identified by Lee, T., & Nam, H. (2016), in the proposed model was adopted with modifications from earlier studies.

3.7. Method of data analysis

An application of different statistical techniques to analyze the quantitative data were employed. The quantitative data was coded and treated with Statistical Package for Social Science (SPSS) and Microsoft Excel 2016. Based on SPSS, both descriptive and inferential statistics was used as deemed appropriate.

Descriptive statistics involved analysis such as frequency distribution, measures of central tendency, ANOVA, Correlation and Multiple Linear Regression Analysis to present quantitative descriptions and describe the basic features of the collected data. Then findings were reported by using tables and charts. Moreover, qualitative data from KII were also used as appropriate.

3.8. Unit of Analysis

The unit of analysis is the major entity that is being analyzed in the study. The unit of analysis for this study were individual EPSA hubs and branches.

3.9. Population

The target population of the study were all EPSA staff who have access to the IPLS system in the 19 EPSA branches and the head office based in Addis Ababa. Thus, the study took employees at both head quarter and regional & hub offices working in the area of pharmacy, laboratory technicians, bio medial engineers and procurement, logistics and supply chain areas who have access to the IPLS, which amount to N=974 staff.

3.10. Sample frame/ design

As this research was aimed to evaluate IPLS performance measurement dimension of the entire Agency, both the head office as well as regional hubs have been included. Thus, a stratified random sampling method was used to represent all units of the organization.

The sample size for the study as calculated by using formula of sample size determination cited by (Cochran 2010). http://www.raosoft.com/samplesize.html

$$n_0 = \frac{Z^2 pq}{e^2}$$

e = desired level of precision

p = percentage picking a choice, expressed as decimal

q = 1-p

Z = Z value,

no = Sample size

Based on 95% level of confidence and 5% margin of error, total sample amounts to be 276

In addition to this, five key informants from the head office were included in the study.

3.11. Reliability and validity tests

3.11.1. Validity

According to Yin (2014), validity can be divided into three categories, internal, external and construct validity. The rest of this section elaborates further on the first two categories, internal and external validity.

Internal validity addresses the issues whether or not a conclusion related to a causal relationship between two or more variables holds (Bryman & Bell, 2011) i.e. if a certain factor *x* really is the factor that led to the event *y*, or if there is another factor *z* that is actually causing the event *y* (Yin, 2014).

As mentioned in the previous section, using KII and multiple sources of data in a study, triangulation have been used to increase the internal validity. In this thesis interviews from several different departments and individuals responsible for supply chain management have been conducted. In addition, secondary data from the data management system and the most recent survey conducted in April 2019 on IPLS implementation have been used to complement the information obtained from the interviews. In terms of external validity, which is concerned with the issue if the findings of a study apply to other contexts (Bryman & Bell, 2011). According to Bryman and Bell (2011) external validity is generally a bigger issue than internal validity when

performing qualitative research, since this type of research often make use of small samples or case studies.

To ensure the questionnaire validity, the questionnaire was "pilot-examined" by interviewing three managers and experts in the supply chain department of EPSA at head office, who agreed to fill in the questionnaire and also to comment on the scales employed. Then, their suggestions were collected and considered to improve validity of questionnaire. Finally, the questionnaire was pre-tested by sending six questionnaires to supply chain professionals working in the public health sector at FMOH and relevant USAID funded project to get their comments and feedback.

3.11.2. Reliability

A study is reliable when errors are minimized, and biases are avoided. This means that if two different researchers follow the same procedures, they will arrive at the same findings and conclusions (Yin, 2014). For a study to be reliable the procedures of a study have to be well documented and possible to perform later in time. Only then can another researcher replicate the procedures in a new case. When a second researcher is able to perform a study and arrive at the same findings and conclusions it is referred to as external reliability. Internal reliability concerns the extent to which several researchers can draw the same conclusions from a situation, in a study (Bryman & Bell, 2011).

Internal reliability can also be seen as a parallel to dependability in qualitative research. Dependability will be achieved when all of the procedures and data collected is adequately described and presented, enabling the study to be reviewed thoroughly.

For the purpose of ensuring the reliability of the questionnaire, Cronbach's alphas was used as a measure of internal consistency reliability. A widely cited minimum threshold for the Cronbach Alpha is 0.70 (Malhotra, 2004). However, the calculated Cronbach's Alphas for the questionnaire as a whole was 0.89. 89% indicates to high internal consistency among the questions in the questionnaire instrument, which is within acceptable range of consistency.

3.12. Ethical Considerations

The researcher addressed ethical considerations of confidentiality and privacy. The respondents who participated in response of an interview and questionnaire were expected to express their full

consent to participate in this study and same consent secured duly. Moreover, respondents were not required to write their name on questionnaire, they were notified to keep their response confidential and clearly told their responses to be used exclusively for academic purposes. The response that the participants gave analyzed without any change by the researcher. In addition, the reference works of other researchers and authors were genuinely recognized and cited appropriately.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSIONS

In this chapter, the data collected using questionnaire and KII were analysed and presented based on the objectives of the study set out above. Out of the total two hundred seventy-six respondents in nineteen branches of EPSA and the head office, 41 of the respondents could not return the questionnaires and 235 were collected. However, still two of the collected questionnaires were found to be incomplete. Thus, a total of two hundred thirty-three questionnaires and all of the ten KII respondents were captured, transcribed and analysed for this study. Of the two hundred seventy-six questionnaires distributed, two hundred thirty-three, which amounts to 84% response rate have been achieved.

4.1. Data Presentation

Descriptive and inferential statistics were used to analyse and interpret results of the study. The descriptive analysis consists of central tendency measures (frequency distribution, percentage, valid and cumulative percentages). In addition, tabular explanations are used with the help of SPSS, ANOVA, and Multiple Linear Regression Analysis with the help of Statistical Package for Social Sciences (SPSS) version 24 software was used to present findings of the study.

The data collected using a score-based questionnaire with maximum allotted score for each measure question the sub-section questions, which fall under the three-supply chain performance measurement dimensions viz. organization & process benefits, financial benefits and set up and operating costs. A summary score of each respondent against each of the questions were computed to evaluate the effects of each of the three-supply chain performance measurement dimensions on the IPLS.

Multiple regression analysis has been used to mathematically sorting out which of the three dimensions indeed have an impact and their magnitude.

4.1.1. Demographic profile of the respondents

The demographic profile of the respondents are discussed in this section below:

Table 4.1. Demographic profile of Respondents

Demographic profile of the respondent	Dimension	Frequency	Percent
Gender	Male	141	61
	Female	92	39
Educational level of the respondent	Diploma	24	10
	Bachelor's degree	193	83
	Master's degree & above	16	7
Job position of the respondent	Non-Management	129	55
	Management	85	36
	Senior Management	19	8
Year of experience in EPSA	< 2 years	73	31
	2-5 years	96	41
	6-10 years	53	23
	>10 years	11	5
Work experience specifically on IPLS	< 2 years	73	31
	2-5 years	115	49
	6-10 years	35	15
	>10 years	10	4

Source: Own study (2020)

As depicted in table 4.1. above, out of the 233 respondents. 61% (141) of them were male and the remaining 39% (92) were female. Thus, it can be concluded that more men are involved in the study than females, however females were also sufficiently represented.

