REVERSE LOGISTICS PRACTICE, CHALLENGES, AND ITS ROLE ON SUSTAINABLE SUPPLY CHAIN PERFORMANCE: THE CASE OF ETHIOPIAN PHARMACEUTICAL SUPPLY SERVICE.

BY

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This is to certify that the thesis is prepared by Endalkachew Mekonnen, entitled, *Reverse logistics practice, Challenges, and its role on sustainable supply chain performance: the case of Ethiopian pharmaceutical supply service*, in partial fulfillment of the requirements for Masters of Arts in Logistics and Supply Chain Management with the regulation of the university.

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DECLARATION

I hereby declare that "*Reverse Logistics Practice, Challenges, and its Role on sustainable supply chain performance: the case of Ethiopian Pharmaceutical Supply Service"* is my original work, and I the undersigned agreed to accept all responsibilities for the scientific and ethical conduct of the research. I provided timely progress reports to my advisor and got the necessary advice and approval from my primary advisor during the research.

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This is to certify that Endalkachew Mekonnen has carried out his thesis on the topic entitled: ***Reverse Logistics Practices, Challenges, and its Role on sustainable supply chain performance: the case of Ethiopian Pharmaceutical Supply Service*.** This work is original in nature and suitable for the award of Masters of Arts (MA) in Logistics and Supply Chain Management.

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Table of Contents

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONN/ACRONYMS

EPSS- Ethiopia Pharmaceutical Supply Service.

FMHACA -Food, Medicine and Health Administration and Control Authority

HCMIS- Health Commodity Management Information System.

SOPs- Standard Operating Procedures

MOH- Ministry of Health

PFSA-Pharmaceutical Fund and Supply Agency

RL-Reverse Logistics

CLSC-Close Loop Supply Chain

EFDA- Ethiopian Food and Drug Authority

SSC-Sustainable Supply chain

SPSS-Statistical Package for social science

GHGs-Green House Gas

RDF-Revolving drug fund

MOH- Ministry of Health

UNOPS- The United Nation Office for Project Service.

ABSTRACT

Reverse logistics play an important role in contributing to waste and resource management. Most of pharmaceutical reverse logistics practices focused on expiry drugs, product with short shelf life, overstocked medicines, and disposal of unused and unwanted pharmaceuticals. Moreover, inappropriate pharmaceutical waste disposal leads to serious personal and environmental health hazards. The primary objective of this study is to assess the reverse logistics practice, challenges, and its role in sustainable supply chain performance: the case of Ethiopian Pharmaceutical Supply Service. The research design was descriptive and explanatory implemented by an organizational-based cross-sectional survey from a 191-sample size in selected EPSS branches. Descriptive statistics used. Moreover, the relationship between reverse logistics practice and sustainable supply chain performance of EPSS computed by using correlation and multiple regression analysis. The finding showed that; EPSS moderately practiced redistribution of pharmaceuticals with a grand mean of 2.89, recall of quality defect pharmaceutical from customers, with a grand mean of 2.67. Whereas, recycling pharmaceutical packaging materials with a grand mean of 1.62, and disposal of unusable pharmaceuticals with a grand mean of 2.52 weakly practiced. Lack of appropriate technology, infrastructure, and lack of definitive rules and regulations on handling returned pharmaceutical products have high influence on implementing reverse logistics practice with a mean of 3.75 and 3.74, and 3.48 respectively. Finally, this study concludes that; Redistribution of pharmaceuticals across branches of EPSS, Recall of quality defect pharmaceuticals from customers, Recycling of pharmaceutical packaging materials and warehouse handling materials, and Disposal of unusable pharmaceuticals have significant and positive effect on the sustainable supply chain performance of EPSS. Generally, this study concludes that reverse logistics implementation in EPSS could contribute to improvement in the economic, environmental, and social performance of EPSS. EPSS should strengthen reverse logistics management system by aspiring to achieve its organizational vision "To be the most responsive and efficient pharmaceuticals supply chain organization in Africa by 2030." (PSTP II, 2020).

Key words: Reverse logistics, sustainability performance, Triple-bottom line sustainably.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

According to David B, Alexander T, and Chee Y (2013) statement, waste produced along the supply chain from the beginning extraction of raw materials to consumer use. However, manufacturers or sellers thought they were exempt from liability once their goods delivered to customers. When a product is no longer usable, its owner may wish to destroy it or dispose of it without being hold accountable for its consequences. Moreover, congested waste damping sites harm the environment and human health as a result, the bulk of lands that were once used for human settlement are now unusable because of the contamination caused by this accumulated trash. They claimed that a linear economy model, which mostly focused on taking, producing, and discarding natural materials, would lead to this kind of issue. Rather, it should replace with a circular economy strategy that produces no waste or pollution. Finally, they argued that although the world's natural and energy resources are finite, human needs are causing an exponential rise in the consumption of these resources. In order to conserve this finite natural resource and reuse the goods we have already made, reverse logistic management required.

According to Blumberg D.F., reverse logistics is the process of organizing, directing, physically collecting and delivering materials, components, and products from the end users to processing and recycling or disposition, and returning them to the end users when appropriate. This procedure found either as a standalone process or as a subset of closed-loop systems, (Blumberg D.F., 2005)

The Un compact (2010), work group publication which stated " The objective of supply chain sustainability is to create, protect, and grow long-term environmental, social, and economic value for all stockholders involved in bringing products and service to market. "

As Hoornweg *et al,* (2013) stated that, by 2100 the solid waste generation exceeded 11 million ton per day. Moreover, they stated if we create waste like this these large amount of waste could cause significant public health and environmental problems. Beside this giant

amount of waste, it will case environmental pollution, global warming, and natural resource depletion.

Contrarily, according to (Vipula, 2016), few developing nations have implemented pharmaceutical waste management programmes, despite the fact that inappropriate medicine waste disposal poses a major risk to both personal and environmental health. A good medication waste management programme is also difficult to develop in these nations because to the particular socioeconomic issues that exist there.

As kan and Suzwari (2009) stated, most of the time pharmaceutical reverse logistics deal with expired and counterfeited drugs , drugs which have short shelf live, and disposal of unused and expired pharmaceuticals. According to WHO (2018) statement, 1 in 10 pharmaceutical products form all therapeutic categories including medicines, vaccines and in vitro diagnostics in low and middle-income countries were substandard or falsified.

In Ethiopia, according to the assessment done by MOH the average wastage rate of medicines is 3.9 % and 81.1% of the public hospitals reported wastage of medicines worth 57,374,603.59 birr by value in 2018/2019. Therefore, in order to increase availability of pharmaceuticals, reduce wastage of health products, minimize risks and reduce economic cost of unused pharmaceuticals and medical devices, a reverse logistics system should be implemented whenever needed (FMOH, 2021).

Mainly the purpose of this study will be to assess the current pharmaceuticals reverse logistic practice, challenges and its role in sustainable supply chain performance in Ethiopian pharmaceutical supply service.

1.2 Statement of the problem.

Reverse logistics in the pharmaceuticals sectors is important from the regulatory, economic as well as environmental point of view. However, business firms are not giving much attention to RL rather they gave much attention for forward logistics by creating fast and simple supply chain system. Particularly in developing countries, firms seem to neglect the essence of implementing reverse logistics and obtaining its benefits (Manoj Kumar T., and Saravanan. 2016).

On top of that, Pharmaceutical waste continuously generated and disposed of in various ways. Due to its nature and impact, it is crucial to have a functional and effective Pharmaceutical reverse logistics system. Developing countries have extremely limited capacity for saving pharmaceutical waste disposal. In countries like Ethiopia, with a decentralized health care system and supply chain management system which is under continuous development, there is a high need to make sure that safe disposal of those wastes is in place. However, progress in placing a standardized and functional system is substandard.

Currently, majorities of health facilities have small-scale and sub-optimal waste disposal pits and incinerators. Moreover, those health facilities, which are practicing disposal of pharmaceutical waste, forced to use unsafe disposal methods to dispose of pharmaceutical wastes, which has a major impact on the health of the public and the environment (MOH, 2021)

According to (EPSS, 2020/2021) annual report a total of 17,011,435,811.19-birr amount of Pharmaceuticals procured and a total of 27,613,443,409-birr amount of pharmaceuticals distributed, in the same year 126,051,318.14-birr amount of pharmaceuticals redistributed this implies that, even though there is a practice of RL in EPSS it's impact is not well studied .

Cognizant of the above facts, small number of study have examined reverse logistics practices, supply chain sustainability, and their interrelationship. Moreover, there is lock of empirical studies on the area of reverse logistic practice and challenges and effect on sustainable supply chain performance EPSS. In addition, as investigators mini survey, small group discussions and document reviews at EPSS, the investigator of this study understand that implementation of pharmaceutical reverse logistics in EPSS where not well understood , and have no research based evidence about the influence of reverse logistics on organizational performance. In addition to that, as far the investigator of this study reading goes there no similar studies done on this organization. There for, this research will help the organization to have a full picture of revere logistics practices and challenges, and its effect on sustainable supply chain performance of EPSS and used as a baseline for future research.

1.3 Research Question

The research Questions that addressed by this research are:

- How is reverse logistics management practiced in EPSS in terms of Redistribution, Recall, Recycling, and Disposal?
- To what extent do current Pharmaceutical reverse logistics practices influence EPSS Sustainable supply chain performance?
- What major challenges are there in the Pharmaceutical reverse logistics management practice at EPSS?

1.4 Objective of the study

1.4.1 General Objective

The objective of this study is to assess the reverse logistics practice, challenges, and its role on sustainable supply chain performance: the case of Ethiopian Pharmaceutical Supply Service.

1.4.2 Specific Objectives

The study specific objectives are:

- To assess the reverse logistics practices in EPSS in terms of redistribution, recall, recycling, and disposal of pharmaceuticals.
- To determine the influence of reverse logistics practice on EPSS sustainable supply chain performance
- To identify major challenges in the implementation of the reverse logistics management system at EPSS.

1.5 Significance of the Study

Reverse logistic play an important role in the supply chain, especially for those resource-limited country like Ethiopia, it helps to maximize their resource usage properly. Moreover, inappropriate disposal of pharmaceutical waste leads to serious human and environmental health hazards. This research is significant for EPSS because it helps to understand how pharmaceutical reverse logistics practiced in the organization, and it helps to determine the effects of reverse logistics practice in EPSS sustainable supply chain performance. Moreover, the study tried to identify the major challenges to the implementation of pharmaceutical reverse logistics management system in EPSS and make some

recommendations. Therefore, by incorporating these recommendations, the organization could minimize challenges and implement a better reverse logistics management system. In addition, as far as the investigator reading goes the area is not researched wall, so it helps to provide baseline information for future work.

1.6 Scope of the study

The scope of this study is restricted to employees, who are technical staff (health workers) of Ethiopian pharmaceutical supply service (EPSS) namely Pharmacy professionals, Biomedical professionals, laboratory professionals, and other health science professionals from all branches which have disposal firms including head office by the year 2015 E.C. Non-technical staffs of the EPSS will not consider by this study, this is because, proportionately, the level of technical engagement in the pharmaceutical reverse logistics management system is minimal.

This study only focuses on pharmaceuticals and reverse logistic practices mainly, redistribution, recall, recycling, and disposal of pharmaceuticals, which are returned from customers (health facilities) and transfers from one branch of EPSS to other branch , including central warehouse.

1.7 Limitations of the Study

The study has some limitation of which, the study only focused on EPSS (the major supplier of pharmaceuticals in Ethiopia) which represent the supplier side only, it did not showed the full picture of reverse logistics across the supply chain. Therefore, it is hard to generalize the findings of this study to other parties of supply chain actors such as Pharmaceutical manufactures and Health facilities and end users.

1.8 Definition of Key terms

Reverse logistics; According to Blumberg D.F., it is the process of organizing, directing, physically collecting and delivering materials, components, and products from the end users to processing and recycling or disposition, and returning them to the end users when appropriate. This procedure found either as a standalone process or as a subset of closed-loop systems, (Blumberg D.F., 2005).

Supply chain sustainability: UN Global Compact (2010) defines it as the management of social, environmental, and economic implications and the promotion of good governance practices throughout the lifecycles of goods and services.

Pharmaceutical: is any substance or mixture of substance used in the treatment, diagnosis, mitigation, or prevention of disease. This includes medical supplies and medical instruments.

Unusable pharmaceuticals: pharmaceuticals that include expired, damaged inappropriately sealed, inappropriately stored, inappropriately labelled substandard and counterfeited. **Redistribution-** defined as the process of movement of usable pharmaceuticals from one branch of EPSS to other branch of EPSS for maximizing product availability and minimizing wastage.

1.9 Organization of the study

This study have five chapters. Chapter one an introductory part, which describes the background of the study the study background , the problem statement , the study objective and research questions study significance and scope of the study. In chapter, two the theoretical and empirical literatures reviewed. Specifically, the meaning of pharmaceutical reverse logistics management system, forward logistics, and close loop supply chain discussed. Chapter three-research methodology, which describes the study area, type of research, data type and data source, reliability & pilot test procedures, method of sampling used, method of data collection, and analysis. In chapter four data analysis and major findings and discussions presented in detail. Finally, the last chapter, chapter five cover a summary of the major findings, conclusion, recommendations, and future research directions indicated.

CHAPTER TWO

2. RELATED LITERATURE REVIEW

This chapter presents the literature written by different authors and research conducted by different scholars in relation to the nature, causes, and consequences of reverse logistic particularly pharmaceutical reverse logistics management system extensively reviewed.

2.1 Theoretical Literature Review

2.1.1 Reverse Logistics Management practices

Reverse logistics is the process of receiving components or items that have been returned, or things that have reached the end of their usable lives, in order to recover value or dispose of them responsibly. Moreover, reverse logistics involves managing product recalls, end-of-life returns, seasonal returns, and components in a way that preserves the value of goods that could otherwise be disposed of in landfills. These products put through a number of inspection and refurbishing stages before being either fixed and shipped back to the original customer, restored to stock, or returned to the original equipment manufacturer (OEM). The base materials or spare pieces can be recycled if the entire product cannot be used. Materials should be discarded if none of these recovery options are feasible (Richard E, William R and Charlie C., 2014).

Reverse logistics is described as "the process of planning, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal" by the Reverse Logistics Executive Council.

