FACTORS INFLUENCING THE LOGISTICS MANAGEMENT PRACTICES ON THE SUPPLY CHAIN PERFORMANCE OF VACCINES IN PUBLIC HOSPITALS IN LAMU COUNTY.

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DECLARATION AND APPROVAL

Declaration by the Student

I declare that this project is my original work and has not been presented to any other institution of higher other Mount Kenya University.

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Approval by the Supervisor

This project has been submitted with my approval as the university supervisor.

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DEDICATION

I have dedicated this thesis document to my dear wife Fatma Famau Mohamed and Hajj Athman Haji, Zain Athman Haji and Zainab Athman Haji, who are my kids, for remaining at my side and supporting me during my academic journey and project writing.

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ABSTRACT

This study embraced descriptive design to investigate the influence of logistics management practices on the performance of supply chain of vaccines among health facilities in Lamu County. This study examined the link between practices of logistics management and supply chain performance of vaccines in Lamu County. The following research objectives guided the study: To find out the effect of cold chain technology on supply chain performance of vaccines in Lamu County; To determine what impact does inventory management has on supply chain performance of vaccines in Lamu County; To establish the effect of distribution system on supply chain performance of vaccines in Lamu County; and lastly, to find out the impact of technical capacity on supply chain performance of vaccines in Lamu County. Descriptive survey design was adopted and the population under study was all the 32 public health facilities and the units of analysis were the facilities managers (32), procurement officers (32) and the vaccine officers (32) totalling to 96 respondents. The research sampled all the public health facilities that dealt with vaccines in Lamu County and distributed a total of 96 questionnaires. Census was used to identify all the respondents. After completing the data collection, the researcher used Statistical Package for Social Sciences Version 25 (SPSS V.25) to analyse data which was presented using inferential and descriptive statistics for easier interpretation of findings. This was done through the use of frequency tables and central tendency of means and standard deviation for the purpose of aiding interpretation and understanding. The study discovered that logistics management practices have been embraced by healthcare centres in Lamu County to a greater extent with the cold chain technology and distribution systems being the most influential on supply chain performance of vaccines in Lamu County. Inventory management was the third most influential and technical capacity was the last variable. This was despite inventory management having the highest mean. The logistics management practices were recommended to be adopted to realize the benefits. The study further pointed to positive link between the independent and dependent variables and therefore it was recommended that the government should embrace LMP and the performance of supply chain of vaccines in Lamu County. The study further recommended that there is need to train staff responsible in the supply chain of vaccines and other drugs to conceptualize the benefits attached to the practices of logistics management.

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LIST OF ABBREVIATIONS AND ACRONYMS

GDP	**:**	Gross Domestic Product
GPRS	**:**	General Packet Radio Services
LM	**:**	Logistics Management
RBT	**:**	Resource Based Theory
SCM	**:**	Supply Chain Management
SDGs	**:**	Sustainable Development Goals
WHO	**:**	World Health Organization

CHAPTER ONE

INTRODUCTION

Background information of this study was discussed with a great emphasis on the global perspective, regional and local perspective is provided in this chapter. Further, problem statement, objectives of the study, research questions, study significance, scope, study limitations, assumptions of the study and operational definitions of terms have been addressed in this chapter.

1.1 Background of the Study

Logistics management practices plays a big role when it comes to the performance of supply chain management in the current global dynamic atmosphere. The core aspect of the diversity in the logistics system ensures that the delightful stream of inputs is possible through the supply chain management in the organization (Gunaseakaran & Ngail, 2018). Both private and public health care facilities recognize that supply chain management is essential to create and maintain economic advantage for outputs in a congested marketplace (Mwinzi, 2018). Logistics management practices are important in the Management of Supply Chain and need to be incorporated with other supply chains like customer services, storage, distributed systems, inventory control, cold chain technology, technical capacity, order process management as well as reduction of cost in supply chain management (Harrison & Hoek, 2019).

Logistics Management of vaccines in the health sector is currently receiving an increased attention as a priority for many countries. There is an improved vaccination coverage in developed countries since the establishment of Expanded Program on Immunization back in the year 1976. Nevertheless, the universal access to immunization has not been achieved attracting the attention of the developed countries (WHO, 2017). Countries like United Kingdom, USA, China, Korea and Germany have a strong supply chain management that complement particular logistics for increasing the final consumer satisfaction through the vaccine's delivery and other health products at the right place and time (Cooper, 2017).

Mentzer et al, (2019) affirms that by these countries adopting logistics management practices, health care facilities drastically reduce cost as well as remain competitive. In countries like South Africa, the management of logistics practices actions develops a valued method of stimulating a competitive advantage to enlighten supply chain presentation (Harrison & Hoek, 2019).

Global healthcare comprises of vaccines, supplies of medical equipment, pharmaceuticals, healthcare services and alternative medicine sectors. The providers of healthcare services all over the world are under pressure to deliver quality medical care and reduce costs in the supply chain management (Emmanuel Habumugisha, 2022). To realise this objective, the governments world over have focused on how to eliminate wastage during the clinical operations.

World Health Organization's main strategy is to expand access to essential medicines through improving financial and supply systems. Stakeholders in the health sector

logistics management are into three main categories: manufacturers, purchasers and providers. Manufacturers' role is to produce products such surgical suppliers, vaccines, drugs and medical equipment while purchasers are the personnel involved in the distribution who hold inventory for manufacturers to facilitate the delivery of the products. The providers of healthcare are the people who take care of the patients, they include but not limited to hospitals, clinics, dispensaries, nursing homes, health centres and dispensing chemists (Burns, 2017).

These Practices have had effect on the overall supply chain management in Sub Saharan Africa. It has as well had effect on quality service, competitive advantage and overall reputation of the firm (Kiplagat, 2020). The governments in these countries have tried to appropriately make the supply chain consist of a process that are incorporated to reduce the cost and increase profitability (Mwinzi, 2018).

The top management of hospitals in in Africa and parts of Asia concentrate on making supply chain management better through enactment of inventory management and transportation. Every public hospital responsible in the vaccines need to come up with great plan to aid in the execution of logistics management practices while ensuring obtainability of the exact products in the best quantity at the right location (Chopra, 2017).