In terms of educational background, 10% (24 respondents) earned their Diploma while 83% (193) which accounts the lion share of the respondents (83%) have acquired their first degree. 7% of the respondents have second degree. Based on their educational status, it can be said that the respondents have adequate understanding about part or all of supply chain characteristics and performance measurement dimensional aspect.

Majority of the respondents 55% (129) were non-management members or executors of day to day routine activities based on the organizational job classification, whilst 36% (85) of the respondents embrace middle or lower level managers, who are managing more than one staff under them. The remaining 8% (19) of the respondents are senior managers. This shows the study represent voices of employees from different level of positions to evaluate the effects of supply chain performance measurement dimensions of the IPLS.

Year of experience within EPSA was an important determinant factor in explaining how well the employee is conversant to the organizational process and practices. Accordingly, the service year related data of the respondents was captured by the questionnaire. This helped, to evaluate whether the identified inquiries were well known and can explain the effects of those dimensions on supply chain performance measurement. The work experience of the respondents in EPSA as summarized above in table 4.1. shows 31% (73) less than 2 years, 41% (96) between 2-5 years, 23% (53) between 6 to 10 years and 5% (11) of them had 10 years and above experience. More senior employees' opinion was instrumental because they have more institutional memory, took several trainings and participated in several reform activities. These exposures helped them to have a better understanding and say about betterment of the organization at large.

It was also important to clearly know and understand respondents' specific system experience on IPLS. Organization wide IPLS system implementation happened over a period of time. Employees who worked on the system for a longer period had opportunity to better understand the strength and the downside of the system and where to fix bugs or ameliorate the system. Based on data collected 31% (73) employees had less than 2 years of system experience or the period since access was granted is less than 2 years. 49% (115) employees worked for a period of 2-5 years on IPLS, which shows nearly half of the respondents have adequate expose to evaluate the system. The remaining 19% respondents had system experience for more than 6 years of which 15% (35) employees had experience within a range of 6 – 10 years. These categories of employees were found to be very well conversant with the system, had ample experience about periodic updates and improvements undertaken and issues that still cause problems or area where additional effort of improvement is required.

4.2. IPLS Supply Chain Performance Measurement Dimensions of EPSA

4.2.1. Organization and Process Benefits (Section 1)

Table 4.2. Effect of Organization and Process Benefits

Ref.	Sub section Description	Weighted score (i)	% of weighted score/section (ii)	Average actual score of the section (iii)	Weighted average of the section (iv)=(ii)*(iii)	% of weighted avg score (v)=(iii)/(i)	Standard Deviation
1.1	Standardization (Product / process)	11	22%	10	2.2	91%	0.416
1.2	Staff Specialization	15	30%	13.1	3.93	87.3%	0.334
1.3	Quality Service Level	7	14%	5.5	0.77	78.6%	0.868
1.4	Safety	7	14%	6.7	0.938	95.7%	0.169
1.5	Supplier Relationship Management	10	20%	5.3	1.06	53%	0.885
	Total	50	100%	41.3	8.898	82.6%	

In general, from most of the response's under section 1, organization and process benefits it can be learnt that EPSA staff members have a strong bond among themselves and the system as their job demands and they communicate on a daily basis which resulted organization wide standardization. From the above analysis, it can be noted that the higher the % of weighted average score, the more stronger or higher positive impact the variables had on the overall SC performance. Accordingly, of the five variables under organization and process benefits safety and standardization stood high with an average high score (95.7%) and (91%) respectively. clearly showed that there seems consensus among many staff on the importance of the two particular parameters. Followed by the three parameters, quality service level, staff specialization and supplier relationship management were also rated as important consideration in the IPLS SC performance, which yield core overall organizational and process benefits.

To triangulate responses collected from closed ended questionnaire, KII respondents were also asked about importance of safety as a measure for health sector clinical appropriateness. In effect, safety is very important for the overall supply chain system and performance measurement in

particular. So far, though its important is not denounced by existing system, there was no linkage with performance measurement of IPLS. IPLS has got very robust clinical risk management indicators in relation to safety in terms of monitoring and supervising prescribing practices. So evidently, safety is critical performance measurement dimension in the system. Similarly, maintaining standards of different products and services being rendered in healthcare facilities is an important dimension as affirmed by respondents. Without having detailed list of products and processes the logistics system would be impaired and this specific aspect of SC performance dimension was identified as key, which is consistent with logistics system strategic plan of EPSA.

According to feedback obtained from KII, in quite considerable lowest level public healthcare facilities IPLS has not yet been fully implemented due to lack of technological infrastructure. Therefore, all possible efforts should be put in place to enhance technology led recording system such as bin cards for all facilities to support standardized product and service delivery.

Staff specialization and quality level were also important dimensions but are not highly rated by respondents as that of the previous two dimensions. Though these parameters are very important in managing and using logistics management information system, their impact was perceived as challenging to maintain and are dependent on multiple other factors which might be beyond the scope of facilities. For example, availability of adequately prepared specialist in a certain area of expertise may not be available, however, other generalist may over take the job. Regardless, lack of specific education and training is considered as critical for successful SC implementation as pointed out by various scholars such as Callendar and McGuire (2007).

Consistent with prior literatures, it is difficult to associate the effect of supply relationship management in public healthcare system. Suppliers in general are known by few staff in public settings as procurement is done centrally by a specific department and other staff do not normally see the effect of such relationship unless there are instances of product return or sub-standard quality product delivered by suppliers. This is expected in public healthcare systems and is consistent with expectations.

Gaps observed on the quality and timeliness of the LMIS component of IPLS need to improve so as to positively impact supply chain performance measurement effort. KII results reveal that gap analysis identified in different survey have not been implemented effectively. For example, as has

been already identified by the 2019 IPLS survey only 59% of health posts had blank bin cards (an increase from 40% in 2015) and use of bind cards was even lower as the average use of bin cards for tracer items was 90% at hospitals, 55% at health centers and only 27% at health posts. If essential record keeping tools under IPLS like bin cars are not consistently used, IPLS will have a long way to become a national system.

4.2.2. Financial Benefits

Table 4.3. Effect of Financial Benefits (Section 2)

Ref.	Sub section Description	Weighted score (i)	% of weighted score/section (ii)	Average actual score of the section (iii)	Weighted average of the section (iv)=(ii)*(iii)	% of weighted avg score (v)=(iii)/(i)	Standard Deviation
2.1	Price Trend	10	45.45%	9.3	4.2273	93%	0.005
2.2	Efficiency in managing supplies	12	54.55%	8.5	4.6364	70.8%	0.775
	Total	22	100%	19.8	8.8636	90%	

Source: Own study (2020)

Consistent with literatures, public healthcare SC is expected to guarantee two different important financial benefits: (1) reductions in purchasing prices and (2) reductions in the volume of supplies stocked internally. In this regard, respondents rated price trend as important dimension for financial benefits (total average score 93%) with little variability (SD=0.005). However, efficiency in managing supplies is rated below literature sources, which is an average total score of 70.8% with comparatively reasonable variability, which could be as a result of high stock holding culture in different regional hubs. As this particular dimension have the capacity to impact the overall supply chain management performance, due attention is required for efficiency in managing available supplies within healthcare units.

