



**The Effect of Inbound Logistics on Public Health Emergency
Supply Chain performance: The Case of Ministry of Health,
Ethiopia**

BY:

Tadesse Dessie

(ID Number GSD/9099/14)

Advisor: Dr. Shiferaw Mitiku

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Approved by a Board of Examiners

_____ External Examiner	_____ Signature	_____ Date
_____ Internal Examiner	_____ Signature	_____ Date
_____ Advisor	_____ Signature	_____ Date

DECLARATION

I declare that the thesis titled “*The Effect of Inbound Logistics on Public Health Emergency Supply Chain performance: The Case of Ministry of Health*”, is my original work and has not been submitted for a degree at any other university and that all sources of materials used for the study have been duly acknowledged.

Tadesse Dessie

Signature-----

Date-----

CERTIFICATION

This is to certify that **Tadesse Dessie** has carried out this thesis on the topic entitled ‘‘*The Effect of Inbound Logistics on Public Health Emergency Supply Chain performance: The Case of Ministry of Health*’ under my supervision. Accordingly, I here assure that his work is appropriate and standard enough to be submitted for partial fulfillment of the requirements for the award of the degree of Master of Arts degree in Logistics and Supply Chain Management.

Shiferaw Mitiku (PhD)

Signature-----

Date-----

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The researcher

List of Abbreviations and Acronyms

PPEs	Personal Protective Equipment
SC	Supply Chain
PHEICs	Public Health Emergency of International Concern
EPHI	Ethiopian Public Health Institute
MOH	Ministry of Health
EPSS	Ethiopian Pharmaceuticals Supply Service
NGOs	Non-Governmental Organizations
RHBs	Regional Health Bureaus
HSCs	Humanitarian Supply Chains
Hos	Humanitarian Organizations
RBV	Resource Based View
SCM	Supply Chain management
MOH/PMED	Ministry of Health/Pharmaceuticals Medical Equipment Directorate
SCOR	Supply Chain Operations Reference
MSF	Médecins Sans Frontières
UN	United Nations
PAHO	Pan American Health Organization

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Abstract

This study assessed the effect of inbound logistics on the performance of public health emergency supply chains within the Ministry of Health (MOH) and its agencies, specifically the Ethiopian Pharmaceuticals Supply Service (EPSS) and the Ethiopian Public Health Institute (EPHI) head offices. In the context of public health emergencies, efficient supply chains are crucial for ensuring timely delivery of medical supplies from suppliers to warehouses, thereby facilitating rapid response efforts.

The study applied both explanatory and descriptive research design. In this study, the census method was employed, and of the total of 85 respondents 72 of them (84.7%-response rate) had responded. The respondents are employees and directors working in six directorates who were directly involved in the operation of emergency supply chain activities. To do so, mixed research was undertaken where the data was collected through questionnaires to gather the primary data of the organizations. The data were analyzed under descriptive and inferential statistics. According to the findings, emergency supply chain management are well practiced in MOH, EPSS and EPHI Ethiopia; among the six practices, receiving processes has been superior but procurement practices have been found low as compared to other practices. Furthermore, transportation and inventory management practices have a positive and significant effect on emergency supply chain performance in the surveyed organizations. This study concluded that effective humanitarian supply chain practice is needed for higher supply chain performance in the organizations since most of the inbound logistics practices are now moderate. This study recommends that organizations should evaluate their transport services regularly and consistently and maintain the right amount of inventory to improve their emergency supply chain performance.

Key words: Public Health Emergency Supply Chain, Practices, Performance

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the study

Globally human history is full of public health incidents where pandemics occurred in a certain period causing suffering and death (Dasaklis, et al., 2012). Around the world, natural disasters and calamities are happening more often, wreaking devastation on human society. Few of these issues are rooted in nature, and many are man-made (Das, 2016). The rate and impact of these disasters have increased dramatically in the past decades. A recent example of this is COVID-19 pandemic which has disrupted the global supply chain system which affects the price, procurement lead time and availability (Thabah, et al., 2021). Typically, during any disaster situation, residents need extraordinary support and relief, as the losses exceed the ability of the affected community to meet and fulfill its demands using regular resources (Xu & Beamon, 2006). Lack of adequate preparedness in major urban areas has raised the likelihood of death and property destruction. Destructive effects of disasters, although inevitable, could be mitigated by a proactive approach and the development of appropriate preparedness and response plans. One important element of preparedness planning is building efficient emergency supply chain system (Dong, 2018). The tasks necessary for estimating demand, evaluating needs, acquiring, storing, and overseeing inventories and logistics, as well as allocating relief to reduce losses prior to, during, and after a disaster are all included in disaster management (Balcik, 2008).

In Africa, a variety of environmental disasters, including bush fires, floods, disease outbreaks, epidemics, and droughts have occurred (Ngwenya, 2016). Specifically, East Africa faces several complex humanitarian challenges arising from famines, civil wars, and natural disasters. The populations in this region are the most susceptible to global humanitarian disasters (Dufour, et al., 2017). These have caused many impacted people to be uprooted from their homes and consequently vulnerable to malnutrition and despair. They have also resulted in fatalities and serious injuries (UN, 2017). Consequently, any control of an epidemic's outbreak should rely on the establishment of an emergency supply chain system. Emergency logistics is an important link of disaster relief and disaster reduction (Zhang, et al., 2022). All the logistics operations such as demand planning,

procurement, transportation, receiving, warehousing and inventory management of medical supplies and commodities must be managed in conjunction with available information and financial resources to contain the epidemic before it reaches critical proportions (Dasaklis, et al., 2012). The benefit of achieving supply chain efficiency during humanitarian operations is the minimization of the extent of suffering of the affected communities and to avoid any further loss of lives. As a result, it is essential that the supply chain be agile, flexible, and responsive (Ngwenya, 2016).

Ethiopia is a country that has suffered from natural and man-made disasters such as wars, internal displacements, famine, floods, and epidemics that resulted in the loss of lives and affected livelihoods of communities (EPHI, 2022). The COVID-19 pandemic, civil conflict and climate shocks including drought have severely impacted the wellbeing of Ethiopia's people (MOH-Ethiopia, 2023). Specifically, the conflict in three regions (Tigray, Amhara and Afar) of northern Ethiopia in 2022 has led to severe shortages in essential health services and an increased risk of disease outbreaks (WHO, 2023).

Among the major public health supply chain management functions; demand planning, procurement of supplies, custom clearance, transportation, receiving, warehousing and inventory management of the required health emergency commodities are critical activities for emergency preparedness and on time response (EPHI, 2022). During emergencies, the country mostly uses the resources from the routine supply chain which affects effectiveness and efficiency of emergency responses and seriously compromises provision of basic healthcare services (MOH-Ethiopia, 2023).

Ethiopian Pharmaceuticals Supply Transformation Plan II (2020) states that obtaining 80% of the country's pharmaceuticals demand from abroad and has a long delivery lead-time. However, managing emergency situations requires availability of very large volume of items within a short period of time. To do this all at once is very difficult due to; high degree of uncertainty in demand volumes, local commodity distribution capacity, and stringent regulatory processes governing importation. This results in high costs for storage and distribution, products' shelf life becoming short, and high stockout rate at the response sites. To tackle these challenges, thorough coordination and creativity is required to successfully avail necessary products for emergency response (EPSA, 2020).

MOH in collaboration with EPHI, EPSS and with other key partners has been working hard in providing appropriate, adequate, and timely responses to the health commodity needs of affected people. Major supply chain operations such as demand planning, procurement, transportation, stock status monitoring and distribution of health commodities which are relevant to the management of public health emergencies, on the behalf of MOH, are undertaken by EPSS and EPHI, in close collaboration with partners (MOH-Ethiopia, 2023).

In a typical public health emergency supply chain, there are sets of suppliers and manufacturers and finished products are shipped from suppliers to warehouses to be ready for outbound activities (Berman & Wang, 2006). To get finished products, there are a lot of inbound logistics activities that have been performed, including demand planning, procurement, transportation, receiving, warehousing, and inventory management. In addition, coordination issues across the entire emergency supply chain arise. Manufacturers, government organizations, and humanitarian agencies should be coordinated during the control effort. Finally, managing the information regarding the demand for medical supplies as well as the flow of funds is also critical (Dasaklis, et al., 2012).

This paper measured public health emergency supply chain performance with the dimensions of reliability, responsibility, flexibility, costs, and asset management efficiency. The effect of inbound logistics activities assessed on the performance of public health emergency supply chain.

1.2. Statement of the problem

With the increasing of frequency and impact of disasters in recent 20 years, countries and humanitarian organizations are under an increased pressure of improving their emergency supply chain performance (Shafiq & Soratana, 2019), due to the disruption of the normal operation of the global supply chain, which requires resilient public health emergency supply chain management (Luo, et al., 2023). The movement of supplies in emergency management is one of the most overlooked areas in emergency supply chain management. As emergency situations increase in scope and number, the resource pool become constricted, thus better management is a necessity (Ye, et al., 2020).

Adopting a fully lean or strictly agile supply chain is ineffective in the turbulent and uncertain humanitarian context of today. Despite using and adopting a variety of supply chain architectures,

humanitarian organizations are having difficulty getting the best performance out of their chains. This is due to the understanding that humanitarian supply chains continue to react to emergencies in a slow, ineffective, and poorly coordinated manner despite the enormous sums of money that are poured into the sector, strict control by donors, and expectations from vulnerable communities (Kiswili, et al., 2021). In the emergency supply chain problem being considered in this research effort, there are government organizations, including governments and NGOs, that each play an important role in terms of cooperation. A variety of responsibilities could be handled by government organizations, such as demand planning, procurement, transportation, receiving, warehousing, and inventory management of emergency commodities (Zobel, 2021).

Inbound logistics activities relating to the movement of materials and products from the supplier to the purchasing organization such as procurement, transportation and inventory management are value creation processes that give organizations competitive advantage (Juma, 2020). However, there are inbound logistics related challenges in the management of public health emergency situations, includes: Shipping inefficiencies, information vacuum, surges in deliveries and receiving, and supplier unreliability (Arumugam, et al., 2019). Supply sources are most restricted to the immediate requirements and lack of long-term relationship with suppliers as in the commercial supply chains (Bhusiri, et al., 2021).

According to Hanbazazah, *et al.*(2020), it needs to negotiate preferred rates with fewer carriers and consolidate inbound shipments to make full truckloads to cut costs. Real-time information systems to track and trace shipments and communicate with suppliers to make sure accurate data is captured when entering products. Without proper planning, organizations can end up managing too many deliveries simultaneously and leads to weak receiving process. Additionally, an organization needs dependable suppliers that offer competitive pricing and quality. However, reliable suppliers can be difficult to find and keep in the management of public health emergency supply chain. To make this easier, have a go step such as: Build long-term relationships, pay suppliers on time, check supplier quality certifications, evaluate supplier risks such as political climate, check supplier lead time and on-time delivery rate, and consistently evaluate alternative suppliers. To understand all the phenomenon and operation of logistics well, it is necessary to see inbound logistics activities from their origin to receiving in country warehouses. An integrated process, interlinked operation, and interoperable communication network amongst operating

agencies are critical for developing an effective emergency supply chain management (Dwivedi, et al., 2018). Studies by Hu & Dong (2018) stated the importance of supplier selection in humanitarian relief and integrates it into the pre-positioning strategy.

For managing outbreaks and pandemics in Ethiopia, on time availability of required medicines and supplies is a critical step. According to the 2019 annual performance report of EPSS, near to 80% of emergency products are imported from abroad and needs high attention in processes of: procurement lead-time, transportation cost, quantity, receiving process and transportation facilities from port to in country warehouses. However, ensuring the continuous availability of essential health commodities during the pandemic poses serious challenges. One of the major challenges is the constraint in the global pharmaceutical market related to shortage of finished product, export ban on certain essential commodities by some countries and shortage of global cargo transport. These constraints cause shortage of health commodities which in turn leads to increase in price of commodities (MOH, 2020).

Different studies have been done on challenges and factors affecting the humanitarian supply chain performance and related subject matters. Biniam Tufa & Shiferaw Mitiku (2023) on the Perceptions Toward the Practice, Performance and Challenges of Humanitarian Logistics Management of Public Health Emergency Pharmaceuticals: The Case of Ethiopian Public Health Emergency; found that in the humanitarian logistics management, inventory and distribution management are well practiced while procurement and transportation management are weakly practiced at the MOH, EPSS and EPHI.

There are also different unpublished studies by Molalign Mekonnen (2019); Netsanet Yirdaw (2022); Dereje Asfaw (2017); Selamawit Assefa (2019) that showed factors affecting emergency supply chain performance, includes: lead time, information technology, supply chain policy, training and development, socio economic factor, institutional donors, and socio-political.

However, the studies failed to address the effect of inbound logistics in the performance of emergency supply chain and there is no statistical data that shows lead-time, transportation cost and quantity received per order. Additionally, there is not empirically shown the cause-and-effect relationship between inbound logistics activities (demand planning, procurement, transportation, receiving, warehousing, and inventory management) associated with public health emergency supply chain performance.

This study, consequently, required closing the existing information gap by providing empirical evidence on the effect of inbound logistics and their relationship with public health emergency supply chain performance on the health emergency supply chain sector by answering the question: what is the effect of inbound logistics on public health emergency supply chain performance in MOH-Ethiopia?

1.3. Objectives of the Study

1.3.1. General objective

The general objective of this study is to assess the effect of inbound logistics on public health emergency supply chain performance in Ministry of Health (MOH) and its agencies in EPSS and EPHI, Ethiopia.

1.3.2. Specific objectives

The specific objectives of this study are:

- To assess the effect of demand planning practices on public health emergency supply chain performance at MOH Ethiopia.
- To examine the role of procurement practices on public health emergency supply chain performance at MOH Ethiopia
- To determine the effect of transportation practices on public health emergency supply chain performance at MOH Ethiopia.
- To measure the role of receiving processes on public health emergency supply chain management at MOH Ethiopia.
- To analyze the effect of warehousing practices on public health emergency supply chain performance at MOH Ethiopia.
- To assess the role of inventory management practices on public health emergency supply chain performance at MOH Ethiopia.

1.4. Research questions

The main research question of this study is to assess the effect of inbound logistics on public health emergency supply chain performance in Ministry of Health (MOH) and its agencies-EPSS and

EPHI, Ethiopia. In such circumstance, the study guided by focus to answer the following research questions:

- What is the effect of demand planning practices on public health emergency supply chain performance at MOH Ethiopia?
- What is the effect of procurement practices on public health emergency supply chain performance at MOH Ethiopia?
- What is the effect of transportation practices on public health emergency supply chain performance at MOH Ethiopia?
- What is the effect of receiving processes on public health emergency supply chain performance at MOH Ethiopia?
- What is the effect of warehousing practices on public health emergency supply chain performance at MOH Ethiopia?
- What is the effect of inventory management practices on public health emergency supply chain performance at MOH Ethiopia?

1.5. Significance of the study

The study will offer insights to the MOH on how to better improve public health emergency SC performance through inbound logistics. This study also adds to the existing body of knowledge by informing public health emergency supply chain performance in the right context through empirical evidence from supply chain practitioners and have a great significance to all stakeholders interested in the public health emergency supply chain response. Findings of this study enable humanitarian organizations in public health emergency SC management appreciate the challenges and success factors that accrue from good inbound logistics practices.

The study will be beneficial to the public health emergency supply chain logisticians and national government policy makers as it enables them formulate policies aligned with inbound logistics basics for better public health emergency supply chain performance. The findings of the study will contribute to the existing body of knowledge and are also vital as reference tools for future research on public health emergency supply chain performance. It is easier to address effects of inbound logistics in public health emergency SC performance and with extension of all other NGOs in Ethiopia those are worked on public health emergency management. Furthermore, it will assist

other researchers in determining which area of inbound logistics and public health emergency supply chain management to focus on in future research.

1.6. Scope of the study

Conceptual scope: This study addresses the public health emergency supply chain performance only with six inbound logistics activities: demand planning, procurement, transportation, receiving, warehousing, and inventory management. In addition, the study gives an insight in relation to the research question & objectives specified above and did not address all the issues related to the Public Health Emergency Supply Chain Performance of NGOs operations in Ethiopia.

Methodological scope: The framework mainly relies on research previously carried out by the authors in the areas of public health emergency supply chain practices for public health emergency supply chain performance. An extensive literature survey is carried out to support the ideas and derive the constructs of the conceptual model as a basis for further empirical research.

Geographical scope: The research will be destined to focus only on health emergency supply chain management operation at Ministry of Health (MOH), EPSS and EPHI head offices. This study particularly covers the performance of public health emergency supply chain in MOH-Ethiopia and in its agencies-EPSS center and EPHI. The study does not consider Regional Health Bureaus (RHB), humanitarian organizations, other supply chain actors, donors, beneficiaries etc.

1.7. Limitation of the Study

The research was only carried out at MOH/PMED, EPSS, and EPHI head offices and did not cover RHBs, ZHDs and other offices. The study was also limited conceptually to the research of public health emergency supply chain practices and factors affecting its performance. The study was also limited temporarily as the time where this study would be conducted is only for a limited period.

1.8. Operational definitions of Key terms

- **Inbound logistics-** refers to the process of receiving and storing raw materials, components and finished products that are needed for production or end use. It involves managing the flow of goods from suppliers to the company's warehouses or production facilities. This includes activities sourcing, purchasing, transportation, receiving and storage (Leite, 2016).