Most of the developing countries in Africa experience stock-outs leading to the interruption of immunization service at the public hospitals, hence missed opportunities for children vaccination. In recent times, the supply of vaccines in Sub Saharan Africa is faced b chronic hard times to avail potent vaccines in public hospitals which remain crippled by inefficiencies in storage of vaccines, distribution, inventory control, cold chain technology and vaccine management (Chopra, 2017).

Public hospitals in Kenya integrate Logistics Management Practices with logistical activities that are connected with the procurement, handling, storage and distribution as well as outbound logistical activities (Gavi, 2018). The vision is to ensure sustainability of chain management, setting of logistical events and procedures to get ultimate results with low overheads in accordance with the customer regulations (Kiplagat, 2020).

A study by Evelyne & David (2019) researched on how procurement impact the distribution of drugs in Kenyan public hospitals. The outcome of the study could as well be applied in various levels of humanitarian organizations. The study identified that public hospitals have a shortage of commitment, lack of proper leadership, co-ordination, unfair competition, lack of distribution systems, lack of cold chain technology and lack of technical capacity as the major challenges that affect logistics management in the procurement system.

Kenya just like other developing countries do not have sufficient systems for proper supply and handling of vaccines leading to lack of enough stock in public hospitals, products that are expired and damaged during storage and distribution leading to missed opportunities for vaccination especially to children and women (Gavi, 2018). In 2020 for instance, during the COVID-19, most developing countries experienced shortage of vaccines which interrupted vaccination at health centres which could have been caused by lack of cold chain technology, poor inventory management, lack of distributed systems and technical capacity (WHO, 2017).

World Bank (2020) and WHO (2019) conducted a study with the Ministry of Health in Kenya and discovered that proper financing of the procurement of vaccines as the major part that would make supply chain performance be at par. It as well indicated that the personnel involved (technical capacity) in the distribution of vaccines must have the requisite understanding of vaccines and that of the people involved who can possibly impact the processes and the Standard Operating Procedures (SOPs).

1.1.1 Supply Chain Performance

Logistics Management and Supply Chain are interchangeably used. Supply Chain Management is termed as the new Logistics Management. However, Supply Chain Performance is defined as an active dominance for distributing foremost customer knowledge (Spens, 2020) while (Zhou, 2019) defined it as the capability of the firm to lower the logistics costs by the transportation of correct goods and services at the exact location within the precise intervals. The measurement is as well delimited in a general process that help in approximating the capability and competence of the management of supply chain.

Logistics management plays a crucial role in the success and sustainability of any organization operating in today's globalized and competitive business environment. Effective logistics management ensures the smooth flow of goods, services, and information throughout the supply chain, resulting in improved customer satisfaction, reduced costs, and increased profitability. This article aims to highlight the importance of effective logistics management in contemporary business operations. First and foremost, effective logistics management enables organizations to meet customer demands efficiently. By implementing robust logistics strategies, companies can ensure that the right products are delivered to the right place at the right time. This not only enhances customer satisfaction but also strengthens the organization's reputation and fosters repeat business. For instance, a well-managed supply chain ensures that products are readily available on store shelves, preventing stockouts and ensuring customers can purchase their desired items without delays. Moreover, effective logistics management contributes to cost reduction and improved profitability. By optimizing transportation routes, warehouse management, and inventory control, organizations

Logistics management plays a pivotal role in the success of any organization. It involves the planning, implementation, and control of the efficient movement and storage of goods, services, and information from the point of origin to the point of consumption. Effective logistics management can provide numerous benefits, including cost reduction, improved customer satisfaction, and enhanced competitiveness. One of the key roles of logistics management is to optimize the supply chain. Through careful planning and coordination, logistics managers can streamline the flow of materials, ensuring that the right products are available at the right place and time. This reduces inventory carrying costs and minimizes stockouts, ultimately leading to cost savings for the organization. Additionally, effective logistics management can help in the identification and elimination of bottlenecks in the supply chain, improving overall operational efficiency. Another crucial role of logistics management is to enhance customer satisfaction. By ensuring timely and accurate delivery of products, logistics managers can meet customer expectations and build long-term relationships.

Logistics management plays a crucial role in the success of any business, particularly in the increasingly globalized and competitive world of today. This article aims to explore

the logistics management practices in Kenya, focusing on the unique challenges and opportunities faced by businesses operating in this country. 1.1 Infrastructure Challenges: One of the key challenges faced by logistics managers in Kenya is the inadequate infrastructure. Poor road conditions, especially in rural areas, significantly impact the transportation of goods. Limited connectivity and unreliable transportation networks can lead to delays, increased costs, and decreased customer satisfaction. Additionally, outdated warehousing facilities and limited technology integration pose further challenges in ensuring efficient logistics operations. 1.2 Supply Chain Efficiency: Efficient supply chain management is crucial for businesses to gain a competitive edge in the Kenyan market. However, several factors hinder the achievement of optimal supply chain efficiency. Inconsistent supply of raw materials, lack of coordination among stakeholders, and bottlenecks

In today's highly competitive business landscape, supply chain management has emerged as a critical factor for organizational success. Companies across industries are increasingly focusing on improving their supply chain performance to enhance customer satisfaction, reduce costs, and gain a competitive edge. To effectively manage and optimize supply chain operations, it is essential to establish robust metrics and measures to evaluate performance. This article explores the key metrics and measures used to assess supply chain performance. One of the fundamental metrics to evaluate supply chain performance is on-time delivery. This measure assesses the ability of a company to deliver products or services to customers within the promised timeframe. Timely delivery not only enhances customer satisfaction but also minimizes the risk of stockouts and associated costs. On-time delivery can be measured as a percentage, comparing the number of orders delivered on time to the total number of orders. A high on-time delivery rate indicates a well-functioning supply chain. Another crucial metric is order fulfillment cycle time