4.2.3. Setup and Operating Costs

Table 4.4. Effects of Set up and Operating Costs (Section 3)

Ref.	Sub section Description	Weighted score (i)	% of weighted score/section (ii)	Average actual score of the section (iii)	Weighted average of the section (iv)=(ii)*(iii)	% of weighted avg score (v)=(iii)/(i)	Standard Deviation
3.1	Technological investment	15	32.61%	14.37	4.6630	95.8%	0.005
3.2	Warehouse Management	7	15.22%	5.5	0.8370	78.57	0.663
3.3	Human Resources	11	23.91	7.6	1.8174	69%	0.854
3.4	Outsourced Services	6	13.04%	2	0.2609	33.3%	0.854
3.5	Tendering	7	15.22%	2.5	0.3804	35.7%	
	Total	46	100%	31.9	7.9587	69.35%	

Source: Own Study (2020)

It is evident that the development, management and performance measurement of a typical supply chain system like IPLS entails a series of set up and operating costs. According to ESTAV framework, these costs are important dimensions of supply chain performance. As can be noted from responses obtained from IPLS users' technological investment (an average total score of 95.8%) with standard deviation of 0.005, human resources (an average total score of 78.6%) with standard deviation of 0.854 and warehouse management (an average total score of 69%) with standard deviation of 0.663 are most found to be more influential factors that contribute to SC performance measurement of IPLS in their order of weight and variation among respondents. This result is consistent with literature sources. However, in Ethiopian context and for the justification mentioned above in relation to supplier relationship management, outsourcing and tendering are not that common. Thus, the two particular parameters of the model did not seem profoundly applicable for the study.

All of the KIIs at the FMOH and USAID funded projects shared the view that IPLS succeeded in applying to a single pharmaceutical reporting and distribution system. In effect all of the three performance dimensions identified showed a positive impact on the overall system implementation and supply chain management in particular. IPLS integrates the supply chain management of all

types of pharmaceuticals (medicines, medical supplies and equipment) in the public health sector, where the system is fully put in place. All of the three components of IPLS viz. LMIS, inventory control and storage of pharmaceuticals at all levels of the supply chain system significantly improved the system. Because, system leakages, tracking the availability and utilization of records (e.g. bin card records) and the extent to which facility laboratories complete and submit LMIS has greatly improved. Based on KII results, it has been found out that in quite many facilities in the public sector, the IPLS components have not yet been fully put in place. As a result, full benefit of technological investment spent on majority of facilities are not being enjoyed by these facilities. Thus, still more effort is underway to roll out IPLS in all public health facilities so that electronic recording system of stock status such as electronic bin cards be available in all facilities.

4.3. The effects of performance dimensions on EPSA's IPLS supply chain performance

4.3.1. Multiple linear Regression Analysis

Leedy *et al*, 2015 assert that multiple linear regression analysis yields an equation in which two or more independent variable are used to predict the dependent variable. Before running multiple linear regression however, the researcher has made some basic assumption test for the model. These are normality of the distribution, linearity of the relationship between the independent and dependent variable and multicollinearity tests. The three independent tests according to Leedy *et al*., 2015 are explained below:

Assumption 1: Normality Distribution Test

Multiple regressions require the independent variables to be normally distributed. If the underlying distribution of the data is normal, the points will fall along a straight line. Deviations from this line correspond to various types of non-normality.

As depicted in appendix B, normal PP plot of regression standardized residual, there exists a linear relationship between the three supply chain performance measurement dimensions and IPLS performance.

Assumption 2: Linearity of the Relationship Test

The second assuption for computing multiple regressions is test of the linearity of the relationships between dependent and the independent variables. As depicted in appendix B scatter the visual inspections of the scatter plot shows there exists a linear relationship between the three supply

chain performance measurment dimensions and IPLS performance even though some of the plots are a little scattered from the linear line.

Assumption 3: Multicollinearity Test

Multicollinearity refers to the situation in which the independent/predictor variables are highly correlated. When independent variables are multicollinear, there is "overlap" or sharing of the predictive power. This may lead to the paradoxical effect, whereby the regression model fits the data well, but none of the predictor variables has a significant impact in predicting the dependent variable but may not individually contribute significantly to the model. Existence of the multicollinearity can be checked using "Tolerance" and "Variance Inflation Factor - VIF" values for each predictor variables. As can be depicted Tolerance value is less than 0.10 and VIF is greater than 10 indicates existence of multicollinearity. Thus, multicollinearity is not an issue for this study.

4.3.2. Model Summary

In view of the above analysis and assumptions model summary below can be developed. The multiple correlation coefficient, R indicates existence of strong correlation 0.889 between IPLS performance and the three independent variables, supply chain performance measurement dimensions. Adjusted R^2 amounted to 0.790 reveal that the model accounts for 79% of the variation in the supply chain performance and is explained by the linear combination of all the three independent variables of supply chain performance measurement dimensions.

Table 4.5. Model Summary

Model Summary [b]				
Model	**R**	**R^2**	**Adjusted R^2**	**Standard error of the estimate**
1	0.889	0.790	0.788	0.1645
a. Predictors: (Constant) – Organization and process benefits, Financial benefits, Setup and operating costs				
b. Dependent variable: IPLS performance measurement				

Source: Own Study (2020)

4.3.3. ANOVA Model Fit

The regression model overall fit can be examined with the help of ANOVA. Based on the study results of R = 0.889 and R^2 = 0.788 from the model summary, F ratio value computed to be 6.211

with P-value ($p<0.001$). Based on the Mintlab blog (https://blog.minitab.com/blog/adventures-in-statistics-2/understanding-analysis-of-variance-anova-and-the-f-test), if we compare the p-value for the F-test to significance level, which amount to 0.02 then it can be concluded that sample data provide sufficient evidence to say the regression model fits the data better than the model with no independent variables. Therefore, the regression model is statistically significant and reasonably predict outcome or dependent variable that is the IPLS performance measurement.

Table 4.6. ANOVA Model fit

ANOVA[a]						
Model		**Sum of squares**	**df**	**Mean square**	**F**	**Sig**
1	Regression	2.521	2	1.261	6.211	0.020
	Residual	1.827	9	0.203		
	Total	4.348	11			
a. Predictors: (Constant) – Organization and process benefits, Financial benefits, Setup and operating costs						
b. Dependent variable: IPLS performance measurement						

Source: Own study (2020)

4.3.4. Beta (β) Coefficient

4.3.4.1. Standard Beta Coefficient

With the aim of simplicity not all factors under sub-sections were considered for analysis. Rather only factors that are statistically important were retained. The standardized coefficients are the coefficients which can explain the relative importance of factors in terms of impacting the dependent variable. Therefore, the coefficients were obtained from regression analysis after all the explanatory variables are standardized.

As can be depicted from the below table 4.7, the standardized coefficient of technological investment is the largest value followed by safety, staff specialization, warehouse management, standardization, price trend, tendering, quality service level, Human resources and outsourced services consecutively. The larger the standard coefficient, the higher is the relative effect of the factors to the IPLS supply chain performance.

The significance tests of the twelve variables indicate that the top seven of the explanatory variables are significant with p-value ($p<0.05$) for impacting supply chain performance. The rest five factors have a p-value greater than 0.05, thus these factors are not statistically significant to impact supply chain performance.

The three dimensions which were found to be statistically important have been retained. The standardized coefficients are the coefficients which can explain the relative importance of the explanatory variables. These coefficients were obtained from regression analysis after the variables are standardized.

As can be depicted from Table 4.7 below, section level the standard coefficient of setup and operating costs is the largest value followed by organization and process benefits and then financial benefits.