According to some scholars, reverse logistics (RL) relates to the management of returns and the optimum way to reintroduce returns as complete units or components into the forward supply chain by repackaging, remanufacturing, or reprocessing. The goal is to reduce expenses or, in more progressive businesses, to increase revenue (Richard E, William R, and Charlie C., 2014).

The concept of RL businesses emerged during the early industrial era, according to Blumberg, D.F. (2005), when people in business realized that used garments, rags, linens, and other materials could replicated and used to create new textile products. Furthermore,

reverse logistics became more well known in the 1980s, a time when environmental issues were a sensitive subject matter. The processing and recycling of garbage (both general and hazardous) resulted from this. The early 1990s saw the emergence of using RL as a commercial strategy to discover new markets or enhance a company's bottom line. For instance, Genco Distribution System used RL to grow its RL revenue from $300,000 in 1991 to an estimated $40 million in 1994

As stated by Blumberg, D.F. (2005), there is of course a requirement for disposal, which deals with specific issues involving solid waste, liquid waste, and hazardous materials, in addition to the usual situation, where the products at the end of the supply chain are no longer wanted or have little value because they are obsolete. It could be parts and subassemblies of items that can reused again or products that have failed in the field and need to repair.

The main objectives of RL strategies are to maximize inventory value through quick returns to the manufacturer for reuse, the ability to liquidate goods, parts, and subassemblies with value on secondary markets, controlled recycling or disposition in compliance with applicable laws, and the capability of quickly processing returns back into the original direct supply chain. (D.F. Blumberg, 2005)

Many crucial elements found in reverse logistics methods contribute to the operation's economic viability. The following are some areas that require action, according to (Blumberg, D.F., 2005); **uncertain material flow**; frequently, businesses are unsure of the quality or return date of a given item. **Customer-specific**; the return flow is extremely varied and depends on the end-user or customer, necessitating in-depth familiarity with and comprehension of the service's particular users. **Time criticality**: Processing the asset as rapidly as possible to make it ready for reuse or disposal is a crucial component of RL and repair services. The vendor must increase the value of the assets being returned in order to provide value improvement, reverse logistics, and repair services. **Flexibility**: To meet goals for returned materials where demand fluctuates, the RL process needs flexible capacity in terms of the facility, transportation, and other relevant services. **Multiparty coordination** is generally necessary for RL and repair operations since they involve multiple participants. To prevent delays or inefficiencies, it is crucial to set up a communications network that can enable effective, quick, real-time contact between the parties.

The CLSC process in consumer goods (food, drugs, cosmetics, clothing, etc.) allows for the redistribution of returned goods through different retail channels, so the retailer may well find that secondary distribution channels can provide more value than returning products to the manufacturer for credit (D.F. Blumberg, 2005).

In this regard, Blumberg noted that the role of warranty and extended warranty support services as part of the reverse logistics (RL) or closed loop supply chain (CLSC) process neither well understood nor well managed in the majority of industrial and commercial firms. Warranty management is another area of RL that neglected by many organizations. This is due to a number of complex factors, but the main ones have to do with our inability to completely comprehend the strategic importance of warranties and the needs of the necessary infrastructure to manage and, in fact, maximize warranty and post warranty support service. It's crucial to comprehend the significant role perceptions play in effectively managing the warranty and extended warranty process from both the buyer's and seller's points of view and successfully managing the warranty and extended warranty process, as part of the overall RL system (Blumberg, D.F., 2005).

2.1.1.1 Reverse Logistics practices

Research on RL has grown dramatically in recent years, and its definition has evolved over time. According to Stock (1998), RL is "the term most often used to refer to the role of logistics in product returns, source reduction, recycling, materials substitution, reuse of materials, waste disposal, and refurbishing, repair, and remanufacturing". Another definition of RL is "the process of planning, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal" (Rogers and Tibben-Lembke, 1999, p. 2).

The processes and goals of RL and forward logistics differ significantly (Tibben-Lembke and Rogers, 2002). Forward logistics includes the actions required to deliver items to clients, whereas reverse logistics (RL) deals with the activities related to reclaiming products from customers for value recovery through reprocessing or proper disposal. In contrast to RL, forward logistics has received the majority of attention in studies on supply chain and logistics management (Stock et al., 2002).

Figure-1 depicts RL and forward logistic processes. The end users (consumers in Figure-1) from whom the used or returned products are gathered are the starting point for RL. From there, the products are acquired and inspected before being categorized into different groups. Making an acceptable disposition choice, such as reuse, repair, remanufacturing, or recycling for recapturing value or disposal, is the following stage. Product acquisition, collection, inspection/sorting, and disposition are the main RL processes (Rogers and Tibben-Lembke, 1999; Fleischmann et al., 2000).

Product acquisition/gate keeping

Product acquisition is the process of acquiring used goods from end customers for further processing. Due to the uncertainty around the timing, volume, and quality of used products, this is a crucial factor in determining the effectiveness of RL (Agrawal et al., 2015). Gate keeping is a method that retailers typically use to determine whether products should be returned to customers or sent for further processing (Agrawal et al., 2015).

Collection

The act of gathering products following an acquisition and sending them to other facilities for inspection, sorting, and disposal is known as collection. In their 2008 study, Kumar and Putnam divided collection techniques into three categories: manufacturers collecting directly from customers, manufacturers collecting returned goods through merchants, and manufacturers collecting goods through third-party logistics.

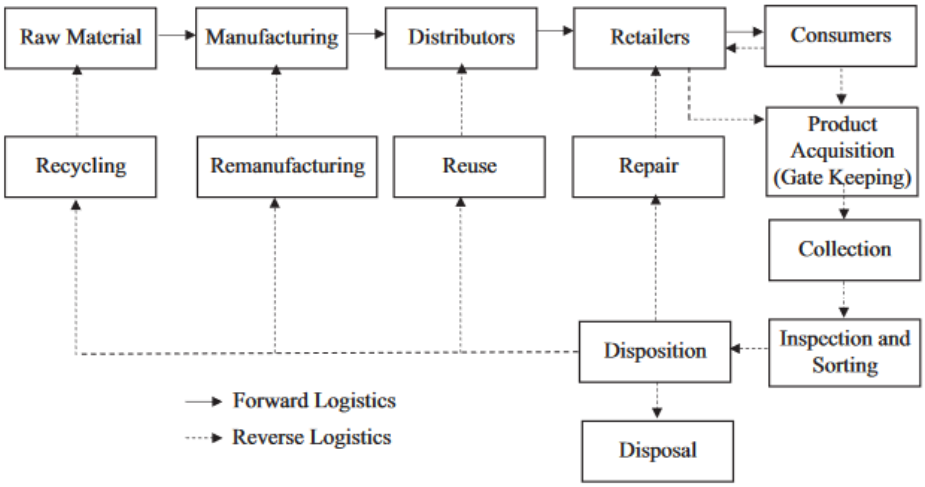
Inspection and sorting

After collecting, products are inspected and categorized as well. According to Rogers and Tibben-Lembke (1999), product returns might be related to production, distribution, or customers and can vary substantially in terms of their quality and condition. Therefore, it is essential to evaluate each product separately before grouping them for disposal (Agrawal et al., 2015).

Disposition

Making decisions regarding the items' disposition follows the inspection and sorting of the goods. A crucial step in the RL process is product disposition. The range of choices for

disposal typically consists of reuse, repair, remanufacturing, recycling, and disposal (Fleischmann et al., 2000).



Source: Adapted from Agrawal *et al.* (2015, p. 78)

Figure 1- Fundamental flow of RL and forward logistics processes

Reverse logistics management guideline for pharmaceutical and medical devices (MOH, 2021) stated that major reverse logistics activities are redistribution, recall, recycle, maintenance, dismantling and retrial of components of medical devices, refurbishment, and disposal. However, this paper majorly focused on redistribution, recall, recycle, and disposal practices in EPSS.

Redistribution

Redistribution is the process of moving usable medications and medical devices from one point of consumption back to the point of origin and then back to another point of consumption where it is most needed, according to reverse logistic management guidelines for pharmaceuticals and medical devices (MOH, 2021).

Recall

A recall is a process of removing a drug or medical equipment from the pharmaceutical distribution network due to defective manufacturing, reports of severe adverse reactions to

the product, or suspicions that the product is fake. The recall procedure started by the producers, retailers, or the government agency EFDA (MOH, 2021).

Regulatory body concerns in this respected industry necessitated special consideration for some products, such as pharmaceuticals. According to Blumberg, special products like prescription medications needed supervision. Regulations set out by the Food, Drug Administration (FDA) provide specific procedures, and system processes for coordinating returns and recalls. As a result, the RL process and management approach for consumer goods (food and drugs) must consider the types, number of stores in their locations, the products, goods sold, and existing systems (Blumberg, D.F., 2005).

Recycle

Recycling materials are those that can turned into usable materials without significantly harming the environment, according to the reverse logistics management guideline for pharmaceutical and medical equipment. Other manufacturers can use these resources as raw materials. (MOH, 2021). Another instance of this concept found in Mogaka's work; entails disassembling the product and removing any pieces or components from a returned item so they can used as raw materials for a new item or packaging and the garbage is subsequently burned or dumped in a landfill, which lowers the need for new raw materials (Mogaka L. M., 2015).

Manufacturers and retailers used to think that they were exempt from liability for collecting their goods after they delivered to customers. The owner of a product can seek to dispose of or trash it without taking responsibility for the results when it is no longer useful, necessary, or fashionable. According to David B, Alexander T, and Chee Y (2013), this operating paradigm causes increases in the consumption of organic materials, pollution from waste disposal, and losses of biological nutrients that may be used to produce additional goods or generate energy.

Society has been figuring out ways to process products along RSCs informally even before the formal acknowledgment of RL or RSCs. These include repairing clothing to extend its lifespan, repurposing old items such as cleaning rags, and making toast or croutons out of stale bread. Some of the practices include composting kitchen scraps and other waste, recycling aluminum, glass, and plastic containers, building swings out of old tyres and rope,

and turning empty wine bottles into candleholders (Richard E, William R and Charlie E., 2014).

Disposal

Every organization's top priority is managing waste, but the pharmaceutical industry is particularly critical when it comes to managing the disposal of unwanted, outdated, and expired medications through an effective reverse logistics channel. According to the medication, waste management, and disposal directive, there are various ways to dispose of medical waste, including returning it to its manufacturer or supplier, burning it in the open field, putting it in a landfill, or incineration. The characteristics of medical waste must considered when selecting a disposal technique (FMHACA, 2011).

2.1.2 Sustainable Supply chain performance

The World Commission on Environment and Development's (1987) phrase "development that meets the needs of the present without compromising the ability of future generations to meet their needs" is an often-cited definition of sustainability. The management of environmental, social, and economic repercussions, as well as the promotion of good governance practices across the lifecycles of goods and services, are both aspects of supply chain sustainability. Creating, preserving, and enhancing long-term environmental, social, and economic "value for all stakeholders involved in bringing products and services to market" is the goal of supply chain sustainability. Businesses may defend their long-term profitability and obtain a social license to operate by ensuring the sustainability of their supply chains. The junction of the three factors economic, environmental, and social constitutes the concept of sustainability, commonly known as the triple bottom line (TBL) (Un Global Compact Workgroup report, 2010).

2.1.2.1 The economic dimension of sustainability.

By taking into account several works on the economic component, Mohsen V. (2016) made his claims in his article about the economic dimension of sustainability. According to him, supply chain management should take into account its connections to both the environment and society because it deals with numerous activities from the extraction of raw materials to

the production, packaging, transportation, and recycling of products, all of which can have a significant impact on both. In other words, achieving economic goals while preserving society and the environment is what is meant by economic sustainability. Implementing environmental and/or social activities can also have financial benefits, such as cost savings from recycling, redesigning for reuse, remanufacturing, and lowering the cost of packaging. Additionally, lower costs for health and safety due to safer manufacture, transportation, and storage. Better working conditions also result in lower expenses for recruitment and labor turnover. Moreover, putting environmental management standards like ISO 14000 into practice has improved lead times and product quality. Improving key performance indicators like service and product quality, market share, customer loyalty, and profit; enhancing suppliers' capacities for innovation; and increasing consumers' trust in suppliers because of suppliers' participation in sustainability initiatives.

2.1.2.2 The environmental dimension of sustainability.

The environmental dimension of sustainability related to the natural environment, which includes land, water, plants, and animals. As stated by (Mohsen V., 2016) the environmental dimension of supply chain management stemming from both the environmental management and supply chain management literature. This area has been referred to as ‘green supply chain management’ and aims to integrate environmental issues with supply chain processes and functions such as product design, supplier selection operations, transportation as well as the end-of-life management of used products. Some of the important environmental concerns investigated in literatures of supply chain management include GHG emissions, resource depletion, and waste generation, hazardous substances in product, energy consumption and water consumption. Of these concerns stated, the issue of GHG emissions, CO2 in particular, has highlighted as the most prominent because of the hazardous consequences on ecosystems and human health.

2.1.2.3 The social dimension of sustainability.

Developing and putting into action business practices that are equitable and beneficial to employees, the community, and the area in which the firm operates are part of the social component of sustainability as it relates to human capital. As mentioned by Mohsen (2016) in his work, focal enterprises must take into account concerns that go beyond organizational

borders in order to address sustainable features, including the social aspect. There aren't many studies in the literature that try to deal with the social aspect and proposed a framework to look at how some social sustainability indicators (labor equity, health, safety, and philanthropy) can be measured and included in a supply chain decision-making process.

Table 1 Categories and aspects of the sustainability framework

Category /Dimension	Economic	Social	Environmental
Aspects /indicators	. Sales growth . Return on investment . Market share growth . Procurement Practice . Reduced cost . Inventory reduction . Quality improvement . Delivery improvement	.Occupational health & safety . Customer satisfaction .Stakeholder's satisfaction . Social commitment . Employee job satisfaction .Firm's corporate image . customer loyalty . product image	. Reduced energy & resource consumption . Waste management. . Reduction in pollution . Reduction of hazardous & toxic materials . Compliance with environmental regulations .Firm's environmental image

Source: (Taknaz B, Jiangang F. Peggy C. (2019)

2.2 Empirical Literature Review

2.2.1 Reverse logistics management practices and their driving forces

The most important driving force to implement reverse logistics in organizations are Economic drivers, environmental related issues, and corporate citizen ship. Rediet D. (2016) highlighted that economic reasons include anticipating impending regulation, market protection, a greener image, enhanced customer/supplier relations, and direct gains from cost reduction, value-added recovery, and input material. Legislation is a second type of driver, as there is a growth in environmental legislation. Original supply chain parties are more frequently hold liable for the recovery and collection of their end-of-life products. Extended producer responsibility, or EPR, is the name given to this take-back obligation at the end of life.