- **A public health emergency-** is any adverse event (natural or man-made) that compromises the health of the population and has the potential to cause widespread illness and/or significant number of human fatalities (Haffajee, et al., 2014).
- **Emergency products-** are a medicine and or medical device that are required to prevent, diagnosis, mitigate, treat, and care for people with life-threatening or urgent health care needs or unforeseen/unexpected/unpredicted/sudden illnesses or injuries (Broccoli, et al., 2018).
- **Emergency supply chain management (ESCM)-** is the process of planning, managing, and controlling the efficient flows of supplies, information, and s of Key services from the points of origin to the points of destination to meet the urgent needs of the affected people under emergency conditions. The process includes demand planning, sourcing, custom clearance, inventory monitoring and distribution of commodities for the management of public health emergencies (Zhu, 2012).

1.9. Organization of the study

This study is organized into five chapters. Chapter one contains the study background, problem statement, general and specific objectives, research questions, the significance of the study, the scope of the study, operational definitions & terms. Chapter two contains the literature review related to the study. It has an introduction, a theoretical review, an empirical review, the theoretical and conceptual frameworks of the study, and the identified literature gap. Chapter three research methodology; describes the type and design of the research, the subjects/participant of the study, the sources of data, the data collection tools/instruments, the procedures of data collection, and the methods of data analysis. Chapter four covers results and discussion/data presentation, analysis & interpretation; this chapter summarizes the results/findings of the study and interpret and/or discuss the findings. Finally, in chapter five summary, conclusion, recommendation is presented.

CHAPTER TWO

2. RELATED LITERATURE REVIEW

2.1 Theoretical Literature Review

2.1.1. Inbound logistics

As per the definition provided by the Council of Supply Chain Professionals (2013), inbound logistics is the movement of materials from suppliers and vendors into production processes or storage facilities which includes all activities that are required at the time of requirement to make the products available for operational processes and use. These inbound logistics activities are demand planning, procurement, transportation, receiving, warehousing, and inventory management of products to facilitate production or market distribution.

The inbound logistics process begins when a company identifies the raw materials, components or finished products it needs for production or use. This may involve working with suppliers to negotiate prices, delivery schedules, payment terms and other purchase agreement terms. Once the products have been sourced, the company must arrange transportation from the supplier to the company's warehouses or production facilities. This may involve coordinating with freight carriers, customs brokers, and other logistics providers to ensure that the materials/products are delivered on time and in good condition (Leite, 2016). By effectively managing the flow of goods from suppliers to the company's facilities, businesses can reduce costs, improve supply chain visibility, and increase their competitiveness in the market. This process is crucial in ensuring that an organization has the materials to operate efficiently and meet customer demand with a required level of flexibility to hedge against demand volatility (Weisel, 2020). The inbound logistics activities include:

- a) **Demand planning:** As for commercial supply chains, the importance of adequate forecasting is paramount for supporting humanitarian operations management (Watson, 2009). In view of the high stakes and the limited budgets that humanitarian organizations face, demand forecasting might even be considered more essential in the humanitarian context. The practice of forecasting demand for anything is yet another best practice, but a lot of flexibility is required to forecast during dynamic situations (Dhamija, et al., 2021). It is usually difficult to carry out forecasting

with a desired level of precision because of the volatility and varying uncertainties involved (Abolghasemia, et al., 2019).

Assessing logistical and supply needs is crucial to determine as accurately as possible: the needs of the population after the disaster; after local capacity and resources; complementary capabilities and resources required for meeting those needs. It is also known that disasters are dynamic, changing processes. Accordingly, an assessment of this sort must not only help to identify the current situation, but also to foresee likely needs in the future. It is important not to stereotype disasters since the needs they generate depend not only on the kind of event but also on the socioeconomic and other characteristics of the affected region or country. Nevertheless, experience shows that some aspects of everyday life are more likely to be affected by disasters, making it possible to foresee the most probable needs for survival. Most catastrophic events tend to affect public health to a greater or lesser extent, generating additional or urgent needs in this area (PAHO, 2001).

b) Procurement: Involves sourcing products and services from a wide range of suppliers through competitive bidding processes and quotations. It involves the following: identifying and selecting suppliers; buying, negotiating, and contracting; conducting supply market research; and managing and improving suppliers (Naude, 2021). Identifying and selecting suppliers that can provide the materials or components needed for production at a competitive price and with reliable delivery. There are various important factors to consider when selecting suppliers, and these factors include quantity discount, transportation cost, carbon emission tax, currency exchange rate, price discount, delivery time, service level, supplier capacity, and lead time (Dong, 2018).

Supplier selection is not only one of the most important decisions but also one of the critical success factors in competitive rivalry. An effective humanitarian supply chain is crucial to a relief operation, and procurement is a critical element of a supply chain. The purpose of the procurement process is to make sure that the organizations involved in relief management have the resources needed to meet identified needs. This in turn requires identifying the sources of those goods and services and the way in which they will be acquired (PAHO, 2001).

An effective humanitarian supply chain is crucial to a relief operation, and procurement is a critical element of a supply chain. Procurement of humanitarian aid and supplies varies depending on the presence of high demand uncertainty, which is a significant challenge in disasters, in which location, time and strength cannot be predicted. Moreover, the efficient and timely delivery of

supplies is often undermined and affected by damaged infrastructure and limited resources. This adds further complexity and uncertainty to the management of humanitarian relief. Typically, humanitarian aid and relief supplies are both tangible and intangible, and humanitarian acquisitions come from two sources – procurement and in-kind donations. This study focuses on supplies obtained through procurement. As sourcing- and procurement-related decisions in humanitarian supply chains can significantly impact the effectiveness of disaster-relief operation, it is important to integrate relief procurement planning when designing a relief operations' pre-positioning and distribution network in humanitarian supply chains. Adequate preparedness enhances response and improves disaster relief, considering the context of the disaster, as different types of disasters require different types of response. To develop and enhance the relief capability, aid organizations choose to pre-position inventories, which contributes to rapid response and significantly improves effective relief efforts. Procurement units are often responsible for purchasing inputs via different methods; for example, in bulk or stored at the vendor until needed, and the purchases can be from local or international sources (Siawsh, et al., 2019).

Whether the crisis is a natural disaster, a present conflict, or an epidemic outbreak, procuring critical goods and services during a crisis presents several challenges. Uncertainty is commonplace, delays occur, and urgent needs go unmet. So, agility and flexibility are crucial. The last century has already experienced several situations characterized by intense crisis contracting. Still, pandemics and epidemics are the most critical from a procurement and supply chain management perspective due to their impact on human lives (Harland, et al., 2021).

Furthermore, post-emergency procurement is the most common sourcing strategy in humanitarian relief because warehousing and inventory costs of keeping physical inventory of pre-positioned supplies can be very high and possibilities of expiry. Establishing close relationships with suppliers is critical to streamline the procurement process and promise the availability and fast delivery of essential emergency supplies. In managing emergency situations, these relationships have been established and maintained through making contractual agreements with suppliers in the emergency preparedness stage (Dong, 2018).

c) Transportation: is recognized as moving inventory from one point to the other in the supply chain, while taking the form of many combinations of modes and routes, each having its own performance characteristics. Transportation can also be defined as the development of all functions and sub-functions into a system of goods movement to reduce cost, exploit service to the customers

that establishes the concept of business logistics. The system, once put in place, must be effectively managed. Movement of goods from the manufacturer to customer is a crucial task in addressing logistic (Lambert, et al., 2005).

The balance between these factors leads to the productivity of organizations. Transport activities include those that can consolidate shipments. Consolidation does not, however, occur at the cost of scheduled transportation, reliability, and timely delivery. Customs enforcement procedures at the entry points of a country will raise transactional costs. Efficiency of clearance determines the speed and predictability of delivery of inventories. Proper documentation allows for quicker customs clearance and reduces its effect on global lead times in sourcing. Electronic channels allow information to be sent directly to government departments, cutting clerical efforts.

According to (Helo, 2011), businesses are monitoring and monitoring shipments by gathering and handling product position information around the SC, helping to identify and reduce exemptions to eliminate delays and interruptions. (Dukare, et al., 2015) say real-time monitoring offers traceability and visibility of cargo delivery. Transport intermediaries in freight forwarding increase operating efficiency and boost service rates through their expertise and skills in the industry. Most freight forwarders provide related services such as warehousing, unloaded shipping, express parcel services and multimodal transportation arrangements. As one of the major logistical drivers, transportation has a large impact on both responsiveness and efficiency of the public health emergency supply chain. By transporting products from locations where they are sourced to locations where they are demanded, transportation provides the essential service of linking the whole supply chain from suppliers to customers (Haial, et al., 2021). For example, transportation practices during the COVID-19 crisis have typically affected sustainability supply chain performance (Aunyawong, et al., 2021).

d) Receiving processes- Humanitarian organizations receive products and services from suppliers, and then stores and distributes to each care unit based on the emergency sites operation processes. Effective internal control systems are essential to an organization's management and provide the framework for its secure and reliable functioning. An organization's ability to meet its goals and objectives, hit long-term targets, and continue to provide accurate financial and managerial reporting can all be enhanced by a robust internal control system (Kiilu & Aпти, 2016).

e) Warehousing- refers to the process of storing goods until they are ready for distribution. Space planning, stock arrangement, configuration, and stock placement are all included in warehousing.

Warehousing activities are used to determine order fulfilment and inventory management. It also ensures that supplies are delivered in the right place and on time to the right customer (Juma, 2020). Effective service of customers depends on the operations of the warehouse, and warehouse has three business functions: the function receiving and passing on customer orders; the IT function ensuring that technology for the efficiency of storage is used and the storage function which temporarily or constantly stores the product (Pienaar & Voght, 2006).

Warehouse processes that need to be planned and controlled include inbound flow handling, product-to-location assignment, product storage, order-to-stock location allocation, order batching and release, order picking, packing, value-added logistics activities, and shipment. Particularly storage and order picking are complex, often labor-intensive processes that determine warehouse performance to a large part (Faber, et al., 2013).

As a node in the material flows between the supplier and the client in a supply chain, the warehouse function plays a crucial role. In the fast-paced economic environment of today, companies are under increasing pressure to expand their warehouse operations. Additionally, a few of companies have modified their value proposition to raise customer service rates, which has improved warehouse position (Lambert, et al., 2006).

Warehouses are important for a supply chain because they provide storage for raw materials, components, work-in-process, and finished goods; operate as distribution and order fulfillment centers; and perform localized and value-added warehousing. To coordinate operations in the stores correctly, a well implemented storage management system should be in place. It is important to ensure that a company performs efficiently and profits from economies of scale and an enhanced customer experience. To obtain this, well-developed storage systems are designed to assist in the definition, operation, and control of inventory procedures. In the past, warehouses were often labeled cost centers and never added value. A radical change in warehouse operations is observed by the migration of production to the Far East, growth in e-commerce and the market requirements (Juma, 2020).

f) Inventory Management- is defined as a framework used by firms to monitor their inventory objectives. It requires the registration and tracking of stock rates, prediction of potential demands and arrangement of when and how (Balda, 2018). It is also a method used by companies to

organize, store and substitute inventory so as to minimize the cost of ensuring that goods are properly supplied simultaneously (Modi, 2013).

Inventory management practices provide visibility in the supply chain system and the upstream and downstream inventory. It ensures adequate inventory to satisfy increasing demand in a firm to defend against disruption from stock outs. This also reduces over-inventory, ensures sufficient efficiency, and increases customer satisfaction through the availability of goods. The purpose of the inventory is to provide the appropriate levels of service for internal and external customers, determine current and potential requirements for all forms of inventory, reduce costs and pay for the inventory. All stock policies in the business must be profitable by operating expenditures and working capital needs over the driving period. The degree to which the business has the right amount of inventory in the right location at the right time is what determines how productive and effective the inventory is. Lead time, inventory cover, stock turnover rate, inventory results over a specific period, and service time (security inventory) are the measuring indicators for this inventory (Juma, 2020).

2.1.2. Supply Chain performance

The heart of every disaster management operation is the effective relief supply chain. This revolves around the money available to gather resources and their usage. The essential elements that form the part of a relief cycle include response planning, mobilization of resources, procurement of resources, transport of resources, management of resources (deciding distribution points), and final delivery of resources to the targeted area (Wassenhove & Martinez, 2010). Effective performance measurement systems can help non-profit managers make better decisions, improve performance, and provide accountability. Moreover, when they are designed and implemented effectively, performance measures provide feedback on agency performance, and motivate managers and employees to work harder and smarter to improve performance. They can also help allocate resources more effectively, evaluate the efficacy of alternative approaches, and gain greater control over operations, even while allowing increased flexibility at the operating level (Poister, 2003).

Humanitarian performance is the effective collective performance of a complex system of international, national, and locally based organizations, which works to save lives, alleviate suffering, and maintain human dignity both during and in the aftermath of man-made crises and natural disasters, as well working to prevent and strengthen preparedness for the occurrence of

such situations. In addition, effective performance means undertaking work in ways that are consistent with humanitarian principles, mobilizing and deploying sufficient financial, material, and human resources in ways that are relevant, well-managed, accountable, impartial, durable and ensure good quality (Gizaw & Gümüş, 2016).

Furthermore, the application of commercial logistics principles and practices to the improvement of humanitarian relief efforts can be very useful. With several recent natural disasters, the international community is seeking an improvement in the process of how individuals, organizations and government agencies provide and deliver relief in a coordinated and integrated manner. Relief encompasses both preparatory measures and reactive practices. Providing relief, therefore, speaks both to being prepared to provide relief in the case of disaster as well as being reactive enough to deploy a response in an effective manner when it is required. Improving the logistics of humanitarian relief is important because of the increasing occurrence and huge impact of these disasters (Akkihal, 2006).

Mitigating the urgent needs of a population with a sustainable reduction of their vulnerability in the shortest amount of time and with the least number of resources is typically the main performance target (Wassenhove, 2006). The humanitarian sector spends billions of dollars annually (Thomas, 2005) to counter the increasing need for humanitarian response. According to Thomas (2005) humanitarian logistics is a critical element of the disaster response process for three reasons: it is the main driver for speed and effectiveness; it is at the connection of several information flows with a potential for process evaluation and improvement; and it is the most expensive part of the response process (Wassenhove, 2006), including the activities of procurement and transportation. In terms of recognition and infrastructure, however, humanitarian logistics used to lag some 15 years behind private sector logistics (Wassenhove, 2006), and things have been changing only slowly. This is evidenced by recent developments at MSF where much work is done to improve international supply for the MSF movement, other NGOs, and UN (Laan, et al., 2016).

In the relief industry, performance metrics and measuring methods have not been created and consistently applied. NGOs are, however, becoming more and more conscious of the need and necessity of performance assessment, especially considering the growing competition within the sector for limited resources and the rising demands of donors and the public for increased

accountability and exposure. However, choosing the right performance indicators and creating measurement systems present serious issues due to the special and innate features of the disaster relief context. NGOs typically focus on inputs rather than outputs (Balcik, 2008).

Davidson (2006) develops a performance measurement framework for relief logistics for the International Federation of Red Cross and Red Crescent Societies and describes an application of the framework to actual relief operations in the response sites. The proposed framework relies upon four performance metrics, namely appeal coverage, donation-to-delivery time, financial efficiency, and assessment accuracy. These performance metrics are fit to measure the actual operations of relief in the emergency response sites rather than inbound logistics activities.

Scholars have modified well-established performance assessment frameworks and models from the business world for application in the disaster relief domain. For instance, the Supply Chain Operations Reference (SCOR) model and the Balanced Scorecard (BSC) have been modified for use in humanitarian settings in several studies. Additional research has looked at how political and contextual obstacles affect HSC achievement (Anjomshoe, et al., 2022). The Supply-Chain Council (SCC) created the Supply-Chain Operations Reference (SCOR) model to help businesses improve the efficiency of their supply chains and to offer a process-based approach to supply chain management (Archie Lockamy III, 2004). According to (Kurien & Qureshi, 2011), the SC Operations Reference (SCOR) model approach promotes for several supply chain performance measures. A process-oriented approach using SCOR model was implemented to make use of the three components of process, performance, and best practices integrating organizations from different sectors (Gizaw & Gümüş, 2016). The SCOR model provides a common process-oriented language for communicating among supply-chain partners in the following decision areas: PLAN, SOURCE, MAKE, DELIVER, and RETURN (Archie Lockamy III, 2004).

