ANALYZING THE OUTBOUND LOGISTICS PRACTICES AND CHALLENGES OF COVID-19 VACCINES IN ETHIOPIA: THE CASE OF ETHIOPIAN PHARMACEUTICAL SUPPLY SERVICE (EPSS) MAIN OFFICE

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Approved by Board of Examiners and Advisor

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Declaration

I, the undersigned, hereby declare that the work which is being presented in this thesis entitled examination of outbound logistics practices and challenges of COVID-19 vaccines in Ethiopia: the case of Ethiopian pharmaceutical supply service (EPSS) main office is the original work of my own, has not been presented in any of other university and that all sources used for the thesis have been duly acknowledged.

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

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Acronyms and Abbreviations

CDC: Centers for Disease Control and Prevention

EPHI: Ethiopian Public Health Institute

EPI: Expanded Program on Immunization

EPSS: Ethiopian Pharmaceutical Supply Service

GRS: Good receiving voucher

HMIS: Health management information system

IPLS: Integrated pharmaceutical logistics system

MOH: Ministry of Health

SARS COV 2: Severe Acute Respiratory Syndrome Coronavirus 2

SCM: Supply Chain Management

SPSS: Statistical Package for the Social Sciences

STV: Stock transaction voucher

VVM: Vaccine vial monitoring

VSC: Vaccine Supply Chain

WHO: World Health Organization

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Abstract

Many nations have significant challenges in obtaining and distributing the COVID-19 vaccine. A vaccination program's performance is greatly influenced by the various requirements and characteristics of the vaccines as well as the countries' distribution techniques. Therefore, this study was envisioned to examine the current COVID-19 vaccine distribution systems of EPSS and the challenges that deter the successful COVID-19 vaccine supply chain. The research employed a mixed-method concurrent approach and employed descriptive research design. A total of 63 staffs working at EPSS participated in the study. Questionnaires and interviews were used as data collecting tools. The study employed descriptive statistics for quantitative data and thematic analysis for the qualitative. The quantitative findings indicated good warehouse management with a group mean of 3.51 which is within the mean values of 13 items (l.e. between 2.21 and 4.39). The qualitative result also supported the quantitative findings. The inventory management practice of COVID-19 vaccines is good because the group mean value obtained with respect to the practice is 4.15, with mean values of 10 items between 4.05 and 4.45. The qualitative results were also in line with the quantitative findings. The transportation management system revealed low performance with the group mean 2.88 compared to the value of 9 items (i.e., between 1.86 to 3.58). The qualitative result showed the existence of challenges in the transportation management. In conclusion, the organization has good performance in outbound logistics of COVID-19 vaccine while the transportation section has low or weak performance. It appears important to improve the transportation facilities to enrich the vaccine to the public.

Key words: Outbound logistics, COVID-19 vaccines

CHAPTER ONE:

INTRODUCTION

The main purpose of this study is to Examine the examination of outbound logistics practices and challenges of COVID-19 vaccines in Ethiopian pharmaceutical supply service main hub. This chapter presents the background of the study, statement of the problem, research question, the objective of the study, the significance of the study, the scope of the study, limitation of the study, definition of terms, and organization of the study.

1.1 Background of the Study

A coronavirus is a virus that infect both people and animals and was originally discovered in Wuhan, China (WHO, 2019). Governments all around the world have taken several preventive measures, but efforts to create a vaccine are paying off, and those vaccine that have already been launched have had good results (Burgos et al., 2021). On the other hand, many nations have significant challenges in obtaining and distributing the COVID-19 vaccine. A vaccination program's performance is greatly influenced by the various requirements and characteristics of the vaccines as well as the countries' distribution techniques (Kupferschmidt, 2020).

Outbound logistics refers to the processing and delivery of goods to their final destination. Outbound logistics operations usually start in a distribution center and terminate when the order is delivered to its final destination. Outbound logistics includes everything from the manufacturing or collecting of products to the delivery of those items to the client. Monitoring manufacturing, collecting appropriate inventory quantities, selecting and packaging orders based on precisely created and processed invoices, and managing a flow via multiple delivery choices are all part of the process (Liberatore & Matthew, 2015).

The importance of optimizing outbound logistics management in sustaining a smooth-running supply chain cannot be overstated. The goal of physical distribution management is to ensure that completed items are distributed to satisfy consumer expectations while being as cost-effective as feasible. Physical distribution management, in addition to transportation,

necessitates strong collaboration with order processing, material control, and warehousing. These areas must be controlled so that they may interact with one another to offer the degree of service that the client expects (Liberatore & Matthew, 2015).

According to Adzimah et al (2014), customer satisfaction is used to determine the success of outbound logistics efforts. Perfect product delivery, ensuring that the given products are in acceptable condition, improved storage sites, deliveries using a variety of delivery vehicles, and maintaining consumer transparency are all factors that impact customer pleasure. During the outbound logistics process, on-time delivery must also offer clients real-time information and update.

Regardless of the kind and characteristics of COVID-19 vaccines, good physical distribution operations such as packaging and material handling, order processing, warehousing, inventory management, and transportation are critical for optimal vaccination success. Outbound logistics activities that are efficient and effective have a crucial role in restricting viral transmission, reducing the possibility of new variants developing, and decreasing hospitalizations and fatalities throughout the world (McCloskey & Heymann, 2020).

The physical precepts of distribution strategy in the United States appear to have focused heavily on the core foundations of physical distribution, namely transportation, warehousing, inventory, and large-venue mass vaccination sites. The strategic plan seems to have been successful. However, the research reveals that the distribution system has not focused on or included key distribution activities, including internal and external communication, data, and customer happiness (kim&Youn, 2021).

Ethiopia cannot be the exception country to face the challenges concerning vaccine shortage and its distribution. Based on the knowledge of the researcher, COVID-19 vaccine distribution, allocation, and associated challenges are not studied well in Ethiopia. Vaccine shortages, demand-supply evaluations, the transportation system, vaccination placement or allocation, expired vaccine management, clearance actions when items arrive in the country before being handed over to the Ethiopian Pharmaceutical Supply Service (EPSS), and waste are all challenges that must be addressed.

If the above challenges surrounding the procedures of COVID 19 vaccine distribution are not appropriately handled in Ethiopia, the country will not be able to overcome the barriers to widespread immunization. Consequently, this research aims to look at the practice and concerns surrounding the distribution of the COVID-19 vaccine, as well as the obstacles that EPSS has experienced, and to provide suggestions based on the results to enhance vaccine distribution practices in the future.

1.2 Statement of the Problem

Management and supply of vaccines is a perceived problem among African countries. In connection to this, Allan (2013) mentioned that Africa has several problems concerning supply issues. These include lack of consumption statistics, selection and quantification of demand, inadequate storage facilities and capacity, a lack of guidance for proper storage operations, insufficient planning, monitoring, and assessment, and insufficient budget allocation.

Furthermore, a study conducted in Ethiopia by Lissanework (2013) has identified several issues related to pharmaceutical distribution including an insufficient number of branch pharmaceutical distribution centers, Warehouse space constraints, low delivery frequency, inadequate forecasting procedures, and a delay of supply due to a routing issue, poor warehousing facilities, a shortage of transport trucks, etc.

The distribution of vaccines has a procedure and an important supply chain. In other words, three significant issues impact the vaccine supply chain. The first issue is vaccine transportation; due to a lack of cold chain transport mechanisms, the temperature will not be maintained at an acceptable level. The second is to ensure that every health institution has a sufficient supply of all vaccinations included in the routine and supplemental immunization regimens. Maintaining the cold chain to retain vaccines in a safe temperature range is another element that affects vaccine supply chain management. The third issue relates to delays or errors in ordering at various levels, allocation challenges, transportation issues, and erroneous demand predictions are all factors that impair vaccination export logistics (Anderson et al., 2014).

New vaccines have increased the requirement for storage in African countries, worsening the existing dilemma. Since it saves lives and protects against serious illness, vaccination is one

of the most effective public health initiatives available today. On the other hand, the programs' performance is highly dependent on the proper management of the immunization supply chain, which includes adequate vaccine storage, transportation, and handling. To ensure vaccine distribution effectiveness, it should rely on a well-functioning end-to-end cold chain. Furthermore, the distribution process necessitates the use of cold rooms or freezers in storage facilities, chilled transport vans or vehicles, and an efficient information system (Weledesenbet, 2020).

COVID-19 vaccines have a wide range of storage and supply chain needs. The temperature ranges from (2 °C to 8 °C) to (-20 °C to -70 °C +/-10 °C) for storage. Pharmaceutical warehouses, including cold chain facilities, must be well-designed and have all of the required storage rooms and product assembly, packaging, receiving, and dispatch bays. They also require an ultra-low temperature cold chain equipment system, which comprises ultra-cold freezers for storing vaccines at shallow temperatures (-80 °C/-60 °C) and passive equipment (ultra-low temperature insulated containers) for storing and distributing low-temperature vaccines (Marzen, 2021).

The coronavirus pandemic has overwhelmed the health care system of many countries and is a challenge to cope with even within a well-prepared setting. Statistical data also suggests that the number of newly diagnosed COVID-19 cases in Ethiopia is growing over time. According to a report released by Ethiopia's Ministry of Health on December 28, 2021, the overall number of COVID-19 cases in Ethiopia is 442,187, with a death toll of 7,012 (Worldometer Jan 8, 2022). If the magnitude of COVID-19 disease increases in this trend, its burden on the health care system of this country will be challenging. The discovery of a potential vaccine has given a ray of hope to fight against this virus. Efforts are taking place to curb the pandemic by vaccinating citizens, but there is a challenge to vaccinate the whole population in a given period due to the scarcity of the vaccine and the system of vaccine distribution.

The COVAX collaboration (a coalition led by GAVI, WHO, and CEPI) is working with its worldwide partners to procure 720 million doses of COVID-19 vaccinations by June 2022 to reach 60 % coverage in Africa. Nevertheless, Africa has completely vaccinated 77 million individuals, barely 6 % of its population, which is below 10 % of vaccinating 60 % of the population by June 2022 (Massinga, Marguerite & John, 2021). In comparison, over 70% of

high-income countries have already vaccinated more than 40% of their people. Several problems have been cited as contributing to the delay, including vaccine shortages, a faulty cold chain system (the process of shipping and storing vaccinations at temperatures within the authorized temperature ranges), inefficient vaccine allocation, and distribution issues (WHO Regional Office for Africa, 2021).

COVID-19 vaccine donations are coming in from a variety of places to Ethiopia. The most extensively used vaccines are those made by AstraZeneca, Johnson & Johnson, and Sino-pharm, which have a range of storage and delivery requirements. By the end of 2021, Ethiopia intends to vaccinate 20% of its population. Around 9,363,344 persons were vaccinated as of January 7, 2022, accounting for 7.94 % of the population. This data shows that the vaccination procedure is not progressing as intended (Getachew, 2021).

At this stage of COVID-19 disease spread, access to a vaccine for all is still one of the basic approaches to curb the problem. Nevertheless, many challenges deter the successful distribution of vaccines and its usage. Vaccine shortages, demand-supply evaluations, customer preferences, the transportation system, vaccination placement or allocation, expiry vaccines management, clearance actions when things arrive in the country before being handed to EPSS, and waste are the issues that must be addressed. Among other things, the proper distribution of vaccines is the most important issue that needs serious attention to attain the target of vaccinating the wider population of Ethiopia. Therefore, this study aims to examine the current COVID-19 vaccine distribution systems that EPSS has implemented and the challenges that deter the successful COVID-19 vaccine supply chain.

1.3 Research Questions

The study aims to examine COVID-19 vaccine distribution practices and associated challenges encountered by EPSS main hub. To this end, the following research questions are formulated.

1. What are the practices of COVID-19 vaccine warehousing at EPSS main office?
2. What are the inventory management practices of COVID-19 vaccines at EPSS main office?
3. What are the transportation practices of COVID-19 Vaccines at EPSS main office?

4. How lean is the integration among warehouse, inventory and transportation management activities involved in the outbound logistics of COVID-19 vaccines in EPSS main office?
5. What challenges of outbound logistics of COVID-19 vaccines faced by EPSS main office?

1.4 Objectives of the Study

1.4.1 General Objective

The general objective of this study was to examine the outbound logistics practices and challenges of COVID-19 vaccines in Ethiopian Pharmaceutical Supply Service (EPSS) Main office

1.4.2 Specific Objectives

The specific objectives of the study were to:

1. Examine the warehousing practices of COVID-19 vaccines at the Ethiopian Pharmaceutical Supply Service's Main office.
2. Assess the inventory management practices of COVID-19 vaccines at the Ethiopian Pharmaceutical Supply Service's Main office.
3. Investigate the transportation practices of COVID-19 vaccines at the Ethiopian Pharmaceutical Supply Service's Main office.
4. Examine the leaness among warehouse, inventory and transportation management involved in the outbound logistics of COVID-19 vaccines in the Ethiopian Pharmaceutical Supply Service's Main office.
5. Assess the challenges faced in the outbound logistics of COVID-19 vaccines at the Ethiopian Pharmaceutical Supply Service's Main office

1.5 Significance of the Study

This study contributes to the field of outbound logistics practices and challenges of COVID-19 vaccines in several ways. From a practical point of view this study adds to the experience of the general outbound logistics procedures and issues associated with covid-19 vaccinations

in the central hub of the Ethiopian pharmaceutical supply service. It aids all parties involved in the area, including EPSS, Ethiopian Public Health Institute, policymakers, and international organizations working on immunization, such as WHO, regulatory authorities, health care providers, and donors, in developing and implementing guidelines for the more effective and efficient management of similar emergency conditions in the future. Furthermore, it allows EPSS to obtain important information on the existing cold chain management practices, including gaps and obstacles in the event of an emergency. From the theoretical point of view the findings of this research will contribute to the existing literature on COVID-19 vaccine management in general, and outbound logistics practices and challenges of COVID-19 vaccine distribution, in particular. Finally, this study helps as a springboard for future researchers in this area of similar study.