In addition to the aforementioned fact, Blumberg D.F. (2005) identified another motivating factor that boosted interest in companies offering RL and CLSC providers in the field of

reverse logistics. Some of them include: increased customer demands for better customer service satisfaction due to legislation imposed by the government and environmentally friendly products created by competitors; cost reduction by sellers to reduce working capital requirements through complete product control and reverse processes are stated. In addition, he mentioned a number of new return alternatives, such as returning goods for credit, returning warranty items, returning items from short- and long-term rentals and leases, and recalling products. He also mentioned other driving factors, such as the shift in consumer purchasing habits from in-store to online shopping. In addition, the rate of product obsolescence has increased, the use of reusable containers has increased, and distribution market techniques have changed, enabling retailers to clear their shelves of unsold goods.

2.2.1.1. Economic drivers

The primary goals of business organizations are earning a profit and generating returns on investment. An organization that engages in reverse logistics despite having no specific or imminent predicted profit drivers related to marketing, competition, or strategy. When Mogaka (2014) examined the impact of reverse logistics practices for new products that were returned on the performance of pharmaceutical firms in Nairobi, she discovered a strong correlation between these practices and financial performance (correlation coefficient: 0.709) and market performance (correlation coefficient: 0.751).

2.2.1.2 Legislation

According to Tarig, K. E., & Suhaiza, H. M. (2011), business organizations expected to adopt green purchasing practices in response to environmental regulations set by a variety of regulation institutions, including government bodies domestically, regulations in the export companies, as well as the regulations set by the parent companies. These regulations include explicit guidelines, legislation, penalties, and inducements.

2.2.1.3 Social (corporate citizenship)

Corporate citizenship refers to a way of principles or ideas that motivate a company to engage in certain activities, such as reverse logistics, responsibly. According to Tarig, K. E., & Suhaiza, H. M. (2011), the interest in reverse logistics anticipated to come from both internal organizational sense of responsibility for the society in which an organization operates as well as external sources (regulation and customers). Due to the

growing severity of environmental issues including global warming and environmental degradation, reverse logistics is particularly sensitive. Such issues anticipated to increase business firm's knowledge of the need to act in a more socially responsible manner and project an organization that dedicated to sustainability and social responsibility.

In the pharmaceutical sector, reverse logistics is crucial from a variety of perspectives, including economic, environmental, governmental, and regulatory. Additionally, pharmaceuticals are extremely precious, temperature-sensitive, and governed by national and international laws (Kabir, 2013).

Companies need a robust framework in place to handle such circumstances because the pharmaceutical supply chain is known for high levels of spillover and wastage as well as common problems with medicine returns and recalls (Haidar Abbas and Jamal A Farooquie, 2013). In addition to the fact that medicines are typically expensive chemicals that are essential to consumers' health, the pharmaceutical industry needs to implement an effective reverse logistics system to manage product returns, expired stock, and product recalls (Sushmita et al., 2012).

Studies on reverse logistics in the pharmaceutical sector focus on problems at the production, distribution, or sales levels. Further consideration must be given to product attributes (expiration date, price), as well as external aspects (regulatory restrictions, market behavior influence on consumers and the environment, and information system) (Sushmita A et al. 2014).

According to the study, 81.1% of Ethiopia's public hospitals recorded drug waste totaling 57,374,603.59 birrs in 2018/2019. The study also found that 25% of the medical devices on the market were not working properly. Providing medicines that will shortly expire, inadequate inventory management, a lack of communication between stakeholders, and a lack of stock rotation or exchange policies are the causes of product waste (MOH, 2021).

2.2.2 Challenges of Implementing reverse logistics

Reverse logistics implementation faces a variety of problems, some of which Richard and his colloquies identified. These challenges listed below.

Similar problems identified by Richard E, William R, and Charlie C. (2014). Some of them do not have executive overseers or advocates to take charge of and push RL, and RL viewed to be nothing more than a cost. In addition, Management does not understand the benefits of client satisfaction and service distinction that RL can bring, and it believed that it is impossible to accurately calculate the cost of returns due to a lack of system and information visibility. Additionally, there is a silo attitude as opposed to a cross-functional mentality, and poor manual processes for performing RL exist.

The Reverse Logistics Executive Council conducted a survey of more than 300 logistics managers in the past, and the results revealed the following major obstacles: relative insignificance, company policies, a lack of systems, competitive issues, management negligence, a shortage of skilled workers, a lack of financial resources, and legal concerns (Caldwell, 1999).

2.2.2.1 Financial constraints

One of the difficulties in implementing reverse logistics in this regarded business is the lack of funds. Companies must allocate cash and other resources for the implementation of reverse logistics, according to Sharma et al. (2011). Additional funding needed for information and technology systems because, in the current environment, it is impossible to track and trace returned products, and recover products through reuse, remanufacturing, recycling, etc.

2.2.2.2 Lack of awareness about RL

The majority of organization frequently lacks knowledge of the advantages of reverse logistics deployment. Additionally, Sharma and his collaborators pointed out that customers today benefit from a wider selection of products. Unsold goods, return rates, packing materials, and waste have all increased as a result. Reverse logistics has become more common as a result of the surge in product returns. By recovering the returned goods for reuse, remanufacturing, recycling, or a mix of these alternatives for adding value to the product, reverse logistics can result in financial gains (Sharma et al., 2011).

2.2.2.3 Management inattention

Reverse logistics implementation is not given much management intention. According to Sharma and his colleagues, most businesses have adopted reverse logistics practices during the past few years mostly due to legislative requirements or pressure from environmental organizations, rather than for financial advantage. As a result, the management is less interested in matters of no profit. Businesses structured around the forward flow of goods (Sharma et al., 2011).

2.2.2.4. Personnel resources

For effectively managing and ultimately creating the reverse logistics, training individuals associated with this process is also crucial. A lack of qualified employees is a major obstacle to effective reverse logistics, according to Sharma and his colleagues. In order to succeed in any organization, education, and training are essential (Sharma et al., 2011).

2.2.2.5. Inadequate Technological Systems

The lack of suitable technologies is one of the factors slowing down the implementation of reverse logistics; without them, it is challenging to locate the products that need to be reversed. Information technology is crucial for end-to-end control, transparency, according to Sharma and his colleagues (Sharma et al., 2011).

2.2.2.6 Policies and guidelines

One of the most frequent problems with reverse logistics deployment is the absence of clearly specified policies and procedures. Companies do not want their "junk" to degrade the quality of what they already have. They must therefore create policies that make it simple to handle returns and to recover a large amount of money from those returns (Sharma et al. 2011).

2.3. Conceptual Framework

The conceptual framework that serves as this paper's direction shown in the figure below. The conceptual framework focuses on the impact of pharmaceutical reverse management practices on the effectiveness of the sustainable supply chain.

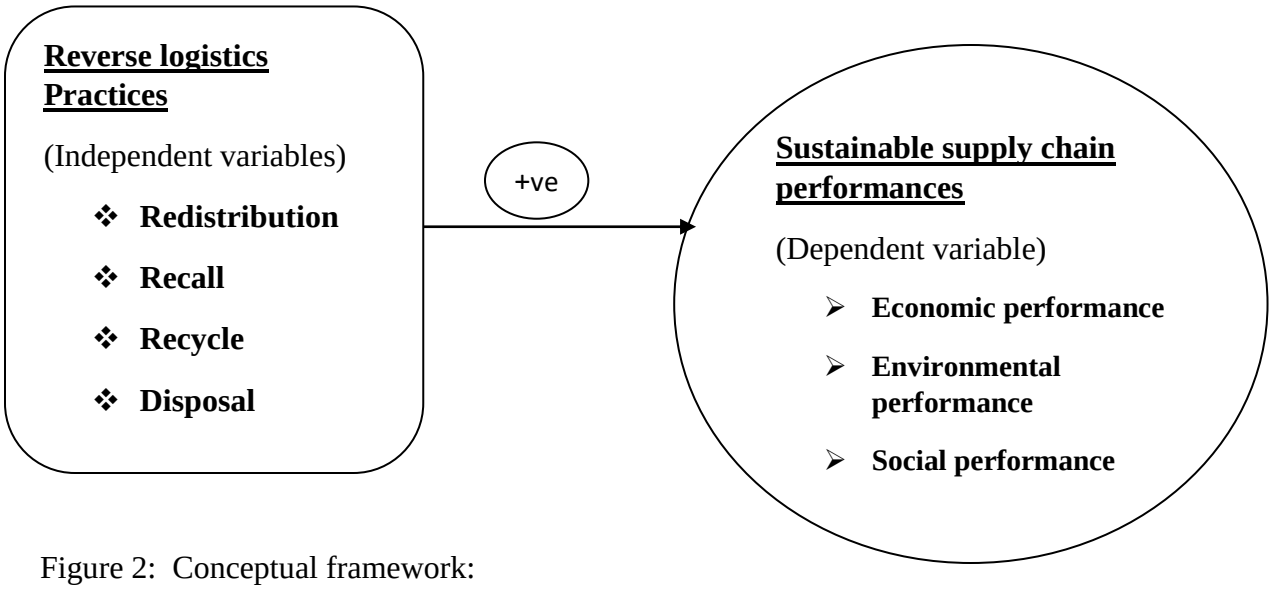


Figure 2: Conceptual framework:

Source: Adopted from (Mogaka, 2015) with modification by researcher.

CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1. Description of the Study Area

The Ethiopian Pharmaceuticals Supply Service (EPSS) was founded by Proclamation number 553/2007 with the goal of providing public health facilities with affordable, high-quality pharmaceuticals in a sustainable way. In doing so, the service is acquiring Pharmaceuticals through procurement from local and international sources and donations from different donors and developmental partners. EPSS's responsibilities have grown significantly since its establishment in 2007 including an estimated ten-fold increase in the volume and value of products procured and donations received in kind from developmental partners. However, in the performance of its obligations, EPSS is challenged by many constraints; one of which is the accumulation of expired and damaged pharmaceuticals for longer periods of time which is mainly due to lake of well-established reverse logistics systems.

By 2030, the Ethiopian Pharmaceuticals Supply Agency (EPSA) wants to be the most responsive and effective pharmaceutical supply chain organization in Africa. It has made great strides in this direction. The Agency has given its share of contributions to the advancements in the management of both communicable and non-communicable diseases in the health sector. Even while the Agency has supported the quick growth of healthcare services in Ethiopia, issues have also come with rapid expansion. The widespread expansion of hospitals and healthcare facilities over the next ten years also suggests that demand growth will continue in the foreseeable future.

This study conducted in all EPSS branches having disposal firms namely Adama, Hawasa, Jigjiga, Jimma, Nekemte, Bhirdar, Desses, and Mekele branches including head office. Moreover, due to holding high volume of stock and high transaction these branches selected for this study.

3.2 Research approach

This study used a mixed-method approach that used qualitative and quantitative methodologies as its overarching framework for directing the gathering of data, conducting analyses, and interpreting the results. This method evaluates various forms of data presented in an objective manner while ensuring the triangulation and validation of information collected from all actors during the data collection process. By including discussion and narratives, the mixed methods study methodology broadens the picture by boosting the depth and insight provided by the data (O'Leary, 2010).

3.3 Research design

In order to evaluate the implementation status and challenges of pharmaceutical reverse logistics, the research methodology was descriptive, explanatory, and implemented by an organizational-based cross-sectional survey supported by a qualitative study in selected EPSS branches, including the head office. The qualitative study involves an open-ended questionnaire, document review, and site observation while the quantitative study was conduct by using a semi-structured self-administered questionnaire.

3.4 Study population and sampling

3.4.1 Study population

The target population of the study was all health professional namely Pharmacy professionals, Biomedical professionals, laboratory professionals and other health science professionals in selected EPSS branches including head office with total number of 385. In order to understand and react to research questions on the performance assessment of EPSS reverse logistics practices, the researcher believed that these people had the necessary knowledge.

3.4.2 Sample Size

Sample taken from each selected branches and head offices based on multistage sampling technique therefore, all technical staff in selected branches had chance of being selected as respondents according to their proportion in their respective branch. This is because we do have the list of the respondents. Therefore, it is suitable in this research estimation of sample size by using Krejcie and Morgan method.

Krejcie and Morgan (1970) used the following formula to determine sampling size:

Formula for determining sample size

$$s = X^2NP(1-P) \div d^2(N-1) + X^2P(1-P)$$

s = required sample size.

X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).

N = the population size.

P = the population proportion (assumed to be .50 since this would provide the maximum sample size).

d = the degree of accuracy expressed as a proportion (.05).

Source: Krejcie & Morgan, 1970

Table 2 Krejcie and Morgan table

N	S	N	S	N	S
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

For the sample size decision, this study used table of Krejcie and Morgan, from the table 2 above reading a total population of 385 had representative sample of 191. To get the sample proportion from each branch the following formula were implemented P= (Sx100) N where p (proportion), s (number of sample size), and N (total population number). Therefore, (191 x100)/385 = 50% based on the sample proportion formula 50% of sample from each selected branch was taken for the total sample of 191.

3.4.3 Sampling Frame

The sampling frame of the research was all EPSS branches having disposal center namely Adama, Hawasa, Jigjiga , Jimma, Nekemte, Bhirdar Mekele and Desses branches including head office due to holding high volume of stock .

3.4.4 Sampling Technique

Each selected EPSS branches including head office had proportional number of respondents with respect to the number of total technical staff available. The total sample from each branch determined using the proportionate stratified sample for each branch as follows. After determining the number of sample for each branches, study participants randomly selected from each branches based on their proportion.

Table 3. Sample taken from each EPSS selected branches

S.N	Head office	Size of the stratum	Proportion	Sample
1	Head office	137	50%	68
2	Bahir Dar EPSS Branch	39	50%	19
3	Hawasa EPSS Branch	44	50%	22
4	Nekemte EPSS Branch	34	50%	17
5	Adama EPSS Branch	38	50%	19
6	Desse EPSS Branch	39	50%	19
7	Jimma EPSS Branch	35	50%	17
8	Jijiga EPSS branch	19	50%	10
	Total	**385**		**191**

N.B Due to instability in the Tigray region the investigator not found the exact number of employees for mekele EPSS branch so the condition enforced to exclude it from the study population.