The American Production and Inventory control Society (APICS; 2018) states that more than 250 SCOR measures are arranged from organization level 1 to process level 2 and diagnostic level 3 in a hierarchical and standardized structure. Five performance attributes; reliability, responsiveness, agility, costs, and asset management efficiency are used to group the metrics. So, performance in this study will be measured with the following metrics:

- A. Reliability:** Supply chain reliability is the ability of a supply chain to fulfill end customer demand to the desired level continually over the planning horizon, despite the risks of external and/or internal shocks to the system and prior to any risk mitigation efforts. Supply chains often have complicated network structures consisting of several companies and facilities, and various paths through which materials and products flow (Chen, et al., 2017). It is predictable, on-time delivery of perfect orders, as expected by the customer. A perfect order is one that is shipped on time and complete, but more important, one received at the customer's desired location within a precise time window, in excellent condition, and ready to use. For supply chain experts, lowering inventory, raising dependability, and anticipating demand are critical tasks. Because it increases productivity and reduces costs, supply chain reliability is crucial for putting an effective supply chain management strategy into practice. Collaboration between shippers and carriers is often cited as the reason for reliable, on-time performance. Typical metrics for the reliability attribute include On-time, the right quantity, and the right quality.
- B. Responsiveness:** The ability of a supply chain to adapt to a wide range of quantities requested, meet short lead times, handle a wide diversity of products, create highly inventive products, attain a high service level, and manage supply uncertainty is known as supply chain responsiveness. In other words, responsiveness is separated into three capabilities: velocity, reactivity, and visibility. Reactivity is the capacity to assess and consider quickly while velocity indicates the capacity to cover needs rapidly. Consequently, visibility covers the capacity to see the developments down the supply chain, including identity, position, and status of the shipment alongside the programmed and specific dates and times for the events (Kiswili, et al., 2022).
- C. Agility:** The ability to respond to external influences, the ability to respond to marketplace changes to gain or maintain competitive advantage. SCOR Agility metrics include Flexibility and Adaptability. Humanitarian Supply Chain flexibility as a multi-dimensional ability to efficiently adapt to changing external and internal conditions in disasters to maintain or improve HSC performance. To deal with unpredictable and turbulent contexts of response, HSCs require flexibility and without sufficient flexibility, HSCs are prone to several disruptions (Baharmand, et al., 2017). The need for flexibility in terms of both resources and co-ordination of operations is particularly important to organizations which

operate in a constantly changing unpredictable environment. Coordination flexibility in this context applies to reconfiguring the chains to deploy the required goods to the identified recipient as speedily as possible (Scholten, et al., 2010).

- D. Costs:** The cost of operating the supply chain processes. This includes labor costs, material costs, and management and transportation costs. The performance of non-profit organizations, specifically focusing on how they managed their operation with limited resources and unlimited demand. Humanitarian organization should focus on resource allocation and on avoiding inefficiencies in procurement of relief items (Abidi, et al., 2014).
- E. Asset Management Efficiency:** According to APICS (Version 12.0), the ability to efficiently utilize assets. Asset management strategies in a supply chain include inventory reduction and in-sourcing vs. outsourcing. Metrics include Inventory days of supply and capacity utilization.

2.2. Empirical Literature Review

2.2.1. Effect of Demand Planning on Emergency Supply Chain Performance

The management of humanitarian supply chain can become very complex with the presence of different stakeholders and large quantity of materials to be procured and distributed. Lack of coordination among humanitarian organizations at the scene of a disaster is ordinary, as there can be as many as several hundred humanitarian organizations at the scene to carry out relief operations, all with different political agenda, ideologies and religious beliefs and all fighting for media and donor attention (Wassenhove, 2006). The greatest challenge lies in aligning them and the coordination of logistical activities without compromising their mandates or beliefs. Also, as pointed out by (Gray, 2006), humanitarian supply chain often entails high levels of uncertainty in terms of demand, supplies, and assessment. This makes them clearly unpredictable, turbulent, and requiring flexibility. This irregularity presents unique challenges to relief fulfillment system as the number and complexity of global emergencies continue to increase.

When looking at the healthcare supply chain literature, discussion about system preparedness to face emergencies (e.g. pandemics, wars, climate catastrophes) is limited. These events cause a rapid surge in demand for critical medical supplies that can be coped only with an appropriate inventory and logistic infrastructure (Leite, 2020). The emergency and disaster management

research which uses the previous SARS and Ebola outbreaks as the unit of analysis already shows the risks of uncontrolled healthcare supply chain behaviors, with critical medical products being hoarded, procurement organizations lacking visibility on available inventory and insufficient support provided by national stockpiles (Dasaklis, et al., 2012). Examples from other natural disasters, such as Hurricane Katrina, also show the need for governments to improve their supply market infrastructure after the crisis to increase future preparedness (Schneck, 2020). Although on a smaller case, those events were already suggesting that optimizing inventory strategies and establishing better coordination between agencies should have been a priority to improve healthcare supply chain preparedness (Calnan, et al., 2018).

Humanitarian aid organizations are most known for their short-term emergency relief. While getting aid items to those in need can be challenging, long-term projects provide an opportunity for demand planning supported by forecasting methods. Demand forecasting may even be more important in the humanitarian situation due to the high stakes and tight budgets that humanitarian groups must work under. But a lot of endogenous factors can make gathering pertinent field data and using forecasting techniques more difficult, and a lot of exogenous factors can make forecast accuracy worse (Laan, et al., 2016).

In the humanitarian context, there is no literature on forecasting methods specifically designed or applied to order planning. Studies that deal with forecasting focus on emergency prediction (Haile, 2005), rather than long-term response after the start of an emergency. Virtually no empirical data about forecasting or demand planning performance exists. A study at MSF-OCA has revealed that forecasting or assessing needs was deemed challenging due to the ever-changing project context and medical needs and the large number of beneficiaries. Meanwhile, MSF-OCA has developed an information system to collect field consumption data suitable for analysis and decision support (Laan, et al., 2016).

2.2.2. Effect of Procurement on Emergency Supply Chain Performance

Inbound Logistics have now been recognized as an important link in business and as such a source of market differentiation (Bowersox, et al., 2020). According to Bowersox, *et al.* (2020) notes that firms are now sourcing their materials globally to benefit from the value of low-cost countries of manufacture. Inbound logistics as a link between suppliers and buying firms is becoming a considerable issue as evident from works of different scholars. Different firms with similar

inbound logistics chain will be at different efficiency levels depending on their management. Inbound logistics pattern impacted the management system of inbound operations (Chetchotsak, et al., 2012). A study also conducted by (Mae & Ohno, 2012) revealed that changes in delivery lead times affect the costs of ownership and flexibility in service delivery. Reduction of lead times positively impacted these factors, and total acquisition cost was dependent on purchasing and logistics activities and not directly related to lead time reduction.

Humanitarian logistics is responsible for getting relief aid to those in need in the most effective manner as much as possible. The hybrid approach of humanitarian logistics links preparedness with response, procurement with the distribution network and the control center with the field offices. Without an appropriate preparedness and ability to procure and distribute the relief at an adequate pace, suffering would be prolonged (Wassenhove, 2009). Commercial logistics encompasses the process of managing the flow of goods, information, and finances from the source to the final customer (Baz, et al., 2019). Humanitarian logistics imitates commercial logistics, as it includes the same range of activities such as procurement, warehousing, transportation, and other related resource management.

Supplier selection has been widely studied in commercial supply chains, and extensive literature exists to address this kind of decision. One complication of the supplier selection decision is the multi-criteria aspect. There are various important factors to consider when selecting suppliers, and these factors include quantity discount, transportation cost, carbon emission tax, currency exchange rate, price discount, delivery time, service level, supplier capacity, and lead time. Another challenge is how to deal with uncertainty embedded in the real system (Dong, 2018). Lei Li (2011) studied a multi-objective stochastic supplier selection problem with consideration of business volume discounts, demand, and supplier capacity uncertainties. Literature on supplier selection in humanitarian logistics is scarce. The most relevant research is the work of (Balcik & Ak, 2013), where a supplier selection problem for establishing framework agreements with a quantity flexibility contract was studied. They proposed a stochastic programming model that selects framework suppliers to minimize expected procurement and agreement costs while satisfying service requirements. However, the major limitation of their work is that they pre-assumed a fixed proportion (i.e., 60%) of the total demand that is satisfied by these cooperated suppliers, but do not consider the remaining demand.

The nature of demand uncertainty is different in the relief context. Specifically, the demand pattern is quite irregular and lumpy, and the timing, location, and number of demands are highly unpredictable; hence, it is difficult to represent demand by using specific closed-form probability distributions. There are only a few studies in the literature that use stochastic programming models for supplier selection problems. Moreover, the existing supplier selection problems either do not consider any contractual setting or they focus on contracts which may not directly apply to a relief environment. Finally, only a few studies that address supplier selection decisions under demand uncertainty consider quantity-based price discounts (e.g., (Zabinsky, 2011), (Ma, 2009)). The price discount schedule in this study is additionally affected by the lead time requirements and shipment destinations.

Despite the importance of procurement in humanitarian logistics, the related literature is scarce. There are several practitioner resources that describe relief procurement practices (e.g., (Cluster, 2011), (Group, 2010)). Also, several studies focus on the competitive bidding process and develop models (e.g., (Bagchi, *et al.*, 2011), (Ertem, *et al.*, 2010), (Trestrail, *et al.*, 2009)). To the best of our knowledge, there is no study that addresses Framework Agreements (FAs) and presents models for supplier selection decisions in the relief literature.

According to Blecker, *et al* (2014) without collaboration among key actors in logistics the ability to utilize existing synergies to address arising challenges in inbound logistics is not maximized. Successful firms in the industry owe their achievements to their cooperation with other relevant entities which includes government bodies, private stakeholders, customers, and technology developers, etc. Huge financial investment has become a barrier to efficient logistics operations. Budget restrictions for many firms limit their expenditure on the intended strategy and hence often change with economic changes, consequently impacting on their inbound logistics operations. Inbound logistics practices are reliant on existing infrastructure like warehouse building, terminuses, highways, communication networks and energy supply amenities that need long-term investment from both governments and private sector. They also involve long lead-times to develop and there after maintenance investments over time which determine the quality of entire logistics operations (Blecker, *et al.*, 2014).

Unlike in humanitarian relief, there is a rich literature that addresses procurement decisions in business supply chains. Study conducted particularly related to the literature that develops *supplier*

selection models under demand uncertainty (e.g., (Hazra & Mahadevan, 2009), (Zabinsky, 2011), (Liao & Rittscher, 2007), (Ma, 2009). Various criteria are used for selecting suppliers in commercial supply chains. Price, delivery times, and quality are among the most important factors (Aissaoui, et al., 2007). Although there are some studies that investigate supplier selection criteria for humanitarian organizations (e.g., (Pazirandeh, 2011), (Shahadat, 2003), there is no study that particularly explores the criteria used in selecting suppliers for Framework Agreements (FAs). In supplier selection problem, there is a consideration that the main criteria discussed in practitioner resources (e.g., ((IFRC, 2023), (Cluster, 2011), which are quantity- and lead time-based service requirements and procurement costs.

Procurement and logistical challenges have been perceived in disaster management and relief operations, and numerous reviews have been performed to address these challenges. Most of these reviews broadly cover the entire field but with a different focus and scope (Bagchi, et al., 2011); (Balcik, et al., 2010); (Gatignon, *et al.*, 2010); (Kunz, et al., 2014); (Oloruntoba, 2010); (Lodree, 2010). Procurement of humanitarian aid and supplies varies depending on the presence of high demand uncertainty, which is a significant challenge in disasters (Pazirandeh, 2012), in which location, time and strength cannot be predicted. Moreover, the efficient and timely delivery of supplies is often undermined and affected by damaged infrastructure and limited resources (Balcik, 2008). This adds further complexity and uncertainty to the management of humanitarian relief (Balcik, 2008); (Spens, 2007). Furthermore, whether the crisis is a natural disaster, a military conflict, or an epidemic outbreak, procuring critical goods and services during a crisis presents several challenges. Uncertainty is commonplace, delays occur, and urgent needs go unmet. So, agility and flexibility are crucial. The last century has already experienced several situations characterized by intense crisis contracting. Still, pandemics and epidemics are the most critical from a procurement and supply chain management perspective due to their impact on human lives (Ivanov, 2020).

Unfortunately, once COVID-19 hit, all the above issues occurred, amplified by the magnitude of this global emergency. Scrutiny of procurement was triggered by buyer rivalry and supplier opportunism, “hijacked” supplies, international piracy, counterfeit and poor- quality products, price gouging and corruption (Kähkönen, 2021). Public authorities and private healthcare providers competed to secure critical supplies as international borders closed and societies and economies locked down (Kamerow, 2020). Prices rose, so new sources of supply were sought, and

opportunistic entrants to the market appeared, increasing risks of fraud and uncertain quality (Atkinson, et al., 2020). National stockpiles were allocated with no apparent distribution strategy (Handfield, *et al.*, 2020). The result was a free-for-all that should never be repeated. As a result, these complex, dynamic healthcare supply chains failed to cope effectively with the impact of the pandemic, showing a lack of responsiveness on the procurement side (Lindsay, 2021). Thus, it becomes imperative, for governments, to learn once and for all from the COVID-19 experience and seriously rethink their procurement systems, increasing their capabilities to coordinate and minimize disruption of supply of critical goods and services and mitigate the effects of emergencies.

Typically, humanitarian aid and relief supplies are both tangible and intangible, and humanitarian acquisitions come from two sources – procurement and in-kind donations. This paper focuses on supplies obtained through procurement. Humanitarian organizations procure and store the necessary relief supplies in strategic locations and warehouses at pre-disaster locations so they can quickly be supplied to disaster-affected regions to save lives in the early post disaster stage (Balcik & Ak, 2013). Zobel (2011) claimed that 65% of humanitarian supply chain expenditure is related to procurement. As sourcing- and procurement-related decisions in humanitarian supply chains can significantly impact the effectiveness of disaster-relief operation, it is important to integrate relief procurement planning when designing a relief operations' pre-positioning and distribution network in humanitarian supply chains (Torabi, *et al.*, 2018).

Sourcing decisions should be made case-by-case; however, the foremost requirement in the initial stage of emergency plan implementation, and in the case of an exigency, is that critical relief materials and resources, including safe drinking water, food, medical aid, sanitation equipment, transportation, power and shelter, flow to the affected areas (Blecken, 2010); (Leaning, 2005). Delivery of these resources is impacted on by three different parts of the relief distribution system; the first is the supply point, which is the point of collection, the second is the demand point, which is the devastated area/s, and the third is transportation between the first two (ROH, et al., 2013). Procurement units are often responsible for purchasing inputs via different methods; for example, in bulk or stored at the vendor until needed, and the purchases can be from local or international sources (Blecken, 2010). Early attempts to understand procurement in humanitarian relief are defined by (Wood, et al., 1995) with a focus on the discussion of local versus international procurement and the associated potential advantages (Balcik, et al., 2010); (Matopoulos, et al.,

2014). Pazirandeh (2012) advocated that there are two types of purchasers in the humanitarian supply chain: large purchasers such as international NGOs and developed country governments, and small purchasers such as local NGOs and governments of developing countries. Hence, their power relations are imbalanced in the context of purchasing and procurement, which signifies their role in the relief operations. In relief operations, it is paramount that the procurement system be able to meet the needs of all victims efficiently and effectively during an emergency. Humanitarian procurement activities must be cost-effective to meet the principles of value for money, economy, efficiency, timeliness, and correctness. To achieve this, procurement attracted competitive quotations and met procurement guidelines like transparency and fairness in sourcing. These elements are reinforcing factors to ensure effective and efficient service delivery in disaster management. The purchasing function of the humanitarian supply chain aims to urgently respond to a disaster to meet survival requirements (Siawsh, et al., 2019).

2.2.3. Effect of Transportation on Emergency Supply Chain Performance

Transportation is an integral part of the supply chain and inbound transport delays compromise delivery of goods and services. In line with this, cost of transportation impacted supply chain on large scale (Waweru, 2013). According to Langat (2013) study, mode of transport impacted on delivery lead times, inbound transport services required regular and consistent evaluations, manual inventory systems hindered optimization of customer service and increased inventory costs.

Transportation plays a major role in the field of logistics as it determines the efficiency of moving products. Freight transport, containerization, bulk material handling, etc. are a few of the roles that fall under its domain. The success of any supply chain is closely linked to the appropriate use of transportation. The transportation system is the physical link that connects customers, raw material suppliers, plants, warehouses, and channel members. These are the fixed points in a logistics supply chain. The basic modes of transportation are water, rail, motor carrier, air, and pipeline. Water is the slowest mode, with rail, motor carrier, and air following in order of speed of delivery. Generally, the order is reversed when looking at costs (Hiddleston, 2021).

Selection of the appropriate carrier has several steps. First the firm selects a transportation mode. The shipper must compare the service desired with the rate or cost of service. Service usually means transit time or the time that elapses from the time the consignor makes the goods available for dispatch until the carrier delivers to the consignee. Pickup and delivery, terminal handling, and

movement between origin and destination account for the time involved in transporting goods. The role that transportation plays in logistics systems is more complex than carrying goods for the proprietors. Its complexity can take effect only through high quality management. By means of a well-handled transport system, goods could be sent to the right place at the right time to satisfy customers' demands. It brings efficacy, and it builds a bridge between producers and consumers. Therefore, transportation is the base of efficiency and economy in business logistics and expands other functions of logistics system. In addition, a good transport system performing in logistics activities brings benefits not only to service quality but also to company competitiveness (Hiddleston, 2021).

Transport practices are the most efficient and realistic method of meeting transport targets, including low cost, timely delivery of transportation-related information to the remaining business and to consumers, improved efficiency, and optimal utilization of company resources. Transport practices are the most effective and practical approach. Best practices in transport management include carriers' practices and load planning and optimization practices, shipment preparation and execution practices, freight payment and audit practices, and performance monitoring (Younkin, 2006).