1.6 Scope of the Study

The main office of the Ethiopian pharmaceutical supply service's outbound logistics practices and challenges with the covid-19 vaccines were the focus of this research. The research is restricted to the storage, inventory, and distribution management operations of the EPSS main office. The study was only conducted in the EPSS headquarters in Addis Ababa.

1.7 Limitation of the Study

The study focused on the Ethiopian Pharmaceutical supply service's main office. Due to time constraints, the research sample did not include all Supply Chain participants involved in the outbound logistics management of COVID-19 vaccines, such as hospitals and health facilities. Furthermore, the research is limited to the agency's perspective on the downstream (customer interface) sides of a supply chain and critical activities in the pharmaceutical logistics cycle, such as storage, distribution, and inventory management. Another drawback of this study was that it was limited to the central EPSS and excluded its regional hub branches.

1.8 Organization of the Paper

The research paper is organized into five chapters. The first chapter deals with the background of the study, statement of the problem, research question, objectives of the study, significance of the study, delimitation, and limitations of the study, and operational definitions of terms

used. The second chapter discusses the review of literature related to the subject matter of the study. Chapter three gives a detailed account of the research methodology involving research design, study site, study population, sample and sampling technique, measures, data collection procedure, method of data analysis, and ethical considerations. Chapter four presents the findings and five discusses the findings. The last chapter presents the summary of findings, conclusions, and the way forwards or recommendations.

1.9 Operational Definitions

Cold Chain: in this study Cold chain refers to the system of transporting and storing COVID-19 vaccines at the recommended temperature range.

Outbound logistics: here refers to the process of moving and storing COVID-19 vaccines from the end of the manufacturing line to the final consumer (Lambert, Stock, & Ellram, 1998).

Supply Chain: this study refers to the complete process of acquiring, storing, and distributing COVID-19 vaccines (Allan, 2013).

Vaccine: is any biological substance that is utilized to boost human immunity without producing illness (oxford dictionary).

Vaccination: This is an effective, safe, and straightforward method of preventing individuals from infections before they become unwell (WHO).

CHAPTER TWO

REVIEW OF RELATED LITERATURE

In this section theoretical and empirical literature review is discussed and under theoretical literature review, Overview of COVID-19 disease and its vaccine, Supply Chain Management,Concept and functions of Outbound Logistics, Vaccine Cold Chain, Association between vaccine quality and proper transport/storage, Cold Chain Status Globally, Vaccine supply chain in Ethiopia, and under empirical literature review, review of empirical Studies on challenges in COVID-19 vaccines supply chain in the world and finally conceptual frame work is discussed.

2.1. Overview of Covid-19 disease and its vaccine

Coronaviruses have been linked to human and animal disease. At the end of 2019, coronavirus was identified as the cause of a cluster of pneumonia disease in Wuhan, China. It swiftly swept China, resulting in an epidemic and a worldwide pandemic. The disease was dubbed COVID-19 by the World Health Organization in February 2020 (WHO, 2019).

COVID-19 has a variety of effects on various persons. The majority of infected persons experience mild to moderate symptoms and recover without hospitalization. Many others suffer seriously and exhibit symptoms: fever, cough, weariness, loss of taste or smell, sore throat, headache, trouble breathing or shortness of breath, chest discomfort. The disease transmits from person to person through the release of an infected air droplets while sneezing or coughing. It can also disseminate when people come into contact with virus-infected hands and then touch their eyes, nose, or mouth with them (contaminated hands) (Mcintosh, 2020).

Many preventative measures have been put in place to halt the spread of the disease such as Physical or social distancing, quarantining, indoor ventilation, covering coughs and sneezes, hand washing, and keeping unwashed hands away from the face.The use of face masks or covers has been advocated to reduce the risk of transmission to the public (Mcintosh, 2020). On the other hand, the most promising strategy to preventa pandemic or SARS-Cov-2 infection

is to develop vaccines according to WHO (2019) COVID-19. Several types of vaccines have been produced for use across the globe. The most often used vaccines for vaccination against COVID-19 illness are the Pfizer-BioNTech vaccine, Moderna vaccine, Janssen vaccine, AstraZeneca vaccine, Sinopharm vaccine, and Sputnik V vaccines. Ethiopia's most extensively used vaccines are the Pfizer-BioNTech vaccine, Janssen vaccine, AstraZeneca vaccine, and Sinopharm COVID-19 vaccines (Orenstein, 2021).

2.2 Supply Chain Management

2.2.1 Supply Chain

A supply chain is a collection of entities involved in the development of new products and services, the procurement of raw materials, the transformation of raw materials into semi-finished and finished products, and the delivery of these items to the users or customers. Inbound logistics and outbound logistics are the two portions of the supply chain. Inbound logistics refers to the acquisition of raw materials and parts as well as the coordination of their input. Material management and procurement are the two aspects of inbound logistics. Outbound logistics is concerned with the procedures of storage, packing, and delivering products to consumers (Lambert, Stock, & Ellram, 1998).

2.2.2 Supply Chain Management concepts and key issues

Supply chain management (SCM) was first coined by Keith Oliverin in the early 1980s, it drew a lot of attention. Supply chain management is defined by the Council of Supply Chain Management Professionals as "the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management operations." (Zigiaris, 2000). Supply chain management has been a crucial component of competitive tactics to improve organizational productivity and profitability, according to Gunasekaran et al. (2004). Simply said, "the supply chain" refers to "all of the actions involved in delivering commodities from the raw materials stage to the ultimate customer" (Zigiaris, 2000).

2.2.3 Concept and functions of Outbound Logistics

Outbound logistics is concerned with customer service and distribution channels. It is the transportation of completed commodities from the point of manufacturing to the point of

consumption. It encompasses all of the actions that fall under this category. Selecting, arranging, transporting, and other activities related to the outflow of goods from the vendor to the consumer. Outbound logistics can include warehousing, material processing, inspection, and transportation for physical products, but it is associated with setting up to convey clients to the service location for intangible objects like services (Liberatore & Matthew, 2015).

2.2.3.1 Warehousing

Every logistics system necessitates the use of warehousing. Warehousing is critical to delivering the appropriate level of customer service at the lowest overall cost achievable. Warehousing operations serve as a vital link between the manufacturer and the consumer. According to Lambert, Stock, and Ellram (1998), warehousing is the portion of a company's logistics system that keeps items (raw materials, parts, work-in-progress, and finished goods) at and between points of origin and consumption, as well as providing management with status information. A warehouse, in general, is a hub in a logistics network where commodities are temporarily held or diverted to a new channel. Depending on the area served, distribution warehouses are classed as central, regional, or local. Central distribution warehouses are central warehouses, whereas supply or delivery warehouses are decentralized regional or local distribution warehouses.

Vaccines must be carefully preserved from the moment they are made until they are given out. Manufacturers, distributors, public health personnel, and healthcare providers all have responsibilities for ensuring vaccinequality and maintaining the cold chain. A suitable cold chain is a temperature-controlled supply chain that encompasses all equipment and processes used to transport, store, and handle vaccines from the moment they are manufactured until they are administered. The temperature monitoring form should be manually filled twice a day by health professionals documenting cold chain equipment temperature to appropriately monitor vaccines' storage conditions (WHO, 2014).

2.2.3.2 Inventory Management

Commodity management refers to overseeing the logistics of receiving, storing, transporting and distributing commodities along with maintaining commodity accounts and

documents, preparing necessary commodity reports, and keeping commodity losses to an acceptable minimum (Adzimah et al,2014).

Inventory management guarantees that enough inventory are available to meet rising demand while avoiding stock-outs. This lowers excess inventory, guarantees adequate efficiency, and improves customer happiness by ensuring that items are available. Inventory management activities such as inventory level monitoring, cost control, lead times, and accuracy help to achieve this. Inventory rates are a critical aspect of organizations attempting to balance supply and demand and avoid overstocking. When it comes to inventory management, reducing replenishment lead times is crucial. When demand is variable and lead times are short, companies maintain additional safety stocks on hand. This increases their stock-holding costs and reduces customer satisfaction, whereas Supply chain partners value shorter lead times and quicker information sharing (Adzimah et al,2014).

2.2.3.3Transportation

Transportation is the process of physically moving goods from their point of origin to their final destination. Place utility is a term used to describe this value. Transportation affects time utility because it impacts how quickly and regularly a product goes from one location to another. Because it influences customer service and cost structure, transportation is the most critical aspect of logistics (Kwateng, Manso, and Osei-Mensah, 2014).

The proper use of passive containers such as cold boxes, packaging procedures with coolant packs such as conditioned ice packs or cool water packs, temperature monitoring throughout transit, and maintaining transport contingency plans are essential aspects of vaccine delivery. One of the most critical aspects of vaccine logistics management is transportation planning. Apart from the vehicle's setup, critical facilities for vaccine distribution, such as an appropriate supply of ice packs, skilled drivers and delivery employees, and the vehicle's logistics, must all be maintained (WHO, 2014).

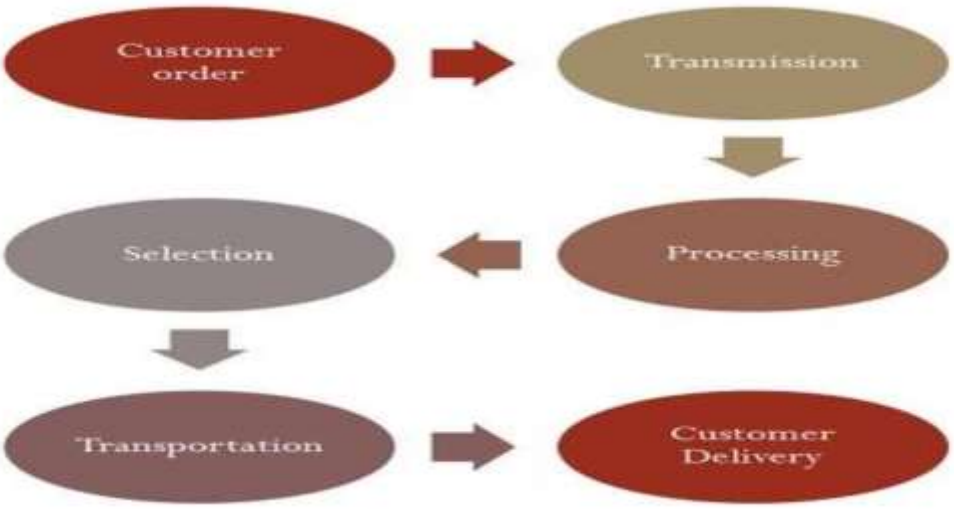

Figure 2.1 The flow of outbound logistics

2.3 Factors Affecting the Performance of Outbound Logistics

Pharmaceutical distribution management's major purpose is to maintain a consistent supply of medications and supplies in health institutions that require them. According to numerous views concerning elements impacting distribution success, financial capacity, transportation outsourcing, information systems, and donor-government cooperation are described below (Johnson, 2006).

2.3.1 Financial Capacity

According to Johnson (2006), the finance function's capabilities and management have a substantial influence on the performance of the public sector's distribution function. Appropriate and stringent financial controls must be maintained to ensure good financial management. There must also be a framework in place to preserve program assets, as well as the capacity to generate regular and credible financial disclosures. Another important aspect of financial capabilities that is relevant to distribution networks is the movement of monies. This has to do with receiving funds in a timely manner in order to satisfy various requirements in the distribution process.

2.3.2 Transport Outsourcing

Outsourcing, traditionally known as “make-or-buy” decision, is the act of contracting internal business activities to outside (either domestic or offshore) suppliers. This process helps companies to merely focus on their core activities. Outsourcing has been utilized as a means of reducing costs and maximizing output (Johnson, 2006).

Success or failure in distribution depends on care and caution in continuous management of this function to ensure the job being done by distribution partners as expected. Johnson (2006) observes that the key to a successful outsourcing relationship includes understanding the process, specifying objectives, establishing internal procedures for evaluating performance against objectives, and deploying systems that help to manage the function effectively.

2.3.3 Information Systems

In value chains, using an information system to manage distribution increases efficiency, predictability, and waste reduction, which benefits all market players. Information system tools like cell phones and internet services, radio, and a wide range of digital devices and related tools like cameras, GIS, and a wide range of hand-held computing devices, when used appropriately, have the potential to increase efficiency in the following distribution activities: record keeping, monitoring field agent activities, procurement operations, credit and payment tasks, input distribution, measuring productivity, and forecasting (Fawcett, 2001).