3.5 Source of Data

The study used both qualitative and quantitative data types while carrying out this investigation. Additionally, primary and secondary sources used.

3.5.1 Primary Data

Primary data was gather by distributing structured and self-administered questions to Health professional staff of selected EPSS branches including the head office. Questioners tested before the actual data collection.

3.5.2 Secondary Data

The secondary data collected from different sources like publications, HCMIS/vitas, EPSS annual reports manuals, and SOPs.

3.6 Data collection procedure

The data for the study collected from the eight EPSS selected branches including the head office based on their portion. The data collection handled by the investigator himself. That is questionnaire after taking preliminary tests distributed through email for those branches far from Addis Ababa and drop and pick method to respondents and later the researcher collects the responses for central EPSS. Secondary data collected from different source such as annual reports, IT data bases (HCMIS) and observations aggregated according to four study areas namely pharmaceutical redistribution practices, recalling practices, recycling pharmaceutical packaging materials and disposal practices and finally used for triangulation in this study.

3.7 Data Analysis

The SPSS Version 25.0 software package used to process the quantitative data collected since it saves time and reduces the workload for the researcher. Before analyzing the data, other important activities such as questionnaire review, editing, coding, transcription, data cleaning, and statistical adjustment carried out.

The primary features of the sample presented using descriptive statistics, which include frequencies, percentages, means, standard deviations, and their connections among the major variables. Additionally, multiple regression and correlation analysis utilized to determine the relationship between the utilization of reverse logistics and the effectiveness of the EPSS sustainable supply chain. Moreover, Reverse logistics practices (redistribution, recall, recycling and disposal) were regressed against the sustainable supply chain (Economical, social, and environmental) performance of EPSS.

3.8 Validity and Reliability test

3.8.1 Validity

To test the validity of measuring instruments of this study Pilot test carried out. Ten respondents was involved for the pilot test. They selected randomly from the professional staff of EPSS. By doing so the researcher could understood whether the questionnaire is understandable by the respondent or not. Moreover, based on feedbacks the questionnaire modified accordingly.

3.8.2 Reliability

Cronbach's alpha used to assess the instrument's reliability. Sekaran (2005) states that an instrument has low reliability (and is therefore susceptible to error) if Cronbach's alpha is less than 0.6. If the instrument's alpha value is greater than 0.7, it is suitable. As a result, the internal consistency of data collecting instrument's items evaluated in this study using Cronbach's alpha approach is acceptable. The reliability of the items created for respondents assessed, by considering the aforementioned literature.

Table 4 *Cronbach's alpha for each independent and dependent variable*

Variables	Cronbach's Alpha	No of Items	Respondents
Redistribution	0.815	5	30
Recall	0.716	4	30
Recycling	0.761	3	30
Disposal	0.740	5	30
Challenge	0702	6	30
Economic performance	0.944	5	30
Environmental Performance	0.747	5	30
Social Performance)	0.761	5	30

Model specification

The study has dependent and independent variables. The dependent variable is sustainable supply chain performance of EPSS, whereas the independent variables are, Redistribution of useable pharmaceuticals between EPSS branches, Recall quality defect pharmaceuticals from EPSS Costumers, Recycling pharmaceutical packaging materials, and Disposal of unusable pharmaceuticals.

The followings described in formula to show the dependent and independent variables. General Function:

$Y = \beta o + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + £$

Where, Y is the dependent variables X1,X2, X3, and X4 are independent variables, βo is constant

3.9 Ethical consideration

For facilitating the study, EPSS received an official letter from the Department of Logistics and Supply Chain Management at Addis Abeba University School of Commerce. Before collecting any data, study participants gave their verbal and written consent. Participants in the study explicitly told that they could stop participating in it whenever they needed to. This thesis includes a thorough evaluation of all relevant literature as well as accurate citations for all sources and materials used. Each respondent's right to decline or respond to some or all questions respected. For reasons of confidentiality, study participants' names are not included in the study report

CHAPTER FOUR

4. RESULT, INTERPRETATION, AND DISCUSTION

4.1 Introduction

This study investigates the extent of adoption of reverse logistics, challenges and role in sustainable supply chain performance: the case of Ethiopian pharmaceutical supply service. The outcomes of the data analyses presented in this chapter along with their interpretations. The analyses under descriptive and inferential analysis compiled. The demographic profile of the respondents described by descriptive statistics, which also analyses the responses to each attribute. While scale reliability tests, correlations, and multiple regression analyses of the topic are included in inferential statistics.

The two components of the self-administered questionnaire data thoroughly analyzed in the results. The respondents' personal details, including gender, education level, length of employment, and current position, are in the first section. Reverse logistics practices (Redistribution, Recall, Recycling, and Disposal), Sustainable Supply Chain performance (Economic performance measures, Environmental performance measures, and Social performance measures), and challenges to reverse logistics practice are all covered in the second section of the study. 191 questionnaires were issued, and 183 of them were filled out and returned, making up 95.8% of the total. However, 183 surveys were valid and acceptable for statistical analysis after missing data and other inconsistencies cleaned out of the gathered questionnaires. In order to make the gathered responses suitable for the suggested method of data analysis, they encoded in SPSS 25.0 and underwent coding and error correction. Following the completion of the preparation necessary analysis was performed, and the outcomes shown below. Missing data frequently happens when a respondent is unable to answer one or more survey items (Hair, 1998). He claims that mean substitution, which replaces missing values for a variable with the mean value based on all valid responses, is a widely used technique for replacing missing data. In this instance, a response excluded from further processing if there are more than one percent (1%) missing

values on a single item. The main technique utilized in this study was mean substitution to replace missing values due to the low percentages of missing values taken into account.

4.2 Demographic characteristics of the respondents

This section provides details on the respondents' demographic attributes, including gender, educational attainment, employment history, and current position, as shown in table 5 below.

Table 5: Demographic characteristics of the respondents

Demographic profile N=183	**Items**	**Frequency**	**Percentage**
Gender	Male	143	78.1
	Female	40	21.9
Level of Education	Diploma	10	5.5
	First Degree	109	59.6
	Second degree and above	64	35.0
Duration of Employment at EPSS	Less than 2 years	13	7.1
	3-5 years	100	54.6
	6-10 years	19	10.4
	More than 10 years	51	27.9
Current position in EPSS	Warehouse Manager	18	9.8
	Officer	97	53.0
	Team leader	35	19.1
	Director/Branch manager	17	9.3
	Supply chain Advisers	16	8.7

Survey result 2023

4.2.1 Gender

In terms of the respondents' gender distribution, Table 5's findings indicate that men made up the majority of the sample (78.1%), while women made up the remaining 21.9%. Males made up more than half of the responders.

4.2.2 Level of Education

The researcher was likewise interested to determine the respondents' educational background. based on the results shown in the table 5. Only 5.5% of respondents had a diploma educational level, while 59.60% of respondents only had a first-degree education. Of the others, 35.0% had a second degree or higher. According to the data, the majority of the employees were highly educated.

4.2.3 Duration of Employment

The researcher was also curious about the respondents' employment history in this investigation. According to Table 5, there were 100 respondents, or 54.6% of the total, who had worked for between three and five years, 51 respondents, or 27.9% of the total, who had worked for more than ten years, and 19 respondents, or 10.4% of the total, who had worked for between six and ten years. The results demonstrate that most respondents have more than three years of relevant job experience, demonstrating that most respondents are familiar with how EPSS operates.

4.2.4 Current position In EPSS

The researcher was also interested to know the current position of the respondents in EPSS**.** From the results indicated in table 5, 53.0% of the respondents were officers, 19.1% were team leader, 9.8 % warehouse manager, 9.3 % were director/ branch managers and only 8.7 % of the respondents were supply chain advisor. Therefore, the findings showed that the majority of the respondents were officers.

4.3 Duration of establishment of reverse logistics practices in EPSS

From the options listed in table 6 below, respondents asked to select the number of years their companies have been using reverse logistics practices. 54.6% of respondents said that

EPSS had only been using reverse logistics practices for the last three years, while 35.5% said that EPSS had been using them for the previous four to six years. This suggests that the business has acknowledged the value of putting policies in place to deal with reverse logistics.

Table 6: Duration of establishment of reverse logistics practices in EPSS

Duration of establishment of RL practices N=183	Frequent	Percentage
Not yet	17	9.3
Up to 3 years	100	54.6
4-6years	65	35.5
More than 6 years	1	.5

Survey result 2023

4.4. Reverse logistics practices at EPSS

The goal of the study was to determine how widely reverse logistics practices were used in EPSS. Respondents asked to describe the extent to which they had adopted indicators for practices related to reverse logistics, such as redistribution, recall, recycling, and disposal. The degree of acceptance of these indicators' components was rated on a 5-point Likert scale, with 1 denoting "no extent," 2 denoting "small extent," 3 denoting "moderate extent," 4 denoting "great extent," and 5 denoting "very great extent." According to Alfarra (2006), the range is calculated by (5-1=4) and then divided by five because it is the highest value of the scale (4/5=0.80), in order to find the lowest and maximum length of a five-point Likert-type scale. The first value on the scale, which is the least, added to determine the cell's maximum. From 1 to 1.80 denotes extremely weak practice, from 1.81 to 2.60 weak practice, from 2.61 to 3.4 moderate practice, from 3.41 to 4.2 strongly practiced, and from 4.21 to 5.00 very highly practiced.

4.4.1 Redistribution reverse logistics practices in EPSS

The study's initial step was to assess how widely redistribution reverse logistics practices had been used. The results, which are shown in Table 7 below, demonstrated that the Ethiopian pharmaceutical supply service has adopted redistribution as a reverse logistics

practice to a clear and measurable extent, as seen by its weighted mean of 2.89. Respondents found to be familiar with reporting on how much money made or saved by redistributing medications, with a moderate mean of 2.67. Likewise, they indicated that adoption of redistributes overstocked pharmaceutical products between EPSS hubs was relatively prominent given its mean of 3.24. Moreover, as per study participants responded, redistributes slow-moving pharmaceutical products between EPSS hubs with a mean of 2.93, and redistributes near-expiry pharmaceutical products between EPSS hubs given its mean of 3.08. Lastly, respondents confirmed that having a well-documented policy and procedure for the redistribution of over stocked/slow-moving and near-expiry pharmaceutical products given its mean of 2.56.

Table 7: Extent of adoption of redistribution reverse logistics practice in EPSS

Indicators N=183	Mean	Std. Deviation
EPSS has a well-documented policy and procedure for the redistribution of over stocked/slow-moving and near-expiry pharmaceutical products.	2.56	0.97
EPSS redistributes overstocked pharmaceutical products between EPSS hubs	3.24	0.81
EPSS redistributes slow-moving pharmaceutical products between EPSS hubs.	2.93	0.81
EPSS redistributes near-expiry pharmaceutical products between EPSS hubs	3.08	0.92
EPSS do report on how much cost saved/revenue generated by doing redistribution.	2.67	0.95
Grand Total	2.89	

Survey result 2023

From the finding, we can conclude that the mean score of redistributed near expiry pharmaceuticals, redistributed overstocked pharmaceuticals, redistribution of near expiry pharmaceuticals, and EPSS do report on how much cost saved or revenue generated by doing redistribution are between the ranges of 2.61 to 3.4, so they practiced moderately. On the other hand, EPSS weakly practiced a well-documented policy and procedure for the redistribution of over stocked/slow-moving and near expiry pharmaceutical products with a mean of 2.56. When we looked at over all EPSS pharmaceutical redistribution, it moderately practiced with a grand mean of 2.89. Furthermore, this finding also evidenced by the

Ethiopian pharmaceutical supply service annual reports of 2013, and 2014 E.C as stated in table 8 below.

Table 8: Pharmaceutical redistribution report in EPSS

Year in E.C	Number of the line of items	Amount in Birr
2013	1038	126,051,318.14
2014	285	97,237,662.06
	Total	223,288,980.2

Source: EPSS Annual reports (2013 and 2014 E.C)

According to the reports, the Ethiopian pharmaceutical supply service redistributes overstocked, slow moving, and near expiry pharmaceuticals between EPSS hubs after inventory analysis done saved 223,288,980.2 birr of pharmaceuticals from being expired.

In this two fiscal years vital and essential pharmaceuticals availability increased by 16.47% (from 64.57 % by the year 2013 to 81% by the year 2014) in the Revolving Drug Fund program (RDF), and by 19.1% (from 72.9%by the year 2013 to 94% by the year 2014E.C) in the health program according to the reports. Moreover, the wastage rate of Pharmaceuticals decreased from 2.32% by the year 2013 to 0.74% by the year 2014 E.C.

From the above survey results and document reviewed, the researcher conclude that redistribution of pharmaceuticals in EPSS played a significant role in pharmaceutical product availability increment, and reduction of pharmaceuticals wastage, in addition to other contributing factors.

4.4.2 Recall reverse logistics practices at EPSS

As specified in table 9 below**,** the results showed that the extent of recall of pharmaceutical products that have quality defect that detected by regulatory bodies (EFDA) or manufacturers practiced by Ethiopian pharmaceutical supply service are measurable as indicated by its weighted mean of 2.67. Respondents found to be aware of having a well-documented policy and procedure to recall pharmaceutical products that have safety issues or defects. Likewise, pharmaceuticals products with safety issues or defects detected by the authorized body (EFDA) or manufacturers recalled on time was relatively prominent. In

addition, this indicator is highly practiced in EPSS with the mean of 3.42. As well as respondents acknowledged that hubs/head office of EPSS has received reimbursement for the reversed product in kind/ cash (only for recalled products) from manufacturers, and also EPSS hubs/head office return recalled pharmaceutical items with safety issues or defects to the respective suppliers, and manufacturer are weakly practiced with the mean of 2.37 and 2.36 respectively. When we look at the overall recalling pharmaceutical, which have quality defect practiced moderately in Ethiopian pharmaceutical supply service with a grand mean of 2.67

Table 9: Extent of Adoption of Recall Reverse Logistics Practice in EPSS

Indicators N=183	Mean	Std. Deviation
EPSS has a well-documented policy and procedure to recall pharmaceutical products that have safety issues or defects	2.56	1.051
EPSS hubs/head office return recalled pharmaceutical items with safety issues or defects to the respective suppliers, and manufacturer	2.37	1.116
EPSS hubs/head office has received reimbursement for the reversed product in kind/ cash (only for recalled products)	2.36	1.064
EPSS recalls pharmaceuticals with safety issues or defects detected by the authorized body (EFDA) or manufacturers on time.	3.42	1.116
Grand mean	2.67	

Survey result 2023

4.4.3 Recycling reverse logistics practices at EPSS

The survey's findings demonstrated in table 10 that recycling pharmaceutical packaging materials is not as widely adopted as may be inferred from its overall mean ranking of 1.62. When we look at recycling practices, recyclable packaging materials like cartoons, pallets, and plastics transferred to recyclers to be recycled weakly practiced with mean value of 1.7. Additionally, EPSS weakly implement policies and procedures for recycling packaging paper (cartoons), pallets, containers, metals, glass, and plastics, as well as reporting on the amount of money saved or revenue earned by recycling with means of 1.51 and 1.66, respectively.