Transport is a crucial strategic link between supply chain companies and must be efficiently managed for fair prices in meeting customer due dates and other shipping requirements. Transportation is the only operation that delivers services via logistics outbound and inbound. An inefficient transportation system may cause the company to incur high costs to deliver the product to the consumer, and this will result in a loss to the company; and the transportation system must be able to resolve the major issues of mode selection, route selection and fleet size because it is the critical force for the company's competitiveness. Transport is an important business activity that both internally and interorganizational plays a connective role (Leuschner, et al., 2014).

Transporting is required in the whole logistics chain since it facilitates the entire process of materials and products moving into, though, out of and back to a firm consisting of four main activities: inbound logistics, covering the movement of material received from suppliers, materials management describing the movement of materials and components within a firm, physical distribution referring to the movement of goods outward from the end of the assembly line to the customer and returns back from customers. Transportation is one of the six key logistics activities

that drive total logistics costs along with customer service (including parts, service support and returns goods handling), inventory management (including packaging and reverse logistics), warehousing and storage, materials handling and procurement and order processing (including information management and demand forecasting) (Juma, 2020).

Inbound freight management entails the management of the transportation, storage and delivery of goods and raw materials coming from suppliers (Misuko, 2015). This therefore means that inbound freight management practices can enable companies to operate efficiently and obtain value for money for different manufacturers especially when the different inbound activities are properly managed. Buying organizations have been able to attain benefits using Free on Board since this puts them at liberty to determine the kind of carriers to undertake the different forwarding activities (Ramfu, 2014). It has proved that inbound freight management has enabled companies to undertake different practices including carrier selection and management, freight consolidation and optimization, technology integration, strategic partnerships, preparation and executing and monitoring practices (Hanbazazah, et al., 2020). Misuko (2015) points out the advantages of inbound freight management including the ability to plan and schedule inbound shipment using both directed and traceable carriers, reduction in inbound congestion at the ports and docks, improved ability to monitor inbound freight costs and choices, lower transportation costs through consolidation of different shipments and finally improved handling of problems and maintenance of data records.

2.2.4. Effect of Receiving processes on Emergency Supply Chain performance

Humanitarian/emergency logistics management refers to the process of planning, implementing, and controlling the efficient, cost-effective flow and storage of goods and materials, as well as related information, from the point of origin to the point of consumption for the purpose of alleviating the suffering of vulnerable people (Thomas, 2005). There are many perspectives that shed light on managing humanitarian crises, e.g. resource dependence theory, contingency theory, and behavioral theory. These can explain coordination, behavioral intentions among disaster-relief teams and the spontaneous volunteerism, cross-sector humanitarian–business partnerships and provide insights for building resilient humanitarian supply chains and developing inventory strategies for disaster-relief materials. (Dwivedi, et al., 2018) identified how the lack of communication among humanitarian actors who are engaged in disaster-relief operations hindered

effective and efficient coordination. The study contributed to cognitive dissonance theory and its application to explain the behavior of actors involved in disaster-relief operations.

According to Spens (2007) an emergency or humanitarian supply chain encompasses a range of activities, including preparedness, planning, procurement, transport, warehousing, tracking, and tracing and customs clearance. Humanitarian logistics is an umbrella term for a mixed array of operations, from disaster relief to continuous support for developing regions, and could be defined as the process of planning, implementing, and controlling the efficient, cost-effective flow and storage of goods and materials as well as related information from the point of origin to the point of consumption for the purpose of alleviating the suffering of vulnerable people. As an example, one of the notable aspects of the relief effort following the 2004 Asian tsunami was the public acknowledgment of the role of logistics in effective relief (Kopczak, 2007).

Studies by Balcik & Beamon (2008); Xu & Beamon (2006) analyze supply chain network for emergency disaster management and acknowledge that in any disaster, government traditionally deploys many organizations. However, inter organizational integration is a serious challenge in disaster management. Specifically, in developing countries, various socio-economic and political issues, particularly corruption, non-accountability, lack of transparency, and political biasness substantially hinder the success of disaster management efforts. The problems observed across disaster management operations through established supply chain network include non-cooperation among employees or volunteers, disrupted chain of commands among versatile groups, misuse of relief items for corruption, lack of information sharing, mistrust, lack of coordination among members, and inappropriate proportion of responsibility and assigned authority (Diallo, et al., 2017). It should be clearly distinguished from regular poverty management under humanitarian grounds. An effective emergency supply chain should focus on the actual need assessment, which essentially includes dynamic, swift, and coordinated field assessment. However, it is evident from some investigations that in developing countries, at different authority levels, this assessed demand derived from the source is randomly reduced anticipating exaggeration of demand (bullwhip). This reduction is not based on any scientific scale. Defining roles and responsibilities and coordination is a serious problem across emergency supply chain management for developing countries (Beamon, 2004).

Researchers studying emergency management (Balcik, 2008); (Max Stephenson, 2005) and supply chain (Zhang, 2016); (Zheng, et al., 2017) have suggested many potential problems in emergency

supply chain for humanitarian assistance. Some of these problems are - mapping the existing emergency supply chain, demand forecasting and need assessment, procurement, inventory management and stocking, logistics management, relief distribution, information management and interoperability. Researchers like; Cozzolino (2012); Balcik, *et al* (2010) in this context also postulate that due to unavailability of an established organizational structure, often members with prior experience of disaster management operations form negative attitude towards the success of the next operation (Dwivedi, et al., 2018).

2.2.5. Effect of Warehousing on Emergency Supply Chain Performance

Warehousing is important because it directly helps reduce suffering of affected people by reducing the time to reach them while also encouraging cooperation and collaboration between large numbers of governmental, non-governmental, national, and international organizations working in the field of disaster management (Hanaokaa, 2017).

Companies could gain cost advantage using their logistics area of the business because warehouse management is a possible source of cost improvements from logistics that companies could use during this economic crisis. Best practices for warehouse performance measurement led to improved performance and their solution led to the optimal use of storage space, activity for customer relations, quality level, use of assets and costs. Performance assessment makes the biggest contribution to figuring out the causes of poor production. Solutions to improve performance and improve performance, to prevent discomfort before it is too late, to monitor customer relationships, to monitor processes and costs and to maintain quality must be found after that step (Juma, 2020).

Warehouse management as a combination of the planning and control systems and the decision rules used for inbound, storage, and outbound flows (Faber, et al., 2013). According to Van den Berg and Zijm (1999), the most important tactical issues in warehouses include: stock planning, storage-location assignment planning, transport planning, and capacity (personnel and equipment) planning. Stock planning decides which products are kept in storage in what quantities and determines when shipments arrive. Intelligent stock planning may reduce warehousing costs. Storage location planning decides the location types (for example, shelf, pallet, high-bay, or block-stack) and the zones within these storage areas where the products will be stored. An effective storage-location assignment plan may reduce the need for space and the mean travel time for

storage/retrieval and order picking. Capacity planning and transport planning determine the required personnel, equipment, and transport capacities.

Researchers identify two major dimensions of uncertainty: complexity and dynamism (Zailani, et al., 2012). Complexity refers to the number and diversity of the elements in an environment. The warehouse system can be characterized by the products stock keeping units (SKUs) that have to be stored and picked, the processes to store and pick these products, and the orders that request the delivery of these products. Complexity increases as the number and diversity of SKUs, order lines, and processes increase. In general, if the number of SKUs increases, more storage space (often different type and control logic) will be needed, and more products have to be registered and managed in the warehouse information system. Some warehouses have a greater number and/or variety of processes and some of these activities are labor intensive and have substantial impact on order throughput time. The number of order lines is a good indicator for the total amount of work in order picking and thereby for the total amount of work to be done in the warehouse. In general, most warehouse work is in order picking (Faber, et al., 2013).

Studies have been done in logistic management practices and their influence on performance. Globally, Green, Whitten, and Inman (2008), established a positive relationship between logistics performance and organizational performance within the manufacturing sector. In Kenya, Gitonga (2017) carried out a study on the link between logistics management practices and operational performance of fast-moving consumer goods manufacturers in Nairobi. The study established that Fast moving manufacturing companies Kenya employed logistics management practices including transportation management practices which enabled timely delivery of products and services to customers, inventory management practices which enable the firm to avoid inventory bottleneck in production. In addition, the study found that warehouse management practices facilitated products delivery at the right quantity to the customers and packaging practices (Juma, 2020).

2.2.6. Effect of Inventory Management on Emergency Supply Chain Performance

Efficient or inefficient management of inventories is one of the main factors that may influence firm performance. Literatures on optimal inventory management uses criteria of cost minimization or profit maximization. An inventory managers' goal for example, is modelled as minimizing cost or maximizing profit while satisfying customers' demands. If inventory decisions do not affect the revenue stream, these two criteria result in the same optimal replenishment policy. In the operations management literature, the question of how much inventory a firm should keep has

been extensively studied but there is dichotomy in the views given that inventory is both an asset and a liability. Too much inventory consumes physical space, creates a financial burden, and increases the possibility of damage, spoilage, and loss. Further, excessive inventory frequently compensates for sloppy and inefficient management, poor forecasting, haphazard scheduling, and inadequate attention to process and procedures. On the other hand, too little inventory often disrupts manufacturing operations, and increases the likelihood of poor customer service. In many cases good customers may become irate and take their business elsewhere if the desired product is not immediately available (Koumanakos, 2008).

Empirical evidence in the inventory management-performance relationship produced also mixed results. Timely and informative customer demand data can result in improved firm performance through reduced inventories. There is a significant negative relation between gross operating income and the number of inventories days for a sample of non-financial Belgian firms and managers can create value for their shareholders by reducing the number of inventories days to a reasonable minimum (Deloof, 2003).

One of the key success factors of any institution, including humanitarian organizations, is effective and efficient inventory management flow across the value chain. The problem in inventory management is to balance the interaction between inventory supplies and demand. To order to meet the expectations of those without loss due to product inventory losses, preferably a company needs to have enough stock. On the other hand, due to the expense of carrying inventories, the company doesn't want to have too much inventory available. Inventory decisions are high risk and have a significant effect on the management of the supply chain of an enterprise (Juma, 2020). Inventory management practices, according to Dimitrios (2008), are recognized as a critical area of concern that requires the highest priority.

In general, measuring and optimizing the performance of emergency supply chains has become critical for all organizations involved in disaster management. However, measuring logistics performance in structured and standardized ways is not common in the humanitarian supply chain context. A recent study by Abidi, *et al* (2014) showed that measuring performance would increase the performance of humanitarian logistics, but the extent was not statistically studied. Another study conducted by Reiner (2012) identified that government situational factors, socioeconomic situational factors, infrastructure situational factors and environmental situational factors can

affect the performance of humanitarian logistics. However, these authors strongly advised that case studies and survey approaches be used more frequently to gather empirical knowledge.

A study conducted in Amhara National Regional State humanitarian aid organizations (Beyene, 2018) showed that the availability of professional staff and adequate institutional learning are the significant predictive internal factors that cause positive change in humanitarian logistics performance. According to the study conducted by Tufa(2023); selected organizations in Ethiopia did not measure performance to enhance proper coordination, minimize redundancies, and improve efficiency at the national level in the management of emergency situations.

2.3. Theoretical framework of the study

2.3.1. Resource Based View

Resource-based view has been developed in work by Barney (1986) for analyzing firm behavior and competitive strategy (Mowery, et al., 1998). The RBV contends that the idiosyncratic resources and capabilities of firms are the key sources of sustained competitive advantage. This premise appears to be supported by logistics and Supply Chain Management research (Juma, 2020). According to Barney(1991) resources can be classified into organizational capital resources, physical capital resources and human capital resources. Capabilities can be defined as the skills a firm needs to take full advantage of its assets. Capabilities are complex bundles of individual skills, assets and accumulated knowledge exercised through organizational processes that enable firms to co-ordinate activities and make use of their resources (Ellinger, 1997). Developing and implementing logistics management practices can only be achieved through creating environmentally responsible policies and investing in the necessary equipment and training. Creating a competitive advantage through implementing reverse logistics practices would lead to improved market share and consequently higher profit margins (Dube & R.R.Gawande, 2011).

2.3.2. Relief Coordination Theory

This theory hypothesizes that it is possible to orchestrate the efforts of diverse organizations and the orderly and organized direction of activities (Seybolt, 1997). The Humanitarianism and War Project offers a more specific and often cited definition of the concept as: managing information; mobilizing resources and assuring accountability; orchestrating a functional division of labor in

the field; negotiating and maintaining a serviceable framework with host political authorities; and providing leadership (Minear, 2002). Scholars also often suggest that coordination is important to improve service delivery effectiveness. Indeed, while effectiveness is rarely defined, it is most often given as the reason why achieving coordination among service providing agencies is important (Minear, 2002). An effort to reduce duplication, often framed as securing or improving organizational efficiency, is also frequently offered as a rationale for why humanitarian organizations should seek to coordinate their assistance operations (McEntire, 1997).

2.3.3. The Principal Agent Theory

Based on the separation of ownership and control of economic activities between the agent and the principal, various agency problems may arise, such as asymmetric information between the principal and the agent, conflicting objectives, differences in risk aversion, outcome uncertainty, behavior based on self-interest, and bounded rationality. The contract between the principal and the agent governs the relationships between the two parties, and the aim of the theory is to design a contract that can mitigate potential agency problems. The “most efficient contract” includes the right mix of behavioral and outcome-based incentives to motivate the agent to act in the interests of the principal (Eisenhardt, 1998). The alignment of incentives is an important issue in SCM. Misalignment often stems from hidden actions or hidden information. However, by creating contracts with supply chain partners that balance rewards and penalties, misalignment can be mitigated (Raman, 2004); (Baiman & Rajan, 2002).

2.3.4. The Network Theory

The performance of a firm depends not only on how efficiently it cooperates with its direct partners, but also on how well these partners cooperate with their own business partners. NT can be used to provide a basis for the conceptual analysis of reciprocity (Oliver, 1990) in cooperative relationships. Here, the firm’s continuous interaction with other players becomes an important factor in the development of new resources. Relationships combine the resources of two organizations to achieve more advantages than through individual efforts. Such a combination can be viewed as a quasi-organization (Gichuru, et al., 2015). The value of a resource is based on its combination with other resources, which is why inter-organizational ties may become more important than possessing resources. Thus, the resource structure determines the structure of the supply chain and becomes its motivating force. Through direct communication, the relationships

convey a sense of uniqueness, ultimately resulting in supply chains as customization to meet individual customer requirements. The parties gradually build up mutual trust through the social exchange processes. A network does not seek an optimal equilibrium but is in a constant state of movement and change. Links between firms in a network develop through two separates, but closely linked, types of interaction: exchange processes (information, goods and services, and social processes) and adaptation processes (personal, technical, legal, logistics, and administrative elements) (Mattsson, 1987). Social networks have also been used to examine how Humanitarian Organizations interact with each other, characterizing the many informal connections that link executives together as well as associations and connections between individual employees at different Humanitarian Organizations. These networks provide ways for Humanitarian Organizations to gather information, deter competition, and even coordinate in setting operational policies (Korir, et al., 2023).

2.3.5. Value Chain Theory

This study relies on the *Value Chain* theoretical frame proposed by Porter (1985), which was first utilized in his book – “Competitive Advantage: Creating and Sustaining Superior Performance”. The value chain theory according to (Nweke, 2017), explained the activities and operations of business ventures which are tied to its survival in the competitive business arena. The primary activities according to Lysons (2006) are included into the following, marketing and sales, inbound logistics, and outbound logistics, amongst others. The secondary activities include the structural systems of the organization, which involves; technological input, human resource management, information system amongst others (Lysons, 2006). As a core mandate of the business organization, the value chain theory tends to explain profit making activities and various systems involved in achieving its core purpose. Also, the theory possesses the capacity in its explanation of identifying and categorizing different operations in the supply chain structure and how to optimum organizations financial performance by mean of establishing value relevance to goods and services in the transitional process from suppliers to customers (Nweke, 2017). The value chain emphasizes the close relationship between functional strategies within a company. Each function is crucial if a company is to satisfy customers’ needs profitably (Sunil Chopra, 2001). Porter (1998) identified the value chain as a set of interconnected generic activities mutual to a wide range of firms.

From the above theories, this study grounds on network theory. An organization has a competitive edge over others in the same industry if it transfers productivity to its clients (McWilliams, et al., 2002). To develop unique and firm-specific capacities in the manner they transport goods to clients, inbound logistics companies may collect physical, human, and strategic capital and integrate them (Karia, 2010).