Table 4.7 Beta Coefficient

Coefficients						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig**
		B	**Std error**	**β**		
1	**Organization and process benefits**					
	(Constant)	0.942	0.862		1.085	0.285
	Standardization (Product/services)	0.643	0.171	0.543	2.542	0.000
	Staff specialization	0.541	0.177	0.842	1.932	0.002
	Quality service level	0.042	0.056	0.011	0.653	0.501
	Safety	1.763	0.201	0.911	5.221	0.000
	Financial Benefits					
	(Constant)	0.856	0.913		1.321	0.266
2	Price Trend	1.831	0.211	0.216	0.752	0.000
	Set up and Operating Costs					
	(Constant)	0.772	0.813		1.771	0.275
	Technological investment	5.345	0.441	0.934	8.666	0.000
3	Warehouse management	0.565	0.178	0.798	0.916	0.008

Coefficients					
Model	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig**
	B	**Std error**	**β**		
Human Resources	-0.221	0.034	0.013	0.734	0.401
a. Independent variable					
b. Dependent variable: IPLS performance measurement					

Source: Own study (2020)

Based on the study results shown above, the top six ranked variables of supply chain performance evaluation have stronger effect on the IPLS SC performance. Inevitably, with standard Beta Coefficient of 93% of the total variation of supply chain performance is explained by technological investment construct. As the most recent survey of EPSA clearly indicated, supply chain processes facilitated by the use of LMIS with standardized process forms and electronic communication technology has significant impact compared to previous paper-based information processing (EPSA, 2019). Similarly F.Lega *et al* asserted the fact that supply chain management systems that provide data and information for analysis, forecasting, management decision and performance management allows significant improvement in different areas of performance evaluation.

The next higher significantly impactful measure according to standard beta coefficient measure is safety with a beta value of 91%. Safety in health care logistics plays pivotal role because any safety related irregularities could have enormous consequences for patient health. According to F. Lega *et al*, error rates during drug management such as prescription, transcription of prescriptions, delivery and administration is critical risk management indicators in the overall evaluation of healthcare supply chain system.

Staff specialization (β value of 84.92%) and warehouse management (β value of 79.8%) according to the standard beta coefficient findings are the next higher significant contributor for supply chain performance measurement. Healthcare organizations are typically staffed with generalist who might lack specific education and training. In Ethiopian context health extension worker and the healthy army might not have adequate competency for critical supply chain implementation. For IPLS to function effectively, staff specialization plays pivotal role. Thus, specialization initiatives and transfer of best practices have been put in place, online IPLS training provided to many service

providers. Thus, supply chain performance measurement is significantly impacted by staff specialization.

Standardization (β=54%) for a healthcare organization which is seeking to promote the adoption of an innovative supply chain approach, which had significant impact. The standardization might come from either product or service standardization in the healthcare sector.

Price trend (β=21.6%) for good (such as medicine) and healthcare services are commonly used to compare the performance of different procurement strategies. In the public healthcare facilities prices are hugely subsidized. However, still price for major services could be exorbitant for those needy communities. Supply chain innovations can help to further push down prices through economies of scale obtained by pooling volumes of standardized products.

The other reasonably significant variable to evaluate SC performance is tendering with β value amounting to 15.4%. Tendering is often centralized by EPSA head office. Proportionately huge amount of the pharmaceuticals is imported for the public healthcare facilities. Efficiency and professionalism in the area of tendering is still an important supply chain performance measure.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

This chapter presents conclusions drawn from the study. Recommendations are also presented based on the evidences and analysis conducted during the course of the study. Finally, relevant suggestions for future research in the area of IPLS of EPSA have been presented.

5.1. Summary

The total sample size selected for the study as 276 and questionnaires were distributed to the respondents out of which 235 were returned, of which 2 of the questionnaires were rejected for incompleteness reason, so the response rate of 84% have been achieved. The sum of the independent variables average Cronbach's alpha values is 0.89 and the reliability test of the study is located on "excellent" rate.

Out of the 233 respondents, 61% (141) were male and the remaining 39% (92) were female. Xx % of the respondents have educational level of first degree and above. Close to 31% of the respondents have less than 2 years of work experience within EPSA and 69% of the respondents have direct IPLS access and working on it for more than 2 years.

The first research question of the study was to identify pertinent IPLS performance measurement dimensions. With the instrumentality of available literature, evaluation framework and model test all the three identified dimensions viz. set up and operating costs, organizational and process benefits and financial benefits were found to be very pertinent for evaluating IPLS supply chain measurement in their order of influence.

5.2. Conclusion

In general, public healthcare supply chain management is expected to incorporate different activities that must be carefully planned and coordinated to ensure the right commodities of acceptable quality get to the right place at the right time so that end users, the community use for diagnosis, treatment and care when needed. Positive health outcomes are highly dependent on how well the health delivery system – health information, financing, personnel and supply chain is performing. Thus, it is critical for established supply chain systems like IPLS be aligned and

interconnected for uninterrupted supply of pharmaceuticals for which objective and integrated supply chain performance measure should be present.

The IPLS system implemented across all public health facilities by EPSA is state of the art integrated supply chain system. The system, with its three major components and its own set of indicators for measuring progresses and performances. These indicators created trackable progress and performance measurement. Unlike before, the system enabled the public health sector to check for system leakages and above all track availability and utilization of stocks. However, there was no objective performance measurement so far to evaluate IPLS as a system. With the instrumentality of similar studies conducted in the developed world, this study attempted to point out suitable performance measurement framework peculiar to the industry instead of generic or "one size fits all" framework.

- *Relevance of the three Pharmaceutical Supply Chain Performance evaluation dimensions (organization and process benefits, financial benefits and set up and operating costs) in the EPSA's IPLS system*

In this study, the three major performance dimensions were tested and evaluated whether they indeed have effect on the IPLS SC performance. In effect, all three dimensions namely financial benefits, Organization & process benefits and set up and operating costs were found to be quite relevant and impactful measure of performance of IPLS in their order of influence. However, parameters like outsourced service and tendering were not as such relevant for the case study as these services are either non-existent at all or managed by few staff engaged in procurement and supply directorate. Given all these merits, according to the most recent monitoring survey conducted on IPLS in April 2019 reveal that IPLS has a long way to go to become a national system. So more effort is expected to scale up, rollout IPLS to the lowest level of facilities so that the supply chain system and associated performance indicators to have a real impact and improve the supply chain system at large.

- *The effects of the pharmaceuticals supply chain performance dimensions (organization and process benefits, financial benefits and set up and operating costs) on EPSA's IPLS SC Performance*

The study attempted to measure the effects of the three SC performance dimensions and found out that all the three dimensions namely financial benefits, Organization & process benefits and set

up and operating costs have significant effects on the performance of IPLS supply chain performance in their order of strength.

5.3. Recommendation

5.3.1. Recommendation for EPSA Management

Based on findings from this study EPSA should keep up in rolling out IPLS to the lowest level of healthcare delivery points and enhance technology led recording system such as bin cards for all facilities. Otherwise, as has been reported in different supportive supervisions the majority of health centers were found overstocked for 10 of 13 items and hospitals for 9 of 12 (IPLS, 2019). On the other hand, automated sites stocked optimally. This shows automation seemed to have notable impact in the overall supply chain performance.