Table 10: Extent of Adoption of Recycling Reverse Logistics Practice

Indicators N=183	Mean	Std. Deviation
EPSS has a well-documented policy and procedure to recycle packaging paper (cartoons), pallets, containers, metals, glass, and plastics	1.51	0.824
EPSS recycles or transfer to other parties' the recyclable packaging materials like cartoons, pallets, containers, metals, glass, and plastics to be recycled.	1.70	0.915
EPSS do a Report on how much cost saved/revenue generated by recycling.	1.66	0.822
Grand Mean	1.62	

Survey result 2023

As per investigator's observation at the Ethiopian pharmaceutical supply service head office recyclable pharmaceutical packaging materials, cartons, pallets, and plastics collected at one site as indicated in finger 3 below and transferred to recyclers by open tender. There for these materials used as a row materials for remanufacturing of other new or similar Martials. Beside, this reverse logistics practice serve as source of income for EPSS.

Figure 3: Recyclable pharmaceutical packaging materials at central warehouse of EPSS

Source: Pictures taken by the investigator on 3/15/2023, 11:59 AM organizational visit.

4.4.4 Disposal reverse logistics practices at EPSS

Finally, this study sought to determine the degree to which components of reverse logistics practices concerning disposal had been adopted. The results shown in Table 11 below using the Likert scale to rate indications of disposal. The results showed that the extent of adoption of disposal of unusable pharmaceuticals is weakly practiced with overall mean ranking of 2.52. When we look at each indicator one by one, uses standardized guild lines and SOPs for disposing of unusable pharmaceuticals, and moderately practiced with mean ranking of 3.25. On the other hand, uses appropriate technologies and equipment for the disposal of unusable pharmaceuticals, EPSS uses Sewer method, Incineration method, and landfill method for disposal of unusable pharmaceuticals weakly practiced with mean values of 2.56, 1.78, 2.75 and 2.28 respectively.

Table 11: Extent of Adoption of disposal unused pharmaceuticals in EPSS.

Indicators N=183	Mean	Std. Deviation
EPSS uses standardized guild lines and SOPs for disposing of unusable pharmaceuticals.	3.25	1.10
EPSS uses appropriate technology and equipment for the disposal of unusable pharmaceuticals.	2.56	0.95
EPSS uses the Sewer method for the disposal of unusable pharmaceuticals.	1.78	0.95
EPSS uses the Incineration method for the disposal of unusable pharmaceuticals.	2.75	1.11
EPSS uses the landfill method for the disposal of unusable pharmaceuticals.	2.28	1.23
Grand Mean	2.52	

Survey result 2023

The extent of adoption of unusable pharmaceutical disposal practices in Ethiopian pharmaceutical supply service mention by the respondents of this survey supported by document review. According to the reviewed documents of EPSS unusable pharmaceutical disposal reports of HCMIS/Vitas, for the past five years (from 2010 - 2014, E.C), a total of 2,089,732,045.31-birr unusable pharmaceuticals were disposed of from the Ethiopian pharmaceutical supply service (EPSS) central warehouse only as indicated in the finger 4

below. Of which unusable pharmaceuticals disposed in the last five years, 1,646,771,993-birr unusable pharmaceuticals disposed by the year 2014 E.C, were unusable pharmaceuticals stored for a longer time in EPSS central warehouses.

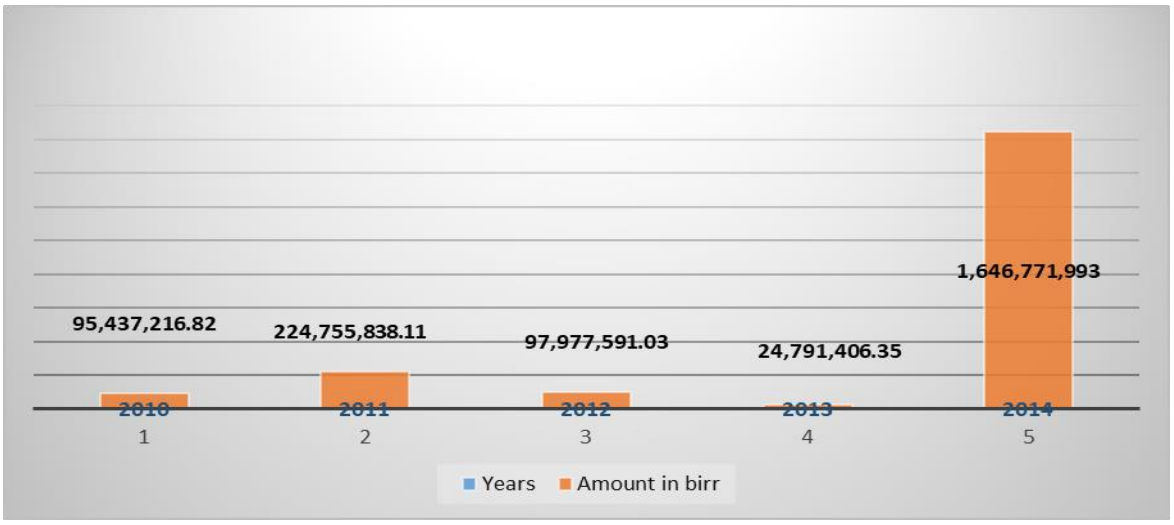


Figure 4: Disposed pharmaceuticals at the central warehouse from 2010-2014 E.C

Source: EPSS HCMIS/vitas

When we look at EPSS's infrastructure and technologies used for disposal of unusable pharmaceuticals, the Ethiopian pharmaceutical supply service (EPSS) and Ministry of Health with the help of global funds currently constructed 8 incinerators at Adama, Bahirdar, Desses, Nekemte, Jimma, Jijjiga, Hawassa, and Mekele sites as stated on the project agreement between MOH and UNOPs dated on 27,Dec,2017. The type of incinerators are diesel-fired, dual chamber, fully automated, continuous feeding, and equipped with heat exchangers and air pollution control systems as stated in their specification.

As investigator of this study field observation on two sites indicated in figure 5 below, namely Adama incinerator firm and Hawassa incnaretore firm, the sites infrastructure and incinerator installation completed. Moreover, the site are currently under operation, with some limitations and challenges like operating cost, skilled manpower, unable to burn some dosage forms of pharmaceutical's like glass vials and bottles, and products with aluminum foils .

Figure 5: Hawassa incinerator firm.

Source: Picture taken by Shiferaw Bekele 4/23/2023

4.5 Challenges of reverse logistics practices in EPSS.

This study aimed to identify the challenges EPSS encountered when using reverse logistics practices. The major challenges in the implementation of reverse logistics in EPSS were rated on a Likert scale of 1 to 5, with 1 representing "not at all," 2 representing "to a small extent," 3 representing "to a moderate extent," 4 representing "to a large extent," and 5 meaning "to a very large extent." The outcomes shown in Table 12 below.

When looking at problems or challenges faced in implementing reverse logistics in EPSS context the survey results presented in table 12 below. The technological challenges like, lack of appropriate technology with a mean value of 3.74, and Infrastructure challenges, like lack of appropriate infrastructure with mean value of 3.75 have high influence on implanting reverse logistics practice in EPSS. Moreover, regulatory challenges like, lack of definite rules and regulations on handling returned products with a mean value of 3.48, and Retailer/supplier, manufacturer conflict on condition of item or value on return or timeliness of response with a mean value of 3.51 also have high influence in implementing reverse logistics practices in EPSS.

On the other hand, reverse logistics operational costs and lack of top management commitment are moderately influence on implementing reverse logistics management system in Ethiopian pharmaceutical supply service with mean score of 3.32 and 3.19 respectively.

Table 12: Challenges of reverse logistics practices in EPSS

Indicators N=183	Mean	Std. Deviation
lack of appropriate technology is a challenge in implementing reverse logistics practices in EPSS	3.74	.892
lack of appropriate infrastructure is a challenge in implementing reverse logistics practices in EPSS	3.75	.885
lack of definite rules and regulations on handling returned products is a challenge in implementing reverse logistics practices in EPSS	3.48	1.099
Retailer/supplier, manufacturer conflict i.e. on condition of item or value on return or timeliness of response is a challenge in implementing reverse logistics practices in EPSS	3.51	.966
Reverse logistics operating cost is a challenge in implementing reverse logistics practices in EPSS	3.32	.966
Lack of top management commitment is a challenge in implementing reverse logistics practices in EPSS	3.19	1.223
Grand mean	3.50	

Source: survey result 2023

A study conducted in different hospitals in Addis Ababa by Zerihun, (2021) revealed similar challenges like a lack of awareness of reverse logistics, not well-specifying policies and guidelines, and limitations with technology. Similarly, a study done by Rediet (2016) in the pharmaceutical manufacturing industry also revealed similar findings to this study.

4.6 Relationship between reverse logistics practices and sustainable supply chain performance.

According to The Un compact working group (2010) publication, "the objective of supply chain sustainability is to create, protect, and grow long-term environmental, social, and economic value for all stockholders involved in bringing products and services to market." As a result, this study attempted to examine the relationship between reverse logistics practice and EPSS's performance on these three sustainability dimensions.

Respondents were asked to rate the indicators of EPSS's sustainable supply chain performance (economic, environmental, and social performance) as well as the degree to which reverse logistics practices (redistribution, recall, recycling, and disposal) were used. The most popular technique for determining the strength and direction of relationships between and among variables, Pearson correlation analysis, utilized by the researcher in this section to try to achieve the study's objective.

4.6.1 Correlation analysis between Pharmaceutical reverse logistics practice and sustainable supply chain performance of EPSS.

To effectively measure, the relationship between sustainable supply chain performance of EPSS (Economic, environmental and social performance) and each reverse logistics practices (redistribution, recall, recycling and disposal). On both variables, Pearson correlation analysis performed at the 0.05 and 0.01 levels. Table 13 below provides a summary of the correlation tests.

According to Marczyk, Deematt, and Fesingeeerr (2005), correlations between 0.01 and 0.30 regarded as weak correlations, 0.30 and 0.70 as moderate correlations, 0.70 and 0.90 as strong correlations, and 0.90 and 1.00 as extremely strong correlations. As a result, there is a significant correlation (r=0.770) between the performance of the EPSS sustainable supply chain and its reverse logistics practices.

There is moderate and positive linear relationship between reverse logistics practices of pharmaceuticals (with redistribution, r=0.589, p value=0.000; with recall; r=0.623, p value=0.000 and with recycling; r=0.636, p value=0.000) and Economic performance of EPSS, while disposal has weak correlation (disposal; r=0.255, p value=0.000). Therefore, as

reverse logistics practices (redistribution, recall and recycling) of Pharmaceuticals increases, Economic performance increases as well and when reverse logistics practices (redistribution, recall and recycling) decreases, Economic performance of EPSS likewise decrease. Similar to Mogaka (2014), who examined the impact of reverse logistics practices on pharmaceutical firms' performance in Nairobi, reverse logistics practices and financial performance strongly correlated, with a correlation coefficient of 0.709, and market performance correlated with a correlation coefficient of 0.751..

There is a moderate and positive linear relationship between reverse logistics practices (with redistribution, r=0.472, p value=0.000; with disposal; r=0.369, p value=0.000, with recall; r=0.509, p value=0.000 with recycling; r=0.529, p value=0.000; and) and social dimension of sustainability of EPSS. Therefore, as reverse logistics practices (redistribution, recall, recycling and disposal) increases, social performance increases as well and when reverse logistics practices (redistribution, recall, recycling and disposal) decreases, social performance likewise decrease.

There is a Moderate and positive linear relationship between reverse logistics practices of pharmaceuticals (with redistribution, r=0.541, p value=0.000; with recall; r=0.580, p value=0.000 with recycling; r=0.597,p value=0.000, with disposal; r=0.306, p value=0.000) and Environmental performance of EPSS. Therefore, as reverse logistics practices (redistribution, recall, recycling and disposal) increases, Environmental performance increases as well and when reverse logistics practices (redistribution, recall, recycling and disposal) decreases, Environmental performance likewise decrease.

The aforementioned findings suggested that EPSS's pharmaceutical reverse logistic practices have a strong and positive relationship with the company's sustainable supply chain performance, with medium Pearson correlation coefficients. Since the correlation coefficient is close to one, this suggests that changes in one variable correlated with changes in the other.

Table 13: Correlation summary between sustainable supply chain performance and reverse logistics practices.

Correlations

		Redistribution	Recall	Recycling	Disposal	Economic performance measures	Social performance measures	Environmental performance measures	Reverse logistics practice	Sustainable supply chain performance
Redistribution	Pearson Correlation	1								
	Sig. (2-tailed)									
Recall	Pearson Correlation	.643**	1							
	Sig. (2-tailed)	0								
Recycling	Pearson Correlation	.603**	.604**	1						
	Sig. (2-tailed)	0	0							
Disposal	Pearson Correlation	0.074	0.145	.156*	1					
	Sig. (2-tailed)	0.318	0.05	0.035						
Economic performance measures	Pearson Correlation	.589**	.623**	.636**	.255**	1				
	Sig. (2-tailed)	0	0	0	0					
Social performance measures	Pearson Correlation	.472**	.509**	.529**	.369**	.616**	1			
	Sig. (2-tailed)	0	0	0	0	0				
Environmental performance measures	Pearson Correlation	.541**	.580**	.597**	.306**	.779**	.737**	1		
	Sig. (2-tailed)	0	0	0	0	0	0			
Reverse logistics practice	Pearson Correlation	.791**	.820**	.827**	.469**	.725**	.647**	.698**	1	
	Sig. (2-tailed)	0	0	0	0	0	0	0		
Sustainable supply chain performance	Pearson Correlation	.597**	.638**	.656**	.342**	.898**	.864**	.933**	.770**	1
	Sig. (2-tailed)	0	0	0	0	0	0	0	0	

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).