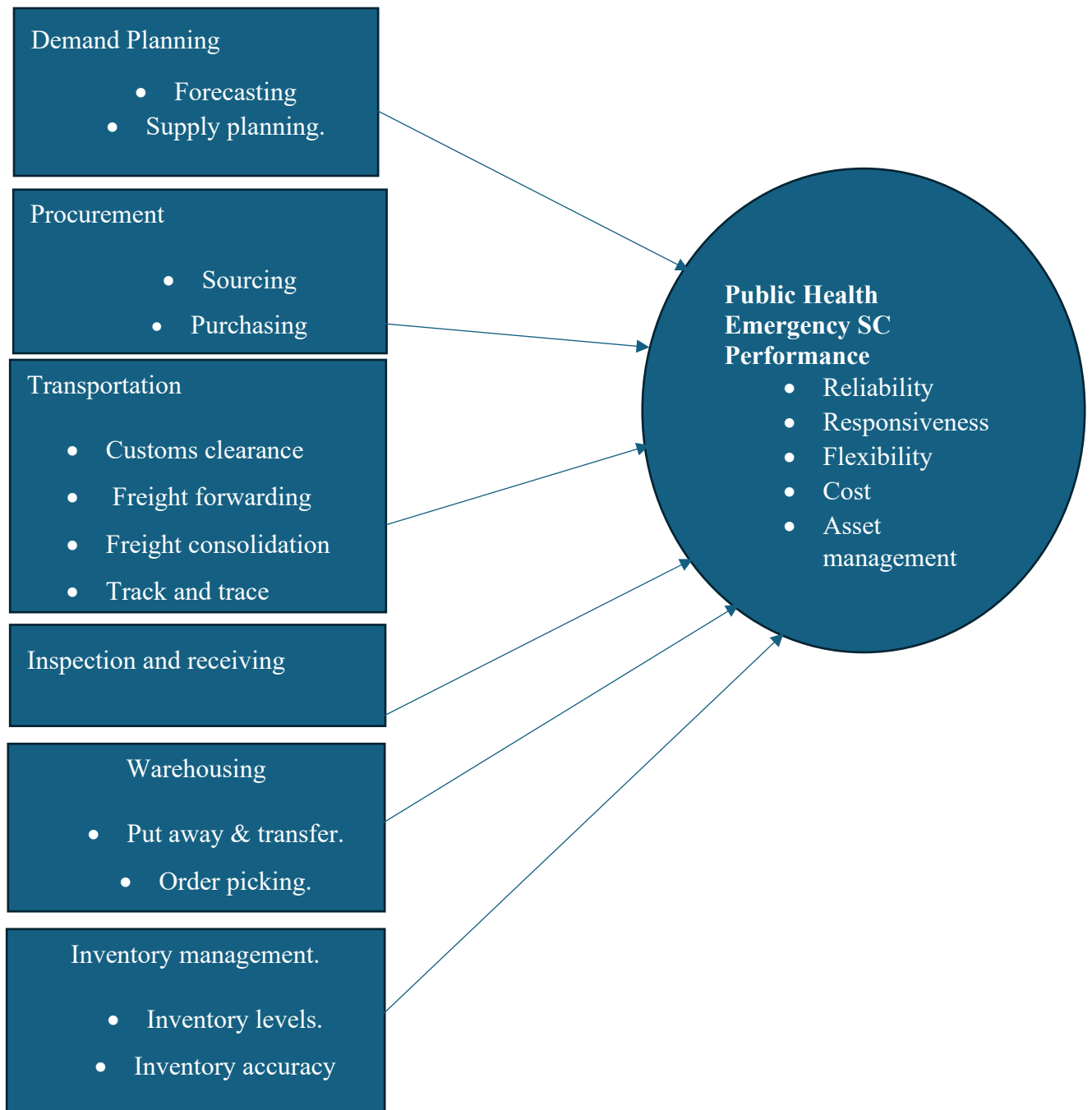
Relief supply chains primarily incorporate the process of planning, implementing, and controlling a cost-effective and efficient flow and storage of materials, goods, and information from the point of origin to the point of consumption, i.e. the disaster area, to alleviate the suffering of the affected population. Implementing and controlling such a cost-effective and efficient flow of relief items requires the structured network between/among stakeholders to realize humanitarian objectives within several stages of relief supply chain management. Therefore, application of network theory in this circumstance is paramount (Thomas, 2005).

Furthermore, a smart network strategy is required to be designed to maximize supply chain performance by involving a collection of both strong and weak links among suppliers, buyers and manufacturers that matches the needs of the supply chain. For example, strong links are those organizations that can be counted on and that provide greater reliability, while weak links improve flexibility and give access to new ideas, alternatives, and sometimes lower prices (Maghsoudi, 2016). Making use of the Network Theory's concept, it is observed that humanitarian supply chain actors have a social relationship during the preparedness and response phase of a disaster (Seybolt, 2009).

2.4. Conceptual framework of the study

The focus of this study aimed to show the relationship between effect of inbound logistics and performance of public health emergency supply chain management in Ethiopia, Ministry of health (MOH). Efficient and effective public health emergency supply chain management (dependent variable) in ministry of health, Ethiopia, is because of a set of independent variables, inbound logistics practices. However, the success of each of these the independent variables is because of a subset of some practices, which related to each of them. Below is a conceptual representation of the variables:

Public Health Emergency Supply Chain practices



Independent variables

Dependent variable

Figure 1- Conceptual framework.

Source: Adopted from (Balcik, 2008); SCOR model

2.5 Identified Literature gap.

Stemming from the theoretical and empirical literature reviewed. It is pertinent that different theories have been employed in the logistic processes involving inbound operations and findings over the years from empirical perspective have been shown in different countries. Based on the different studies reviewed it is evident that only few studies have been carried out in Ethiopia in emergency supply chain management, especially in public health sector. In addition, the studies conducted so far cannot generate better recommendations that could guide policy makers in the country.

The present study therefore bridges this gap focused on the effect of inbound logistics on public health emergency supply chain performance at MOH-Ethiopia which is responsible for the control of emergency situations in the country. Also, it is noteworthy that most of the literature focused on downstream logistic functions even though inbound operations are the critical step to avail required products timely for responding any emergencies. This study assessed the effect of inbound logistics and the effect on public health emergency supply chain management. Furthermore, existing literature lack to look at the impact of some of the major inbound operations such as demand planning, procurement, transportation, and receiving process of goods comprehensively on the performance of an organization. This study differs from others in this regard as it is further to see the impact of the key logistic inbound operations on the organizational performance which other studies ignored. Therefore, this study tried to fill the gap that had been identified above as much as possible by contributing additional knowledge through focusing on the practices relevant to the field of the study.

CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1. Descriptions of the study area

This study was conducted in MOH, EPSS and EPHI head offices found in Addis Ababa, Ethiopia. Ethiopian government departments MOH and its agencies EPSS and EPHI oversee managing public health emergencies as well as public health issues. Together with developmental partners, the armed forces, regional health offices, and healthcare facilities around the country, these governmental organizations participate in national public health emergency preparedness and response activities. Thus, this study focused on these organizations due to their responsibilities in the management and facilitation of inbound logistics activities in public health emergency supply chain management.

3.2. Research Design

Creswell, *et al.*(2003) defines research design as, it is the plan for collecting and utilizing data so that desired information can be obtained, answer the research questions, and meet the research objectives. The design of this study used both descriptive and explanatory(causal). This approach was chosen because the analysis aimed to provide a broad overview of the effect of inbound logistics on organizational performance at the country level in the management of public health emergencies.

As per Mugenda (2003), descriptive research is a process of collecting data to answer questions concerning the status of the subjects in the study and it aims to determine and report the way things are going on. It is used to understand and systematically describe practices of public health emergency supply chain and its performance. Descriptive research is used to obtain information concerning the status of the phenomena to describe what exists with respect to variables or conditions in a situation. The methods involved a range of activities: from the survey which describes the status quo to the regression study which investigates the relationship between variables.

The main use of descriptive statistics is to explain emergency supply chain practices and their related performance information or data using numbers. The explanatory research design is much

more related to defining the cause and effect or causality relationships among independent and dependent variables. For that reason, this research involved descriptive and explanatory research approaches to give an adequate depiction of the association between practices of public health emergency supply chain and supply chain performance.

3.3. Research approach.

A mixed research approach (qualitative and quantitative) was undertaken to recognize the target and provide a conclusive answer for the research questions outlined in chapter one. It had both quantitative and qualitative data that focused on the several facets of emergency supply chain procedures and how well they performed in relation to Ethiopia's Ministry of Health and its agencies. This makes it easier to comprehend reality in both its objective and subjective dimensions and to take use of the various benefits that come with using the two approaches, such as improved explanation and generalization. Quantitative data were collected for sample public health emergency procured products by the ministry of health (MOH) for the last one year, from January 2023 to January 2024. Furthermore, supplier relationship management, transportation system, and receiving processes assessed in the organizations. The qualitative approach included covering subjective matters to better explain realities, and to triangulate the study's results of the quantitative data.

3.4. Population of the study

The target population were public health emergency first respondents of government organizations MOH/PMED staff, EPHI-ESC logistics section staff and four EPSS directorates (Quantification and market shaping, tender management, procurement and custom clearance, and warehousing and inventory management directorates). These organizations are selected because they are responsible for the management of public health emergencies of the country. Furthermore, this study encompassed all experts and directors from the above-mentioned organizations who are engaging directly in the management of public health emergency commodities.

3.5 Sample size and Sample techniques

In this study the census method was employed, and a total of 85 employees in technical and managerial positions working in six directorates (MOH/PMED, EPHI-ESC logistics section, EPSS Quantification and market shaping, tender management, procurement and custom clearance, and

warehousing and inventory management directorates) under ministry of health and its agencies who are directly involved in the management of public health emergency supply chain in bound logistics activities. Specifically, employees engaging in demand planning, initiate and follow procurement processes, supplier relationship management, contract management and port clearance, warehousing, and inventory control.

3.6 Data collection instruments

The questionnaire technique was used to collect primary data with the closed-ended questionnaire. The researcher distributed the questionnaire to the respondents of employee in MOH PMED team, EPHI-ESC logistics section, EPSS Quantification & Market shaping team, EPSS tender management team, EPSS contract management and custom clearance team, and EPSS warehousing & inventory management team. Moreover, secondary data was obtained through a review of records and research papers.

3.7 Methods of data analysis and presentation

Descriptive and inferential statistics were used to analyze quantitative data. Once the data was collected from the field, it would be checked for completeness, coded and entered. The entered data would be cleaned for any errors before the final analysis began. The demographic characteristics data of the respondents would be analyzed using descriptive statistics which is in terms of frequency percentage, mean and standard deviation. Moreover, to determine the extent to which supply chain practices, an analysis of questions relating to this section would be carried out using their mean scores and standard deviations.

Inferential statistics for emergency supply chain practices and their performance have been analyzed and results tested using regression and correlation analysis. The results would be interpreted based on their coefficients, the level of significance of the coefficient of inbound logistics, the R-squared, adjusted R -squared, significance of F statistic. The whole analysis would be aided using Statistical Package for Social Sciences (SPSS). Moreover, Tolerance and Variance Inflation Factor (VIF) values were calculated to check multicollinearity of independent variables.

3.8 Validity and reliability test

Validity is a means to assure/check whether the given measuring instruments enable to measure what they are expected to measure or not. Good measures should be both consistent and accurate. It is the accuracy of a measure or the extent to which a score truthfully represents a concept. If a measurement is valid, it is also reliable (Golafshani, 2003). The validity of the data collection instrument was conducted through the advice of professionals and experts of the subject matter as well the literature reviewed throughout doing the research.

Measuring techniques to be called reliable, they must be consistent and stable on the score obtained while the researchers measure and/or assess over the given period and condition. Thus, reliability assured those measure techniques placed on the given research are being consistent and dependable. If the measurement is reliable, then there is less chance that the obtained score is due to random factors and measurement error (Field, 2009). To measure the reliability of certain research data collection instruments, customarily, Cronbach's alpha engaged as it draws impartial estimation on data generalization as it is described by (Richard E. Zinbarg, 2005), and the threshold point for acceptability of the instrument is regarded to be proposed ≥ 0.70 . Cronbach 's alpha is known as a good measure of reliability (Demers, et al., 2002). Its values range from 0 to 1 with Cronbach 's alpha values between 0.8 and 1.00 indicating a considerable reliability, values between 0.70 and 0.80 indicate an acceptable reliability while values below 0.70 are considered less reliable and unacceptable. The results from reliability analysis aided to suggest whether questionnaire should be reformulated or not. Furthermore, the data was encoded with the Statistical Package for Social Sciences for reliability procedures.

3.8.1 Validity Test

Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity are both important tools used in factor analysis to assess the adequacy and appropriateness of the data for this statistical technique. The KMO measure is a statistic that varies between 0 and 1. Higher values indicate that the data are more suitable for factor analysis. A KMO value close to 1 suggests that there is substantial common variance among variables, making them suitable for factor analysis. KMO values below 0.5 indicate that factor analysis may not be appropriate for the data. Values between 0.5 and 0.7 suggest marginal adequacy, and values between 0.7 and 0.8 are considered good.

Whereas values above 0.8 are generally considered very well, indicating that factor analysis is likely to yield distinct and reliable factors (Napitupulu, et al., 2017).

Bartlett's test of sphericity examines whether the correlation matrix is an identity matrix, which would indicate that variables are uncorrelated in the population. This test is used to determine if the variables in the dataset are interrelated enough to justify conducting a factor analysis. If Bartlett's test is statistically significant (i.e., if the p-value is less than the chosen significance level, often 0.05), it suggests that correlations between variables in the dataset are sufficiently large to justify using factor analysis. In general, KMO assesses the overall adequacy of the data for factor analysis based on the strength of correlations between variables, Bartlett's test specifically evaluates whether these correlations are large enough to justify conducting factor analysis. Both are essential in the initial stages of factor analysis to ensure the reliability and validity of the results (Napitupulu, et al., 2017).

Table 1- KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.812
Bartlett's Test of Sphericity	Approx. Chi-Square	355.674
	Df	66
	Sig.	.000

Source: (SPSS Output, 2024)

Based on Table 1, it can be seen that the value of KMO and Bartlett's Test for this study was 0.812 with a significance of 0.000. This implies that the data has been eligible for further analysis in the factor analysis and that the relationships between variables are adequate for extracting meaningful factors because it has met the requirements of KMO greater than 0.5 (>0.5) and significance under 0.05 (<0.05).

3.8.2 Reliability Test

Samuel A. Livingston (2018) stated that reliability is the degree of internal accurateness and internal Consistency with which an instrument measures the constructs it is designed to measure. If a multiple item construct measure is administered to respondents, the extent to which respondents rate those items in a similar manner is the reflection of internal consistency. Moreover,

reliability is recognized as to what extent the research findings can be replicated, if another study is undertaken using the same research methods.

Table 2- Reliability Statistics

Variables	N of Items	Cronbach's Alpha
Demand planning	4	0.701
Procurement	6	0.763
Transportation	6	0.716
Receiving process	7	0.788
Warehousing	8	0.846
Inventory management	6	0.867
Reliability	4	0.808
Responsibility	4	0.933
Flexibility	3	0.745
Cost	5	0.819
Asset management efficiency	3	0.810

Source: (SPSS Output, 2024)

The internal consistency/reliability of the study instrument was assessed with an overall Cronbach's alpha (α) of 0.959, and the reliability values for all constructs were confirmed to be greater than 0.7, which are considered reliable in general.

3.9 Ethical Considerations

According to Cacciattolo (2015) ethical considerations in research work include: right to choose; right to safety; right to be informed; right to privacy; and confidentiality. Thus, in this study, every respondent would have the right to determine whether to participate or not in the interview and he/she has the full right to not respond to any uncomfortable questions. In line with these, participants would have the right to be informed of all aspects of a research task. Moreover, confidentiality of this study was strictly maintained, and respondents' personal information was not displayed and linked with the research.

CHAPTER FOUR

4. RESULTS, DISCUSSION, AND INTERPRETATION

4.1. Demographic profile of the respondent

A total of 85 questionnaire was distributed to the staff of MOH/PMED, EPHI-ESC logistics section, EPSS Quantification and market shaping, tender management, procurement and custom clearance, and warehousing and inventory management directorates under MOH and its agencies who are directly involved in the management of public health emergency supply chain. Out of the 85 questionnaires distributed 72 of the respondents returned their response while 13 of questionnaires were not retrieved. The response rate represents 84.7% of the total sample which shows that a higher percentage of the respondent view were captured. This implies a good response rate, as studies indicate that the response rate to a questionnaire survey is 70% and above is considered valid and used for analysis and reporting (Beerten, et al., 2014). The collected data were presented and analyzed using SPSS (version 26).

The general information of respondents and organizations considered in the study was the respondent's gender, age, educational qualification, years stayed in the organization, directorate/department or functional area in the organization, and total years of experience in emergency supply chain operation.

Table 3 - Demographic profile of the respondents (N=72)

Variables	Items	Frequency	Percent (%)
Gender	Male	61	84.7
	Female	11	15.3
Age	18-30 Years	15	20.8
	31-40 Years	45	62.5
	41-50 Years	10	13.9
	Above 50 Years	2	2.8
Educational qualification	First degree	27	37.5
	Second degree and above	45	62.5
	Less than 5 years	25	34.7

Variables	Items	Frequency	Percent (%)
Years stayed in the organization	6-10 years	25	34.7
	Over 10 years	22	30.6
Directorate or functional area	MOH/PMED	6	8.3
	EPHI-ESC Logistics section	7	9.7
	EPSS Quantification and market shaping	15	20.8
	EPSS Tender management	11	15.3
	EPSS Procurement and custom clearance	7	9.7
	EPSS Warehousing and Inventory management	16	22.2
	Other	10	13.9
Work experience in emergency supply chain	Less than 5 years	49	68.1
	6-10 years	16	22.2
	Over 10 years	7	9.7

Source: (SPSS Output, 2024)

The respondents were asked their demographic profile, includes gender, age, educational qualification, years stayed in the organization, their directorate/functional area, and work experience in emergency supply chain. The results show that 84.7% of respondents were male and the remaining 15.3% of the total respondents were female. It gives a confirmation that males could be leading in public health emergency supply chain or employment environment. Out of a total of 72 respondents, 62.5% fell between the age ranges 31 to 40 which shows that emergency supply chain has been practiced by adults. This table also shows that most of the respondents (62.5%) were second degree and above holders while the remaining 37.5% of the respondents had first degree in their educational qualifications. And there are no college diploma and grade 12 completed respondents in the organizations. The result indicates that most of the respondents were qualified professionals so that they can easily understand and provide their opinion on the research questionnaire.