2.3.4 Donors and Government Relationship

The necessity of forming partnerships between donors and governments stems from the need to improve service delivery. When donors and host governments work together harmoniously, they establish a unified purpose that they may use to steer the utilization of available resources to efficiently achieve the goal. Donors are explicitly urged to step up their efforts to work with the government in the delivery of humanitarian aid to various groups of people (Fawcett, 2001).

2.3.5 Customer satisfaction

The perspective of the buyer and the view of the product maker are not necessarily the same. Low cost, on-time delivery, delivery date assurance, or having a customized product may be more important to customers. Manufacturers and merchants, are continually seeking for realistic after-sales strategies that would allow them to improve customer satisfaction levels. Customer-firm-supplier relationship management also boosts operational efficiency and boosts customer satisfaction (Johnson, 2006).

2.3.6 Human Resource

A paradigm change in labour allocation should be explored in order to have more administrators operating health institutions who are qualified in supply chain concerns. As long as human resources are allocated in the current manner, all health employees involved in the supply chain should get appropriate medical supply chain training. Staff in the medical supply chain, particularly those involved in product distribution, must receive ongoing specialized training (Johnson, 2006).

2.4 Challenges of Outbound Logistics

Poor outbound logistics management leads to increasing operational cost & decreased customer service. A successful company will understand the value of having a strong outbound logistics process and also understand that having the right tools and experience can help them simplify and accelerate their logistics planning.Logistics management activities are affected by challenges werethe firm experiences difficulties while providing products and services to its customers. Some ofthe challenges need an overtime effort to deal with them due to their long service effect on thecompany's performance while other challenges need a rapid response (Wilding,1998).

2.4.1 Infrastructural problems

To enhance service, logistics operations must be complemented by a well-established setting. In terms of achieving customer satisfaction, the link between logistical operations and infrastructural upgrades has a direct relationship. The most crucial parts for executing successful logistical operations in outbound logistics are well-equipped and spacious

warehouses, information and communication technology, well-equipped trucks, and skilled manpower. If there is any deficiency in terms of infrastructure the service provisions will be compromised. In Africa, there is a constant shortage of skilled workers and supply chain infrastructure (Wilding, 1998).

2.4.2 Information technology / system

The issues in information technology include incompatible technology or systems, lack of sophisticated information system, inadequate information sharing, poor information system, and lack of integrated information systems and electronic commerce linking firms (Hau, et al., 2004). Hau, et al. (2004), concluded as one of the most common problems that hamper the smooth functioning of SCM is the so-called bullwhip effect which is resulted from inaccurate information flow resulting in low utilization of the distribution channel and High transportation costs.

2.4.3 Geographical distance

The geographical proximity of suppliers and customers plays a significant role in fostering the flow of goods among customers. It also has a very significant impact on customer-supplier relationships by reducing logistical costs (Siti, and Abu Bakar, 2010).

2.4.4 Increasing Logistics Costs

Transportation of goods makes up for one of the highest operational expenses, and these costs are steadily going up which are attributed to various reasons. The increasing price of fuel, multiple modes of transportation, poor coordination, lack of visibility, high management, and administration cost contribute to the overall increasing logistics costs, which are also ultimately passed on to the customers. This has a drastic impact on outbound logistics operations (Siti, and Abu Bakar, 2010).

2.4.5 Inefficient In-Plant Operations

Warehousing and inventory management are two logistics activities. The success of these in-plant operations has a big influence on overall logistic performance. Disorganization in any in-plant activity can have a detrimental influence on the entire income of the company. Wastage,

poor product quality, bad material handling, an inexperienced staff, lack of training and a lack of trustworthy inventory data all influence how disorganizations impair operational performance. As a result, it will influence the firm's earnings as well as its market competitiveness (Siti, and Abu Bakar, 2010).

2.4.6 Poor Delivery Fleet

The term "fleet management" refers to a system for organizing and coordinating delivery vehicles to maximize efficiency and cut expenses. Aside from tracking and recording delivery trucks, it is also used to track and record delivery workers. Timely deliveries of products are imperative for every business in a competitive market. Poor productivity of delivery fleet can be due to a shortage of vehicles, inadequate driver performance, and irregular maintenance of vehicles, among other factors. These obstacles are responsible for the elevation in operational costs and delayed deliveries which drop the expectation amongst customers and impact the reliability of the business in the long run (Wilding, 1998).

2.4.7 Lack of coordination

Relationship between the members of a supply chain becomes one of the important barriers to achieving supply chain integration. Among the recognized issue is trust. Lack of trust can be considered as a lack of trust inside and outside of a company and a lack of trust among supply chain members (Fawcett, 2001).

2.5 Vaccine Cold Chain

A vaccine is a biological substance that increases the body's resistance to a particular infection. vaccine usually contains an agent that resembles a disease-causing microorganism. The agents induce the immune system to recognize the agent as foreign, destroy it, and remember it, making it more straightforward to recognize and eradicate any germs it encounters later (Strive, 2005).

According to Kartoglu and Milstien (2014), a cold chain is an integrated system of equipment (e.g., cold rooms, shipping containers, refrigerators, vehicles), processes, records, and

activities used to handle, and store, transport, distribute, and monitor temperature-sensitive items.

The cold chain has the process of shipping and storing vaccines at temperatures within the authorized temperature ranges of (+2°C to +8°C for refrigerator vaccines) and (-15°C to -25°C for freezer vaccines). The cold chain begins with the manufacturing, storage, and distribution of vaccines and concludes with administering a vaccine to a customer. However, Sustaining the cold chain is an issue within the vaccine distribution system (Strive, 2005).

Vaccines are the sole critical item that requires their supply chain system, as they must be stored in a cold chain between 2 and 8 °C, unlike any other essential drug (Strive, 2005). Vaccine's properties impact its dissemination, acceptance, and use, especially in low-resource contexts. They must be kept at the proper temperature during travel and storage to remain alive. Refrigerators and freezers are used in storage facilities and refrigerated vehicles, and cold boxes for transportation (Anderson et al., 2014).

Equipment transit and storage, qualified people, and effective management procedures are all components of the cold chain. These three elements must be maintained at each stage in the cold chain system to ensure that the vaccine is delivered safely. Maintaining the cold chain system is very important to retain the maximal vaccine potency (Ogboghodo et al., 2017). It entails understanding vaccine temperature sensitivity and being suitably trained and equipped in terms of storage and transit circumstances for each vaccine, as well as cold chain and power supply monitoring for those involved. The availability of trained employees is vital to ensure the cold chain system is monitored effectively at each stage. The temperature should be read twice daily and documented on the temperature sheet to keep track of it (Ateudjieu et al., 2013).

2.5.1 Cold Chain Equipment

Excellent rooms, freezers, refrigerators, cool boxes, cool packs, vaccine carriers, and generators are part of the cold chain infrastructure (Saraswati et al., 2018). All cold chain equipment must meet the WHO Expanded Program on Immunization (EPI) program's and UNICEF's performance criteria, as well as national regulations. Each step of the cold chain has its own set of storage conditions for vaccines. As a result, each level requires different storage

equipment depending on the amount of vaccine to be kept, storage length, and the required temperature (PATH et al, 2011).

2.5.2 Association between vaccine quality and proper transport/storage

Several reports demonstrate an association between vaccine quality and appropriate vaccine transport and storage. When oral polio vaccine and vaccinations for measles and yellow fever were transferred from the national warehouse to health institutions in Nigeria, the potency of the vaccines fell below international standards (PATH et al., 2011). Repeated vaccine freezing and thawing cycles caused by flaws in cold storage equipment, unreliable electrical distribution systems, a lack of backup energy, and improper vaccine storage were most likely to blame for the loss of effectiveness.

According to research conducted in Australia, incorrect vaccinestorage may have been linked to a diphtheria outbreak between 1993 and 1996. In 1970, a limited measles epidemic in the United States was linked to the vaccination being stored on the refrigerator's door shelf rather than in the refrigerator's central core (PATH et al., 2011). In general, appropriate storage and transportation of vaccines has a very significant link with the vaccine quality.

2.5.3 Cold Chain Status Globally

According to research conducted in the United States, a temperature evaluation of freezers used to retain vaccines in medical institutions was undertaken. The lowest and highest temperatures were measured using thermometers for 24 hours. According to the statistics, only two of the twenty-one clinics assessed had refrigerator temperatures within the permissible range. Out of 63 percent of samples, temperatures were under the permissible limit, 59 percent were beyond the acceptable range, and 93 percent were in between the acceptable range. It is impossible to determine how long the temperatures were outside the approved range because the study only looked at the lowest and highest temperatures (PATH et al., 2011).

A study in New South Wales used data loggers to measure the temperature of 53 vaccine refrigerators in pharmacies over three days and found that only 19% of the refrigerators studied

had temperatures that were within the acceptable range, while 23% had temperatures that were less than 0°C and 29% had temperatures that were higher than 8°C. According to assessments of 440 storage units in rich and developing nations, the percentage of storage units where vaccines were exposed to temperatures below recommended ranges was 33.3% in wealthy countries and 37.1% in low-income countries (Hanson et al., 2017).

In developing countries, such as Cameroon, cold chain monitoring remains a serious concern. An assessment conducted on 65 health facilities in Cameroon's North West area showed that only about 56% of health facilities fill their temperature charts twice a day as advised by previous studies. In 26 (50 percent) of the health institutions that used a temperature recording sheet, a total of 409 days were missed without recording the temperature twice daily as directed. The temperature chart was correctly filled in 25 (50%) of the 50 (96.2%) facilities that had one. In the two months following data collection, approximately 14 (26.9%) health facilities recorded at least one aberrant temperature. 17 (28.3%) employees were unaware of the proper vaccination storage temperature (Yakum et al., 2015).

2.5.4 Vaccine supply chain in Ethiopia

The current vaccination management system is paper-based and relies on stock cards, widely used in most health facilities (approximately 80 percent). This sort of management method is inefficient and prone to errors, and it makes it impossible to collect and use comprehensive data for decision-making at any level of the supply chain (Hajara, 2010).

These vaccines are significant and are more expensive to buy and store. It was essential to implement an enhanced and efficient logistics system to decrease waste, stock-outs, overstocks, and expired stock, and improve decision and information flow between national cold storage, regional health institutions, and all levels of the vaccine supply chain (Hajara, 2010). The Ethiopian Pharmaceutical Supply Service (EPSS), a government agency responsible for distributing vital medications and other health commodities, took over responsibility for the vaccination supply chain from the Ethiopian Federal Ministry of Health in 2013 (TechNet conference, 2015). In Ethiopia the Vaccine Distribution Cold Chain system for vaccines and other cold storage health commodities is made up of five layers:

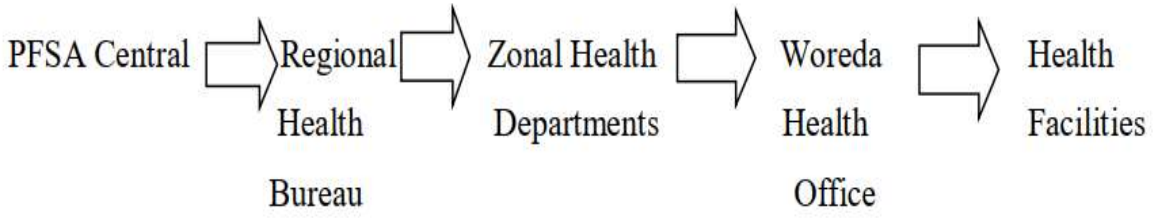

Figure 2.2: Ethiopian vaccine distribution cold chain system(TechNet conference, 2015)

2.6 Theories on supply chain

2.6.1 Porter's value chain model

In 1985, Michael Porter first used the phrase value chain. The value chain of a corporation consists of a connected collection of internally executed value-creating activities. Two different sorts of activity make up the value chain. Primary activities, which are those that produce the majority of the value for consumers, and Support activities, which help the primary activities to be performed. Michael Porter developed a generic value chain model that consists of a series of tasks that have been discovered to be shared by many different organizations. These core and auxiliary operations serve as the building blocks that businesses employ to develop valued goods and services (Jonikas, 2013).

Along the supply chain, several separate companies engage in independent operations. Therefore, each company has a unique value chain, which is a part of the supply chain. Value is the price that customers are willing to pay for a company's good or service (Jonikas, 2013). When a company's value creation surpasses the cost of supplying it, profits change. Value creation becomes an essential component of competitive analysis because this is the strategy's end aim. Every value creating activity makes use of prices like raw materials, other acquired products and services, direct and indirect labor, and technology to convert raw materials into completed commodities. Similarly, value is gained through lowering stocks, accounts receivable, and other assets while value is lost by incurring liabilities for the purchase of materials, among other things. In order to create value, the majority of firms participate in a variety of activities (Zamora, 2016).

Primary Activities

These operations are intimately related to the actual production, marketing, maintenance, and support of a good or service. Inbound logistics, which involves receiving, storing, and internally distributing inputs, is the first activity. Operations is the second. It deals with the processes that convert inputs into finished products that are sold to consumers. Outbound logistics, which includes operations to transport products or services to consumer, is the third important activity. These include activities like warehousing, inventory, and transportation systems. Sales and marketing are the other activity. These are the procedures used to encourage customers to buy from the company rather than rivals. The final key activity is service, which has to do with preserving the worth of the product or service to clients after they've paid for it (Simatupang, Piboonrungroj & Williams, 2017).