Periodic technical supportive supervision of EPSA should consider safety as an important anchor of supply chain performance measures so that Regional Health Bureaus and facilities collaborate towards welfare of end users.

As has been discovered from KII there is acute shortage of pharmacy professional working in the health sector of Ethiopia. According to the IPLS survey, 2019 15% of health facilities and all of the health centers had no pharmacy professionals on their staff. While significant investments have been made in training on IPLS and commodity management, for a variety reasons service expansion and staff turnover gaps sustained.

Staff specialization and training gaps in supply chain management should still need more attention. In spite of significant investments made in training on IPLS, commodity management problems still remain unaddressed in view of service expansion. So additional effort is still required in this area as well.

The other important considerations that the management of EPSA should take into account is about the issue of cold chains. As KII results and the most recent IPLS survey revealed cold chain conditions are a deep concern in the public healthcare sector of Ethiopia. Only 65% of health centers had a functional refrigerator (97% had a refrigerators so nearly 1/3 health centers had a non-functional refrigerators). Given the fact that all health centers dispense vaccines, and many

health posts rely on the cold chain at their associated health center, which seriously hamper service delivery.

5.3.2. Recommendation for academia

This study focused on the identifying and testing ESTAV supply chain performance measures framework and attempted to link with already developed USAID/Deliver tools. Future studies and researches in the area of healthcare SC performance measurement could focus and test robustness of ESTAV and other equivalent frameworks to uncover many other relevant performance measurement dimensions too.

IPLS's performance can be determined and evaluated more conclusively by looking at facility level implementation status and facility specific challenges.

Thus, further research is needed to explore the ESTAV as SC performance evaluation framework to boost data visibility, systematic performance monitoring that includes KPIs that go beyond availability to include efficiency related KPIs like inventory turnover and order fill rate.

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Appendix

Appendix A: Questionnaire

ADDIS ABABA UNIVERSITY, SCHOOL OF COMMERCE

DEPARTMENT OF LOGISTICS AND SUPPLY CHAIN

MANAGENMENT GRADUATE PROGRAM

Dear respondents,

The purpose of this questionnaire is to gather data for scholarly research entitled "*The Effects of Supply Chain Performance Measurement on Integrated Pharmaceuticals Logistics System of the Ethiopian Pharmaceuticals Supply Agency*."

This research is aimed to fulfill the Addis Ababa University's requirement set for awarding of a Master's Degree in Logistics and Supply Chain Management. The study is purely for academic purpose and thus will never affect you in any case. So, your genuine, frank and timely response is vital for the success of the study. Therefore, I kindly request you to respond to each items of the question very carefully.

General Instructions

- There is no need of writing your name
- Where answer options are available please tick in the appropriate box for part I and part

Contact Address

If you have any query, please do not hesitate to contact me and I am available as per your convenience at (Mobile: 09-11-42-54-43 or e-mail: *endishkifle12@gmail.com./ endishkifle12@ yahoo.com*)

Thank you for scarifying your precious time in advance!

PART I: Demographic Information

1. Educational Qualification:
   - ☐ Grade 12 completed
   - ☐ Certificate
   - ☐ College Diploma
   - ☐ First Degree
   - ☐ Second Degree and above
2. Job title

_____

3. Years stayed at EPSA:

   ☒Under 2 years ☐ 2-5 years ☐ 6-10 years ☐over 10 years

4. Gender

   ☐ Male ☐ Female

5. Years of experience in using IPLS:

   ☐Under 2 years ☐ 2-5 years ☐6-10 years ☐over 10 years

Part II: Instruments for dimensions of supply chain performance measurement

Section one: Organization and Process Benefits

Section 1.1. Standardization (Product/process)		**Score**	**Maximum Score**
1. Does EPSA have standard duration for procurement of products?	Yes ☐ No ☐		1
If no to question 1, score 0 for question 2.			
2. Do EPSA have standard process to handle urgent requests coming from different units?	Yes ☐ No ☐		1
3. Are number of emergency orders sufficiently handled with the use of units of products stocked?	Yes ☐ No ☐		1
If no to question 3, score 0 for question 4			
4. Does EPSA have workable standardization strategies for products and/or processes to manage different sources of variabilities such as urgencies?	Yes ☐ No ☐		1
5. Does the functional unit of EPSA have common list of detailed products or processes for its activities?	Yes ☐ No ☐		1
6. Are commodities provided only to facilities that have staff trained and are equipped to use them?	Yes ☐ No ☐		1
7. Are prescribing practices monitored and compared to standard treatment guidelines?	Yes ☐ No ☐		1
8. Does the logistics officer(s) have the same level of authority for decision making as other functional unit heads?	Yes ☐ No ☐		1
9. Does the logistics system have a strategic plan that covers the next 1-3 years?	Yes ☐ No ☐		1
10. Are there laws and regulations that promote the importation or local purchase of pharmaceuticals being assessed?	Yes ☐ No ☐		1
11. Are there laws and regulations that hinder the importation or local production of health commodities being assessed?	Yes ☐ No ☐		1

Section 1.1. Standardization (Product/process)		Score	Maximum Score
TOTAL			11
SCORE FOR THE SECTION			100%
SCORE FOR THE SECTION = (THE TOTAL SCORE/MAXIMUM TOTAL SCORE) * 100			

Section 1.2. Staff Specialization		Score	Maximum Score
1. Does the head office / branch / hub level have a logistics management unit?	Yes ☐ No ☐		1
If no, please check no in question 2 a-h			
2. Is the logistics management unit fully responsible for the following activities			
a. Managing and using the logistics management information system?	Yes ☐ No ☐		1
b. Forecasting quantities needed?	Yes ☐ No ☐		1
c. Procurement	Yes ☐ No ☐		1
d. Inventory management, storage, and distribution?	Yes ☐ No ☐		1
e. Product selection	Yes ☐ No ☐		1
f. Staffing of logistics positions?	Yes ☐ No ☐		1
3. Are there documented guidelines for:			
a. Managing and using the logistics management information system?	Yes ☐ No ☐		1
b. Forecasting quantities needed?	Yes ☐ No ☐		1
c. Procurement?	Yes ☐ No ☐		1
d. Inventory management, storage and distribution?	Yes ☐ No ☐		1

4. Is there a central level position dedicated to logistics?	Yes ☐ No ☐		1
If no, check no in question 5			
5. Does the logistics officer(s) have the same level of authority for decision making as other functional unit heads?	Yes ☐ No ☐		1
6. Does the logistics system have a strategic plan that covers the next 1-3 years?	Yes ☐ No ☐		1
7. Are there laws and regulations that hinder the importation of local production of the health commodities being assessed? Note: (No = 1, Yes=0)	Yes ☐ No ☐		1
Total			15
SCORE FOR THE SECTION			
SCORE FOR THE SECTION = (TOTAL SCORE/MAXIMUM TOTAL SCORE) *100			

Section 1.3. Quality Service Level		**Score**	**Maximum Score**
1. Is there a functional national/regional drug policy document	Yes ☐ No ☐		1
If no, skip to question 3			
2. Does the national / regional drug policy contain written guidelines for donation of products?	Yes ☐ No ☐		1
3. Is duty tax imposed on imported drugs or products? (No = 1, Yes =0)	Yes ☐ No ☐		1
4. Are donated pharmaceuticals exempt from duty tax?	Yes ☐ No ☐		1
5. Does the program have a functional written policy for maintaining continuity of brands and avoiding unnecessary duplication of interchangeable products	Yes ☐ No ☐		1
6. Is there a national / regional essential drug list?	Yes ☐ No ☐		1
If question 6 is no, check no for question 7			
7. Are all pharmaceutical products in the supply chain being assessed included on the essential drug list?	Yes ☐ No ☐		1
TOTAL			7