Regarding to respondents work experience in the organization, the results shows that 34.7% of the respondents had less than 5 years of work experience, 34.7% of the respondents had 6-10 years of work experience, and 30.6% of the respondents had over 10 years of experience. The result illustrates that almost all the respondents had sound knowledge and experience in the organization to understand the supply chain activities and so that they can provide reliable information to the research question. Furthermore, the respondents were asked to indicate their directorate or functional area in the organization and the results show that about 8.3% of the respondents were from MOH/PMED, 9.7% of the respondents were from EPHI-ESC logistics section, 20.8% of the respondents were from EPSS Quantification and market shaping directorate, 15.3% of the respondents were from EPSS Tender management, whereas, 22.2% and 13.9% of the respondents were from EPSS warehousing and inventory management directorate and from other seconded technical experts in the organizations. This result indicates that the respondents were from different directorates and functional areas to help to assess different perspective and an independent view of emergency supply chain practices and its performance.

Finally, respondents were asked to indicate their work experience in emergency supply chain, and the result shows in the above Table-3, 68.1% of the respondents had less 5 years of work experience, 22.2% of the respondents had 6-10 years of work experience, and the remaining 9.7% of the respondents had more than 10 years of work experience in the management of public health emergency supply chain. The result shows that almost all the respondents had sound knowledge and experience in the area to understand and give adequate response for the questions.

4.2. Emergency supply chain practices of MOH, EPSS, EPHI head offices

This study collected primary data from respondents about the emergency supply chain management practices in the surveyed organizations under demand planning, procurement, transportation, receiving processes, warehousing, and inventory management. Respondents gave responses by using the five-point Likert scale. The weighted mean values are interpreted with the degree of agreement for each supply chain practice and performance calculated, and its interpretation was made based on Moidunny's (2009) mean score analysis considerations as stated by; mean score that is ranged from 1.00 to 1.80 considered as never practiced; 1.81 to 2.60 as poorly practiced; 2.61 to 3.20 as moderately practiced; 3.21 to 4.20 as well-practiced; and 4.21 to 5.00 extremely practiced.

Table 4- Emergency supply chain management practices of MOH, EPSS, and EPHI head offices

Emergency supply chain practices	Descriptive Statistics	
Demand planning practices	Mean	Std. Deviation
Demand forecasting practices for the management of emergencies	3.51	.934
Forecasting of public health emergency products on emergency prediction	3.86	.775
Field consumption data collection practice and analysis	3.01	.971
Demand planning on the needs of the population after the disaster	3.24	.942
Grand mean for demand planning	3.40	
Procurement practices	Mean	Std. Deviation
Supplier selection of MOH/EPSS/EPHI	3.38	1.054
MOH/EPSS/EPHI relationship with its suppliers.	3.53	.872
Procurement practice in good quality.	3.47	.903
Procurement practice in delivering within the agreed lead-time	3.00	1.021
Documentation management practice in procurement	3.38	.956
Procurement practice before the occurrence of an emergency.	2.89	.912
Grand mean for Procurement	3.27	
Transportation practices	Mean	Std. Deviation
Modes of transportation available and use	3.92	.783
Third party transporters are engaged & contracted during emergencies	3.62	.941
Prequalified transporters during emergencies.	3.03	1.087
Regular and consistent evaluations for inbound transport services	2.99	1.000
Proper transportation practices for relief supplies.	3.82	.811
Transporter vehicle is good enough to maintain quality of the products.	3.46	.963
Grand mean for Transportation	3.47	
Receiving processes	Mean	Std. Deviation
Pre-receiving planning and clear communication channels with suppliers	3.51	.919
Visual inspections before unloading	3.72	.876
Delivery documentations are always crosschecked	4.13	.580
Standard Operating Procedure (SOP)for receiving process	3.83	.822

Immediate data entry is practiced and integrated with other systems	3.60	.959
Receiving practices through standardized inspection	3.74	.822
Internal control system during receiving	3.62	.911
Grand mean for Receiving	3.73	
Warehousing practices	Mean	Std. Deviation
Sufficient and appropriate warehouses to temporarily store	3.51	.979
Warehouse's location accessibility for distribution of relief items.	3.64	.909
Warehouses as a facilitator for coordination of warehousing operations	3.79	.711
Warehouse implements modern filling system for information provision	3.42	.946
Warehouse allows quick and easy mapping for unexpected shipments	3.33	.949
Warehouse has designated specific areas for different operations	3.47	.888
Warehouses proactively send information to MOH/EPHI about shipments	3.18	1.025
Warehouse timely reports the status of the delivered goods	3.50	.888
Grand mean for Warehousing	3.48	
Inventory management practices	Mean	Std. Deviation
Data tracking practices for stock rates and prediction of potential demands	3.40	.883
Inventory management practices for visibility	3.50	1.007
Practice of maintaining the right amount of inventory	3.13	1.020
Regular stock situation analysis practice	3.35	.937
Inventory management during shortage	3.26	.949
Inventory management system and policy	3.31	.988
Grand mean for Inventory management	3.32	
Grand mean for emergency supply chain management practices of MOH, EPSS, EPHI	3.44	

Source :(SPSS Output, 2024)

4.2.1 Demand planning practices

Demand planning implementation in emergency supply chain management enables better exploitation of forecasting in planning prospect to make decision about the size of production, stocks to be purchased and securing budget for purchasing. Demand planning is essential part of many modern logistic technologies and organization for the provision of efficient customer service

(Patak, 2011). The findings in this survey shown that the practice of demand forecasting (3.51, SD=0.934); forecasting of public health emergency products focus on emergency prediction rather than long term response after the start of an emergency (3.86, SD=0.775), and demand planning on the needs of the population after the disaster (3.24, SD=0.942) are well-practiced in the organizations. However, field consumption data collection practice and analysis method for emergency products demand estimation (3.01, SD=0.971) is moderately practiced. The result indicated that the mean score 3.40 for demand planning was rated as well-practiced. This implies that they had a rational attitude towards demand planning practices in MOH, EPHI and EPSS.

This result concurred with the study conducted by Haile (2005), forecasting of relief items focus on emergency predictions rather than long term response after the start of an emergency. Even though there is virtually no empirical data obtained from literatures about forecasting or demand planning of relief items exists, the surveyed organization in Ethiopia is practiced moderately. In line with this, a study conducted at MSF-OCA has revealed that forecasting or assessing needs was deemed challenging due to the changing needs and the large number of beneficiaries. In the meantime, MSF-OCA has developed information system to collect field consumption data suitable for analysis and decision making (Laan, et al., 2016). The result obtained from the analysis shows that field data collection practice and analysis method for emergency products demand estimation is moderately practiced which aligns with the MSF-OCA practice.

4.2.2 Procurement practices

The procurement of relief items is a critical and challenging process for humanitarian organizations (HOs), accounting significant costs relief operations (Moshtari, et al., 2021). Based on the results from table 4 showed that supplier selection of MO/EPSS/EPHI focused on reliable delivery of relief items in addition to price and specification (3.38, SD=1.054), MOH/EPSS/EPHI relationship with its suppliers (3.53, SD=0.872), procurement practice in good quality (3.47, SD=0.903), and documentation management practice in procurement (3.38, SD=0.956) are well-practiced in the organizations. Whereas procurement practice in delivering within the agreed lead-time (3.00, SD=1.021) and procurement practice before the occurrence of and emergency (2.89, SD=0.912) are moderately practiced. The result indicated that the mean score 3.27 for procurement was rated as well-practiced. This indicates that they had a rational attitude towards procurement practices in MOH, EPHI and EPSS. Results in the above table show that most mean values were greater than

3.20 and less than 4.00 indicates that the respondents agreed with the various items. Similarly, the standard deviation values were less than two which is small and therefore suggests that respondents had similar opinions. Consequently, it can be said that the highest mean (3.53) indicated that MOH/EPSS/EPHI has a good and long-term relationship with its suppliers. Whereas procurement practice before the occurrence of an emergency (2.89) is moderately practiced and needs to be improved for effective emergency situations management.

Literature on supplier selection in emergency supply chain management is scarce and where a supplier selection problem for establishing framework agreements with a quantity flexibility contract was studied (Zabinsky, 2011). There is no study that addresses framework agreements and presents models for supplier selection decisions in the relief literature. In line with this, there are various important factors, like; price discount, delivery time supplier capacity, and lead time are considered when selecting suppliers (Dong, 2018). Based on the results from the analysis, surveyed organizations have a good practice in selecting suppliers focused on reliable delivery of relief items in addition to price and specification.

Furthermore, the emergency is a natural or an epidemic outbreak, procuring the relief items faces several challenges, includes uncertainty, delays occurring, and urgent needs go unmet. So, agility and flexibility are crucial (Ivanov, 2020). The result indicated from the study that procurement practice in delivering within the agreed lead-time and procurement practice before the occurrence of an emergency are moderately practiced and needs to be improved.

4.2.3 Transportation practices

Transportation plays a major role in the field of logistics as it determines the efficiency of moving products (Hiddleston, 2021). In terms of transportation, respondents agreed that the organization uses all modes of transportation (3.92, SD=0.783), third party transporters are engaged & contracted during emergencies (3.62, SD=0.941), proper transportation practices for relief items (3.82, SD=0.811), and transporter vehicle is good enough to maintain quality of the products (3.46, SD=0.963) are well-practiced. On the other hand, prequalified transporters during emergencies (3.03, SD=1.087), and regular and consistent evaluations for inbound transport services (2.99, SD=1.000) are moderately practiced. The result indicated that the mean score 3.47 was rated as well-practiced. This indicates that respondents had a rational attitude towards transportation practices in the organization. Results in the above table show that most mean values were greater

than 2.99 and less than 3.92 indicates that the respondents agreed with the various items. Similarly, the standard deviation values were less than two which is small and therefore suggests that respondents had similar opinions. Regular and consistent evaluations for inbound transport services need to be improved as compared to other transportation practices.

According to Langat (2013) study, mode of transport impacted on delivery lead-times. Thus, this study indicated that the organizations use all modes of transportation for the movement of relief items. However reviewed literature failed to address the role of inbound logistics in the performance of emergency supply chain. Transport practices are the most efficient and realistic method of meeting transport targets, including low cost, on time delivery to customers, improved efficiency, and optimal utilization of company resources (Younkin, 2006). From this study in the surveyed organizations proper transportation management and transporter vehicle is good enough to maintain quality of the products. Similarly, inbound freight management entails the management of storage and delivery of relief items from suppliers (Misuko, 2015). This therefore means that inbound freight management practices can enable companies to operate efficiently (Ramfu, 2014). It has proved that inbound freight management has enabled organizations to undertake different practices including carrier selection and management, freight consolidation and optimization (Hanbazazah, et al., 2020). To do so, the assessed organizations engaged and contracted third party transporters during emergencies. Nevertheless, the study indicated that prequalified transporters during emergencies and regular and consistent evaluations for inbound transport services are moderately practiced and needs to be improved for better service delivery.

4.2.4 Receiving processes

Humanitarian logistics is an umbrella term for a mixed array of operations, from disaster relief to continuous support for developing regions, and could be defined as the process of planning, implementing, and controlling the efficient, cost-effective flow and storage of goods and materials as well as related information from the point of origin to the point of consumption for the purpose of alleviating the suffering of vulnerable people (Kopczak, 2007). Thus, this study assessed practices of receiving processes in EPSS and EPHI and results in the above table show that all the mean values were greater than 3.51 and not more than 4.13; this indicated that the respondents agreed with the various statements or items. The grand mean score (3.73) was rated as well-practiced. In the same way, the standard deviation values were less than two which is small and

therefore suggests that respondents had similar opinions. In line with this, the highest means (4.13) delivery documentations (such as the bill of lading or delivery note with purchase) are always cross checked. However, practices such as pre-receiving planning and clear communication channels with suppliers need to be improved in the surveyed organizations.

According to Spens (2007) an emergency or humanitarian supply chain encompasses a range of activities, including preparedness, planning, procurement, transport, warehousing, tracking, and tracing and customs clearance. Studies (Balcik & Beamon, 2008; Xu & Beamon, 2006) analyzing supply chain network for emergency disaster management and acknowledge that in any disaster, government traditionally deploys many organizations. However, inter organizational integration is a serious challenge in disaster management. The study result shows that practice of pre-receiving planning and clear communication channels with suppliers and other receiving processes and activities are well practiced in the surveyed organizations.

4.2.5 Warehousing practices

Warehouses are a substantial component of emergency supply chain management operations and an important contributor to speed and cost in supply chains (Johnson & McGinnis, 2010). In this study, respondents perceived that EPSS/EPHI has sufficient and appropriate warehouses to temporarily store (3.51, SD=0.979), warehouses location accessibility for distribution of relief items (3.64, SD=0.909), warehouses as a facilitator for coordination of warehousing operations (3.79, SD=0.711), warehouse implements modern filling system for information provision (3.42, SD=0.946), warehouse allows quick and easy mapping for unexpected shipments (3.33, SD=0.949), warehouse has designated specific areas for different operations (3.47, SD=0.888), warehouses timely reports the status of the delivered goods (3.50, SD=0.888) are well-practiced. However, warehouses proactively sending information to MOH/EPHI about shipments (3.18, SD=1.025) is moderately practiced and needs to be improved as compared to other warehousing activities. The grand mean score (3.48) was rated as well-practiced. This indicates that they had a rational attitude towards warehousing practices in the surveyed organizations. Results in the above table show that all the mean values were greater than 3.18 and less than 3.79. This is an indication that the respondents agreed with the various items. In the same way, the standard deviation values were less than two which is small and therefore suggests that respondents had similar opinions.

Warehouse management as a combination of the planning and control systems and the decision rules used for inbound, storage, and outbound flows (Faber, et al., 2013). According to Van den Berg & Zijm (1999), the most important tactical issues in warehouses include: stock planning, storage-location assignment planning, transport planning, and capacity (personnel and equipment) planning. The result indicated from the study that EPSS/EPHI has sufficient and appropriate warehouses to temporarily and its location are accessible for distribution of the relief items which consistent with the reviewed literatures. In the same manner, the surveyed organizations well practiced warehouses as a facilitator for coordination of warehousing operations and implements modern filling system for information provision. This result is supported by the study conducted in Kenya, Gitonga (2017) found that warehouse management practices facilitated products delivery at the right quantity to the customers and packaging practices (Juma, 2020).

4.2.6. Inventory management practices

One of the key success factors of any institution, including humanitarian organizations, is effective and efficient inventory management flow across the value chain. The problem in inventory management is to balance the interaction between inventory supplies and demand (Juma, 2020). Therefore, regarding to inventory management, respondents agreed that maintaining the right amount of inventory to manage emergency situations (3.13, SD=1.020) is moderately practiced. While data tracking practices for stock rates and prediction of potential demands (3.40, SD=0.883), inventory management practices for visibility (3.50, SD=1.007), regular stock situation analysis (3.35, SD=0.937), inventory management during shortage (3.26, SD=0.949), and inventory management system and policy (3.31, SD=0.988) are well-practiced in the organizations for the management of emergency situations. In line with this the grand mean score of inventory practice is 3.32 and was rated as inventory management tasks are well-practiced. This implies that respondents had a rational attitude towards inventory management practices in MOH/EPSS/EPHI. Results from the above table show that all the mean values were greater than 3.13 and less than 3.50; this is an indication that the respondents agreed with the various statements. Similarly, the standard deviation values were less than two which suggests that respondents had similar opinions.

Literatures on optimal inventory management uses criteria of cost minimization or profit maximization (Koumanakos, 2008). This study result agreed that maintaining the right amount of inventory to manage emergency situations is moderately practiced and helps to reduce cost. If

inventory decisions do not affect the revenue stream, these two criteria result in the same optimal replenishment policy. In the operations management literature, the question of how much inventory a firm should keep has been extensively studied but there is dichotomy in the views given that inventory is both an asset and a liability. Too much inventory consumes physical space, creates a financial burden, and increases the possibility of damage, spoilage, and loss. Further, excessive inventory frequently compensates for sloppy and inefficient management, poor forecasting, haphazard scheduling, and inadequate attention to process and procedures. On the other hand, too little inventory increases the likelihood of poor customer service. In many cases good customers may become irate and take their business elsewhere if the desired product is not immediately available (Koumanakos, 2008).

Similarly, in the surveyed organizations data tracking practices for stock rates and prediction of potential demands, inventory management practices for visibility, regular stock situation analysis, inventory management during shortage, and inventory management system and policy, are well-practiced in the organizations for the management of emergency situations which supports the study conducted by Koumanakos (2008). Empirical evidence in the inventory management-performance relationship produced also mixed results. Timely and informative customer demand data can result in improved firm performance through reduced inventories (Deloof, 2003). Inventory management practices, according to Dimitrios (2008), are recognized as a critical area of concern that requires the highest priority.

4.3 Emergency Supply Chain Performance of MOH/PMED, EPSS inbound directorates and EPHI-ESC logistics sections head offices

This study collected primary data from respondents about the supply chain performance in the surveyed organizations. Respondents gave responses by using the five-point Likert scale. it followed Moidunny's (2009) mean score analysis considerations as explained in the previous part.