This article aims to examine the impact of inventory management on the performance of vaccine supply chains in public hospitals. Vaccines play a crucial role in preventing and controlling the spread of infectious diseases, making their availability in hospitals a critical factor. Effective inventory management in the vaccine supply chain is essential to ensure continuous availability, reduce wastage, and improve overall performance. This article reviews existing literature on inventory management practices and explores their impact on the performance of vaccine supply chains in public hospitals. The findings highlight the importance of implementing efficient inventory management strategies to optimize the performance of vaccine supply chains and enhance patient care. 1. Introduction: Inventory management is a critical aspect of healthcare supply chain management, particularly in the context of vaccine distribution within public hospitals. Vaccines are perishable and require careful handling and storage to maintain their efficacy. Efficient inventory management practices can help minimize wastage, prevent stockouts, and ensure timely availability

The distribution of vaccines plays a crucial role in ensuring their availability and accessibility to individuals and communities. Efficient distribution systems are essential for maintaining the quality of vaccines and minimizing waste. This article aims to examine the effect of distribution systems on vaccine supply chain performance and explore potential strategies for improvement. 1.1 Distribution Systems and Vaccine Supply Chain Performance Distribution systems encompass the processes and infrastructure involved in delivering vaccines from manufacturers to end-users. These systems include

transportation, storage facilities, inventory management, and last-mile delivery. Their performance directly affects vaccine availability, timeliness, and overall effectiveness of immunization programs. 1.2 Factors Influencing Distribution Systems Several factors influence the performance of distribution systems in the vaccine supply chain.

The health public sector is under pressure to demonstrate improvements from both internal and external sources of the Supply Chain Management (Cooper, 2017). All sectors are having interest in the management of supply chain and there is an improved performance as well as increased accountability (Chopra, 2017). The healthcare sector is required to review the way things are planned, preparation of budgets, implementation and management of programs and delivering of services to meet the taxpayers needs while improving performance and accountability. Developed economies such as United Kingdom, South Africa, Australia, USA and China have public sector reforms instituted to improve their performance and as a result, there are various sectors that are going through the process of management change (Lee, 2017).

The supply chain performance measures all the sectors of the economy differently which is subjective to individual firms (Gunaseakaran & Ngail, 2018). Benchmarking, Stable Scorecard and Supply Chain Operations Reference (SCOR) are the three methods Supply Chain Performance measurements uses in the industry and various distinct management processes like sourcing, decision making, planning, return and delivery are used (Palevich, 2018).

The measurement of supply chain performance is represented by the determining logistics management practices of efficiency of supply chain from the manufacturers all the way to the final consumers. The balance scorecard by (Gunaseakaran & Ngail, 2018) offers a comprehensive measurement for Supply Chain Performance which comprises of four different viewpoints, which are; financials, customers, learning and innovations as well inner business processes.

Public hospitals play a critical role in providing healthcare services to the general public. To ensure the efficient and effective delivery of healthcare, logistics management practices have become increasingly important in public hospitals. These practices encompass various activities, including procurement, inventory management, distribution, and monitoring of medical supplies and equipment. These activities are crucial in maintaining the availability of vaccines in public hospitals and optimizing the overall supply chain performance. Public hospitals face unique challenges in managing the logistics of vaccines.

Supply Chain is a subsidiary of the effectiveness and efficiency to deliver goods and services to the end consumer. Most organizations concentrate on improving the services as a way of enhancing competitive advantage by the use of Supply Chain Management. Lee (2017) states that organizations in any Supply Chain are unable to increase productivity when they pursue goals independently. Organizations in the same network of supply chain should be privy to the measurements and offer minimum chances of manipulation. In respect to this, management performance should be formulated for logistical objectives which are rated to allow the usefulness of methods used to be accessed easily.

1.1.2 Lamu County Government

All public hospitals in Lamu county are managed by the county government of Lamu. This is because all Level five hospitals fall under the county government while level six are

managed by the national government under the ministry of health. Lamu County face chronic hardships in provision of potent vaccines up to the delivery levels as the government agencies have become inept due to the ineffectiveness in terms of storage of vaccines, distribution, management of inventory and stock control (Maryam, 2019).

The health sectors in Lamu County are categorized into private and public hospitals. Public hospitals Level 5 hospital, district hospitals and health centres. The level 5 hospital is the first referral health center that form the integral part of the county health system. It is the main centre of excellence in the county providing complex healthcare that require more complex technology and highly skilled personnel.

The distribution of vaccines in Lamu County is administered by the Kenya Medical Supplies Agency to the county government since all the hospitals in Lamu are managed by the county government through the Unit of Vaccines and Immunization Services (UVIS) which was fully affected in 2013 under the new constitution (Samuel, 2016). Since vaccines are very sensitive products; they lose their potency if subjected to high temperatures. Lamu county being farthest part of Kenya with insecurity, proper forecasting, handling, distribution, storage and procurement of vaccines is a challenge. To reap the maximum benefits and vaccines get to the end users, an effective supply chain must be in place.

The key focus areas for this study will include to study the logistics management practices that can improve vaccine availability and adequacy at the last mile. These practices that were studied include cold chain technology, inventory management, distributed systems and technical capacity. It is against this backdrop that my thesis seeks to find out the link between logistics management practices and the vaccine supply chain performance in Lamu County public hospitals.

1.2 Statement of the Problem

Health sector forms the economic evolution engine recognized as the major tradable segment in the developing economies like Kenya (Cooper, 2017). Logistics is part of the retail management that is thorny for the scholars and researchers when focusing on the last mile problem in the context business management (Maryam, 2019). About 8% of the vaccines taken to Lamu county lose their value annually due to the inefficient execution of critical day-to-day processes in terms of inventory, distribution, cold chain technology and technical capacity (Branch, 2019). This is caused by the distance and insecurity experienced in Lamu over the recent years. The speed is essential hence the time for the distribution of the products to the end user is essential. The logistics manager should ensure that both inputs and outputs get their point of destination for the purpose of satisfying customer needs.

The current environment calls for hospitals to integrate Logistics Management Practices into the purposes to remain competitive and ensuring that logistical cost and supply chain management is taken care of well (Branch, 2019).While previous studies; Mwinzi, (2018), Timnah (2017) and Gunasekara & Ngail (2018) explain various aspects of how logistics practices and supply chain management are related but fail to explain the association between logistics practices and supply chain of vaccines. However, in areas where logistics management practices are fully adopted, performance is guaranteed.