SCORE FOR THE SECTION			
SCORE FOR THE SECTION = TOTAL SCORE/MAXIMUM TOTAL SCORE *100			

SECTION 1.4: Safety		**Score**	**Maximum Score**
1. Do written universal safety precaution guidelines exist?	Yes ☐ No ☐		1
2. Are standard patient treatment guidelines distributed to all the service delivery points?	Yes ☐ No ☐		1
3. Does the IPLS system has clinical risk management indicators in relation to safety?	Yes ☐ No ☐		1
4. Are there written procedures for monitoring and supervising prescribing practices	Yes ☐ No ☐		1
5. Are the written safety procedures distributed to service providers at all levels	Yes ☐ No ☐		1
6. Are commodities provided only to facilities that have staff trained and are equipped to use them?	Yes ☐ No ☐		1
7. Are prescribing practices monitored and compared to standard treatment guidelines?	Yes ☐ No ☐		1
TOTAL			7
SCORE FOR THE SECTION			
SCORE FOR THE SECTION = TOTAL SCORE/MAXIMUM SCORE *100			

SECTION 1.5 Supplier Relationship Management		**Score**	Maximum Score
1. Are short term procurement plans based on forecasted needs?	Yes ☐ No ☐		1
2. Do these procurement plans take into account the following logistics systems elements			
a. Current inventory levels (stock on hand)?	Yes ☐ No ☐		0.5
b. Consumption (dispensed to user or issues)?	Yes ☐ No ☐		0.5
c. Losses and adjustments?	Yes ☐		0.5

	No ☐		
d. Required order lead times of the suppliers/donors?	Yes ☐ No ☐		0.5
e. Established stock levels, if relevant (i.e. maximum and minimum levels)?	Yes ☐ No ☐		0.5
f. Need for safety stock	Yes ☐ No ☐		0.5
If no, check no in question 5			
3. In general, are the correct amounts of all products procured and obtained at the appropriate time at the following levels			
a. Central?	Yes ☐ No ☐		1
b. Regional?	Yes ☐ No ☐		1
c. Zonal?	Yes ☐ No ☐		1
d. Woreda?	Yes ☐ No ☐		1
e. Service delivery point?	Yes ☐ No ☐		1
Total			1
SCORE FOR THE SECTION			10
SCORE FOR THE SECTION = (TOTAL SCORE/MAXIMUM TOTAL SCORE) *100			

SECTION 2: FINANCIAL BENEFITS

SECTION 2.1. PRICE TREND		**Score**	Maximum Score
1. Is price trend used to compare performance of different procurement strategies?	Yes ☐ No ☐		2
2. Is the price sufficiently subsidized to enable low income beneficiaries get the service?	Yes ☐ No ☐		2
3. Does the price trend and reductions help to improve supplies stock out?	Yes ☐ No ☐		2

4. The price reduction in public facilities help economies of scale?	Yes ☐ No ☐		2
5. The price of pharmaceuticals help in pooling volumes of standardized products	Yes ☐ No ☐		2
TOTAL			10
SCORE FOR THE SECTION			
SCORE FOR THE SECTION = TOTAL SCORE/MAXIMUM TOTAL SCORE *100			

SECTION 2.2: Efficiency in managing supplies		**Score**	Maximum Score
1. Are there guidelines and established policies for maximum and minimum stocks levels at which full supply produces should be maintained?	Yes ☐ No ☐		1
a. At the central level of the supply chain?	Yes ☐ No ☐		0.25
b. At the regional level of the supply chain?	Yes ☐ No ☐		0.25
c. At the zonal / woreda level of the supply chain?	Yes ☐ No ☐		0.25
d. At the service delivery point of the supply chain?	Yes ☐ No ☐		0.25
2. Are there written provisions for the redistribution of the overstocked supplies?	Yes ☐ No ☐		1
3. Does the IPLS system have a policy of storing and issuing stock according to first-to-expire, first-out (FEFO) inventory control procedures at all levels?	Yes ☐ No ☐		1
4. In practice, does IPLS system manage and issue stock according to FEFO inventory control procedures at all levels?	Yes ☐ No ☐		1
5. Are damaged /expired products physically separated from inventory and removed from stock records at the following levels	Yes ☐ No ☐		1
a. Central?	Yes ☐ No ☐		0.5
b. Regional?	Yes ☐ No ☐		0.5
c. Zonal/ woreda?	Yes ☐ No ☐		0.5
d. Facility/ service delivery point?	Yes ☐ No ☐		0.5

6. Does IPLS have a system for tracking product losses and other adjustments?	Yes ☐ No ☐		1
7. Have stockouts occurred for any product in the last 12 months at the following levels?			
Score 1 for no stockouts, score 0 if there has been a stockout for each level of the system			
a. Central?	Yes ☐ No ☐		0.5
b. Regional?	Yes ☐ No ☐		0.5
c. Zonal/woreda?	Yes ☐ No ☐		0.5
d. Service delivery point?	Yes ☐ No ☐		0.5
8. Are there established procedures for placing emergency orders?	Yes ☐ No ☐		1
TOTAL			12
SCORE FOR THE SECTION			
SCORE FOR THE SECTION = TOTAL SCORE/MAXIMUM TOTAL SCORE *100			

Section 3: Set up and Operating Costs

SECTION 3.1: Technological Investment		**Score**	Maximum Score
1. Is the Logistics Management Information system of IPLS functional?	Yes ☐ No ☐		0.25
2. Does the information system (LMIS, HMIS, DHIS2) include?			
a. Stock keeping records (e.g. inventory control cards, bin cards, stock registers) at all levels?	Yes ☐ No ☐		0.25
b. Requisition and issue records (e.g. bills of lading, shipping records, requisition/issue vouchers) at all levels?	Yes ☐ No ☐		0.25
c. Dispensed-to-user records at service delivery points?	Yes ☐ No ☐		0.25
d. Summaries of consumption data at levels above service delivery points (e.g. central, regional, zonal/woreda level)?	Yes ☐ No ☐		0.25

e. Stock on hand?	Yes ☐ No ☐		0.25
3. Do information system reports at all levels of the system show:			
a. The inventory balance (stock on hand)?	Yes ☐ No ☐		0.25
b. Quantity dispensed or issued during a specified reporting period?	Yes ☐ No ☐		0.25
c. Losses and adjustments?	Yes ☐ No ☐		0.25
d. Quantities received	Yes ☐ No ☐		0.25
4. Do the LMIS / HMIS / DHIS2 reports received at the central level provide information on stock status at the health facility level?	Yes ☐ No ☐		0.25
5. What is the appropriate percentage of information system reports received in time to be used for logistics decision (ordering, distribution etc.) at the following each level of the system? If 90-10 then score 1, if 89-75% then score 0.5, if below 75% then score 0. If necessary, delete or and a level according to the structure of the logistics system			
Score 1 for no stockouts, score 0 if there has been a stockout for each level of the system			
Levels	Reporting %		
a. Central			1
b. Regional			1
c. Zonal			1
d. Service delivery point			1
6. What decisions are based on information system reports? If answers a-e are all checked, then score 1; if not all, but some then score 0.5; otherwise 0			
a. Forecasting			1
b. Procurement			1
c. Transport / Delivery			1
d. Scheduling supervisory visits			1
e. Resupply Quantities			1
f. Other_____			1