Table 5- Emergency Supply Chain Performance of MOH/PMED, EPSS and EPHI head offices (N=72)

Emergency Supply Chain Performance	Descriptive Statistics	
A. Reliability	Mean	Std. Deviation
Delivered in perfect condition.	3.10	.891
Perfect order fulfilment	3.01	.927
Delivery performance to beneficiary committed date.	3.06	.902
Orders are received in full	2.93	.954
Grand mean for Reliability	3.02	
B. Responsiveness	Mean	Std. Deviation
Order fulfilment cycle time	3.22	.996
Delivery cycle time	3.17	.979
Return cycle time	3.14	.924
Source cycle time	3.18	1.025
Grand mean for Responsiveness	3.18	
C. Flexibility	Mean	Std. Deviation
Upside supply chain flexibility	3.35	.906
Downside supply chain adaptability	3.11	.912
Overall value at risk	3.26	.934
Grand mean for Flexibility	3.24	
D. Cost	Mean	Std. Deviation
Total supply chain management costs	3.25	1.004
Planning costs for relief items	3.01	1.028
Sourcing costs for relief items	3.21	.978
Delivery costs	3.29	.956
Cost to returns for any defect	3.19	1.016
Grand mean for Cost	3.19	
E. Asset Management Efficiency	Mean	Std. Deviation
Cash-to-Cash Cycle Time	3.07	1.012

Emergency Supply Chain Performance	Descriptive Statistics	
Inventory days of supply	3.33	1.048
Inventory of relief items in min-max level.	3.13	1.006
Grand mean for Asset Management Efficiency	3.18	
Grand mean for emergency supply chain performance	3.16	

Source: (SPSS Output, 2024)

Different supply chain performance indicators using the SCOR model are used to measure the performance of emergency supply chains in MOH, EPSS, and EPHI head offices. As can be seen from the above table, results of supply chain dimensions include.

Reliability

The results in this study show that most of the reliability performance scores are between in the range of 2.93-3.10 indicates that emergency supply chain reliability is medium at the surveyed organizations. Specifically, orders delivered in perfect condition (3.10, SD=0.891), perfect order fulfilment at MOH/EPSS/EPHI (3.01, SD=0.927), delivery performance to beneficiary committed date (3.06, SD=0.902), orders received in full (2.93, SD=0.954). The result from the respondents showed that delivered in perfect condition for ordered relief items is more reliable than other indicators. Whereas relief items orders received in full without quality deviation is less reliable, as per the observation of respondents, and the organizations need to be improved in this area. In general, the observed performance of emergency supply chain management in terms of reliability at MOH, EPSS, and EPHI is medium (3.02).

Supply chain reliability is the ability of a supply chain to fulfill end customer demand to the desired level continually over the planning horizon. Supply chains often have complicated network structures consisting of several companies and facilities, and various paths through which materials and products flow. It is predictable, on-time delivery of perfect orders, as expected by the customer. Supply chain reliability is crucial for putting an effective supply chain management strategy into practice. Collaboration between shippers and carriers is often cited as the reason for reliable, on-time performance. Typical metrics for the reliability attribute include On-time, the right quantity, and the right quality (Chen, et al., 2017). Thus, the study result shows that reliability

performance is medium at the surveyed organizations. This implies that emergency supply chain management organizations' performance in terms of reliability needs to improve through implementation of supply chain practices effectively.

Responsiveness

Regarding the responsiveness of emergency supply chain, respondents relied on that the order fulfilment cycle time is high (3.22, SD=0.996). However, delivery cycle time (3.17, SD=0.979), return cycle time (3.14, SD=0.924), and source cycle time (3.18, SD=1.025) in the organizations are medium. The result from the respondents showed that order fulfilment cycle time for emergency supply is more responsive as compared to other indicators. While delivery cycle time, return cycle time and source cycle time are less responsive and need to be improved in the organizations.

Responsiveness is the ability of a supply chain to adapt to a wide range of quantities requested, meet short lead times, handle a wide diversity of products, create highly inventive products, attain a high service level, and manage supply uncertainty. In other words, responsiveness is separated into three capabilities: velocity, reactivity, and visibility. Reactivity is the capacity to assess and consider quickly while velocity indicates the capacity to cover needs rapidly. Consequently, visibility covers the capacity to see the developments down the supply chain, including identity, position, and status of the shipment alongside the programmed and specific dates and times for the events (Kiswili, et al., 2022). Thus, the result from this study indicates that the overall perceived performance of emergency supply chain management in terms of responsiveness at MOH, EPSS, and EPHI is medium (3.18). The results of the study can support improvements in emergency supply chains, thereby providing affected people with rapid, cost-efficient, and better-adapted responses (Jahre & Fabbe-Costes, 2015).

Flexibility

About the flexibility of emergency supply chain management in the given organizations, respondents agreed that upside supply chain flexibility for unplanned increase in emergency supplies delivery (3.35, SD=0.906) and monitored overall value at risk (3.26, SD=0.934) are high. However, downside supply chain adaptability for relief items is medium in the surveyed

organizations and needs to be improved. In general, the observed performance of emergency supply chain management in terms of flexibility at MOH, EPSS, and EPHI is high (3.24).

To deal with unpredictable and turbulent contexts of response, emergency supply chain (HSC) require flexibility and without sufficient flexibility, HSCs are prone to several disruptions (Baharmand, et al., 2017). The need for flexibility in terms of both resources and co-ordination of operations is particularly important to organizations which operate in a constantly changing unpredictable environment. Coordination flexibility in this context applies to reconfiguring the chains to deploy the required goods to the identified recipient as speedily as possible (Scholten, et al., 2010). The study result of the surveyed organizations explained that flexibility is high and has the capability to deal with unpredictable and turbulent situations.

Cost

In this study, the respondents were also asked about cost dimension to measure MOH, EPSS, and EPHI position on performance of emergency supply chain. The results show that reasonability of total supply chain management cost (3.25, SD=1.004), sourcing costs management (3.21, SD=0.978), and delivery costs (3.29, SD=0.956) are high in the organizations. On the other hand, continuous monitoring of planning costs (3.01, SD=1.028) and cost to return to the original supplier for any defect (3.19, SD=1.016) are medium. Therefore, the surveyed organizations need to be continuously monitored planning costs and cost to return for any defect relief items. To conclude this, the assessed performance of emergency supply chain management in terms of cost at MOH, EPSS and EPHI is medium (3.19).

The performance of humanitarian organizations, specifically focusing on how they managed their operation with limited resources and unlimited demand. Public health emergency management organizations should focus on resource allocation and on avoiding inefficiencies in procurement of relief items (Abidi, et al., 2014). Thus, the overall performance of emergency supply chain management in terms of cost is medium at the surveyed organizations that needs to be improved for the provision of the humanitarian services with constrained resources.

Asset management efficiency

Concerning the asset management of emergency supply chain management, respondents observed that the magnitude of cash-to-cash cycle time (3.07, SD=1.012) and maintaining inventory of relief

items in min-max level (3.13, SD=1.006) are medium. While, monitoring inventory days of supply for relief items (3.33, SD=1.048) is high in the assessed organizations. Therefore, the cash-to-cash cycle and maintaining inventory of relief items in min-max level need to improve in the emergency supply chain management organizations. In general, the observed performance of emergency supply chain management in terms of asset management efficiency at MOH, EPSS, and EPHI is medium (3.18).

According to APICS (Version 12.0), asset management efficiency is the ability to efficiently utilize assets. Metrics included for asset management efficiency are inventory days of supply and capacity utilization. The result indicated in the surveyed organizations is cumulatively medium which needs improvement for the efficient management of public health emergency situations in Ethiopia.

The summarized emergency supply chain performance with the mean values of each of the scales were calculated between 3.02 and 3.24 with almost comparable standard deviations. The lowest mean value is recorded in the case of supply chain Reliability with the mean value of 3.02 followed by Responsiveness and Asset management efficiency with the mean value of 3.18 each, and supply chain Cost with the mean value of 3.19. Whereas, supply chain Flexibility scored the highest mean value, i.e., 3.24.

4.4 inferential Statistics for emergency supply chain practices and supply chain performance

4.4.1 Correlation Analysis

Correlations are the measure of the linear relationship between two or more variables. As explained by Kothari (2004), a coefficient of correlation has the value of 'r' which has a value of ranging from -1 to 1. Values that are closer to the absolute value of 1 indicate that there is a strong relationship between the variables being correlated. Positive values of 'r' indicate positive correlation between the two variables, whereas negative values of 'r' shows negative correlation. A zero value of 'r' indicates that there is no association between the two variables.

According to Bruce Ratner (2009), the following points are the accepted guidelines for interpreting the correlation coefficient, values between: 0 and 0.3(0 and -0.3) indicate a weak positive/negative relationship; 0.3 and 0.7(-0.3 and -0.7) a moderate positive/negative relationship; 0.7 and 1.0(-0.7 and -1.0) a strong positive/negative relationship.

The result of the correlation analysis conducted to analyze the relationship between supply chain practices and its operational performance in each research objectives using Pearson's coefficient of correlation analysis since it is the most widely used method of measuring the degree of relationship between two or more variables.

Table 6- Emergency Supply Chain Performance of MOH/PMED, EPSS and EPHI head offices (N=72)

Correlations									
Variables			A	B	C	D	E	F	G
Demand planning	A	Pearson Correlation	1						
		Sig. (2-tailed)							
		N	72						
Procurement	B	Pearson Correlation	.472**	1					
		Sig. (2-tailed)	.000						
		N	72	72					
Transportation	C	Pearson Correlation	.415**	.628**	1				
		Sig. (2-tailed)	.000	.000					
		N	72	72	72				
Receiving	D	Pearson Correlation	.397**	.583**	.501**	1			
		Sig. (2-tailed)	.001	.000	.000				
		N	72	72	72	72			
Warehousing	E	Pearson Correlation	.451**	.544**	.614**	.614**	1		
		Sig. (2-tailed)	.000	.000	.000	.000			
		N	72	72	72	72	72		
Inventory management	F	Pearson Correlation	.435**	.593**	.406**	.526**	.682**	1	
		Sig. (2-tailed)	.000	.000	.000	.000	.000		
		N	72	72	72	72	72	72	
Supply chain performance	G	Pearson Correlation	.446**	.629**	.608**	.484**	.676**	.692**	1
		Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	
		N	72	72	72	72	72	72	72
**. Correlation is significant at the 0.01 level (2-tailed).									

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

Source: (SPSS Output, 2024)

The above table 6 displays correlation test results for emergency supply chain practices and its Performance of the MOH, EPSS, and EPHI. According to this table, the relationship between Demand planning as one of the key supply chain practices and its performance of the public health emergency management organization is examined using Pearson Product Movement Correlation

Coefficient. Subsequently, there is a moderate ($r = .446$) positive correlation between the two variables. In the same method, the relationship between procurement practices and its performance of the surveyed organizations and contribution of the selected predictors for the emergency supply chain practices has also been checked. As a result, there is a moderate ($r = .629$) positive relationship between these two variables. In addition to this, the relationship between inbound transportation practices and supply chain performance of the organizations and influence of the selected internal practices for emergency supply chain practices has also studied using Pearson Product Movement Correlation Coefficient. Hereafter, it is found that there is a moderate ($r = .608$) positive relationship between the two variables.

Furthermore, the relationship between Receiving processes and operational performance indicated correlation coefficient of ($r=.484$) is moderate and significance value of 0.000 shows there was a statistically positive correlation between receiving processes and supply chain performance. In the same way, the relationship between the warehousing practices and its performance of the emergency supply chain in the organizations has a moderate ($r = .676$) positive relationship between these two variables. Besides, the relationship between the Inventory management as a key supply chain practices and its performance has also checked. As a result, there is a moderate ($r = .692$) positive relationship between these two variables. In general, all the supply chain practices, and their performance have moderate positive relationship in the studied public health emergency management organizations.

4.4.2 Regression Analysis

This study tested the cause-and-effect relationship between the supply chain practices and organizational emergency supply chain performance using regression analysis. To see the effect of supply chain practices on emergency supply chain performance, multiple regression analysis was employed. This allows us to make statements about how well one or more independent variables will predict the value of a dependent variable. According to Sarstedt and Mooi (2019), the true relationship between independent variables and dependent variables can be approximated by the regression model: The six variables under Supply Chain Practices were entered into regression analysis to determine their effect in contributing to the overall Emergency Supply Chain Performance.

4.4.3 Multicollinearity test

According to Daoud (2017), Multicollinearity is a statistical phenomenon where two or more independent variables in a linear regression model are strongly correlated. It means that the variables have an almost perfect or exact relationship between them. Multicollinearity is a problem because it reduces the reliability of the statistical inferences from the model. Before conducting the regression analysis Tolerance and Variance Inflation Factor (VIF) values were calculated to check multicollinearity and the result is presented on table-7 below. An ideal approach of measuring the multicollinearity is through examination of the variance inflation factors (VIFs) or the tolerances of the explanatory variables. The Tolerance value is an indication of the percentage of variance in the predictor that cannot be accounted for by the other predictors implying the fact that very small values indicate overlap or sharing of predictive power. According to Shrestha (2020), tolerance is simply the inverse of VIF. The lower the tolerance, the more likely is the multicollinearity among the variables. The value of $VIF = 1$ indicates that the independent variables are not correlated to each other, and multicollinearity does not exist in the regression model. If the value of VIF is $1 < VIF < 5$, it specifies that the variables are moderately correlated to each other. The challenging value of VIF is between 5 to 10 as it specifies the highly correlated variables. If $VIF \geq 5$ to 10, there will be multicollinearity among the predictors in the regression model and $VIF > 10$ indicate the regression coefficients are estimated with the presence of multicollinearity.

Table 7-Multicollinearity Test

Coefficients ^a			
Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	Demand planning	.708	1.412
	Procurement	.422	2.371
	Transportation	.472	2.119
	Receiving	.530	1.886
	Warehousing	.360	2.780
	Inventory management	.436	2.294
a. Dependent Variable: Supply chain performance			

Source: (SPSS Output, 2024)

Therefore, the results from the above table-7 indicates that the VIF value of the six factors were less than 5 which shows the fact that no collinearity is observed on this data. This further explains

that there is no strong multicollinearity and degree of association between variables according to the result obtained from this analysis. Research study understanding and experience in using multiple regression analysis, most of the studies indicate that if any of the VIF results exceed 5 or 10, it is a suggestion that the connected regression coefficients are unwell estimated because of multicollinearity.

4.4.4 Heteroskedasticity tests

To determine if the variance of the errors, or residuals, in a regression model is consistent across all levels of the independent variables or projected values, statistical procedures known as heteroskedasticity tests are employed. Said another way, these tests assist in determining if the residuals' variability or spread varies predictably over a range of predictor values. One of the fundamental presumptions of regression analysis is homoskedasticity, which denotes a constant variance for the residuals. When heteroskedasticity occurs, this assumption is broken, which may result in skewed standard errors, inaccurate confidence intervals, and possibly deceptive inferences about the statistical significance of the regression model's coefficients. Heteroskedasticity tests are therefore crucial instruments in regression analysis to guarantee the validity of statistical inferences drawn from the model.

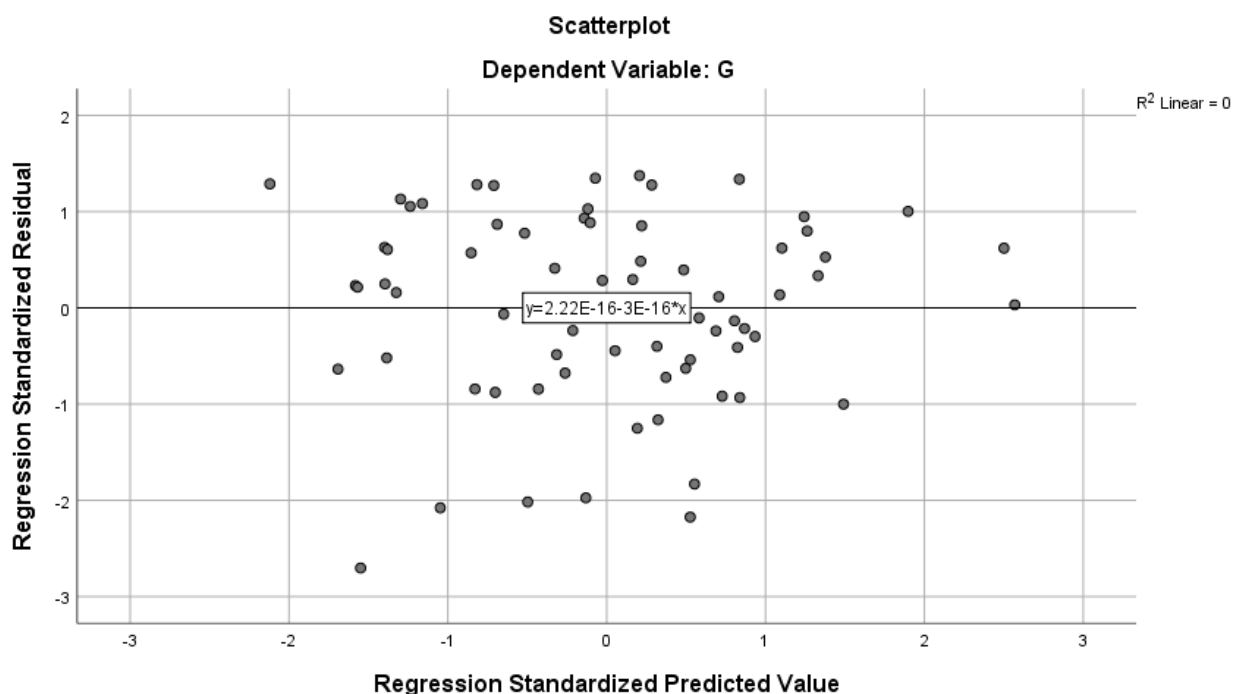


Figure 2- Heteroskedasticity tests

The result shows in the above figure that the points in the scatter plot are randomly scattered around zero (both horizontally and vertically), without any clear funnel shape, there is likely no heteroskedasticity. This suggests that the variance of the residuals is constant across the range of predicted values. Moreover, when there is no heteroskedasticity, it can be more confident in the reliability of this study regression coefficients and their significance levels. Apart from this, the model used in this study is correctly specified in terms of the variance assumption, enhancing the robustness of conclusions drawn from the regression analysis. This strengthens the validity of the regression analysis, ensuring that the conclusions drawn from the model are more likely to be accurate and reliable.