There are limited studies on how supply chain performance of vaccines is influenced by management logistics practices in Kenya and more specifically in Lamu county. A knowledge gap has been created and need to be filled. From the problem statement, the study intended to fill the research gap. This study answers the question: What is the influence of logistics management practices on the supply chain performance of vaccines in Lamu County public health care centres?

1.3 Purpose of the Study

The purpose of this study was to determine the influence of logistics management practices on the supply chain performance of vaccines in Lamu county public healthcare centers.

1.4 Objectives of the Study

1.4.1 Main Objective

The main objective of this study was to find out the relationship between Logistics Management Practices and Supply Chain Performance of vaccines in public hospitals in Kenya. A case study of Lamu County.

1.4.2 Specific Objectives

i. To establish the influence of cold chain technology on vaccine supply chain performance in public hospitals in Lamu County.
ii. To determine the influence of inventory management on vaccine supply chain performance in public hospitals in Lamu County.
iii. To find out the influence of distribution systems on the performance of vaccine supply chain in public hospitals in Lamu County.
iv. To assess the influence of technical capacity on performance of vaccine supply chain within the public hospitals in Lamu County.

1.5 Research Questions

The following questions were answered in this study: -

i. What is the impact of cold chain technology on the performance of vaccine supply chain in public hospitals in Lamu County?
ii. What is the impact of inventory management on the performance of vaccine supply chain in public hospitals in Lamu County?
iii. What is the effect of distribution systems on vaccine supply chain performance in public hospitals in Lamu County?
iv. What is the effect of technical capacity on vaccine supply chain performance in public hospitals in Lamu County?

1.6 Significance of the Study

The usefulness of the study may be in terms of the supply chain in the appraisal of supply networks. Specifically, the results of this study will have benefits to everyone involved in the public health sector. Public hospitals and other vaccine distribution agencies will be in a position of substantiating the association that exist between practices of logistics management and performance of supply chain. As such, striving to the adoption of such

practices for the purpose of improving profitability, cost reduction, productivity and opening doors for improvement of supply chain.

The Government of Kenya will rely on the outcomes of this study to come up with legal frameworks to ensure public hospitals have conducive environment for implementation of such practices that would add value on the supply chain of vaccines not only in Lamu but also other parts of the country.

Future researchers will be able to contribute in the existing knowledge and provide literature in the field of supply chain performance and become reference materials for students, researchers and scholars.

1.7 Scope of the Study

This research was carried out in Lamu County and target public health centres were the facility managers, procurement officers, clinical officers and vaccine managers. It specifically majored on assessing the influence of logistics management practices on the performance of vaccines supply chain. The study did not focus on all variables influencing performance of vaccine supply chain in Lamu County. It was confined in Lamu because of the security issues that affect vaccine distribution especially in cold chain technology.

1.8 Limitations of the Study

Subjective rather than objective measures were used to obtain the necessary data which was a limitation. This is because some health facilities were adamant to disclose the information that concerned health logistics. Secondly, the study was conducted on one cultural background that limited its generalization to other health facilities in Kenya. Despite these limitations, the research findings would be used in future for debate and generation of research gap for laying the foundation of further research.

1.9 Assumptions of the Study

Lamu County was assumed to have the suitable illustration to gather the desired information and the statistics gathered from the populace were legitimate and correct representation of the whole population. The study further assumed that the results would be sufficient to make generalizations and conclusions reflecting the results of the entire population.

1.10 Operational Definition of Key Terms

Cold Chain Technology – It is the system of keeping and distributing vaccines at an acceptable temperature from the manufacturers to the end users

Distribution Systems – This is the overseeing of various events that are engaged in transportation of goods from the vendor to the firm, all the way to the end user.

Inventory Management – This is a significant representation practice by entities in a logistics due to the obligation of storing goods that are expected in production, shipping or delivery to the final consumer

Logistics Management Practices – These are the activities that take place in an organization to promote effective administration of the logistics.

Supply Chain Performance – This is the firm capability to lower the logistics costs by the distribution of correct goods and services at the exact location within the precise intervals.

CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction

The aim of the literature review part of the study is to evaluate the existing research this thesis can build on new knowledge. The four logistics management practices namely cold chain technology, inventory management, distribution systems and technical capacity have been addressed. Further, theoretical and conceptual framework have been addressed in this chapter.

2.1 Concept of Logistics Management Practices

Logistics management practices are the activities that take place in a business environment to promote effective management of the logistics (Rushton, 2019). When the logistics management practices are adopted in an organization, it is tasked with the responsibility of formulation and implementation of strategies that lead to sustained competitive advantage (Vikapia, 2015). It manages resources such as physical items like food, materials, drugs, liquids and abstract ones like information and time. Logistics management becomes part of supply chain management when it comes to implementing and controlling the goods from the manufacturers to the final user in order to meet their requirements. It plays a very vital part of the organization's success and operations with a direct impact on its bottom line.

Customer satisfaction is guaranteed by the process of logistics that play a big part more important than low product costs. Logistics management practices include handling, ordering, inventory, arranging, distribution and processing of merchandise within the store (Kamuri, 2020). This involves the returns from customers as well as the end of season returns from the store to the distribution centre and eventually the end consumer.

2.1 Empirical Review

2.1.1 Cold Chain Technology

Maintaining quality of vaccines is the major challenge facing immunization programs in Kenya. World Health Organization (2018) in its journal Global Programme for Vaccine and Immunization: Journal for cold chain and immunization indicates that the technology of cold chain is the process of keeping and distributing vaccines at an acceptable degrees of temperature from the manufacturers to the end users (WHO, 2018). Throughout the chain, primary health care providers should have enough information to manage the cold chain. It is recommended by the World Health Organization; the storage of vaccines has to be maintained in the range of 2°C – 8°C, use thermometers, charts for temperature and the shake test. Further, these guidelines are often practically hard to implement due to different factors like problems of infrastructure and workload pressures as reported by (Weir E, 2020) in his journal Preventing Cold Chain Failure: Vaccine Storage and Handling.