Support Activities

These are the additional sets of activities that are used to assist the main ones. Procurement, which is what the organization undertakes to obtain the resources it needs to operate, is one of the operations. Finding suppliers and obtaining the best pricing are part of it. Human resource management is concerned with how successfully a business finds, employs, develops, and keeps its employees. Businesses may gain a distinct edge through effective human resource procedures since people are a big source of value. The management, processing, and protection of an organization's knowledge base are all topics covered by technological progress. Value development strategies include lowering information technology expenses, keeping up with technological advancements, and preserving technical quality. Finally, one of the supporting activities is infrastructure, whose capabilities enable it to continue carrying out its regular operations. These are materials which are necessary to undertake the day to day activities in the firm (Zamora, 2016).

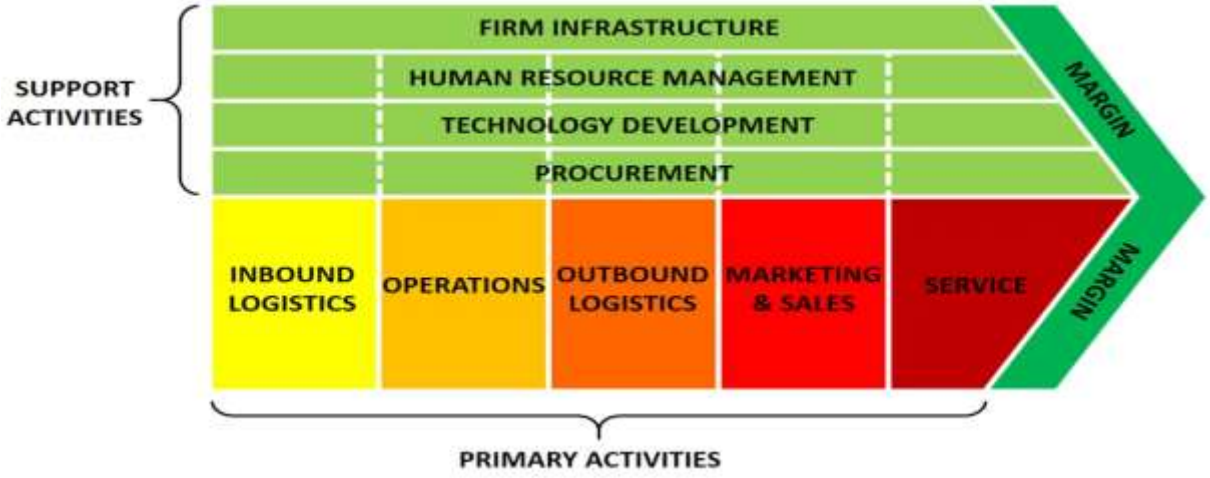

Figure. 2.3 Porters value supply chain model (Simatupang, Piboonrungroj & Williams, 2017).

The value chain may be a useful tool for identifying and elucidating how a corporation manages its competitive advantage. An essential explanation of the nature of competitive advantage in big, complex companies may be found in the interactions between the components of the value chain (Zamora, 2016).

The outbound logistics tasks and difficulties associated with COVID-19 operations are the main subjects of this study. According to Porter's theory, one of the key tasks that must be successfully completed in order to generate revenue and customer satisfaction is outbound logistics. The actions necessary to gather, store, and physically deliver the output are collectively referred to as outbound logistics, according to the theory. As control over distribution strategies is proving to be a major source of competitive advantage in many industries, especially in light of the realization that up to 50% of the value created in many industry chains occurs close to the ultimate buyer, this activity can prove to be extremely important both in generating value and in improving differentiation (Jonikas, 2013).

2.7 Review of Empirical Studies

The declaration of Coronavirus (COVID-19) disease as a public health emergency and the development of novel vaccine candidates will be critical, as will addressing the challenges of cold chain management for storage and distribution. While most vaccines require similar transport and storage controls, some of the innovative COVID-19 vaccine technologies will present additional cold storage and shipping challenges to maintain product stability, with some requiring ultra-low storage temperatures [e.g., -80 to -70 degrees Celsius] to maintain product stability (Reginald, 2020).

COVID-19 vaccines must be kept cold to be safe and effective. Maintaining a steady temperature throughout the supply chain is tough enough as it is, but the shallow temperature requirements for some vaccinations (-70°C) make it considerably more problematic. Within the warehouse, quality control and compliance methods help to ensure that vaccinations are safe and effective. Constant temperature monitors during storage, product labeling, data matching, and ensuring proper paperwork accompanies the vaccine through every step of receiving, storing, picking, packing, and shipping are just a few of the safeguards in place. These vaccines must be kept at freezing temperatures (Singkarin et al., 2021).

The United States' distribution strategy appears to have been heavily focused on the basic tenets of physical distribution, namely transportation, warehousing, inventory, and large-venue mass vaccination sites. The strategy appears to have been successful when only looking at the physical tenets of distribution. The study, however, reveals that the distribution strategy has not either focused on or included main distribution activities such as internal and external communication, information, and customer satisfaction. The resource constraints faced by state and local health organizations, which will be in charge of regulating vaccine distribution, are critical and potentially limiting factors in spreading a COVID-19 vaccine (kim & Youn, 2021).

According to a study conducted in Norway using simulation-based analysis to determine the most effective distribution of COVID-19 vaccines, the fleet size, fleet composition, type of vehicle used, and route optimization can all have a significant impact on the service level, cost-effectiveness, environmental performance, and equity of a cold chain vaccine logistics system. As a result, these aspects must be taken into account in the development of a successful COVID-19 vaccine delivery system (Sun, Andoh, and Yu, 2021).

The factors influencing access to immunizers are unknown, raising questions about which criteria were used in this distribution. Given the preceding, a study from various public databases to investigate the factors influencing different countries' access to the SARS-CoV-2 vaccine has to pin out socioeconomic and the disease's impact in the country is among the determinants considered in COVID-19 vaccine distribution and it must be available to all affected countries, regardless of socioeconomic status (Oliveira et al., 2021).

To investigate the major problems of the COVID-19 VSC, the study combines the decision-making trial and evaluation laboratory (DEMATEL) technique with intuitionistic fuzzy sets (IFS). As a result, the study identifies 15 challenges, with the most serious being a small number of vaccine manufacturing companies, inappropriate coordination with local organizations, lack of vaccine monitoring bodies, difficulties in monitoring and controlling vaccine temperature, and vaccine cost and lack of financial support for vaccine purchase (Alam et al., 2021).

A study conducted in the USA by Bae et al. (2020) have identified several problems with regard to COVID-19 vaccine production and distribution. The cold chain references the necessity for several COVID-19 vaccines to be stored at sub-zero temperatures during both transportation and storage,the need of dry ice in each of these processes, lack of vaccine-qualified, and a lack of proper data monitoring framework to track and evaluate vaccines' transport and storage conditions across multiple countries. In addition, populations which are prioritized for vaccination are not evenly distributed across countries. These can pose a challenge in determining where best to allocate vaccine doses and properly enact that distribution. Therefore, it is a must to develop a vaccination framework to curb the condition.

Experts identified the following potential hitches in the COVID-19 Vaccine Supply Chain in a webinar held by the Supply Resource Chain Cooperative at the Poole College of Management at NC State University on December 16: National security issues, Shortage of personnel, Lack of coordination, Shortage of supplies, Limited capacity, Vaccine damage, Gaps for rural areas and misinformation about vaccines and tracks were identified as the main challenges in the associated vaccine supply chain system (Caroline, 2021) .

The issues of COVID-19 vaccines distribution are diverse, ranging from a lack of infrastructure, insufficient capacity, and limited integration of new technology to poor worker training in the cold chain system. These issues are exacerbated by the storage peculiarities of the Pfizer and Moderna COVID-19 vaccines. In this connection a scholar attempts to compare the capabilities of cold chain workers in Nigeria's various geopolitical zones and provides a concise overview of the cold chain system in neighboring African countries (Oyadiran et al., 2021).

Low-income nations face significant challenges in delivering COVID-19 vaccines due to a lack of cold chain infrastructure and current technologies to monitor the cold chain for vaccine storage, distribution, and transportation, particularly in remote locations. It might lead to inadequate vaccination coverage and, as a result, COVID-19 infection pandemicity in specific locations. Low socioeconomic status, as measured by education, income, and employment, is another issue. These characteristics may have a direct impact on how individuals buy vaccines and accept them. Furthermore, the situation might deteriorate in deserts and distant locations mired in war, instability, and violence. In this scenario, it is predicted that more than 160 million individuals in Yemen, Syria, South Sudan, and Ethiopia are in danger of not receiving the COVID-19 vaccination (Acharya, Ghimire, and Subramanya, 2021).

A study conducted from March to April 2017 in ten districts of the East Gojam zone of Amhara Region assessed the factor affecting vaccine cold chain management practice in immunization. This study indicates that there was a knowledge gap among health workers who are working on cold chain management. There is an urgent need to improve knowledge and practice on cold chain management through improved supervision and training at a different levels of the health care system (Bogale, Amhare, and Bogale, 2019).

A PFSA research discovered issues impacting vaccine supply chain management and identified factors affecting vaccine supply chain management systems, such as insufficient vehicles for vaccine distribution to public healthcare institutions. Lack of on-the-job training, with a focus on vaccine storage, handling, and distribution. In PFSA and PFSA subsidiaries, there is a lack of storage space (Bayeh, 2018).

2.8 Research gap

COVID-19 is one of the few pandemics that has remained an emergency for an extended time. Unlike other modalities, vaccination is one of the most efficient and successful techniques for controlling the spread of pandemics such as COVID-19. EPSS is the only government agency tasked with handling and distributing medications and medical equipment across Ethiopia's several health institutes in both normal and emergencies. Although the COVID-19 vaccine takes less time to produce, immunization rates are lower, particularly in Ethiopia. The COVAX consortium donates the most frequent vaccination in Ethiopia. However, vaccine supply at various health institutions is disrupted, and there is a substantial time gap between successive dose vaccinations (first and second...). This situation causes an increase in outdated vaccines, slowing immunization rates, and increasing financial costs. This study is the first of its sort, and in the instance of Ethiopia, there have been no earlier studies in the field. As a result, examining the practice and challenges of COVID-19 vaccine distribution lays the way for developing essential solutions to the problem and forming effective methods for managing future pandemics. In addition, it adds to the corpus of knowledge in the field.

2.9 Conceptual Framework of the study

Given the research subject under inquiry, a conceptual framework is an argument that the ideas chosen for examination and any predicted links among them would be acceptable and valuable (Lester, 2005). This conceptual framework depicts the primary activities of outbound logistics (transport, warehousing, and inventory management) activity and the challenges encountered.

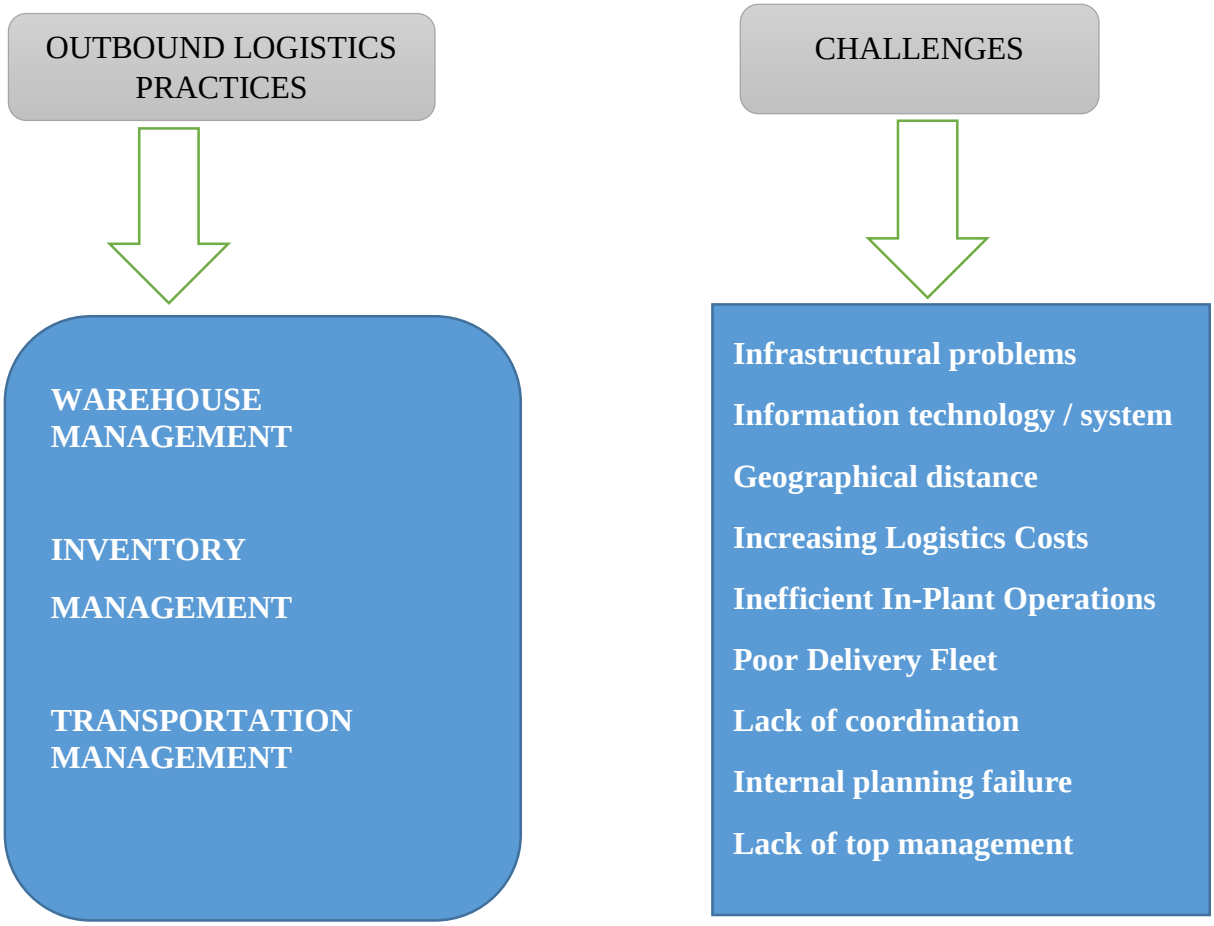

Figure 2.4: Conceptual framework of the study outbound logistics activities (Warehousing, Inventory management, and Transportation) and associated challenges adapted from (Liberatore & Matthew, 2015).