7. Are logistics data used at each level of the system as appropriate for:			
a. Continuous monitoring of stock balances?			
Central			0.25
Regional			0.25
Zonal			0.25
Service delivery point			0.25
b. Calculating quantities for resupply?			
Central			0.25
Regional			0.25
Zonal			0.25
Service delivery point			0.25
8. What feedback mechanisms are in place to channel logistics information back to lower levels? If (a) then score 0; if any other answer is checked, then score 1 (even if multiple choices were selected)			
a. None			1
b. Telephone call			1
c. Reports			1
d. Meetings			1
e. Supervisory visit			1
f. Other			1
TOTAL			15
SCORE FOR THE SECTION			
SCORE FOR THE SECTION = TOTAL SCORE/MAXIMUM TOTAL SCORE *100			

SECTION 3.2: Warehouse Management		**Score**	Maximum Score
1. Does the program have written guidelines for storage and handling of the products at all levels of the system	Yes ☐ No ☐		1
2. Are there written guidelines for disposal of sharps, biohazardous materials and other medical waste?	Yes ☐		1

	No ☐		
3. Does the program conduct at least one physical inventory of all products annually at storage facilities at the following levels	Yes ☐ No ☐		
a. Central?	Yes ☐ No ☐		0.25
b. Regional?	Yes ☐ No ☐		0.25
c. Zonal?	Yes ☐ No ☐		0.25
d. Service delivery points?	Yes ☐ No ☐		0.25
4. Is the existing storage capacity adequate to handle the current quantities of products at the following levels			
a. Central?	Yes ☐ No ☐		0.25
b. Regional?	Yes ☐ No ☐		0.25
c. Zonal?	Yes ☐ No ☐		0.25
d. Service delivery point?	Yes ☐ No ☐		0.25
5. Are visual quality assurance inspections of products conducted at the storage facility at the following levels?	Yes ☐ No ☐		
a. Central?	Yes ☐ No ☐		0.25
b. Regional?	Yes ☐ No ☐		0.25
c. Zonal?	Yes ☐ No ☐		0.25
d. Service delivery point?	Yes ☐ No ☐		0.25
6. Are there written procedures or guidelines for destroying damaged and expired products?	Yes ☐ No ☐		1
7. In practice, are damaged and expired products destroyed according to the IPLS disposal guidelines, at the following levels?			
a. Central?	Yes ☐ No ☐		0.25

b. Regional?	Yes ☐ No ☐		0.25
c. Zonal?	Yes ☐ No ☐		0.25
d. Service delivery point?	Yes ☐ No ☐		0.25
TOTAL			7
SCORE FOR THE SECTION			
SCORE FOR THE SECTION = TOTAL SCORE/MAXIMUM TOTAL SCORE *100			

SECTION 3.3: Human Resources		**Score**	Maximum Score
1. Does the national/regional level logistics management unit	Yes ☐ No ☐		0.5
If no, please check no in question 2 a-h			
2. If the logistics management unit fully responsible for the following activities?			
a. Managing and using the logistics management information systems?	Yes ☐ No ☐		0.5
b. Forecasting quantities needed?	Yes ☐ No ☐		0.5
c. Procurement	Yes ☐ No ☐		0.5
d. Inventory management, storage and distribution	Yes ☐ No ☐		0.5
e. Product selection?	Yes ☐ No ☐		0.5
f. Staffing of logistics positions?	Yes ☐ No ☐		0.5
g. Budgeting for the logistics systems?	Yes ☐ No ☐		0.25
h. Supervision and logistics staff development	Yes ☐ No ☐		0.25
3. Are there documented/ functional guidelines for			
a. Managing and using the LMIS?	Yes ☐ No ☐		0.25
b. Forecasting quantities needed?	Yes ☐ No ☐		0.25

c. Procurement?	Yes ☐ No ☐		0.25
d. Inventory management, storage and distribution?	Yes ☐ No ☐		0.25
e. Product selection?	Yes ☐ No ☐		0.25
f. Staffing of logistics positions?	Yes ☐ No ☐		0.25
g. Budgeting for logistics systems?	Yes ☐ No ☐		0.25
h. Supervision and staff development?	Yes ☐ No ☐		0.25
4. Is there a central level position dedicated to logistics?	Yes ☐ No ☐		1
If no, check no in question 5			
5. Does the logistics officer(s) have the same level of authority for decision making as other functional unit heads?	Yes ☐ No ☐		1
6. Does the logistics system have a strategic plan that covers the next 1-3 years?	Yes ☐ No ☐		1
7. Are there laws and regulations that promote the importation or local production of pharmaceuticals supply chain being assessed	Yes ☐ No ☐		1
8. Are there laws and regulations that hinder the importation or local production of pharmaceuticals supply chain being assessed (No=1, Yes=0)	Yes ☐ No ☐		1
TOTAL			11
SCORE FOR THE SECTION			
SCORE FOR THE SECTION = TOTAL SCORE/MAXIMUM TOTAL SCORE *100			

SECTION 3.4: Outsourced Services		**Score**	Maximum Score
1. Do written/functional procedures specify what type of distribution system should be used to distribute products between each level?	Yes ☐ No ☐		2
2. Is there a documented / functional distribution schedule for all levels?	Yes ☐ No ☐		2
3. Are a sufficient number of functioning vehicles available, with petrol and drivers, at appropriate levels, to meet the desired distribution schedule?			

a. Central	Yes ☐ No ☐		0.25
b. Regional	Yes ☐ No ☐		0.25
c. Zonal	Yes ☐ No ☐		0.25
d. Service delivery point?	Yes ☐ No ☐		0.25
4. In general, are orders delivered as scheduled at the following levels	Yes ☐ No ☐		
a. Central?	Yes ☐ No ☐		0.25
b. Regional?	Yes ☐ No ☐		0.25
c. Zonal?	Yes ☐ No ☐		0.25
d. Service delivery point?	Yes ☐ No ☐		0.25
TOTAL			6
SCORE FOR THE SECTION			
SCORE FOR THE SECTION = TOTAL SCORE/MAXIMUM TOTAL SCORE *100			

SECTION 3.5: Tendering		**Score**	Maximum Score
1. Are short term procurement plans based on forecasted needs?	Yes ☐ No ☐		1
2. Do these procurement plans take into account the following logistics systems elements			
a. Current inventory levels (stock on hand)?	Yes ☐ No ☐		0.5
b. Consumption (dispensed to user or issues)?	Yes ☐ No ☐		0.5
c. Losses and adjustments?	Yes ☐ No ☐		0.5
d. Required order lead times of suppliers/donors?	Yes ☐ No ☐		0.5
e. Established stock levels, if relevant (i.e. maximum and minimum levels)	Yes ☐ No ☐		0.5

f. Shipment and handling schedules?	Yes ☐ No ☐		0.5
g. Need for safety stock?	Yes ☐ No ☐		0.5
3. In general, are the correct amounts of all products produced and obtained at the appropriate time at the following levels			
a. Central?	Yes ☐ No ☐		0.5
b. Regional?	Yes ☐ No ☐		0.5
e. Zonal?	Yes ☐ No ☐		0.5
f. Service delivery point?	Yes ☐ No ☐		0.5
4. Is the pipeline status regularly monitored so that procurement decision can be made to avoid stockout?			0.5
TOTAL			
SCORE FOR THE SECTION			
SCORE FOR THE SECTION = TOTAL SCORE/MAXIMUM TOTAL SCORE *100			