Source: survey result 2023

4.6.2 Effect of reverse logistics practices on sustainable supply chain performance of EPSS

4.6.1 Multiple Regression Analysis Assumptions.

Regression analysis is a statistical method that evaluates the relationship between a dependent variable and a group of independent variables, according to Aron (1999). Regression used as part of a statistical model with assumptions for modelling causal connections, testing hypotheses, and making predictions. The effect of EPSS (pharmaceutical companies') use of reverse logistics on the effectiveness of sustainable supply chain investigated using multiple regression analysis. Before analyzing the test results, the multiple regression analysis the following assumptions made.

4.6.1.1 Normality Test

This study's normality test carried out utilizing the histogram, kurtosis, and skewness. The appropriate range for skewness and kurtosis, according to Barbara Tabachink & Fidel (2013), is below +1.5 and above -1.5. As a result, the analysis's findings indicated that all of the independent and dependent variables have skewness values less than +1.5: Redistribution, Recall, Recycling, Disposal, and sustainable supply chain performance. -0.256, -0.157, 0.360, -0.061, -0.286 respectively. In contrast, all of the variables' kurtosis ranges from -1.178 to -0.708. Therefore, the outcome clearly demonstrates that the normalcy assumption is valid for all independent and dependent variables. As seen in Table 14 below, all of the variables' kurtosis and skewness values fall within the allowed range.

Table 14: Normality test for dependent and independent variables

Statistics

		Redistribution	Recall	Recycling	Disposal	Sustainable supply chain performance
N	Valid	183	183	183	183	183
	Missing	0	0	0	0	0
Skewness		-.256	-.157	.360	-.061	-.286
Std. Error of Skewness		.180	.180	.180	.180	.180
Kurtosis		-.244	-.494	-1.178	-.813	-.708
Std. Error of Kurtosis		.357	.357	.357	.357	.357

Survey result of 2023

The dependent variable examined for normal distribution, which is the most crucial assumption in regression analysis. A histogram is a visual representation of how numerical data are distributed. Karl Pearson was the first to introduce it as an estimate of the probability distribution of a continuous variable (quantitative variable). The research dependent variable sustainable supply chain performance (Environmental performance measures, Social performance measures, and Economical performance measures) histogram gives a basic sense of whether data follows the assumption of normality.

There would be little use in undertaking regression analysis if the environmental performance measurements, social performance measures, and environmental performance measures were not normally distributed. The term "normality" refers to a symmetrical, bell-shaped curve with the highest frequency of scores located in the middle and lower frequencies located towards the extremes (Pallant, 2005).

In the next histogram result, there are a normal curve placed over and the black line ruled on the histogram symbolizes the bell-shaped and "normal" curve, it implied that there is no problem on the assumption of normality of frequencies. This showed that the regression model used in this research was suitably preferable or the model fitted very well as showed in Figure 6 below.

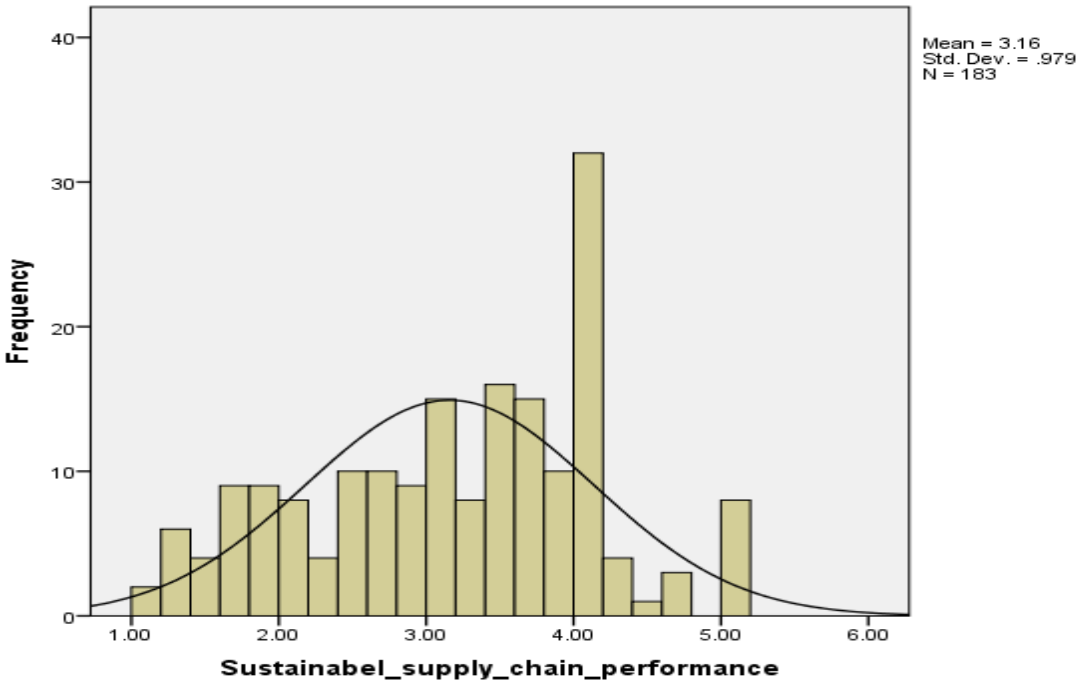


Figure 6: Histogram of Dependent variables

4.6.1.2 Multi Collinearity test

Collinearity, which refers to a relationship between two predictor variables, or multi-collinearity, which refers to a relationship between more than two predictor variables, is the presence of correlation between the predictors. Because no correlation coefficient value is more than 0.7 or 70%, this study has not encountered a multi collinearity problem. According to (Hair et al., 2010), the Pearson's correlation should not have a correlation coefficient between any two independent variables greater than 0.70. Table 13's highest coefficient is 0.640. Therefore, the study is free from multi collinearity on the basis of this premise. Additionally, as shown in table 15 below, the researcher examined multi collinearity with tolerance and Variance Inflation Factors (VIF). According to statistics, multi collinearity does not exist when the tolerance value ranges from = 0.1-1.0 and the VIF ranges from = 1 - 10.

Table 15: Multi collinearity test between dependent and independent variables

Coefficients[a]			
Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	Redistribution	0.513	1.95
	Recall	0.51	1.962
	Recycling	0.551	1.815
	Disposal	0.968	1.033
a. Dependent Variable: Sustainable supply chain performance			

The above coefficient table showed that there is no tolerance value below 0.1 and above 1.0 and there is no VIF value less than 1 and above 10. So that based on the assumption, in this research there is no multi-co linearity problem.

4.6.1.3 Homoscedasticity test

When there is homoscedasticity, all IV levels have the same level of error variance. When the error variance fluctuates at multiple IV levels, heteroscedasticity observed. Mild heteroscedasticity, according to (Tabachnick and Fidell, 2019), has little effect on significance testing. However, when heteroscedasticity is strong, it can seriously undermine the research and skew the findings, increasing the chance of a Type I error. The most common assumption is that the homoscedasticity errors have a known, constrained variance that is constant across all levels of the predictor variables. Another name for this premise is the homogeneity of variance assumption. Since the errors are independent, ordinary least squares estimates will be fair and stable, but they won't work if the errors have a variance that is constrained but not constant across different levels of the predictors, or if heteroscedasticity is present (Sanford Weisberg, 2005). Making a fitted value versus residual plot is the simplest technique to identify heteroscedasticity. “Cone” shape is a classical sign of heteroscedasticity. Therefore, the scatterplot below in Fig-7 have no cone shape

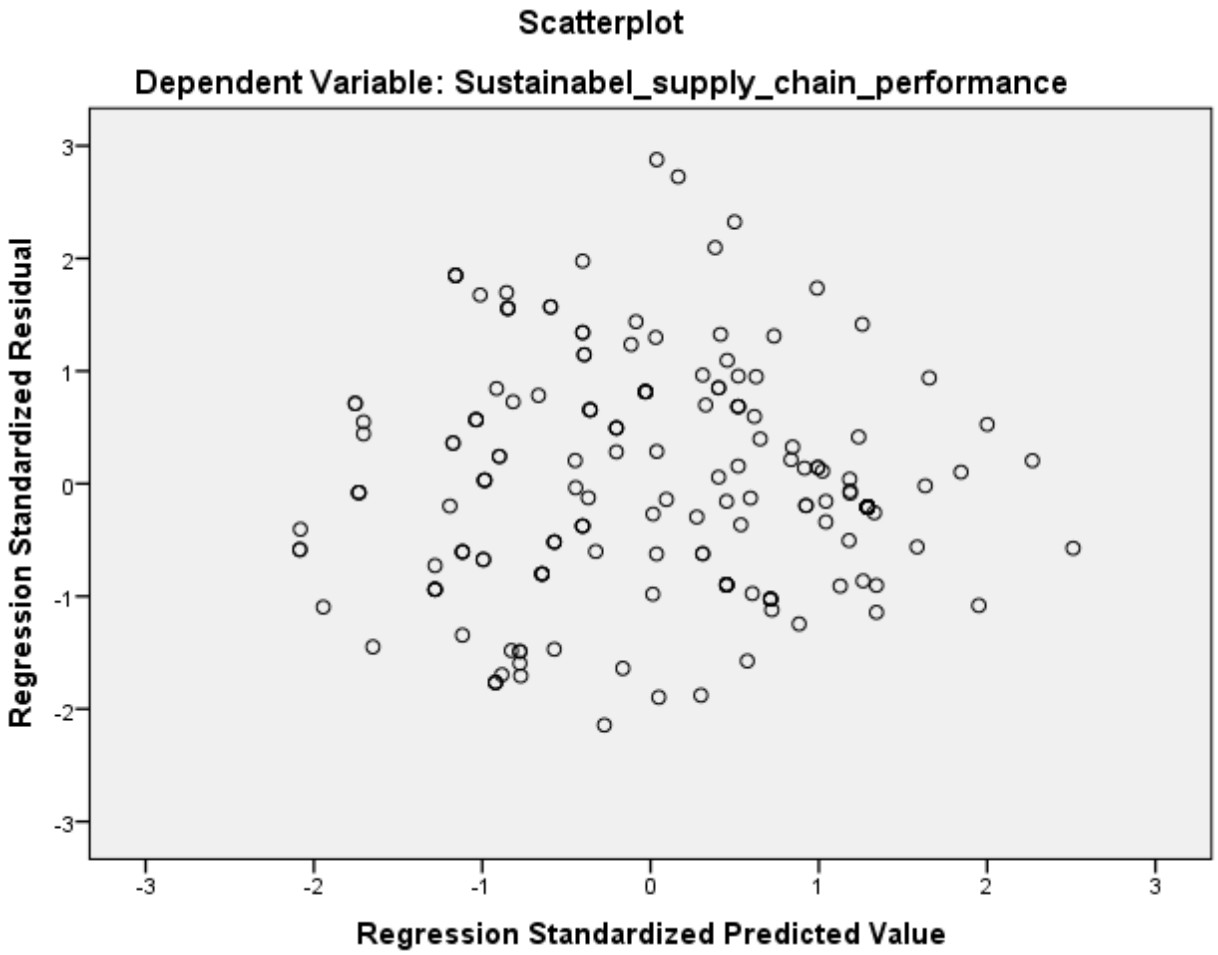


Figure 7: Scatter plot test of Homoscedasticity.

4.6.1.4 Linearity Assumptions

The following figures showed that the study's P-P plot and scatter plot result presented to test linearity assumption of this study. The term "linearity" refers to the straight-line representation of the correlation between two variables. It is critical to understand the degree of association between variables while analyzing data. In order to spot any deviations that can have an impact on the correlation, it is crucial to look at the relationships between the variables. In statistics, P-P plot, scatter plot and Pearson's correlations used to determine linearity (Tabachnick and Fidell, 2019). Figure 8 of the information below indicates that the assumption was true for this study, as shown by the Normal P-P Plots.

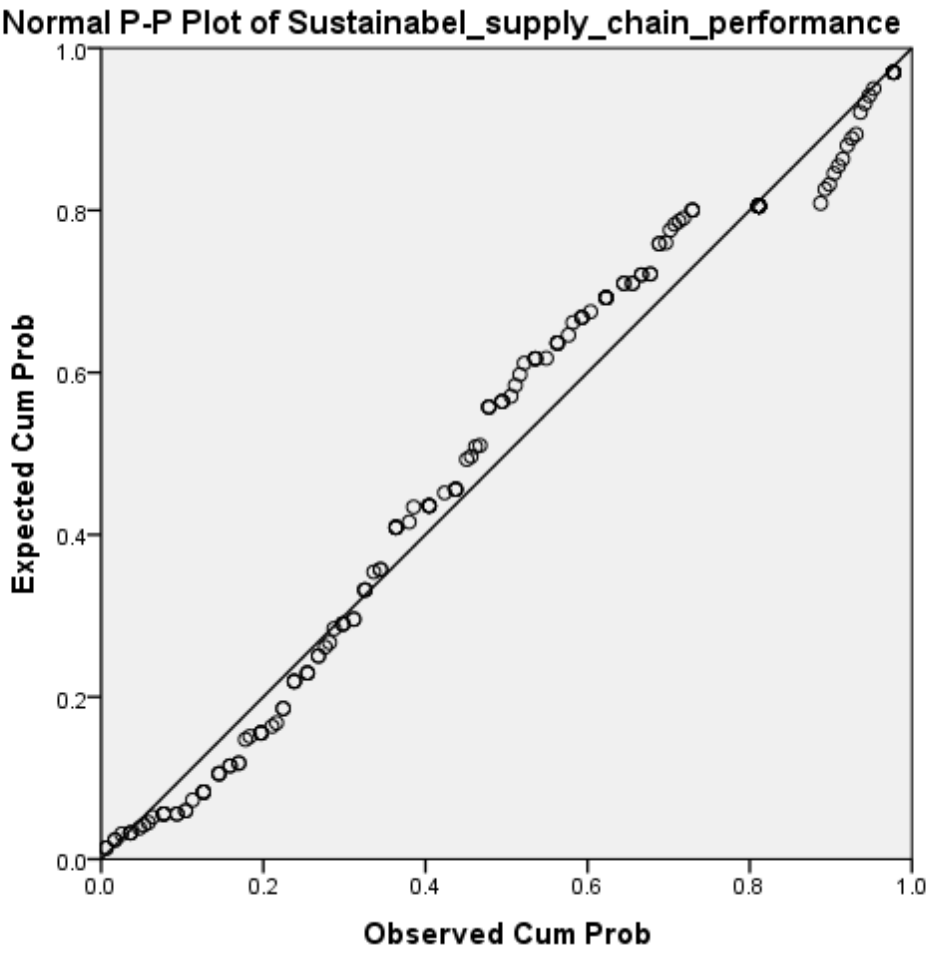


Figure 8: Normal P-P plots of dependent variables

In regression, if there is no outlier linearity assumption fulfilled. Regression relies on the assumption that variables related in a linear fashion (Berry and Feldman, 1985). Therefore, the regression has no outliers based on the P-P plot results discussed above; this suggests that linearity is strongly satisfied, as seen in Figure 8 above.