CHAPTER THREE:

METHODOLOGY

3.1 Introduction

This chapter presents the methodology section of the study and consists of the study design, the study sites, the study population and sample size determination, Measures, reliability and validity of the instruments, data collection procedures, data analysis, and ethical considerations.

3.2 Research approach

The researcher employed a mixed-method concurrent approach (i.e., collecting QUAL and QUAN data at the same time). According to Mitchell & Jolley, (2013), mixed design is the most widely used to explain, interpret or conceptualize quantitative and qualitative findings. If one of the methodologies is insufficient to comprehend and appraise the research topic, this combined approach is appropriate. Adequate data from both ways was used to answer the study's overall goal, and data was collected from both sources at the same time to gain thorough analysis of the research problem and interpret the overall outcome.

3.3 Study design

The study design is the blueprint for achieving research objectives and answering research questions. The study was intended to examine outbound logistics practices and challenges of covid-19 vaccines in Ethiopia in the case of the Ethiopian Pharmaceutical Supply Service (EPSS) in Addis Ababa. The purpose of this research is to find out the underlying facts and /or actual circumstances existing within the case organization concerning COVID-19 vaccines distribution management. Therefore, the researcher employed descriptive research design.

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3.3.1 The Study Setting

This research was carried out at the central Ethiopian Pharmaceutical Supply Service (EPSS) in Addis Ababa. The agency was established in 2007 by Proclamation number 553/2007 with the mission of providing economical and high-quality drugs to all public health institutions and ensuring their proper usage. The EPSS head office is located in front of St. Paul Referral Hospital, at Gullele sub-city, Addis Ababa. This organization has 19 branch offices in the country, organized into seven clusters to distribute medications to more than 3,500 public health facilities (EPSA, n.d). The EPSS central office manages 19 warehouses in Addis Ababa.

This organization was selected because it is the only largest government pharmaceutical supplier and stands for forecasting, procurement, warehousing, and distribution of medications across the country.

3.4 Sampling Design

3.4.1. Population of the study

The total population of the technical staffs working at the central Ethiopian Pharmaceuticals Supply Service (EPSS) in the year 2014 E.C (2021/22 GC) is 144. Out of this total population, only those who are experts/ technical and managerial staffs that are directly involved in the main functions of EPSSwere selected. Specifically, the respondents were identified from two directorates (Warehouse and inventory management directorate and Distribution and fleet management directorate**)** of the central EPSS which has a total of 63 employees in these directorates. Therefore, all 63 subjects were used for the study using a census method.

3.4.2 Sample and sampling technique

The target population for this research was defined to be supply chain officers, warehouse managers, storage and distribution officers, team coordinators, storage and distribution directorate directors, and others who were directly related to the subject of the study. Accordingly, a total of 54 subjects were selected to be included in the study using the census method for the quantitative study. For the qualitative study, the primary data were collected through an in-depth interview with 9 participants(i.e. 4 coordinators in warehouse and inventory management directorate supply chain officers, 3 coordinators from distribution and

fleet management, and 2 directors from the two directorates) were selected through purposive sampling and subjective assessment of participants' qualifications, responsibility in the organization, and willingness to provide data.

3.5 Data Source and Types

The researcher employed primary data sources to accomplish the study's aims. Closed-ended questions and semi-structured interview questions were used to acquire primary data from employees of the Ethiopian Pharmaceutical Supply Service. Respondents get questionnaires via a 'drop and pick later' technique and a face-to-face interview. In addition, semi-structured interviews were utilized to interview important agency departments, and questionnaires aid in the best understanding of the problem and achievement of the study goal.

3.6 Research Instruments

The study used two types of measures; the quantitative measure is adapted from previous studies. The second instrument is an interview which is developed by the researcher based on a reading of several kinds of literature that are related to the subject matter. The questionnaires were used to collect quantitative data and Interviews to gather qualitative data. For quantitative measures, a list of Likert-style scale questionnaires was developed. Also, an interview guide was prepared for qualitative data collection.

The interviews address the following issues: background information of the participants; outbound logistics problems and possible solutions; (see annex 1 for the In-depth interview guide and annex 2 for quantitative measures).

For the qualitative study, the primary data was collected through an in-depth interview with 9 participants that were selected through purposive sampling. Also, a close-ended questionnaire was developed and administered to a total of 54 respondents to collect data for the quantitative study. The questionnaire rating scales were in the Likert scale format type.

3.7 Data Collection Procedures

Questionnaires and interviews were used as data collecting strategies in both quantitative and qualitative research methodologies for this study. The interview technique, being a verbal approach, is very useful in obtaining information about a person's past and future behavior, attitudes, perceptions, faiths, beliefs, mental processes, and motives, among other things. In short, a face-to-face interview was conducted to elicit the qualitative data. The interview was conducted by the researcher to get adequate quality data.

"A questionnaire is a mechanism for getting responses to questions by utilizing a form that the responder fills in themselves," according to Bailey (1994). A questionnaire is distributed to a small number of people; its scope is limited, but within that scope, it can prove to be the most successful method of eliciting information if it is well-written and the respondent fills it out completely. A well-designed and conducted questionnaire might be the most relevant and helpful data collection tool. In this study, respondents fill the questionnaires via a 'drop and pick later' technique, that is, the researcher drops the questionnaire at the secretary's office and the respondents fill their responses and finally collect it. and a face-to-face interview

3.8 Methods of Data Analysis

After data collection, the researcher made data screening and cleaning, and analysis using Statistical Package for the Social Sciences (SPSS) version 25. The data obtained were categorized and interpreted according to the research questions.

For quantitative data, the study used descriptive statistics such as mean, standard deviation, proportion, percentage, and tables. For the qualitative data, thematic analysis was employed. To develop themes, the following steps were used: recording the interview (audio-taping), transcribing, coding, categorization, and developing themes. This was carried out manually using the content analysis technique and then presented in form of text. And the themes that were established are interpreted to further explain and support the findings of the quantitative data.

3.9 Validity and Reliability Measures

3.9.1 Validity

The validity, according to Patino and Ferreira (2018) is the degree to which a test measures what it promises to measure. If a measure measures what it claims to measure, it is genuine and the content validity is good. Mahajan (2017) states that the amount to which an instrument's items cover the whole spectrum of significant properties of the issue under research is referred to as content validity. It relates to how well the measurement instrument adequately covers the study's investigative questions. To remain the instruments' validity in this study the majority of the questionnaires were adapted from past studies and a thorough reading of different pieces of literature has been made. In addition, the researcher consulted subject matter experts to check content validity for an existing test to rate each question as "essential," "useful, but not essential," or "not necessary" to the performance of what is being measured, and some Ethiopian pharmaceutical supply service employees were asked to examine and judge the adequacy and appropriateness of the items .

3.9.2 Reliability

Reliability is the extent to which a variable or set of variables is consistent in what it is intended to measure and the rationale for this internal consistency is that the individual items or indicators of the scale should all be measuring the same construct and thus be highly inter-correlated. A high value of the Cronbach alpha coefficient suggests that the items that make up the scale are internally consistent and measure the same underlying construct (Tavakol & Dennick, 2011). The results of the current study reliability indicate a good value (0.851). See the table below.

Table 3.1 Reliability Cronbach's alpha

Reliability Statistics		
Tests	**Cronbach's Alpha**	**N of Items**
COVID-19 vaccines warehouse management practice	0.818	13
Inventory control management practice of covid-19 vaccines	0.803	10
Transportation management practice of covid-19 vaccines	0.814	9
Challenges of outbound logistics of covid-19 vaccines	0.809	8

Source: Own survey (2022)

The Cronbach's alpha coefficient for the 32 items in this study is 0.851 which suggested that each item has relatively high internal consistency. A reliability coefficient of 0.70 and above is considered to be acceptable (Tavakol & Dennick, 2011).

3.10 Ethical Consideration

The study was conducted after obtaining ethical approval from the Addis Ababa University School of Commerce ethical review board and permission from EPSS management.

The researcher then made formal contact with the Director of the EPSS through a letter obtained from the School of Commerce, Addis Ababa University, and give a brief explanation about the objectives of the study and the ethical issues. After an acceptance was obtained from the Director of the organization data collection was performed. The subjects to participate in the study were fully informed about the purpose of the research that participation is fully voluntary and that they were assured about the confidentiality of the information using anonymous personal identifiers.

CHAPTER FOUR

RESULT AND DISCUSSION

4.1. Introduction

This chapter presented the quantitative and qualitative results on examination of outbound logistics practices and challenges of covid-19 vaccines in Ethiopia. Prior to conducting quantitative data analysis, data were cleaned for completeness and consistency, and then entered into the Statistical Package for Social Sciences (SPSS) version 25 for analysis. The data was analyzed using descriptive statistics such as means and standard deviations. Thematic analysis was also employed to describe the qualitative research findings.

A total of 54 questionnaires were administered to the staff of 54 outbound logistics technical staff working at the Ethiopian pharmaceutical supply service main office. The questionnaires were adapted from earlier studies to meet the objective of the study. From the total of 54 administerd questionnaires for the quantitative study, 51 were returned which showed an overall response rate of 94.4%.

4.2. Participants' socio-demographic characteristics

The demographic profile of the sample respondents is presented and analyzed below; the importance of describing this profile is to describe the characteristics of the sample, as the proportion of males and females, age, profession, educational background, work experience, and position of the respondent in the agency.

Table 4.1: Socio-Demographic Characteristics of the participants

No	Items	Description	Frequency	Percentage (%)
1	Gender	Male	31	60.8
		Female	20	39.2
		Total	**51**	**100**
2	Work experience of the respondents'	1-3years	15	29.4
		4-6 years	21	41.2
		7-11years	13	25.5
		Above 11years	2	3.9
		Total	**51**	**100**
3	Educational Qualification	Diploma	1	2
		First degree	38	74.5
		Second degree and above	12	23.5
		Total	**51**	**100**
4	Field of specialization	Pharmacist	32	62.7
		Logistic and supply chain	7	13.7
		Others	12	23.6
		Total	**51**	**100**
5	Current position in the agency	Supply chain officer	11	21.6
		Ware house manager	9	17.6
		distribution officer	15	33.2
		Inventory officers	12	23.5
		Marketing manager	1	4.1
		Total	**51**	**100**

Source: Own survey, 2022

In this research, a total of 51 Ethiopian pharmaceutical supply service main office outbound logistics department staff were involved. The age range falls between 32 – 51 years.

The gender distribution of respondents showed 60.8% male and 39.2% female. The minimum age of the respondent is 23 and the maximum 51 with a mean age of 37. This showed that the majority of the employees working in the agency are at their productive age. At this younger age employees are active so that their contribution to the development of the agency will be high and the agency to be benefitted much from them.

Regarding respondents work experience in the agency, 29.4% (#15) have 1- 3 years work experience, 41.2% (# 21) 4- 6 years, 25.5% (#13) 7- 11 years, and 3.9% (# 2) have above 11 years work experience. From the above information, the majority of the respondents have

four years and above of work experience in the agency which enables the researcher to get adequate information about the research problems as participants have rich experiences in this regard. Additionally, because COVID-19 is an emergency, their professional expertise will enable them to fill the supply chain for these vaccines in a more efficient and effective manner. Regarding the educational qualification of respondents, 74.2% (# 38) were first-degree holders and 23.5% (#12) second degree and above. This shows that most of the respondents in the agency are educationally competent and qualified to perform their tasks.