TOTAL SCORE	SCORE
Section 1: Organization and Process Benefits	
1.1. Standardization (products/services)	
1.2. Staff specialization	
1.3. Quality service level	
1.4. Safety	
1.5. Supplier Relationship Management	
Section 2: Financial Benefits	
2.1. Price trend	
2.2. Efficiency in managing supplies	
Section 3: Set up and Operating Costs	
3.1.Technological investment	
3.2.Warehouse Management	

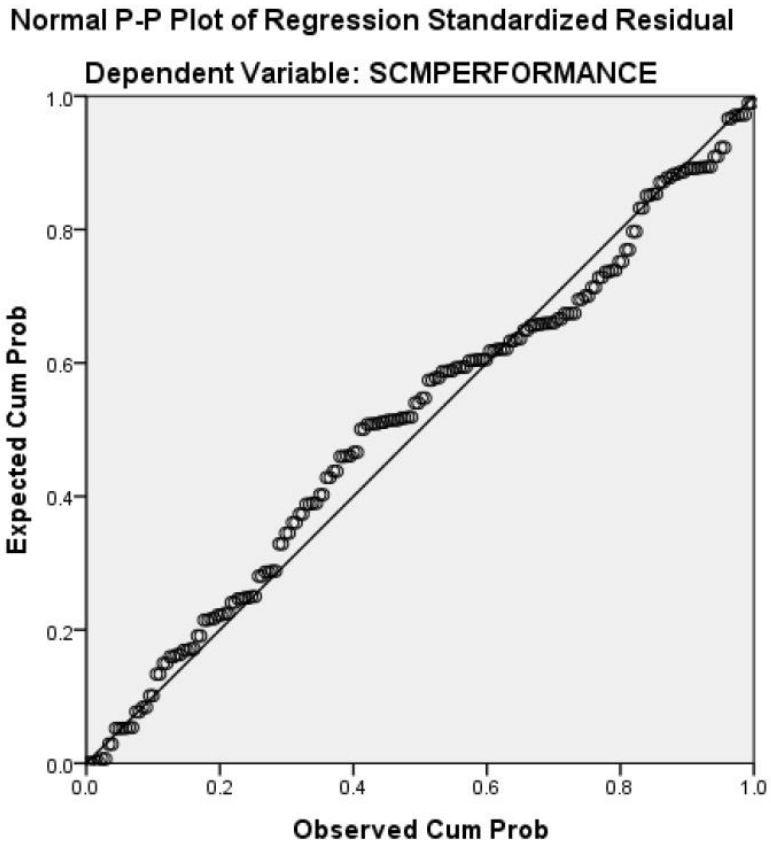
3.3.Human Resources	
3.4.Outsourced Services	
3.5.Tendering	
TOTAL	

Appendix B: Interview Question for Key Informant Interviews (KII)

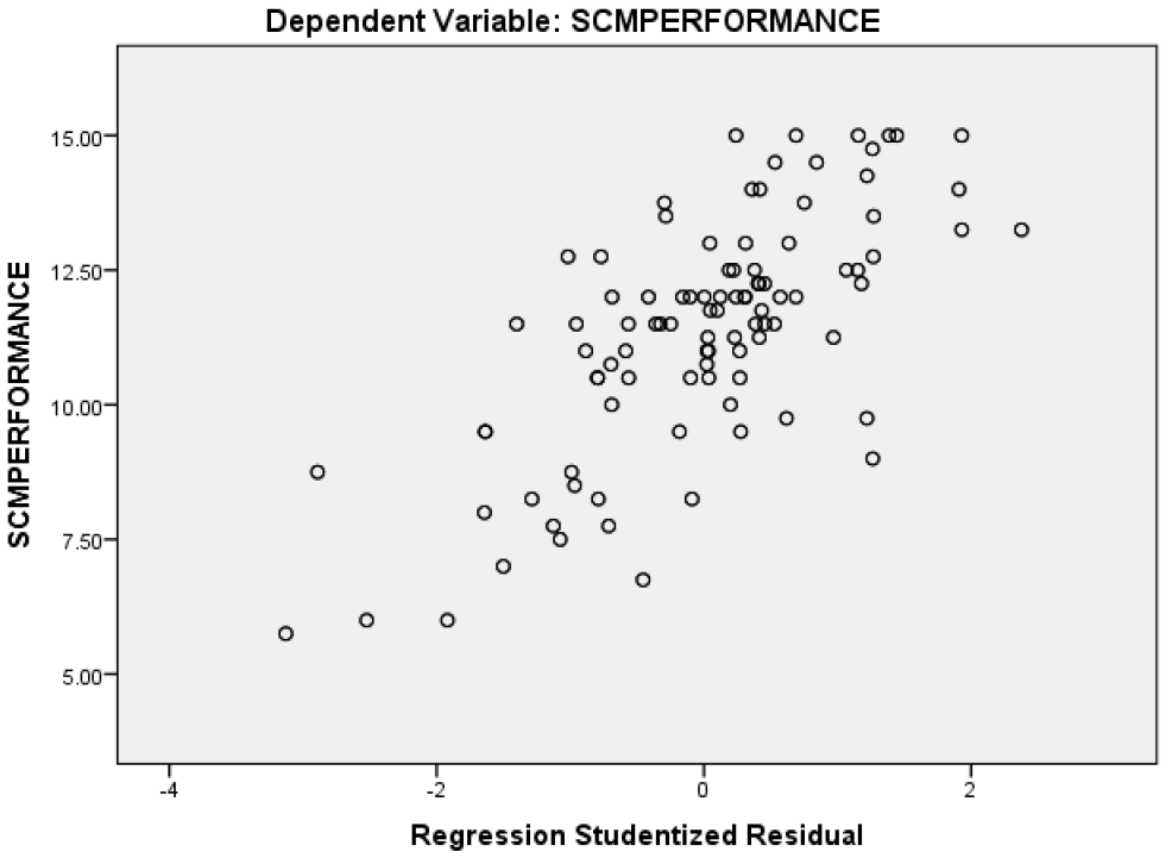
1. How do you evaluate IPLS supply chain performance practice of EPSA?
2. How do you rate IPLS implementation status in view of implementation plan?
3. How do you describe the relevance of IPLS supply chain performance measurement to ensure efficient and effective public healthcare performance in general?
4. What are the current supply chain performance indicators in use and what do you think are their limitations? Are all gaps identified in different survey being implemented effectively?
5. How do you compare supply chain performance results before and after implementation of IPLS?
6. What specific supply chain performance measurement issues can you identify for improvement?
7. Can you mention any specific instance whereby IPLS supply chain performance measurement be refocused, modified or updated in the last few years?

Appendix B

1. Normality Distribution Test



2. Linearity of the relationship test



3. Multicollinearity Test

Model		Collinearity Statistics	
		Tolerance	VIF
1	Organization & Process Benefits	.736	1.387
	Financial Benefits	.751	1.467
	Set up and Operating Cost	.682	1.359