The cold chain technology is at great risk in areas like Lamu County where power supply is unreliable and maintenance facilities are not well developed. World Health Organization in its journal, The World Medicines Situation (2017) observes that areas like

Lamu has a common trend of observing 30% - 50% when the refrigerators and freezers are out of order (WHO, 2017). Research done in the USA by (Woodyard & Alto, 2018) indicated that there was lack of refrigerated temperature that fell within the acceptable range (Woodyard, 2018). The weaknesses of this technology is often observed during distribution and storage of the vaccines where the factors that contribute are delays during distribution, quality of the refrigerators, storage method, longer stay at the health unit, breakage of equipment, power interruption as well as lack of qualified personnel to handle the cold chain technology.

The significance of cold chain technology on supply chain performance is clear to the health industry based on their impact. Little has been done by the relevant stakeholders on the controlling of the effects of logistic practices such as distribution, packaging, storage, technical capacity and other sensitive practices in the supply chain performance like good quality and vaccine safety. Bishara, (2019) in his study Cold Chain and Clinical Trial Materials, PDA's Clinical Trial Interest Group, confirms that vaccines are sensitive materials which should be produced and distributed in strict controls to avoid becoming useless or harmful to the end consumer due to the reduced potency. Spens, (2020) in his study on the International Journal of Logistics Management indicated that there are various regulatory requirements that are met while transporting and handling vaccines for the quality not to be compromised along the supply chain (Spens, 2020).

Supply chain performance in the health sector refers to the ability of the supply chain to effectively and efficiently deliver vaccines and other medical products to healthcare facilities. It encompasses several key indicators, such as product availability, on-time delivery, inventory management, and capacity utilization. The supply chain performance of vaccines in public hospitals directly impacts the quality of patient care and safety. Logistics management practices are essential in ensuring the timely and accurate diagnosis of patients and meeting their healthcare needs throughout their care. Implementing effective logistics management practices in public hospitals is crucial for ensuring the smooth flow of vaccines and other medical supplies. These practices facilitate the proper storage, handling, and distribution of vaccines, minimizing the risk of stockouts or expired vaccines.

The supply chain performance of vaccines in public hospitals is influenced by various factors, including the utilization of technology and innovative strategies. The use of technology and innovative strategies can significantly improve the efficiency and effectiveness of vaccine supply chains in public hospitals. Implementing these practices can help public hospitals enhance their supply chain performance and ensure the availability of vaccines to meet patient needs. The logistics management practices in public hospitals play a vital role in ensuring the availability of vaccines and optimizing supply chain performance. Additionally, adopting logistics management practices in public hospitals can improve decision-making areas such as inventory policy, purchasing policy, return policy, demand control, stock control, monitoring, orders, use and claims, delivery policies, maintenance of inventories, purchase and delivery time, definition of quality standards, import or domestic market decisions, emergency purchasing decisions, distribution of products, use control, and management of infrastructure (Longaray et al., 2017). Furthermore, the logistics management practices in public hospitals also contribute to the overall efficiency and cost-effectiveness of the healthcare supply chain.

By implementing efficient logistics management practices, public hospitals can optimize the flow of vaccines within their supply chain, ensuring that vaccines are readily available when needed and minimizing the risk of stockouts or expired vaccines. In summary, the logistics management practices in public hospitals have a significant impact on the supply chain performance of vaccines. These practices contribute to the timely availability of vaccines, efficient distribution, and effective communication strategies for vaccination. Furthermore, implementing robust cold chain logistics and adequate inventory management is crucial in middle-income countries where resources may be limited. In summary, optimizing logistics management practices in public hospitals is key to improving supply chain performance and ensuring the availability of vaccines. In conclusion, the implementation of efficient logistics management practices is crucial for public hospitals to improve the supply chain performance of vaccines.

Implementing robust cold chain logistics and adequate inventory management is crucial in middle-income countries for the supply of vaccines due to several reasons:

1. Temperature control: Vaccines are sensitive biological products that require specific temperature conditions to maintain their efficacy. Cold chain logistics ensure that vaccines are stored, transported, and distributed within the required temperature range. Middle-income countries may have limited infrastructure or resources for proper cold chain management, making it crucial to implement robust cold chain logistics to prevent temperature fluctuations that can compromise vaccine quality.

2. Vaccine wastage reduction: Adequate inventory management helps minimize vaccine wastage in middle-income countries. By accurately monitoring vaccine stock levels, public hospitals can avoid overstocking or understocking. Overstocking can lead to vaccine wastage if they expire before being administered, while understocking can result in vaccine shortages and missed immunization opportunities. Proper inventory management balances supply and demand, reducing wastage and ensuring that vaccines are available when needed.

3. Improved vaccination coverage: Robust cold chain logistics and adequate inventory management lead to better vaccination coverage in middle-income countries. These practices ensure that vaccines are available in the right quantity and quality to reach target populations. With proper cold chain logistics and inventory management, public hospitals can plan and implement effective vaccination campaigns, reaching more individuals and achieving higher immunization coverage rates.

4. Cost-effectiveness: Implementing robust cold chain logistics and adequate inventory management helps optimize resources and reduce costs in middle-income countries. Effective cold chain management minimizes the need for vaccine replacements due to temperature excursions, reducing expenses. Proper inventory management avoids wastage and reduces the need for emergency stock purchases. By optimizing resources and minimizing costs, middle-income countries can allocate their healthcare budgets more effectively.

In summary, implementing robust cold chain logistics and adequate inventory management is crucial in middle-income countries for the supply of vaccines to ensure vaccine effectiveness, minimize wastage, improve vaccination coverage, and optimize cost-effectiveness. These practices contribute to the overall performance and success of vaccine supply chains in public hospitals.

Implementing robust cold chain logistics in middle-income countries for the supply of vaccines is important for several reasons:

1. Ensuring vaccine efficacy: Vaccines are sensitive biological products that require specific temperature conditions to remain effective. Cold chain logistics ensure that vaccines are stored, transported, and distributed within the recommended temperature range. This is crucial for maintaining the potency and effectiveness of vaccines, as exposure to temperatures outside the required range can render them ineffective.