The field of specialization of the study participants was examined. Accordingly, 62.7% (#32) of the respondents were pharmacists, 13.7% (#7) MA in logistics and supply chain management, and 23.6% (#12) were laboratory professionals and biomedical engineers. Regarding to this, majority of the staff are pharmacists, allowing them to handle these vaccines more efficiently and effectively because they are more familiar than any other specialists with these medicinal items. Furthermore, the respondent's occupational status (position) indicates that 21.6% (#11) were supply chain officers, 17.6% (#9) warehouse managers, 33.2% (#15) distribution officers, 23.5% (#12) inventory officers, 4.1% (#1) marketing manager, and the remaining 5.9 % (#3) worked as UNICEF assigned officers.

Four coordinators from the warehouse and inventory management directorate, three coordinators from distribution and fleet management, and two directors from the two directorates were chosen as interview participants.

4.3. Outbound logistics practice of COVID-19 vaccines

To analyze the raw data on the outbound logistics practices of COVID-19 vaccines including warehouse management, inventory management, and transportation management mean and standard deviation scores were computed. A total of 32 questions were developed. In each of the variables 13, 10, and 9 questions were constructed for warehouse management, inventory management, and transportation management respectively. Thus, those participants who scored above the group mean are considered as there is good outbound logistics practice and those who scored below the group mean are considered as there is a low level of the outbound logistics practice regarding COVID-19 vaccines.

The outbound logistics practices of COVID-19 were measured as follows: 1= strongly disagree; 2= disagree; 3= neutral; 4 = agree; 5=Very strongly agree. The scores of strongly disagree have been taken to represent a variable that had a mean score of 1 to 1.8, the scores of disagree have been taken to represent a variable with a mean score of 1.81 to 2.60, the score of neutral have been taken to represent a variable which had a mean score of 2.61 to 3.40, the score of agree have been taken to represent a variable which had a mean score of 3.41 to 4.20 and the score of strongly agree have been taken to represent a variable which had a mean score of above 4.21 to 5.00. According to Sözen & Güven (2019) the standard deviation of >0.9 implies a significant difference on the impact of the variables among respondents.

(Note: SD- strongly disagree, D -disagree, N-neutral, SA–strongly agree, F-Frequency, M-Mean, SD-Standard Deviation)

4.3.1. Warehouse Management Practice

Table 4.2: warehouse management practice

	Warehouse management practices	**Likert's rating score**						
		SD F (%)	**D F (%)**	**N F (%)**	**A F (%)**	**SA F (%)**	**M**	**SD**
1	Covid-19 vaccines are arranged with arrows	0(0%)	0(0%)	1(2%)	29(56.9%)	21(41.2%)	4.39	.532
2	Covid-19 vaccines Are stored at the appropriate temperature	0(0%)	0(0%)	0(0%)	32(62.7%)	19(37.3%)	4.37	.488
3	Backup source of power are available	0(0%)	5(9.8%)	7(13.7%)	26(51%)	13(25.5%)	3.92	.890
4	The floor is convenient for movement	0(0%)	1(2%)	18(35.3%)	26(5%)	6(11.8%)	3.72	.695

5	Sufficient number of staffs run warehouse	11(21.6%)	25(49%)	9(17.6%)	5(9.8%)	1(2%)	2.21	.965
6	Onsite training on warehouse management are conducted	2(3.9%)	17(33.3%)	17(33.3%)	11(21.6%)	4(7.8%)	2.96	1.019
7	Fire safety equipment is available	0(0%)	4(7.8%)	6(11.8%)	34(66.7%)	7(13.7%)	3.86	.748
8	Security controlling system is available	6(11.8%)	24(47.1%)	7(13.7%)	10(19.6%)	4(7.8%)	2.64	1.163
9	Staffs are assigned to handle maintenance	0(0%)	10(19.6%)	5(9.8%)	26(51%)	10(19.6%)	3.70	1.00
10	Temperature records are reviewed once a month	0(0%)	0(0%)	6(11.8%)	36(70.6%)	9(17.6%)	4.05	.544
11	Trained staffs review temperature logs weekly	1(2%)	5(9.8%)	11(21.6%)	26(51%)	8(15.7%)	3.68	.927
12	SOP are available for covid-19 vaccine management	0(0%)	4(7.8%)	27(52.9%)	14(27.5%)	6(11.8)	3.43	.806
13	Sufficient equipment's are available to facilitate ctivities	2(3.9%)	25(49%)	16(31.4%)	4(7.8%)	4(7.8%)	2.66	.972
Group mean							***3.51***	

Source: Own survey, 2022

Table 4.2 indicates the Warehouse management practice of covid-19 vaccines. There are thirteen items used to determine the practice of warehouse management. Accordingly, the mean values of each of the items were calculated and the minimum mean were 2.21 and the maximum 4.39, and the minimum and maximum standard deviations were 0.532 and 1.163 respectively. And, the group mean was 3.51 which indicates good performance. This indicate the existence of good storage practice, which is critical and basic activity to the implementation of subsequent activity in outbound logistics cycle.

In addition, the respondents were asked to quantify their level of perception regarding each item in warehouse management practice of COVID-19 vaccines of the agency. Among the warehouse management activities, COVID-19 vaccines are stored at appropriate temperature was found to be in a leading activity with a mean score and standard deviation as shown here (M=4.37, SD=0.488). The mean score indicates good practice of the agency. The statement; Covid-19 vaccines are arranged with arrows pointing upward was rated second with a mean (M=4.39) and standard deviation of (SD=0.321) which indicate good practice of the agency. The next activity statement relates to temperature records reviewed once in a month and the recorded mean and standard deviation (M=4.058, SD= 0.544) showed good practice.

The remaining statements have the following mean and standard deviation: backup source of power are available (M=3.92, SD=0.890), fire safety equipment is available ((M=3.86, SD=0.748), the floor is convenient for movement (M=3.72, SD=0.695), staffs are assigned to handle maintenance (M=3.70, SD=1.00), and trained staffs review temperature logs weekly (M=3.68, SD=0.927). The mean of the above variables showed good level of practicability as per the suggestion of Sözen & Güven (2019). Similarly, the following statements have the mean and standard deviations as follow: on site training on warehouse management are conducted (M=2.96, SD=1.019), security controlling system is available (M=2.64, SD=1.163) and sufficient equipment's are available to facilitate activities (M=2.66, SD=0.972). These showed moderate level of practice. Finally, items on sufficient number of staffs run warehouse were rated with a minimum mean (M=2.21) and SD=0.965, which indicate poor level of practices.

The quantitative findings of the study were in line with the qualitative findings. The warehouse management practice was scored with the group mean of 3.51 in quantitative data while the predicted mean value is between 3.41-4.20. In this finding the warehouse management approach is good. Similarly, the qualitative data indicated that participants in the interview stated that there were adequate storage units in the main office initially and additional the ultra-cold chain installed for the Pfizer vaccines with the support of UNICEF. Except for Pfizer's COVID-19 vaccine, the majority of vaccines require a storage place at room temperature, and the already existing warehouses are sufficient to handle COVID-19 vaccines. In support of this idea, participant (1) had to say the following in relation to the theme "sufficient warehouse availability":

> Regarding the vaccine warehouse management, the agency has enough storage space for vaccines that require room temperature storage. A vaccine arrival report will be given to the institution after a vaccine arrives at the airport. Then we'll set up storage areas. For the Pfizer vaccine, a new ultra-cold chain was built, while the other vaccines are being maintained in the current storage rooms. Following that, based on the breakdown obtained from the federal ministry of health, distribution is carried out.

The overall practice of the warehouse management is good based on the quantitative and qualitative findings. Despite that there are few challenges observed. These include lack of vaccine vial management (VVM) is a problem to the agency, since the products are new there is no quality tracking tool. Participant (2), elucidated the practice undertaken in the warehouse in the following way:

> All covid-19 vaccines except Pfizer were stored with other routine vaccines like TB, and malaria. Since the vaccines lack VVM we boost communication to better speed up vaccination before failure on the quality of the products.

In connection to this Alam et al., (2021) argued that one of the challenges experienced in the distribution of COVID-19 is the lack of vaccine monitoring units and difficulty in monitoring and managing vaccine temperature.

Another major theme was lack of sufficient store house manager. In support of this idea participant (3) has stated in the following way:

> In the instance of the covid-19 warehouse, there is now just one person in charge.There used to be two, but owing to theft, there is now just one. However, if the person becomes ill, such a situation might produce problems in the system.As a result, we continue to mobilize personnel from other units to cover in the event of an emergency.

The most prevalent problems in the distribution of COVID-19 vaccinations, according to research done by Acharya, Ghimire, and Subramanya, (2021), include a lack of cold chain infrastructure, insufficient training, and labor scarcity.

4.3.2. Inventory management practice

Table 4.3: Inventory management practice

	Inventory management practice	**Likert's rating score**						
		SD F (%)	**D F (%)**	**N F (%)**	**A F (%)**	**SA F (%)**	**M**	**SD**
1	Nearly expired and overstocked COVID-19 vaccines are istributed	2(3.9%)	16(31.4%)	11(21.6%)	16(31.4%)	6(11.8%)	3.15	1.120
2	Logistics records are in warehouse to track COVID-19 vaccines	0(0%)	1(2%)	3(5.9%)	22(43.1%)	25(49%)	4.39	.695
3	COVID-19 vaccine sufficiency reports are signed by relevant EPI	0(0%)	0(0%)	2(3.9%)	24(47.1%)	25(49%)	4.45	.576
4	Designated staff report and update vaccine	0(0%)	0(0%)	2(3.9%)	27(52.9%)	22(43.1%)	4.39	.568

	management system							
5	COVID-19 vaccines are organized in FEFO	0(0%)	0(0%)	7(13.7%)	22(43.1%)	22(43.1%)	4.29	.701
6	The facility is supervised by national program of immunization	0(0%)	1(2%)	6(11.8%)	24(47.1%)	20(39.2%)	4.23	.737
7	COVID-19 vaccines are checked for expiry date at the beginning and end of month	0(0%)	5(9.8%)	1(2%)	25(49%)	20(39.2%)	4.17	.887
8	Stocks damages, losses, errors and discrepancies are reported	0(0%)	0(0%)	5(9.8%)	27(52.9%)	19(37.23%)	4.27	.634
9	COVID-19 vaccine dispatched are updated in bin cards and stock cards	1(2%)	4(7.8%)	1(2%)	30(58.8%)	15(29.4%)	4.05	.903
Group mean		***4.153***						

Source: Own survey, 2022

The above table indicates the mean value of each of the items and the group mean of the inventory management practice of COVID-19 vaccines. Accordingly, the mean value of each item is scored between 3.5 and 4.5, with group mean value of 4.15. Except for the statement nearly expired and overstocked covid-19 vaccines are distributed to health facilities, the rest of the items were graded between the mean value of 4.05 and a maximum of 4.45. According to Sözen & Güven, (2019), expected mean value between the range of 3.41 and 4.20 indicate

good practice. The overall practice of inventory management showed good practice. However, one variable has shown low performance which is expired and overstocked covid-19 vaccinations (M=3.15, SD=1.120).

Based on the results shown above the inventory management practice of COVID-19 vaccines is good because the group mean value obtained with respect to the practice is 4.15, which is above the average mean.

Coming to the qualitative result, respondents were transparent to disclose the inventory management practice of COVID-19 vaccines. They discussed several activities undertaken regarding the inventory management of covid-19 vaccines. After the transcription of the data and subsequently made coding and categorization, the following theme was identified: quantification performed by the Federal Ministry of Health. In line with this participant (6) has shared his view as follows:

> The entire stock level is reported to the ministry of health regularly.Within the ministry, some groups keep track of stock levels. Vaccines are provided in accordance with instructions issued by the Ministry of Health during a campaign.When the ministry's only distribution plan is available, inventory activity is carried out.

In addition, a participant (9) has said the following;

> The Ministry of Health is in charge of inventory management. Every month, we send our end balance to the ministry, and the ministry will organize a campaign based on the statistics. In general, the ministry of health is solely responsible for inventory management. We have gotten a significant supply of vaccinations, but we are not using them properly, which is a difficulty for management.

The mean response score for warehouse and inventory management was somewhat higher than predicted. As a result, respondents thought the COVID-19 vaccinations' two key tasks were well-executed.

4.3.3. Transportation management practice

Table 4.4: Transportation management practice

No	Transportation management practice	Likert's rating score						
		SD F (%)	D F (%)	N F (%)	A F (%)	SA F (%)	M	SD
1	Sufficient vehicles fitted with refrigerators are available	16(31.4%)	29(56.9%)	3(5.9%)	3(5.9%)	0(0%)	1.86	.775
2	Sufficient vaccine containers are available	1(2%)	25(49%)	11(21.6%)	14(27.5%)	0(0%)	2.74	.890
3	SOP are available at the facility during transportation	2(3.9%)	15(29.4%)	22(43.1%)	9(17.6%)	3(5.9%)	2.92	.934
4	Temperature are documented every 30 minute during COVID-19 vaccine transport	0(0%)	5(9.8%)	23(45.1%)	23(45.1%)	0(0%)	3.35	.657
5	Designated staffs ensure temperature is maintained at transportation	0(0%)	7(13.7%)	13(25.5%)	28(54.9%)	3(5.9%)	3.52	.808

6	Vehicles are equipped with self-sustained diesel refrigerator unit	5(9.8%)	10(19.6%)	21(41.2%)	13(25.5%)	2(3.9%)	2.94	1.008
7	GPS is placed on vehicles	7(13.7%)	23(45.1%)	11(21.6%)	9(17.6%)	1(2%)	2.49	1.007
8	The drivers know the required temperature to be maintained	5(9.8%)	25(49%)	14(27.5%)	7(13.7%)	0(0%)	2.45	.855
9	There is a temperature monitoring system during transportation	9(17.6%)	8(15.7%)	29(56.9%)	5(9.8%)	0(0%)	3.58	.898
Group mean								**2.88**

Source: Own survey, 2022

As table 4.4 above depicts**,** there are nine items used to determine the COVID-19 vaccines transportation management practice in the agency. Accordingly, the mean value of each item is between 1.86 to 3.58, and the group mean was 2.88, with a comparable standard deviation of 0.775 and 0.898.