4.6.2 Regression Analysis on the effect of reverse logistics practices on sustainable supply chain performance of EPSS

Basically, the researcher used regression model to analyze the effect of independent variable Pharmaceutical reverse logistics practices (Redistribution, Recall, Recycling and Disposal) on dependent variable sustainable supply chain performance of EPSS . The study examined the R^2 result to test how much sustainable supply chain performance (Economic performance measures, Environmental performance measures and Social

performance measures) is explained by reverse logistics practices (Redistribution, Recall, Recycling and Disposal). According to Hair et al. (1988), R^2 (coefficient of determination) is a measure of how much of a dependent variable's variance around its mean is explained by independent or predictor variables. The coefficient of determination R^2, also known as the regression coefficient, assesses how strongly one dependent variable is correlated with one or more independent variables.

The regression model result in table 16 below showed that reverse logistics practices of pharmaceuticals (Redistribution, Recall, Recycling and Disposal) explained sustainable supply chain performance by 59.4% and the rest of 41.6 % explained by other factors that are not included in this study.

Table 16: Coefficient of Determination

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.771[a]	.594	.585	.63040

a. Predictors: (Constant), Disposal, Redistribution, Recycling, Recall

To show whether the regression model is significance better in explaining dependent variable sustainable supply chain performance ANOVA (An analysis of variance) is most appropriate by using the mean as the best predictor. From table 17 below analysis of variance (ANOVA) a significant result of F=65.2 at p value =0.000 clearly displayed reverse logistics practices (Redistribution, Recall, Recycling and Disposal) have a significant influence on sustainable supply chain performance. Statistically if the model value of $F>1$ and $p<0.05$, the model is fit to predict the effect of independent variables on dependent variable. For that reason, the multiple linear regression models are suitable to this research to predict the effects of reverse logistics practices to sustainable supply chain performance.

Table 17: F Test for the full model ANOVA

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	103.666	4	25.917	65.214	.000[b]
	Residual	70.739	178	.397		
	Total	174.405	182			

a. Dependent Variable: Sustainable supply chain performance

b. Predictors: (Constant), Disposal, Redistribution, Recycling, Recall

For the purpose of this study, Beta value used to show the contribution of each independent/predictor variables considered in the model reverse logistics practices (Redistribution, Recall, Recycling and Disposal) to sustainable supply chain performance of EPSS. In order to verify which of the predictors contributed to prediction of sustainable supply chain performance, the unstandardized regression coefficients or beta weights (ß) examined in the table below 18. The greater value of beta and less value of significance level ($p<.05$) of each independent variable shows the strongest contribution to dependent variable (Pallant, 2005).

A coefficient table that showed the degree of relationship between each independent variable under pharmaceutical reverse logistics practice with the constant seen in table 18 below. Therefore, sustainable supply chain performance with constant at (0.284) while Redistribution (0.202), Recall (0.257), Recycling(0.280) and Disposal (0.223) were statistically significant since all of them had ($p< 0.05$).

In the regression analysis using the coefficient of determination ($Y= Bo+B_1X_1+B_2X_2 +B_3X_3 +B_4X_4$) the researcher's findings are as follow; Bo= 0.284, B1= 0.202, B2= 0.257, B3= 0.280 and B4= 0.223. There for, $Y= 0.284+ 0.202X_1 + 0.257X_2 + 0.280X_3 + 0.223X_4$.

According to Table 18 below, recycling has the greatest Beta value (0.280) when compared to Redistribution, Recall and Disposal. As a result, it predictor variable contributes the most to the variance of the dependent variable (sustainable supply chain performance) . When the variance explained by all other predictor factors in the model is controlled,

recycling offers the strongest individual contributor to explain the variation of the dependent variable.

Table 18: Regression analysis output.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.284	.217		1.305	.194
	Redistribution	.202	.066	.205	3.077	.002
	Recall	.257	.063	.272	4.063	.000
	Recycling	.280	.054	.332	5.160	.000
	Disposal	.223	.046	.236	4.862	.000

a. Dependent Variable: Sustainable supply chain performance

4.7 Discussion of results and interpretation

In this section, the quantitative and qualitative results of the finding triangulated and discussed. The correlation and regression results between dependent variable (sustainable supply chain performance) and independent variables (redistribution, recall, recycling and disposal of pharmaceuticals) translated based on the context of Ethiopian pharmaceutical supply service. However, as far as the investigator reading goes, there is no similar empirical study on this regard. Similarly, Takanaz and his associates mentioned that; When RL examined in the context of GSCM, it analyzed as a single factor without taking into account how the various RL processes interacted with one another and without taking into account the numerous disposition alternatives and potential performance outcomes. Furthermore, it was evaluated in comparison to other GSCM approaches with a focus on the environmental performance and less on the contributions to the economic and social advantages. Additionally, RL in the context of sustainability and their connection have only been examined in a small number of research (Taknaz B., Jiangang F., Peggy C. (2019).Therefor, the result and interpretation of the finding presented below.

4.8.1 Hypothesis testing

Table 19: summary of hypothesis

Hypothesis	P-value	Remark
H1a: Redistribution practice has a significant positive effect on sustainable supply chain performance of EPSS.	0.002	H1a- accepted
H1b: Recall practice has a significant positive effect on sustainable supply chain performance of EPSS	0.000	H1b- accepted
H1c: Recycling practice has a significant positive effect on sustainable supply chain performance of EPSS	0.000	H1c-accepted
H1d: Disposal practice has a significant positive effect on sustainable supply chain performance of EPSS.	0.000	H1d-accepted

Question 1. To what extent redistribution of usable pharmaceuticals across EPSS branches affects sustainable supply chain performance of EPSS.

The objective of this question was to examine the effect of redistribution of usable pharmaceuticals across EPSS branches affects sustainable supply chain performance of EPSS. As per table, 15 demonstrated the regression between pharmaceutical reverse logistics practice and sustainable supply chain performance, the predictor (Pharmaceutical reverse logistics practice) is statically significant at (β= 0.202, P=0.002). Therefore, to this predictor, keeping others independent variables constant the beta value 0.202 indicates that, if there is a one-unit increase in redistribution of usable pharmaceuticals across EPSS hubs there will be 20.2% increase in sustainable supply chain performance of EPSS. Mogaka (2014), who examined the impact of reverse logistics practices on pharmaceutical firms' performance in Nairobi stated similar finding indicates that a unit increase in reuse RL

would lead to a 0.499 increase in financial performance while a unit increase in recycle RL would lead to a 0.042 decrease in financial performance. Similarly, Zhang Yu et al.,(2018) also support these results and revealed that financial and operational performance is improved by 11.5% and 12.1% respectively due to implementation of reverse logistics operation in pharmaceutical firm.

Question 2. To what extent recall of pharmaceuticals having quality defect from the customers affect sustainable supply chain performance of EPSS.

The objective of this question to examine the effect of recall of pharmaceuticals having quality defecate on sustainable supply chain performance of EPSS. As per stated in the table 15 above, the regression between recall of pharmaceutical reverse logistic practice and sustainable supply chain performance, the predictor (recall pharmaceutical having quality defect) statically significant at (β=0.257, P=0.000). Therefore, to this predictor keeping other independent variables constant the beta value 0.257 indicates that, if there is a one-unit increase in recall of pharmaceuticals having quality defect from EPSS customers, there will be 25.7% increase in sustainable supply chain performance of EPSS.

Question 3. To what extant recycling pharmaceutical packaging materials and others affect sustainable supply chain performance of EPSS.

The objective of this question is to examine the extent of recycling pharmaceutical packaging materials, and other warehouse material handlings affect sustainable supply chain performance of EPSS. As per demonstrated in the table 15 above the regression between recycling pharmaceutical packaging materials reverse logistic practice and sustainable supply chain performance, the predictor (recycling pharmaceutical packaging materials) statistical significant at (β=0.280, P=0.000). Therefore, to this predictor keeping other independent variables constant the beta value 0.280 indicates that, if there is a one-unit increase recycling of pharmaceutical packaging materials and warehouse martial handlings such as cupboards, cartons, plastics, and pallets, there will be 28% increase in sustainable supply chain performance of EPSS. Mogaka (2014), who examined the impact of reverse logistics practices on pharmaceutical firms' performance in Nairobi finding, indicates that a unit increase in recycle RL would lead to a 0.042 decrease in financial performance.

Question 4. To what extent Disposal of unusable pharmaceuticals reverse logistics practice affect sustainable supply chain performance of EPSS.

The objective of this question to examine the extent of disposal of unusable pharmaceuticals affect sustainable supply chain performance of EPSS. As per demonstrated in the table 15 the regression between disposal of unusable pharmaceuticals practice and sustainable supply chain performance, the predictor (disposal of unusable pharmaceuticals) statically significant at (β=0.223, p=0.000). Therefore, to this predictor keeping other independent variables constant the beta value 0.223 indicates that, if there is a one-unit increase disposal of unusable pharmaceuticals, there will be 22.3% increase in sustainable supply chain performance of Ethiopian pharmaceutical supply service. Mogaka (2014), who examined the impact of reverse logistics practices on pharmaceutical firms' performance in Nairobi stated similar finding indicates that A unit increase on landfill RL would increase financial performance by 37%. Zhang Yu et al.,(2018) also support these results, environmental performance increased by 18.2% through adaptation of reverse logistics operations.

CHAPTER FIVE

5. SUMMARY, CONCLUSTION AND RECOMMENDATION

In this chapter, key findings summarized and addressed for each of the primary research objectives, in addition, the findings that came from the analysis part of this study and recommendations that could put into practice or used in future research also covered.

5.1 SUMMARY OF MAIN FINDING

The major objective of this study was to assess the reverse logistics management practice, challenges, and its role on sustainable supply chain performance: the case of Ethiopian Pharmaceutical Supply Service. The study sought to establish the extent of adoption of reverse logistics practices in EPSS. Respondents requested to state the extent of adoption of reverse logistics practices including redistribution, reuse, recycling and disposal.

The finding showed that, EPSS moderately practiced redistribution of over stocked, slow moving and near expiry pharmaceutical products across EPSS hubs with a grand mean of 2.89. EPSS weakly practiced recycling pharmaceutical packaging materials with a grand mean of 1.62. EPSS weakly practiced disposal unusable pharmaceuticals with a grand mean of 2.52. In addition, EPSS moderately practice recall quality defect pharmaceutical from customers, with a grand mean of 2.67.

Among challenges faced by EPSS in implementing pharmaceutical reverse logistics practice lack of appropriate technology and infrastructure, and lack of definitive rule and regulation on handling, returned pharmaceutical products have high influence with a mean of 3.75 and 3.74, and 3.48 respectively. Likewise, Pharmaceutical reverse logistics operating cost, top management commitment, and suppliers/manufactures conflict on conditions of items, value on return, and timeliness of response have moderate influence with a mean of 3.32, 3.19 and 3.50 respectively.

The study revealed that, there is a strong and positive linear relationship between reverse logistics practices of EPSS and Sustainable supply chain performance of EPSS with correlation value of r=0.770.

Redistribution of usable pharmaceuticals across EPSS branches affects sustainable supply chain performance of EPSS is statically significant at (β= 0.202, P=0.002). Recall of

pharmaceuticals having quality defecate affects sustainable supply chain performance of EPSS is statically significant at (β=0.257, P=0.000). Recycling pharmaceutical packaging materials, and other warehouse material handlings affect sustainable supply chain performance of EPSS is statistical significant at (β=0.280, P=0.000). Disposal of unusable pharmaceuticals affect sustainable supply chain performance of EPSS is statically significant at (β=0.223, p=0.000).

5.2 Conclusion

Base on the finding this study conclude that, pharmaceutical reverse logistics (redistribution, recall, recycling and disposal) Weakley practiced in Ethiopian pharmaceutical supply service (EPSS) with average mean of 2.42 operation.

In EPSS pharmaceutical reverse logistics management system, lack of appropriate technologies and infrastructure, and lack of appropriate rule and regulations on returned pharmaceutical are major challenges. Moreover, Pharmaceutical reverse logistics operating cost, top management commitment, and manufactures/ suppliers conflict on conditions of items, values on returns, and timelines of response have moderate influence

Finally this study conclude that, redistribution of pharmaceuticals across branches of EPSS, recall quality defect pharmaceuticals from customers, recycling of pharmaceutical packaging materials and warehouse handling materials, and disposal of unusable pharmaceuticals have a significant positive effect on sustainable supply chain performance of EPSS. Overall, this study conclude that reverse logistics implementation in EPSS could contribute to improvement in economic, environmental, and social performance of EPSS.

5.3 Recommendation

The study showed that, EPSS weakly practiced pharmaceutical reverse logistics, therefore, the organization should give emphasis on system strengthening of its's pharmaceutical reverse logistics practice for better outcome.

Based on the findings of this study, lack of appropriate technologies and infrastructures and lack of appropriate rules and regulations on handling returned pharmaceuticals are major challenges, Hence EPSS is the major supplier of pharmaceuticals in Ethiopia it is difficult to

manage all operations by internal capacity, Therefore, the investigator of this study recommends that:

EPSS construct infrastructure that can accommodate reverse logistics practices of EPSS and other customers; Apply better technologist and IT system (ERP) to increase data visibility of pharmaceutical products and easily communication; Set clearly defined rule and regulation on handling of returned pharmaceuticals; Build public private partnership; Work with different stockholder and development partners to fill the gaps. Moreover, implement good leader ship follow up for the strengthening of reverse logistics practice at EPSS.