2. Preventing vaccine wastage: Cold chain logistics help minimize vaccine wastage in middle-income countries. By maintaining proper temperature control throughout the supply chain, the risk of vaccines expiring before they can be administered is reduced. This prevents unnecessary disposal of expired vaccines, saving costs and ensuring that vaccines are used efficiently.

3. Increasing access to vaccines: Robust cold chain logistics enable the distribution of vaccines to remote and hard-to-reach areas in middle-income countries. Cold storage facilities, refrigerated vehicles, and temperature monitoring systems ensure that vaccines reach even the most inaccessible regions, improving access to immunization services for underserved populations.

4. Managing expansion of vaccine programs: Middle-income countries may experience a growth in their vaccine programs over time, introducing new vaccines and expanding coverage. Robust cold chain logistics allow for the effective management and scaling up of these programs, ensuring that the increased demand for vaccines can be met while maintaining the integrity of the cold chain.

5. Enhancing public confidence: Proper cold chain management in middle-income countries contributes to public confidence in vaccination programs. When people trust that vaccines are stored and transported under appropriate conditions, they are more likely to accept and participate in immunization efforts. This is crucial for achieving high vaccination coverage rates and preventing outbreaks of vaccine-preventable diseases.

Overall, implementing robust cold chain logistics in middle-income countries is essential for maintaining vaccine efficacy, minimizing wastage, increasing access to vaccines, managing program expansion, and enhancing public confidence in immunization efforts. These practices are vital for the success of vaccination programs and the overall health of populations in middle-income countries.

The main focus of supply chain management is to oversee and coordinate the entire process of product or service delivery, from sourcing raw materials to the final delivery to customers. This includes managing the flow of goods, information, and finances across all parties involved in the supply chain, such as suppliers, manufacturers, distributors, retailers, and customers. The goal is to optimize the efficiency, quality, and cost-effectiveness of the supply chain while ensuring timely and accurate delivery to meet customer demands.

Supply chain management comprises several key components that work together to ensure successful product or service delivery. These components include:

1. Planning and forecasting: This involves analyzing historical data, market trends, and customer demands to develop an efficient plan for inventory management, production, and distribution.

2. Sourcing and procurement: This component involves identifying and selecting reliable suppliers, negotiating contracts, and managing supplier relationships to ensure timely and cost-effective procurement of raw materials or finished goods.

3. Production and manufacturing: This component focuses on organizing and managing the production process, including scheduling, quality control, and optimizing production capacity to meet demand and minimize costs.

4. Logistics and transportation: This component deals with managing the physical movement of goods from suppliers to manufacturing facilities, warehouses, distribution centers, and ultimately to customers. It includes selecting the appropriate transportation modes, optimizing routing, and monitoring transportation activities.

5. Inventory management: This component involves efficiently managing inventory levels to avoid stockouts or excess stock. It includes tracking inventory levels, implementing inventory control measures, and utilizing forecasting techniques to determine optimal stock levels.

6. Warehousing and storage: This component entails managing storage facilities, optimizing warehouse layouts, and implementing effective inventory allocation strategies to streamline the movement and storage of goods within the supply chain.

7. Information systems and technology: This component utilizes technology and information systems to capture, analyze, and share data across the supply chain. It includes using tools such as enterprise resource planning (ERP) systems, supply chain visibility software, and data analytics to enable real-time tracking, decision-making, and collaboration among supply chain partners.

By integrating and aligning these key components, supply chain management ensures a smooth and efficient flow of goods and services, minimizes disruptions, reduces costs, enhances customer satisfaction, and ultimately contributes to the overall success of the product or service delivery process.

Supply Chain and Technology

Supply chain management relies on technology and information systems to enhance efficiency and collaboration among supply chain partners. Here are a few ways in which technology is used in supply chain management:

1. Enterprise Resource Planning (ERP) systems: These systems integrate various functions of the supply chain, such as inventory management, order processing, and production planning. By centralizing data and providing real-time updates, ERP systems enable better communication and coordination among supply chain partners.

2. Supply chain visibility software: This technology provides end-to-end visibility into the movement of goods and information throughout the supply chain. It helps stakeholders track shipments, monitor inventory levels, and identify bottlenecks or delays. This

visibility improves decision-making, enables proactive problem-solving, and enhances collaboration among partners.

3. Electronic Data Interchange (EDI): EDI allows for the secure and automated exchange of business documents, such as purchase orders and invoices, between supply chain partners. By eliminating manual processes and reducing paperwork, EDI improves the speed and accuracy of information flow, leading to faster order processing and reduced lead times.

4. Internet of Things (IoT): IoT devices, such as sensors and RFID tags, can be used to track the location and condition of goods in real-time. IoT technology enhances supply chain visibility, enables predictive maintenance, and facilitates inventory management by providing accurate and timely data.

5. Data analytics: Advanced analytics tools, such as big data analysis and machine learning, are employed to analyze vast amounts of supply chain data. This helps in identifying trends, optimizing operations, and making data-driven decisions. Predictive analytics can also be used to forecast demand, manage inventory levels, and mitigate supply chain risks.

6. Collaborative platforms: Supply chain management is greatly facilitated through collaborative platforms that allow partners to share information, collaborate on orders, and coordinate activities. These platforms often include features such as chat, document sharing, and process automation, which streamline communication and enhance collaboration among supply chain partners.

This study has found out that this technology consists of a series distribution and storage links for the purpose of keeping the vaccines withing the temperature range until its utilized by the end user. Supply chain of vaccines is a serious parameter to maintain the safety, stability, quality and efficiency. They should as well be stored according to the regulations of WHO. Therefore, this study finds a gap that should be filled to ensure that the supply chain of vaccinces is done well using the latest cold chain technologies.