According to Sözen & Güven (2019), a mean score of 1.81-2.60 is deemed low practice. Still, Sözen & Güven argues that a mean score of 2.61-3.40 show good practice.

Some of the measuring items such as the drivers are aware of the appropriate temperature had the mean value 2.45 and SD=0.855 and GPS installed on cars showed the mean value of 2.49, and SD=1.007. This indicates poor practice.The statements Sufficient vaccine containers are available, SOP are available at the facility during transportation, and vehicles are equipped with self-sustained diesel refrigerator unit, had the following mean and standard

deviations respectively (M=2.74, SD=0.980), (M=2.92, SD=0.934), and (M=2.94, SD=1.008). These values indicate moderate practices. On the other hand, the following statements, there is a temperature monitoring system during the transit of covid-19 vaccinations, designated staffs guarantee temperature is maintained and temperature is logged every 30 minutes has received a mean score of (M=3.58, SD=0.898), (M=3.52, SD=0.808), and (M=3.35, SD=0.657), respectively. This demonstrates the proper procedure. Finally, one item of the transportation practice of COVID-19 vaccines, sufficient vehicles equipped with freezers are available, obtained a lower score (M=1.86, SD=0.775). This, indicate a higher rate of disagreement.

Coming to the qualitative results, the findings obtained were consistent with the quantitative results. Participants had disclosed several challenges regarding transportation management. One of the themes was the lack of sufficient cold vans with self-sustained diesel refrigerators. Regarding this, the participant (5) has expressed the following:

> We control the transportation system by holding Zoom meetings or sending letters to regional hubs requesting the use of their refrigerated vans for distribution. This is a crucial component that influences the hubs' actions in the vaccine distribution to health institutions. Simply said, a lack of refrigerated vans is a significant barrier in the distribution of covid-19 vaccinations.

According to a study conducted in Norway by Sun, Andoh, and Yu, (2021), the effective distribution of COVID-19 vaccine is determined by, the fleet size, type, and the number of vehicles which have a significant impact on the service level, cost-effectiveness, environmental performance, and equity of a cold chain vaccine logistics system.

The other major theme is the use of temperature loggers during transportation. Regarding this, the participant (4) has said the following:

> Because there is no vail vaccine monitoring, it is extremely difficult to assess the quality of vaccines throughout transit and warehousing. During shipping, we employ a temperature logger to keep track of the vaccinations' temperature range. Then we check to see if the vaccinations are being carried out at the proper temperature. This procedure is repeated until the product reaches the hubs. We also

give the hubs instruments to monitor the temperature when the vaccinations are being delivered to health institutions. Due to a scarcity of cold vans, the Pfizer vaccination temperature will be reduced to the normal range of 2-8 degrees Celsius. However, this method cut the vaccine's shelf life, from 90 to 31 days.

Finally, the interview findings and the mean value related to the warehouse and inventory management were good. However, the data indicated that transportation management practices were lower.

4.4. Challenges of outbound logistics practices of COVID-19 vaccines

Challenges hindering the practice of outbound logistics of COVID-19 vaccines in the agency are presented and discussed below

Table 4.5: Challenges for effective outbound logistics of COVID-19 vaccines

No	Challenges for effective outbound logistics of COVID-19 vaccines	Likert's rating score						
		SD F (%)	D F (%)	N F (%)	A F (%)	SA F (%)	M	SD
1	Insufficient warehouses for covid-19 vaccines	16(31.4 %)	29(59.9%)	3(5.9%)	3(5.9%)	0(0%)	1.8 6	0.77 5
2	Inventory fluctuation due to inaccurate information sharing	1(2.0%)	6(12.2%)	8(16.3%)	28(57.1 %)	10(18.4 %)	3.7 8	.944
3	Shortage of manpower to run physical distribution activities	1(2.0%)	6(12.2%)	8(16.3%)	28(57.1 %)	10(18.4 %)	3.7 8	.944
4	Lack of Top management support	15(30.6 %)	27(55.15 %)	12(24.5 %)	3(6.1%)	0(0%)	1.8 8	.682

5	Lack of training regarding covid-19 vaccines management	10(20.4 %)	30(61.2%)	2(4.1%)	7(14.3%)	2(4.1%)	2.2 3	1.05
6	Lack of sufficient and Functional cold chain vehicles	20(39.2 %)	25(49%)	5(9.8%)	1(2%)	0(0%)	4.1 7	.887
7	Inadequacy of material handlingequipme nt in warehouses	31(63.3 %)	13(26.5%)	4(4.1%)	3(6.1%)	0(0%)	1.5 8	.875
8	Poor coordination with stakeholders	4(4.1%)	9(18.4%)	19(38.8 %)	16(32.7 %)	3(6.1%)	3.2 5	.997
	Group mean						**2.74**	

Source: Own survey, 2022

As shown in Table 4.5, the respondents were asked to rate the degree of their awareness regarding barriers to effective outbound logistics of COVID-19 vaccines at the agency's main office. There were list of eight items used to identify the most common barrier that hinders effective implementation of outbound logistics practice in the agency. Accordingly, the mean values of each of the items were calculated between 1.58 and 4.17, with an average group mean value of 2.74. When Item by item analysis was made inventory fluctuation due to inaccurate information sharing item indicated the mean (3.78) and standard deviation (0.944). Likewise Shortage of manpower to run physical distribution activities had the mean (3.784, and SD = 0.944). Still, poor coordination with stakeholders had a mean (of 3.25, and SD=0.99). Finally, lack of training regarding COVID-19 vaccines management and lack of sufficient and functional cold chain vehicles respectively had mean value and standard deviation (M=2.23, SD= 1.05) and (M = 4.1765, SD = 0.8878). The findings from the above table are partly in agreement with the literature. For example, Allan, (2013) said the main Supply Challenges of African countries are poor information, communication and consumption data, inadequate storage facilities, and Inventory fluctuation.

The qualitative findings were consistent with the quantitative results. One of the major challenges is a shortage of manpower. In this regard, the participant (2) stated the following:

> The warehouse is currently handled by a single individual. There were two workers assigned to the warehouse. Among these one was arrested for stealing, and the current warehouse manager now prefers to work alone for safety reasons. However, such circumstances might pose issues in the system because if the individual becomes absent from work because of different reasons or sickness, the warehouse's system would be affected.

Similarly, the participant (4) also said the following:

> In terms of human resources, the system faces a serious issue in the form of a warehouse manager shortage. However, we are attempting to address the issue by shifting personnel from other units, which has a significant impact on other service areas. Even yet, this did not give us the best alternative for resolving the matter. There is also continuous discussion among department heads about reporting the problem to the human resources department and the federal ministry of health.

The other major theme is the lack of coordination between EPSS and MoH. In this regard participant (1) has said the following:

> It is critical to improving collaboration between the agency and the ministry. The breakdown for a campaign is always provided by the Ministry of Health, which specifies that this amount of goods must be delivered to this hub and so on for a campaign to take place. The report, however, is behind schedule. For better and more effective distribution, the breakdown must be available before a month or fifteen days. Similarly, the failure may compel us to supply the product within three days. As a result, the amount may be lower or greater, resulting in increased shipping costs, time lag, and other issues.

According to Oyadiran et al., (2021), the issue of covid-19 vaccines distribution is diverse, ranging from a lack of infrastructure, and limited integration with stakeholders including new technology in the cold chain system

Similarly, participant (7) also mentioned the challenge in this regard as follows:

> As we all know, the federal ministry of health is in charge of covid-19 inventory management. The ministry of health receives a monthly report on the vaccination supply status. Following that, the ministry of health plans a campaign based on the findings.The ministry is responsible for the overall quantification. Most of the time, the quantification report is sent to us late, which makes distribution difficult. This is because the warehouses, even those located within the main office, are dispersed. As a result, time was wasted gathering the required amount from each storage unit.

Furthermore, all of the interviewers stressed the point that there is a shortage of cold vans and it was summarized as follows:

This is one of the most significant challenges we are now facing. The majority of the vehicles need maintenance and are insufficient to carry out the transportation procedure efficiently. To handle the problem, we conduct zoom meetings with hub managers and issue request letters to recover vehicles located at various hubs. This has an impact on the hub's normal operations. We are in charge of transporting the items to the hubs, who will then distribute them to the health institutions. The distribution procedure to the health facilities would be hampered if they use their automobiles.

Finally, the qualitative result also showed that security issues and customer preferences were also other major challenges in the distribution of COVID-19 vaccines. According to Acharya, Ghimire, and Subramanya, (2021), mired in war and instability, and violence is considered the most deteriorating factor in the distribution of COVID-19 vaccines.

According to the respondent (8);

> The country's security and political situation have made the distribution of covid-19 vaccines and other health supplies extremely difficult. In this situation, the agency will employ air transportation, which will cost a substantial amount of money. On the other hand, for road-transported vaccines in places where security is a concern, vehicles spend much too much time on the road and use alternate routes for distribution, which is both expensive and time-consuming.

Regarding customer preference participant (1) has said the following:

> Following the delivery of vaccines to health institutions by the hubs, consumer preference for vaccines leads to stock return, which costs too much money and considerably increases the number of expired products. The majority of people choose Pfizer and Astra Zeneca vaccines, and they have a greater turnover rate. As a result, this situation can be a cause of the slower immunization rate within the country.

Regarding to the leanness of the outbound logistics of COVID-19 vaccines management according to the qualitative result, 4% of the participants revealed it to be smooth. For instance, in connection to this, participant (9) said the following;

> The outbound logistics operation is completed flawlessly. Because it is an emergency, immediate action is required. From port approval through distribution, a case team has been formed to manage the process. Starting with the preparation of warehouses when new vaccines arrive, to distribution documentation and transportation arrangements, the operations are quite quick. For product data generation, we utilize HMIS (health management information system). The goods will then be stored in EPSS, and a periodic report will be provided to the Ministry of health. The ministry will give us instructions on the amount and type of vaccine to distribute. The vaccines, along with other bundles such as syringes, safety boxes, coveralls, and other items, will be gathered and sent to the distribution directorate via stock transfer voucher (STV). The distribution directorate will then transport the vaccines, along with other bundles to the intended hubs. The hubs will ensure that the items are received and returned to the EPSS main office using good receiving vouchers (GRV).

Similarly, the participant (8) also said the following:

> All of the operations involved in outbound logistics for covid-19 vaccinations are intricately linked.The federal ministry of health, as well as other donors like as UNICEF and GAVI, oversee the entire process (global alliance for vaccines and immunization).The federal ministry of health has a group of professionals tasked with overseeing all of the agency's activities.EPSS provides a summary report on

the COVID-19 vaccine stock status level on a regular basis, and the federal ministry of health provides quantification of the vaccinations, showing the number of vaccines and distribution regions, which EPSS aggregates and transmits to the hubs.The most prevalent difficulty that EPSS is now facing is transportation management, namely a scarcity of refrigerated trucks.International organizations such as UNICEF and GAVI will help to simplify the process by contributing money and renting automobiles for the vaccine program.

CHAPTER FIVE

SUMMARY OF KEY FINDINGS, CONCLUSION, AND RECOMMENDATION

5.1. Introduction

The study was carried out to examine the practice and challenges of the outbound logistics of COVID-19 vaccines in the Ethiopian pharmaceutical supply service main office (EPSS). This chapter presents the summary of the findings, conclusions, and recommendations. .

5.2. Summary of Key Findings

The warehouse management practice of COVID-19 vaccines at EPSS was good, with a group mean of 3.51. A mean result in the range of 3.41- 4.20 suggests good performance, according to Sözen & Güven (2019). As in the quantitative results, the qualitative result also disclosed that there is a strong management of the vaccines at the warehouses. According to the qualitative finding, 100% of the interviewees responded that, sufficient warehouse cold chain equipments are avilaible only with the installation of ultra-cold freezers for vaccines like Pfizer with support form UNICEF and GAVI.

In terms of inventory management for covid-19 vaccines, the overall procedure is satisfactory. According to the quantitative result, the predicted group mean value is 4.15, which is within the mean range of 3.41- 4.20, indicating good practice. The qualitative result also revealed that the inventory management procedure is effective. According to one of the primary themes from the qualitative results, inventory management is under the Ministry of Health's jurisdiction. 90% of the participants responded that distribution of COVID-19 vaccines were carried out according to the quantification plan provided by the ministry.