Overall, this study conclude that reverse logistics implementation in EPSS could contribute to improvement in economic, environmental, and social performance of EPSS. Therefore, EPSS should strengthen reverse logistics management system by aspiring to achieve its organizational vision "To be the most responsive and efficient pharmaceuticals supply chain organization in Africa by 2030." (PSTP II, 2020).

5.4. Suggestion for further researches

This study mainly focused on the reverse logistics management practice, challenges, and its role on sustainable supply chain performance: the case of Ethiopian Pharmaceutical Supply Service, which is a major supplier of pharmaceuticals in Ethiopia predominantly for public health institutions. Hence, further study is recommended by investigator's to asses reverses logistics practices, challenges and effects sustainable supply chain on other pharmaceuticals supply chain actors like pharmaceutical local manufacturers and health facilities in Ethiopia to have a full picture on this regard.

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Appendix -1 Research questioners

Addis Ababa University

College of Business and Economics

School of Commerce

Department of Logistics and Supply Chain Management

Dear Dr/Sir/Madam

Acknowledgment to the respondent

Without your diligent assistance in completing this questionnaire, the research could not have been carried out. Please accept my sincere gratitude.

I am Endalkachew Mekonnen student from Addis Ababa University, college of Business and Economics School of Commerce, currently carrying out research in partial fulfillment of the requirements for the award of a Master's degree in logistics and supply chain management.

This survey intended to gather information on reverse logistics practises, challenges, and contributions to sustainable supply chain performance, with particular reference to the Ethiopian pharmaceutical supply sector. The goal of the study is to ascertain the degree to which EPSS has embraced reverse logistics practises, the impact of reverse logistics on the performance of sustainable supply chains, and the difficulties encountered in doing so. Information obtained will be used only for academic purposes and will be handled with the utmost confidentiality. Dear responder, your participation is voluntary, and I can guarantee that the data we collect will be kept private and anonymous. Your informed consent to participate in the study evidenced by your completion of this survey. Your involvement will be greatly valued. In case of any questions, please call me on 0913990477 /email, mekonnenendalkachw@gmail.com

Thank you once again for your cooperation!

Section A: General information

Please mark (√) your choice on the box

1. Gender? 1. Male 2. Female

2. Level of Education?

1. Certificate 2. Diploma 3. First degree 4. Second Degree and above

3. How long have you worked in EPSS?

1. Less than 2 years 2. 3-5 years 3. 6-10 years 4. More than 10 years

4. What is your current position in EPSS?

1. Warehouse manager 2. Officer 3. Team leader 4. Director/ branch managers 5. Supply chain advisor

5. How long has EPSS established a reverse logistics system?

1. Not yet 2. Up to 3 years 3. 4-6years 4. More than 6 years

Section B: Extent of adoption of reverse logistics practices

6. Indicate the extent to which EPSS has adopted the following reverse logistics practices by ticking the appropriate box using the following scale

1=Not at all, 2=Small Extent, 3=Moderate extent, 4= large extent 5 =Very large extent

Reverse logistics practices	1	2	3	4	5
Redistribution (R)					
R1. EPSS has a well-documented policy and procedure for the redistribution of overstocked/slow-moving and near-expiry pharmaceutical products					
R.2. EPSS redistributes overstocked pharmaceutical products between EPSS hubs					
R3. EPSS redistributes slow-moving pharmaceutical products between EPSS hubs					
R4. EPSS redistributes near-expiry pharmaceutical products between EPSS hubs					
R5. EPSS do report on how much cost saved/revenue					

generated by doing redistribution.					
Recall (RA)					
RA1. EPSS has a well-documented policy and procedure to recall pharmaceutical products that have safety issues or defects.					
RA2. EPSS recalls pharmaceuticals with safety issues or defects detected by the authorized body (EFDA) or manufacturers on time.					
RA3. EPSS hubs/head office return recalled pharmaceutical items with safety issues or defects to the respective suppliers, and manufacturer.					
RA4. EPSS hubs/head office has received reimbursement for the reversed product in kind/ cash (only for recalled products)					
Recycling (RC)					
RC1. EPSS has a well-documented policy and procedure to recycle packaging paper (cartoons), pallets, containers, metals, glass, and plastics					
RC2. EPSS recycles or transfer to other parties' the recyclable packaging materials like cartoons, pallets, containers, metals, glass, and plastics to be recycled.					
RC3. EPSS do a Report on how much cost saved/revenue generated by recycling.					
Disposal (D)					
D1. EPSS uses standardized guild lines and SOPs for disposing of unusable pharmaceuticals.					
D2. EPSS uses appropriate technology and equipment for the disposal of unusable pharmaceuticals.					
D3. EPSS uses the Sewer method for the disposal of unusable pharmaceuticals.					
D4. EPSS uses the Incineration method for the disposal of unusable pharmaceuticals.					

D5. EPSS uses the landfill method for the disposal of unusable pharmaceuticals.					

Section C: Relationship between reverse logistics practices and EPSS sustainable supply chain performance.

7. To what extent has EPSS experienced the following financial performance outcomes because of adopting reverse logistics practices? Tick the appropriate box by using the following scale:

   1= Not at all 2= Small extent 3= Moderate extent 4=Large extent 5= Very large extent

Economic performance measures (F)	1	2	3	4	5
F1. The gross profit margin of EPSS increased because of adopting reverse logistics practices.					
F2. Return on Investment increased because of adopting reverse logistics practices in EPSS.					
F3. The market share growth of EPSS increased because of adopting reverse logistics practices.					
F4. Sales volume growth of pharmaceuticals by the value of EPSS increased because of adopting reverse logistics practices.					
F5. Sales volume growth of pharmaceutical by item number of EPSS increased because of adopting reverse logistics practices.					

8. To what extent has, EPSS experienced the following environmental performance outcomes because of adopting reverse logistics practices (especially during disposal). Tick the appropriate box by using the following scale:

   1= Not at all 2= Small extent 3= Moderate extent 4=Large extent 5= Very large extent

Environmental performance measure (E)	1	2	3	4	5
E1. EPSS applies green procurement practices					
E2. EPSS uses environmentally friendly waste disposal methods during disposing of unusable					

pharmaceuticals**.**					
E3. EPSS has a certificate from the international agency (ISO) for a commitment to environmental sustainability.					
E4. EPSS prevent environmental impact of pharmaceutical waste by taking measures like donating short expiry pharmaceuticals to health facilities.					
E5. EPSS practices greenhouse gas (CO2) emit ion control mechanisms during reverse logistics practices (mainly during disposal practice).					

9. To what extent has EPSS experienced the following social performance outcomes because of adopting reverse logistics practices? Tick the appropriate box by using the following scale:
   1= Not at all 2= Small extent 3= Moderate extent 4=Large extent 5= Very large extent

Social performance measure (S)	**1**	**2**	**3**	**4**	**5**
S1. EPSS ensures labor equity (ensuring fair wages) for its employees during reverse logistics practice.					
S2. EPSS has health and safety(Improving working conditions and accident prevention) measures during reverse logistics operation					
S3. EPSS is responsive to the complaints of end users and has customer complaint handling system.					
S4. EPSS have Philanthropy (Charity and donation events) programs					

Section D: Challenges of implementing reverse logistics

10. To what extent are the following challenges experienced in your firm when implementing reverse logistics? Indicate your answer by ticking the appropriate box using the following scale.
    1=Not at all 2=Small Extent, 3=Moderate extent, 4= large extent, 5=Very large extent

Challenges (C)	1	2	3	4	5
C1. lack of appropriate technology is a challenge in implementing reverse logistics practices in EPSS					
C2. lack of appropriate infrastructure is a challenge in implementing reverse logistics practices in EPSS					
C3. lack of definite rules and regulations on handling returned products is a challenge in implementing reverse logistics practices in EPSS					
C4. Retailer/supplier, manufacturer conflict i.e. on condition of item or value on return or timeliness of response is a challenge in implementing reverse logistics practices in EPSS					
C5. Reverse logistics operating cost is a challenge in implementing reverse logistics practices in EPSS					
C6. Lack of top management commitment is a challenge in implementing reverse logistics practices in EPSS					

Section E: opportunities for implementing reverse logistics

11. What opportunities do you think the future holds for EPSS to improve and adopt reverse logistics practices? ----------
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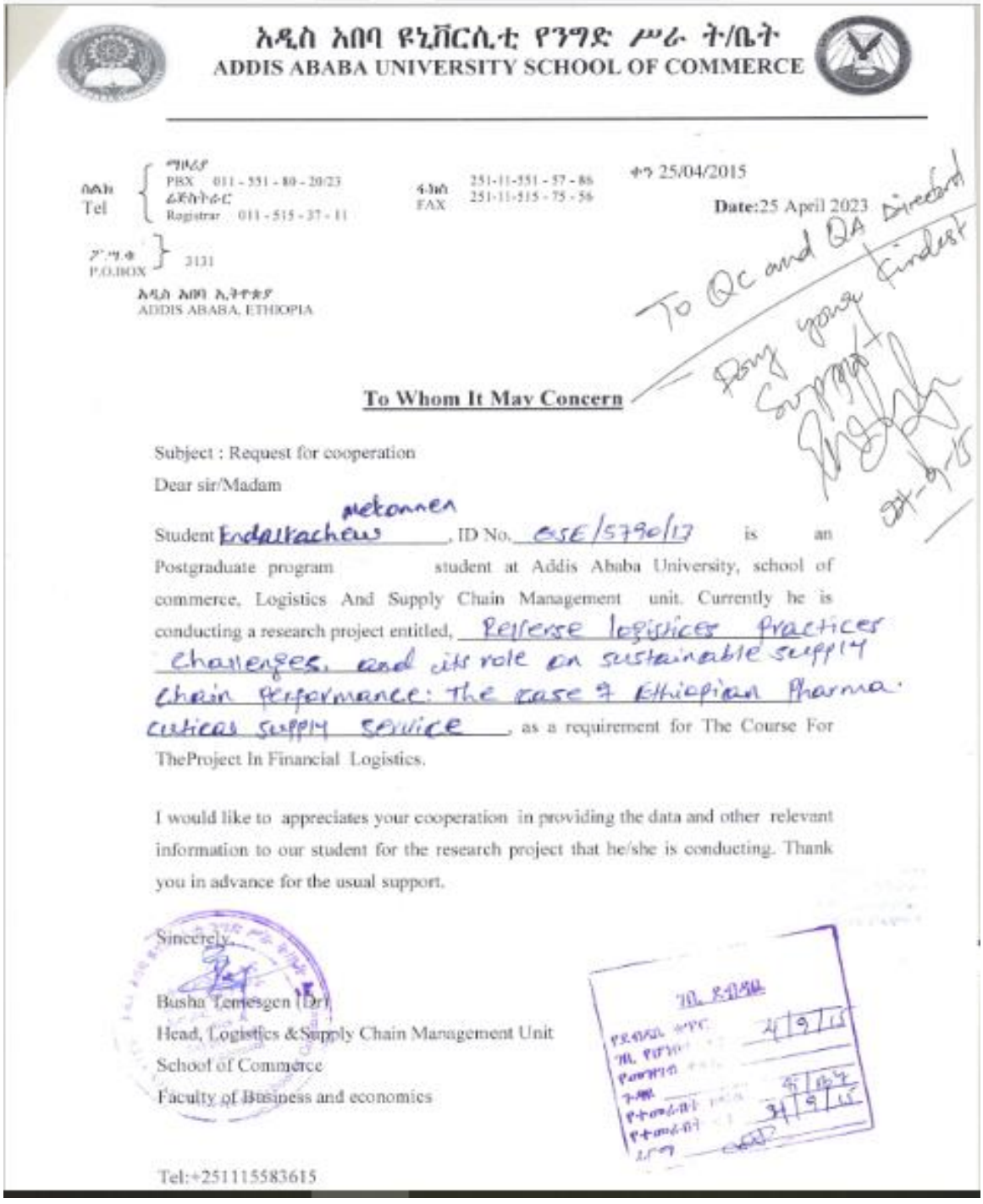
Thank you

Appendix 2- Ethical Clearance papers



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አዲስ አበባ ኢትዮጵያ ADDIS ABABA, ETHIOPIA

To Qc and QA Director
Kindly your support
24-04-15

To Whom It May Concern

Subject : Request for cooperation

Dear sir/Madam

Student Endalkachew Mekonnen, ID No. GSE/5790/13 is an Postgraduate program student at Addis Ababa University, school of commerce, Logistics And Supply Chain Management unit. Currently he is conducting a research project entitled, Reverse logistics practices challenges, and its role on sustainable supply chain performance: the case of Ethiopian Pharmaceuticals supply service, as a requirement for The Course For TheProject In Financial Logistics.

I would like to appreciates your cooperation in providing the data and other relevant information to our student for the research project that he/she is conducting. Thank you in advance for the usual support.

Sincerely,

Busha Temesgen (Dr)
Head, Logistics &Supply Chain Management Unit
School of Commerce
Faculty of Business and economics

Tel:+251115583615

EPSA

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Date 07/09/2015 ዓ.ም
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Ref. No. ኢ.መ.አ.ኤ.18/5ዳይ/101/15

የውስጥ ማስታወሻ
Office Memo

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ጉዳዩ፡ ትብብርን ይመለከታል፡፡

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ከሠላምታ ጋር

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EPSA

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Ethiopian Pharmaceuticals Supply Agency

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ለሁሉም ቅርንጫፎች

<u>በያሉበት</u>

ጉዳዩ፦ <u>ትብብርን ይመለከታል፡፡</u>

ከአዲስ አበባ ዩኒቨርሲቲ የንግድ ስራ ት/ቤት በቀን 27 April 2023 ዓ.ም በተፃፈ ደብዳቤ የዩኒቨርስቲው ተማሪ የሆኑት እንዳልካቸው መኮንን የመመረቂያ ጽሁፍ "Reverse Logistics Practices Challenges and its Role on Sustainable Supply Shain Performance. The Case of Ethiopian Pharmaceutical Supply Services" በሚል ርዕስ ስለሚሰሩ አስፈላጊውን ትብብር እንዲደረግላቸው ጠይቀዋል፡፡

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እንዳልካቸው መኮንን

ፊርማ..............................

ከሠላምታ ጋር