2.1.2 Inventory Management

In the study done by Emmanuel H., (2022) shows that inventory management is a significant representation practice by entities in a logistics due to the obligation of storing goods that are expected in production, shipping or delivery to the final consumer (Emmanuel U., 2021). However, Gavi, (2018) in the Vaccine Alliance of 2016 progress report pointed out that public hospitals have their inventory function provided by either Kenya Medical Suplies Agency (KEMSA), the warehouses or other distribution centres.

According to (Branch, 2019) in his book on Global Supply Chain and International Logistics of Vaccines, the vital choice for the companies responsible in distribution is standards for pinpointing inventory management. This is because the cost are determined by the top management with capital capabilities like technical capacity, approachability, throwaway wastes and obtainability of the conveyance approaches. Oketch (2019) emphasized in his book, Supply Chain Performance in Manufacturing Pharmaceutical companies in Kenya that some models and dependabilities are associated with deliberations that include proximity between the production amenities, providers and the end consumers (Oketch, 2019).

Chopra, (2017) in Supply Chain Management: Strategy, Planning and Operations indicates that inventory control is a representative of the logistical operations that bear the overall effectiveness and efficiency of the supply chain. Although inventory buffer protects variations in customers' demand levels, there is concern to reduce the capability of public hospitals to respond to discrepancies on needs of the patients and affect supply chain performance. However, (Capacino, 2019) in Perspectives on global logistics shows that inventory management on the supply chain can subsequently become a shield defence to risk while at the same time raising different kinds of perils and some other factors that include quickness to market the products that are first-hand, the response interval for eminence issues and receptiveness towards market riches.

Cooper (2017) in the International Journal of Logistics Management found out that inventory Management has a decisive role to play to improve the effectiveness of the business entity. Thus, there is a big need for the public hospitals to embrace inventory management practice as a strategy of improving supply chain performance. Consequently, (Gunaseakaran & Ngail, 2018) in the International Journal for production economics indicates that too much inventory consumes a lot of space, creation of financial affliction, increased possibility of great loss as well as great loss and spoilage. Less inventory management often disrupts operations and therefore bring a likelihood of poor supply chain and customer service (Cooper, 2017).

This paper finds a research gap whereby the prudent inventory of vaccines needs the analysis of the cost to maintain certain levels because of the costs involved to hold too much stock and that for holding less, leading to the need of putting in place stock management system that ensures reliable sale projections.

2.1.3 Distribution Systems

According to Kiplagat (2020) distribution system is the overseeing of various events that are engaged in transportation of goods from the vendor to the firm, all the way to the end user. Gunaseakaran & Ngail (2018) in his International Journal for production economics indicated that distribution of products originating from the vendor to the place of collection has a huge cost of production hence to gain competitive advantage, firms must ensure that the logistics cost is reduced in the supply chain. Mwinzi (2018) did a research and found out that distribution systems usually depend on the types of transport used as the per the goods to be transported, delivery points and distribution centres. For instance, vaccines are transported using cold chain technology to reach remote areas like Lamu through the Kenya Medical Supplies Agency (KEMSA) in Mombasa.

Chopra, (2017) in Supply Chain Management: Strategy, Planning and Operations explains that the distributor creates speculation choices in terms of the conveyance equipment and in some scenarios, arrangements are done to make decisions that are functional. Branch (2019) did a research on Global Supply Chain and International Logistics of Vaccines and found out that distribution systems takes the highest amount in terms cost of ligistics, therefore, distribution management has effect on the supply chain of vaccines in public hospitals and their logistics because the movement is necessary from manufacturing process to distribution and eventually to the final consumers.

The findings on the past researchers found out that management and coordination of the systems should be perfect between the vaccine manufacturers, distributors to the final destination to bring maximum benefis. These are worthy distribution systems that are

able to provide efficient logistics, reduction of operation cost and promotion of quality service on hospitals that administer vaccines.

2.1.4 Technical Capacity

Emmanuel Habumugisha, (2022) did a study in the Rwanda Journal of Medicine and Health Sciences. He found out that the interest of various governments has been on how to develop new vaccines for emerging illness and gauging their effect on the human body. However, Mwinzi (2018) in his study found out that the most effective product can only have impact by getting to the final consumer. Cooper (2017) found out that the supply chain of vaccines is a complex process that involves various equipment, distribution system, location involved in getting vaccines (bearing in mind some are perishable and sensitive to temperature) from the producer to the final consumer. Therefore, the technical capacity of the people involved in the supply chain is very important as there are many issues to be considered before the vaccine gets to the market to help in designing vaccines that matches the needs of the end user.

Assi (2021) did the study on influenza vaccination policy affecting vaccine logistics. It was found that the development of clinical and vaccines testing involve many decisions which are connected with the supply chain of vaccine. For instance, when HERMES modelling work in Thailand was established and found out that the delivery of vaccines to selected population affected not only influenza vaccine but other vaccines as well. Cervantes-Apolinar, (2021) in his Arch Medical research noted that it was important for the technical capacity of the vaccine clinical trialists to be involved since choosing a general prevention instead of a more focused greater risk people for the influenza vaccine that is seasonal like health workers, kids, old people and women that are pregnant would lead to more volumes of vaccines during flue vaccination season leading to impediment of the flow of the program. Clinical trialists are involved in making decisions like identifying the population to be targeted and consider the system-wide effects for supply chain strengthening (Cooper, 2017).

The technical capacity of the vaccine package designers is equally important as the package of the vaccine impact the supply chain in a greater way. This is seen when in 2020 the preliminary packaging for COVID-19 vaccines was larger for supply chains in Italy and Latin America to work with (Cervantes-Apolinar, 2021). Pfizer and Johnson and Johnson's Rotarix worked on filling larger cold chain quantities than different normal vaccines, thereby putting in place bottlenecks that finally interfered with the flow of all other vaccines due the pandemic.

WHO (2020) in the study of to develop a vision of immunizing systems of supply chain in 2020: analysis of landscape summaries noted that healthcare workers have the mandate of adapting the logistics management practice because of the accessibility of vaccines. The issues of supply chain can bring about stock outs that would eventually push the healthcare workers to turn people away without vaccination (World Health Organization., 2020).