Another critical task in outbound logistics is transportation management. According to the quantitative results of this study, the transportation management approach for COVID-19 vaccines was not adequate. The scarcity of refrigerated cars is a severe issue, with an estimated mean (M=4.17, SD= 0.887). Similarly, all of the interviewees said that lack of refrigerated

vehicles is a big challenge in the distribution of the vaccines with all vaccines being carried between 2 and 8 degrees Celsius, reducing the half-life and effectiveness and producing negative impacts on consumers. In addition, the distribution system has been established from the EPSS head office to hubs, woredas, and health facilities. It demonstrates that the hubs vehicle shortage will impact the distribution of health commodities to health institutions.

The following are the key issues encountered during the outbound logistics of COVID-19 vaccines at EPSS mian office. One of the major challenge is shortage of manpower at the warehouses with a mean value of (M= 3.78, SD= .944). The qualitative result revealed that training opportunities are scarce. Based on the quantitative findings of training opportunities, the predicted mean value was (M=2.96, SD= 1.101) which indicates below the average mean. In addition, the qualitative findings also highlighted that the warehouses within the central office are dispersed, making it difficult to gather appropriate quantities of supplies during campaigns and costing too much time in emergencies according to 70 % of the interviewees.

Qualitative result also demonstrated that, security concerns lack of VVM, and inventory volatility is another topic of concern. In addtiton to this, the quantification is only done during a campaign, limiting the items' accessibility across the board. Thus, combining and distributing the COVID-19 vaccines with other vaccines is critical in cost and accessibility.

5.3. Conclusion

The aim of the current study was to examine at the outbound logistics practice of COVID-19 vaccines at EPSS and challenges that are barrier to pacticing successful outbound logistics. On the basis of the findings of the study, the following conclusions have been made.

The study disclosed that the COVID-19 vaccines warehouse and inventory management of the organization is good. Transportation management is another important aspect of outbound logistics. The transportation management of COVID-19 vaccines is moderate. One of the biggest hindrance is the unavailability of sufficient refrigerated cars. This made the on-time product delivery impossible and forced the agency to gather trucks from other hubs, affecting the service they provided.

The integration among the major activities in the outbound logistics is good according to the qualitative findings of the study. However, the transportation management must be inline with inventory and warehouse activities.

The quantitative as well as the qualitative findings of the study also demonstrate the challenges that hinders effective distribution of the COVID-19 vaccines in EPSS main office. The challenges includes, delayed quantification report from the federal ministry of health, the dispersion of warehouses of the agency, security concerns of the country, the distribution of the avccines being heavily relient on campaigns, shortage of human resource and separate use of reporting system for the avccines are among the challenges for the agency that may contribute in the delayed vaccination process of the country.

5.4.Recommendations

The following suggestions are given based on the study findings.

- Shortage of manpower in some sections of the EPSS have been realized. It is adviseable to recruit additional skilled staff members, and provide on job training on cold chain for those working in the organization.

- The EPSS needs to establish good coordination and work alliance with the Ministry of Health of Ethiopia in order to make the distribution process more efficient, effective, and timely. For successful product distribution, the ministry of health must quantify the items and transmit them to the EPSS on time.

- EPSS must use a last-mile distribution strategy to reach clients and exclude third parties such as woreda from the COVID-19 vaccine supply chain. This technique aids in the transportation of goods from a nearby distribution center to their final destination. Implementing such solutions in an emergency will cut transportation costs and lag time.

- Transportation management needs to be equipped with sufficient refrigerated vehicles for effective and efficient transportation.

- It is better if the distribution process is outsourced and the main focus of EPSS to be warehousing products in general at appropriate temperature.

- EPSS supply chain does not include varieties of vaccines to distribute altogether simultaneously. This means that the vaccines for tuberculosis, malaria, and other diseases are supplied/distributed separately. The cost of transportation is expensive if the organization dispatches different types of vaccines separately. Because the Integrated Pharmaceutical Logistics System (IPLS) is particularly efficient inside the agency, covid-19 vaccines can be delivered and the reachability of the goods may be increased by using a single report with many items.As a result, it is preferable to include covid-19 vaccinations in a normal program to enhance availability and accessibility.

- Last but not least, it is preferable to build an emergency response supply chain for future emergency situations, as it may be difficult to handle with only the Ministry of Health, Ethiopian Airlines, EPSS, and EPHI.

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ANNEX

ANNEX-1 Written consent form

Addis Ababa University

School of Commerce

Department of Logistics and supply chain management

I'mAbiye Assefa Berihun, a postgraduate (MA) student at Addis Ababa University, School of Commerce, Department of Logistics and supply chain management. As a partial fulfillment for the degree in logistics and supply chain, I am conducting a research entitled **"examination of outbound logistics practices and challenges of covid-19 vaccines in Ethiopia: the case study of the Ethiopian pharmaceutical supply service (EPSS) main hub"**. The study aimed at identifying the challenges and finding possible solutions.

An in-depth interview is prepared to gather the information. Participating in the interview is fully voluntary and the information you provide will be kept confidential. Audio-tape will be used to record the interview along with note taking to collect the information. Personal identifiers will not be used to ensure participants' anonymity and keeping confidentiality of information gathered is assured; there would be no direct individual benefits expected from participating in the study but rather that the findings from the study would help the improvement of the organization. Thank you.

Instruction: the following interview questions are intended to collect information from the study participants regarding the current outbound logistics practices and challenges of covid-19 vaccines at EPSS main Hub.

Code no: _____

1. Name of the Interviewer: _____
2. Date of interview: _____
3. Place of interview: _____

The first section contains questions about the background information of participants and the second part consists of the main questions regarding the study

Part 1: Demographic characteristics of the participants

1. Gender A. Male B. Female
2. Age: _____(in years)
3. Profession: _____
4. Academic qualification: _____
5. Job Position in the organization: _____
6. Work experience: _____ (in years)

Part 2: Interview Questions

1 What are the warehouse management practices of COVID-19 vaccine with regard to the legal framework, human resources, infrastructure, budget, and reporting system?

2 What are the inventory management practices of COVID-19 vaccines in the organization?

3 What are the transportation management practices of COVID-19 Vaccines at EPSS main Hub mainly related to? Diversion and leakage, distribution, and track vaccine shortage.

4 In your opinion, what other best distribution channels to be followed to get closer to the end users regrding to COVID-19 vaccines?

5 In your opinion, what challenges are there in the outbound logistics (warehousing, inventory management and distribution) of COVID-19 vaccines at EPSS main Hub and what measures are undertaking by EPSS to overcome the challenges?

6 What could be your possible suggestions to improve the current outbound logistics system (warehousing, inventory management and distribution) in the country in relation to COVID-19 vaccines?

"END OF INDEPTH INTRERVIEW GUIDE"

ANNEX –II : QUESTIONNAIRE TO BE FILLED BY THE RESPONDENTS

ADDIS ABABA UNIVERSITY

SCHOOL OF COMMERCE

DEPARTMENT OF LOGISTICS AND SUPPLY CHAIN MANAGENMENT GRADUATE PROGRAM

Dear respondents, my name is Abiye Assefa Berihun., The purpose of thisquestionnaire is to gather data on the practices and challenges affecting the outbound logistics of COVID-19 vaccines in EPSS as a partial fulfillment of the University's (Addis Ababa University) requirement for a Masters Degree in Logistics and supply chain Management. The study ispurely for academic purpose. Therefore, I kindly requestyou to fill the questionnaire carefully.

General Instructions

- ✓ There is no need of writing your name
- ✓ Indicate your answer with a check mark (✓) on the appropriate block/cell both for multiple choice and Likert scale questions.

Questionnaires are used to assess the practices and challenges that affect the outbound logistics of COVID-19 vaccines at Ethiopian Pharmaceutical Supply ServiceAddis Ababa Main Hub

Code No……

Name of the organization..……..

Dear study participant,

The purpose of the research is to investigate the "**examination of outbound logistics practices and challenges of covid-19 vaccines in Ethiopia: the case study of the Ethiopian pharmaceutical supply Service (EPSS) main hub"**. The success of the study highly depends on your genuine response for the items in this questionnaire. Assuring you that the response you provide will be kept confidential and are used only for research purpose, I kindly ask your cooperation in filling the questionnaire honestly and completely.

SECTION I: GENERAL INFORMATION OF THE RESPONDENTS

1. **Sex:**
   A. Male B. Female
2. **Age**:_____
3. **Year of work experience in the organization:**
   A. 1-3years B.4- 6 years C. 7-11 years D. above 11 years
4. **Educational Qualification:**

A. Certificate
B. College diploma
C. First Degree
D. Second Degree and above

5. **Your Profession**

A. Pharmacist
B. Logistics and supply chain
C. Biochemical engineer
D. Laboratory technologist
E. Others:-
   specify_____

6. **Your current position in the agency**

A. Supply chain officer

B. Ware house manager

C. Distribution officer

D. Inventory manager

E. Others specify _____

SECTION II: QUESTIONNAIRS ABOUT OUTBOUND LOGISTICS PRACTICES AND CHALLENGES OF COVID-19 VACCINES

INSTRUCTION:

Below is a list of statements. Please indicate the extent to which you agree or disagree with them by putting ***"√" mark, 1 = strongly disagree, 2= disagree, 3= neutral, 4= agree and 5= strongly agree.*** There is no right or wrong answers. Please give honest answers; otherwise the result would not be valid.

A	COVID-19 VACCINES WAREHOUSE MANAGEMENT PRACTICE	1	2	3	4	5
1	COVID-19 vaccines are arranged with arrows pointing up, and with identification labels, expiry dates, and manufacturing dates clearly visible					
2	COVID-19 vaccines are stored at the appropriate temperature according to product temperature specifications					
3	Backup source of power like generator and solar energy for cold chain storage are avialiable.					
4	The floor is convenient for movement of goods during receiving, put away, and dispatching activities using forklift.					
5	Sufficient number of staffs run the warehouse					
6	On sitetrainings on warehouse management related to COVID-19 vaccines are conducted					
7	Fire safety equipment is available and accessible.					
8	Security controlling system in the warehouse are avialiable with camera and alarms.					
9	Staffs are assigned to handle maintenance of cold chain equipment during failure					

10	Temperature records are formally reviewed at least once a month in order toidentify temperature excursions and their causes.					
11	Trained staff (other than staff designated to record the temperatures) review the temperature logs weekly.					
12	Detailed, up-to-date, written standard operating procedures are are avialiable for COVID-19 vaccines management.					
13	Sufficient equipments are aviliable to facilitate the warehouseactivities.					
B	**INVENTORY CONTROL MANAGEMENT PRACTICEOF COVID-19 VACCINES**					
1	Over-stocked and nearly expiredCOVID-19 vaccines are distributed by communicating with health sectors before the products are expired.					
3	Logistic records are in the warehouse to track COVID-19 vaccines					
4	COVID-19 vaccine stocksufficiency reportsare signed by therelevant EPIwarehouseauthority andproperly maintainedin files.					
5	Designated staffregularly report andupdate theWarehouse management system or Vaccine logistics management system.					
6	COVID-19 vaccines are organized and stored in their areas in the sequence of firstexpire first Out (FEFO)					
7	The facility is supervised by National Program of Immunization or regional health bureau and partners on EPI service with in the last six months					
8	COVID-19 vaccines are checked for expiry dates at the beginning or end of every month.					
9	Designated staff report daily and print COVID-19 vaccines and supplies stock sufficiency reportsthrough the warehouse management system or vaccine logistics management system.					
10	For received stock,damages, losses,errors, anddiscrepancies arereported.					
11	COVID-19 vaccines dispatched are updated electronicaly.					
12	Inventory visibility exist amongstcentral EPSS, hubs and health facilities.					
C	**TRANSPORTATION MANAGEMENT PRACTICE OF COVID-19 VACCINES**					
1	Sufficient vehicles fitted with refrigerator are avialiable for transportation.					
2	Sufficient vaccine containers (carriers) are aviliable to meet demand of clients for vaccine transportation purpose					
3	Standard operating proceduresare available at the facility for cautions to be taken during vaccine transport					

4	Temperature are documented every 30 minutes during the COVID-19 vaccines transport.					
5	The designated staffsensure the required temperatureis maintained throughout the transport using temperature monitoring devices tocheck the cold chain of the vehicles					
6	Vehicles are equipped with a self-sustained diesel refrigeration unit which can operate when the vehicle's engine is switched off					
7	GPS is placed on vehicles that are transporting the vaccines					
8	The drivers knowthe required temperature that must be maintained in the cold chain truck while transporting the vaccines					
9	There is temperature monitoring system during transportation (thermometer with vaccine carrier)					

N_O	**CHALLENGES OF OUTBOUND LOGISTICS OF COVID-19 VACCINES**					
		1	**2**	**3**	**4**	**5**
1	Insufficient warehouses for covid-19 vaccines					
2	Inventory fluctuation due to inaccurate information sharing					
3	Shortage of manpower to run physical distribution activities					
4	Lack of Top management support					
5	Lack of training regarding covid-19 vaccines management					
6	Lack of sufficient and Functional cold chain vehicles					
7	Inadequacy of material handlingequipment in warehouses					
8	Poor coordination with stakeholders					

Contact Address

If you have any query, please do not hesitate to contact me and I am available as per your Convenience at (Mobile: 0913-74-55-48 or e-mail: *a.abiye2014@gmail.com*)

Thank you in advance for scarifying your precious time !