4.4.5 Multiple regression analysis result

Regression is a statistical method that relates a dependent variable to one or more independent variables. When performing a regression analysis each independent variable is associated with specific coefficients in the equation that summarizes the relationship between that independent variable and the dependent variable. Once estimate a set of coefficients in a regression equation, it can use a confidence interval to make inferences about the corresponding parameters in the population.

Table 8-Regression results Model Summary

Model Summary ^b					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.797 ^a	.634	.601	7.949	1.381
a. Predictors: (Constant), demand planning, Procurement, Transportation, Receiving, Warehousing, Inventory management					
b. Dependent Variable: Emergency supply chain performance					

Source: (SPSS Output, 2024)

This measurement is made by inferring the value of Adjusted R square to explain the magnitude of the effect of the independent variable on the dependent variable. At this time underneath depicted and explained are the linear regression of various independent variables and dependent variables. As can be observed from the above table, the overall package of predictors of the six independent variables were 60.1% (Adjusted R² = .601) explained the dependent variable (performance). This suggests that 60.1 % of supply chain performance level in the public health

emergency clearly depends on the supply chain practices or independent variables while the remaining less than 39.9 % is determined by other unaccounted factors in this study.

Table 9- Regression results ANOVA

ANOVA ^a						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	7129.474	6	1188.246	18.804	.000 ^b
	Residual	4107.512	65	63.192		
	Total	11236.986	71			
a. Dependent Variable: Emergency supply chain performance						
b. Predictors: (Constant), demand planning, Procurement, Transportation, Receiving, Warehousing, Inventory management						

Source: (SPSS Output, 2024)

The ANOVA table's p-value, designated as "Sig.", determines whether the independent variables are statistically significant in predicting the dependent variable. From the above table-9, the model is statistically significant because p-value is less than 0.05. Hence the above ANOVA table-9 indicates the regression model is a good fit for the data. ($p=0.000$, which is < 0.05). Therefore, all independent variables are statistically significant as indicated in the table.

Table 10- Regression Test Coefficients Results

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-.757	7.602		-.100	.921	-15.940	14.425
	Demand planning	.223	.516	.038	.431	.668	-.808	1.254
	Procurement	.530	.375	.163	1.414	.162	-.218	1.279
	Transportation	.876	.387	.247	2.265	.027	.103	1.648
	Receiving	-.239	.329	-.075	-.727	.470	-.895	.418
	Warehousing	.514	.309	.208	1.661	.102	-.104	1.131

Inventory management	1.054	.319	.376	3.309	.002	.418	1.691
a. Dependent Variable: Emergency supply chain performance							

Source: (SPSS Output, 2024)

The regression model developed shows that transportation ($\beta_3 = .876$, $p = .027$) and inventory management practices ($\beta_6 = 1.054$, $p = .002$) have a positive relation and significance on emergency supply chain performance. In line with this, findings in the above table show that the major significant variables are inventory management practice ($P = .002$). This shows that increases in the extents of inventory management practices will cause increased supply chain performance. This positive relationship is in line with Almrdoef & Attia, (2021) who states that efficient inventory management practices enable an organization to reduce the length of delivery time and meets customer requirements. Besides to this, according to Stajniak & Koliński, (2016) who states that robust and efficient transportation practices enable an organization to gain an organization a competitive advantage through superior customer service. However, from this finding, demand planning, procurement, receiving processes and warehousing practices have insignificant relationship with emergency supply chain performance.

In general, this study used correlation and multiple regression analysis to meet the objective of the study. The result indicated that the relationship between all inbound supply chain practices and emergency supply chain performance has positive correlation in the studied public health emergency management organizations. In addition, it applied regression analysis and it found that inventory management and transportation practices have a positive and significant effect on supply chain practices performance of the public health emergency supply chain management. Decision makers play an important role in facilitating effective control and correction by reporting the current level of performance and comparing it with the desired level of performance (Abidi, et al., 2014).

CHAPTER FIVE

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of major findings

Correlation analysis, using Pearson's coefficient, was employed to gauge the relationships between various supply chain practices and emergency supply chain performance across the surveyed organizations. The coefficients ranged between 0 and 1, with closer values to 1 indicating stronger correlations. Here's a summary of the key findings includes, Demand Planning showed a moderate positive correlation ($r = 0.446$) with emergency supply chain performance, signifying its role in shaping operational effectiveness. Procurement demonstrated a stronger positive correlation ($r = 0.629$), highlighting its critical impact on enhancing supply chain performance. Transportation indicated a robust positive correlation ($r = 0.608$), emphasizing its pivotal role in ensuring efficient delivery and logistics. Receiving revealed a moderate positive correlation ($r = 0.484$), underscoring its influence on streamlining inbound logistics processes. Moreover, warehousing displayed a substantial positive correlation ($r = 0.676$), indicating its importance in inventory management and storage efficiency. And inventory Management showed the strongest positive correlation ($r = 0.692$), highlighting its significant impact on overall supply chain performance. In general, the study highlighted several significant findings pertaining to emergency supply chain management practices and performance within MOH, EPSS, and EPHI:

- **Practice Assessment:** Emergency supply chain management practices, encompassing demand planning, procurement, transportation, receiving, warehousing, and inventory management, were generally well-implemented across the organizations. However, procurement practices were identified as relatively weaker compared to other operational facets.
- **Performance Highlights:** The highest level of emergency supply chain performance across the organizations was observed in terms of flexibility, indicating adaptability and responsiveness in crisis situations.

- **Regression Model:** Statistical analysis revealed that effective inventory and transportation management significantly contribute to enhancing emergency supply chain performance. These practices were identified as pivotal in ensuring operational efficiency during emergency responses.

5.2 Conclusions

In conclusion, the study provides insights into the emergency supply chain management practices at MOH, EPSS, and EPHI. While several aspects of supply chain operations were well-practiced, such as demand forecasting and supplier relationships, there are notable areas for improvement, particularly in pre-emptive planning, transportation evaluation, and proactive communication in warehousing. These findings suggest opportunities for enhancing overall supply chain resilience and efficiency during emergency response efforts.

Effective emergency supply chain management is pivotal in ensuring timely and effective response during crises. The findings of this study underscore the importance of continuous improvement in supply chain operations within public health organizations. By implementing targeted improvements based on these findings, these organizations can strengthen their resilience and responsiveness in the face of future emergencies, ultimately improving health outcomes for communities across Ethiopia.

Therefore, this study provides valuable insights into enhancing emergency supply chain management practices within public health emergency organizations. By emphasizing the critical roles of transportation and inventory management, stakeholders can prioritize investments and improvements to optimize supply chain efficiency. These findings underscore the importance of strategic supply chain management in ensuring timely and effective responses to health emergencies, ultimately benefiting both organizations and the communities they serve.

As organizations navigate the complexities of emergency response logistics, understanding these statistical insights can guide decision-making processes towards more resilient and responsive emergency supply chain practices. This study synthesizes the statistical findings on emergency

supply chain practices and performance in public health emergency management organizations, highlighting correlations, regression analyses, and their implications for operational efficiency.

5.3 Recommendations

Based on the findings of this study, the following recommendations are given.

- Transportation and inventory management practices at EPSS and EPHI should be improved because these practices have a positive and significant effect on the performance of emergency supply management.
- Specifically, EPSS and EPHI should evaluate their transport services regularly and consistently and maintain the right amount of inventory to improve their emergency supply chain performance.
- EPSS and EPHI should maintain the right amount of inventory in their warehouses before the occurrence of an emergency for the provision of swift response
- Further improvement action on procurement practices in delivering within the agreed lead time and before the occurrence of an emergency should be taken by EPSS to improve the performance of the emergency supply chain.
- Demand planning practices in terms of field consumption data collection and analysis for emergency products demand estimation should be performed regularly by MOH and EPSS to improve the performance of emergency supply chain.

5.4 Future Research Recommendation

The study adopted on limited government owned organizations, it might be possible that the findings may not reflect the actual practices of all emergency management organizations since public health emergency situations are managed by multiple stakeholders and similarly the recommendations also might not be the final and sole solutions. It is, therefore, important that the present study can further be extended by including additional internal and external stakeholders (i.e. Beneficiaries, suppliers, transport service providers, other service providers and the donors) and by covering more NGOs and emergency supply chain actors.

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Annex-1: Questionnaire

ADDIS ABABA UNIVERSITY, SCHOOL OF COMMERCE DEPARTMENT OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT

Questionnaire to be filled by Employees of MOH/PMED, EPHI-ESC logistics section, EPSS Quantification and Market Shaping, Tender Management, Procurement and Custom clearance, Warehousing, and Inventory management directorates.

Dear respondent,

This questionnaire is developed for an academic purpose, planned for the collection of primary data that will be used to examine “**The effect of inbound logistics on Public Health Emergency Supply Chain performance of MOH/EPSS/EPHI**”, for the partial fulfillment of the requirements for the Degree of Master of Arts in Logistics and Supply Chain Management from the Addis Ababa University, School of Commerce. The information obtained from this questionnaire will be kept confidential and will be used for academic research purpose. No need to write your name. You are kindly requested to answer to the questions freely and openly.

Thank you for your cooperation!!!

Sincerely,

Tadesse Dessie

CellPhone:0913451269

E-mail: tadesse.dessie@yahoo.com

Addis Ababa, Ethiopia

Part I: General Information.

This part of the questionnaire is intended to gather general information about the background of the respondent and the organization.

1. Gender

A. Female ☐

B. Male ☐

2. Age

A. 18 -30 Years ☐

C. 41-50 Years ☐

B. 31-40 Years ☐

D. Above 50 Years ☐

3. Educational Qualification

A. Grade 12 completed ☐

C. First Degree ☐

B. College Diploma ☐

D. Second Degree and above ☐

4. Years stayed in the organization

A. Less than 5 years ☐

C. Over 10 years ☐

B. 6-10 years ☐

5. Your Directorate/Department or functional area in the organization

A. MOH/PMED ☐

B. EPHI-ESC Logistics section ☐

C. EPSS Quantification and Market Shaping ☐

D. EPSS Tender Management ☐

E. EPSS Procurement and Custom clearance ☐

F. EPSS Warehouse and Inventory Management (WIM) ☐

G. Other ☐

6. How long have you been working in emergency supply chain operation

A. Less than 5 years ☐

C. Over 10 years ☐

B. 6-10 years ☐

Part II: Assessment of inbound logistics practices for emergency supply chain management in MOH, EPSS and EPHI head offices, Ethiopia

Regarding inbound logistics practices for the management of emergency supply chain in your organization, please tick/mark the appropriate box to indicate the extent to which you agree or disagree with each statement as using a 5-point Likert scale where; **1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.**

	Supply chain management practice	Scale				
A	Demand planning practices	1	2	3	4	5
1	There is demand forecasting practices for the management of public health emergency situations					
2	Forecasting of public health emergency products is focus on emergency prediction rather than long-term response after the start of an emergency.					
3	There is field consumption data collection practice and analysis method for emergency products demand estimation.					
4	The demand is planned based on the needs of the population after the disaster.					
B	Procurement practices	1	2	3	4	5
1	Supplier selection of MOH/EPSS/EPHI is focused on reliable delivery of relief items in addition to price and specification.					
2	MOH/EPSS/EPHI has a good and long-term relationship with its suppliers.					
3	There is effective procurement practice in delivering all the ordered products in good quality.					
4	There is effective procurement practice in delivering all the ordered products within the agreed lead time.					
5	There is accurate documentation management practice in procurement in terms of document completeness, correctness and readily available for use.					
6	There is procurement practice of relief items before the occurrence of an emergency.					
C	Transportation practices	1	2	3	4	5

1	The organization uses all modes of transportation available for the movements of relief supplies.					
2	Third party transport companies are engaged & contracted during emergencies to transport relief supplies/items.					
3	There is a prequalified list of transport companies for MOH/EPSS/EPHI to choose from during emergencies.					
4	MOH/EPSS/EPHI uses regular and consistent evaluations that required for inbound transport services					
5	Proper transportation allows the cargo to be delivered with no (or minimum) damage, loss, or waste, including its package (bags) for relief supplies.					
6	The vehicle used by the transporter to transport the products is good enough to maintain the quality of the products.					
D	Receiving processes	1	2	3	4	5
1	There is a practice of pre-receiving planning and clear communication channels with suppliers					
2	Before unloading, the receiving staff conducts quick visual inspections of the delivery vehicle and the goods					
3	Delivery documentations (such as the bill of lading or delivery note with purchase order) are always cross checked, and ensure that the listed items, quantities, and other details match expectations.					
4	Standard Operating Procedure (SOP) for receiving process is available and implementing during the operation					
5	Immediate data entry is practiced and integrated with other systems (like, VITAS) to ensure seamless data flow and real time updates across platforms for relief supplies.					
6	There is a practice of receiving the incomings through standardized inspection to dispatching inventories.					

7	MOH/EPSS/EPHI has an effective internal control system during receiving products.					
E	Warehousing practices	1	2	3	4	5
1	EPSS/EPHI has sufficient and appropriate warehouses to temporarily store emergency supplies.					
2	EPSS's/EPHI's warehouses location are very accessible for distribution of relief items.					
3	EPSS/EPHI uses warehousing as a facilitator for coordination, sorting, and packaging activities for easier and efficient emergency delivery to the beneficiaries.					
4	The warehouse implements modern filling system that enables it to easily provide any information upon request.					
5	EPSS's/EPHI's warehouse management system allows quick and easy mapping for unexpected products shipping requests.					
6	The warehouse has designated specific areas for incoming shipments, arranged for clearing, setting up temporary holding zones, and pre-label storage areas based on anticipated goods.					
7	Warehouses proactively send information to MOH/EPHI about shipment of relief items as it dispatched from suppliers.					
8	Warehouse timely reports the status of the delivered goods to the users and suppliers and takes necessary action on damaged or lost goods.					
F	Inventory management practices	1	2	3	4	5
1	There is a practice of tracking of stock rates, prediction of potential demands and arrangement of when and how an order is placed.					
2	The inventory management practices provide visibility in the supply chain system and the upstream and downstream inventory					

3	There is a practice of maintaining the right amount of inventory to manage emergency situations.					
4	There is regular stock situation analysis to enable informed decisions regarding relief items procurement.					
5	Inventory management is tasked with anticipating and planning steps in the event of an unavailability or shortage of relief supplies.					
6	There is an effective inventory management system and policy that helps to properly monitor inventory and manage inventory risk.					

PART III – Emergency Supply Chain Performance of MOH/PMED, EPSS inbound directorates and EPHI-ESC logistics sections head offices.

Please indicate to what extent the following measurement of emergency supply chain performance of MOH, EPSS and EPHI head offices has been demonstrated. Please indicate your level of agreement using a 5-point Likert scale where; **1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.**

S/N	Supply Chain Performance	Scale				
A	Reliability	1	2	3	4	5
1	Relief items orders are delivered in perfect condition					
2	Relief items experiences perfect order fulfilment at MOH/EPSS/EPHI					
3	Relief items has high delivery performance to beneficiary committed date.					
4	Relief items orders are received in full without quality deviation					
B	Responsiveness	1	2	3	4	5
1	Order fulfilment cycle time for emergency supply were responsive					
2	Delivery cycle time for emergency supply were responsive					

3	Return cycle time for emergency supply were responsive					
4	Source cycle time for emergency supply were responsive					
C	Flexibility	1	2	3	4	5
1	Upside supply chain flexibility for unplanned increase in emergency supplies delivery.					
2	Downside supply chain adaptability for relief items with no inventory or cost penalties.					
3	Overall value at risk is monitored for emergency supplies					
D	Cost	1	2	3	4	5
1	Total supply chain management costs are reasonable for relief items					
2	Planning costs for relief items are continuously monitored in the organization.					
3	Sourcing costs for relief items are efficiently managed in the organization.					
4	Delivery costs are exaggerated for relief items in the organization.					
5	Cost to returns for any defect relief products to the original source is considered.					
E	Asset management efficiency	1	2	3	4	5
1	Cash-to-Cash Cycle Time for relief items is managed in the organization.					
2	Inventory days of supply for relief items is monitored in the organization					
3	Inventory of relief items are managed in min-max level.					

Any comments

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Thank you!