By leveraging these technologies and information systems, supply chain management improves efficiency, reduces costs, minimizes errors, and enables seamless collaboration and coordination among all parties involved in the supply chain.

Supply chain software and decision making

Supply chain visibility software enhances decision-making and collaboration among supply chain partners by providing real-time and accurate visibility into the movement of goods, inventory levels, and supply chain performance. Here's how it improves decision-making and collaboration:

1. Real-time information: Supply chain visibility software captures and displays real-time data on inventory levels, shipment status, and other critical supply chain metrics. This visibility allows partners to make informed decisions based on the most up-to-date information, leading to faster and more accurate decision-making.

2. Proactive problem-solving: With real-time visibility, supply chain partners can identify bottlenecks, delays, or disruptions in the supply chain promptly. This empowers them to take immediate action to address issues, minimize disruptions, and mitigate risks, thereby allowing for proactive problem-solving rather than reactive firefighting.

3. Demand planning and forecasting: Visibility software provides partners with insights into customer demands, sales trends, and market conditions. By analyzing this data, partners can improve demand planning and forecasting accuracy, allowing for better inventory management, production planning, and resource allocation.

4. Collaboration and coordination: Supply chain visibility software facilitates collaboration and coordination among partners by creating a centralized platform for sharing information. Partners can access real-time data, communicate, and collaborate on orders, inventory levels, and supply chain activities. This real-time collaboration enhances coordination, reduces lead times, and improves overall supply chain efficiency.

5. Performance monitoring: Visibility software provides partners with visibility into each other's performance metrics, such as delivery times, order accuracy, and inventory accuracy. This promotes accountability and encourages continuous improvement by enabling partners to monitor and measure each other's performance against agreed-upon metrics.

6. Data-driven decision-making: With access to accurate and comprehensive supply chain data, partners can make data-driven decisions. Advanced analytics capabilities within visibility software enable partners to analyze historical and real-time data, identify trends and patterns, and gain valuable insights. These insights support more informed decision-making and enable partners to optimize operations, improve efficiency, and enhance customer service.

In summary, supply chain visibility software improves decision-making and collaboration among supply chain partners by providing real-time information, proactive problem-solving capabilities, enhanced demand planning, improved coordination, performance monitoring, and enabling data-driven decision-making. By leveraging this software, partners can make informed decisions, streamline operations, and drive mutual success within the supply chain.

Supply chain and practice problem solving

Supply chain visibility software plays a critical role in promoting proactive problem-solving by providing real-time and accurate visibility into supply chain operations. Here's how it facilitates proactive problem-solving:

1. Early detection of issues: Supply chain visibility software captures data on various supply chain activities, such as inventory levels, transportation status, and production processes. By analyzing this data in real-time, the software can detect any anomalies, delays, or disruptions that occur throughout the supply chain. This early detection allows supply chain partners to take prompt action and address issues before they escalate into bigger problems.

2. Alert and notification systems: Supply chain visibility software can be equipped with alert and notification systems that send automated alerts to relevant stakeholders when certain pre-defined thresholds or exceptions are met. For example, if there is a delay in a shipment or if inventory levels fall below a specified threshold, the software can trigger instant alerts to relevant stakeholders. This enables them to quickly respond, investigate the issue, and take necessary corrective actions to prevent further problems.

3. Trigger-based workflows: Supply chain visibility software often includes the ability to create trigger-based workflows. These workflows can be set up to automatically initiate certain actions based on specific triggers or events. For example, if a shipment is delayed beyond a certain time frame, the software can automatically trigger the re-routing of the shipment or notify customers about the delay. By automating these workflows, supply chain visibility software ensures quick responses and proactive problem-solving without the need for manual intervention.

4. Collaboration and information sharing: Supply chain visibility software provides a centralized platform for sharing critical information among supply chain partners. This information can include real-time data on inventory levels, production schedules, and transportation status. By having access to this shared data, stakeholders can collaborate, share insights, and work together to identify potential issues and address them proactively.

5. Supply chain analytics: Many supply chain visibility software solutions come equipped with advanced analytics capabilities. These analytics tools allow stakeholders to analyze historical and real-time data to uncover trends, patterns, and potential issues. By leveraging these insights, supply chain partners can identify sources of inefficiencies, optimize processes, and proactively address underlying issues to prevent future problems from arising.

In summary, supply chain visibility software promotes proactive problem-solving by enabling early issue detection, automated alerts, trigger-based workflows, collaboration and information sharing, and supply chain analytics. By leveraging these features, supply chain partners can anticipate and address potential problems before they escalate, ensuring smoother and more efficient supply chain operations.

Logistics management practices

Logistics management plays a pivotal role in ensuring the efficient flow of goods, services, and information across the supply chain. It involves a range of activities, including transportation, warehousing, inventory management, and customer service. This article aims to explore the key practices used in logistics management, highlighting their significance in achieving operational excellence. 1. Effective Demand Planning: Demand planning is a critical aspect of logistics management as it helps in aligning supply with customer demand. Accurate demand forecasting enables companies to optimize inventory

levels, reduce stockouts, and enhance customer satisfaction. By leveraging historical data, market trends, and advanced analytics, companies can make informed decisions regarding production, procurement, and transportation.

Efficient Transportation Management: Transportation management is a crucial practice within logistics management. It involves selecting the appropriate mode of transportation, optimizing routes, and managing carrier relationships. By leveraging technology solutions such as transportation management systems, companies can streamline operations,

Supply chain management (SCM) plays a pivotal role in the success of organizations across industries. It involves the coordination and integration of various activities that contribute to the flow of goods, services, and information from raw material suppliers to end customers. This essay aims to provide a comprehensive overview of the key practices used in supply chain management. 1. Effective Demand Planning: Demand planning is a critical practice in SCM that involves forecasting customer demand accurately. By leveraging historical data, market trends, and collaborative inputs from stakeholders, organizations can optimize their inventory levels, minimize stockouts, and improve customer satisfaction. Advanced demand planning techniques, such as statistical modeling and machine learning algorithms, can further enhance the accuracy of demand forecasts.

Efficient Inventory Management: Inventory management is crucial for maintaining a balance between supply and demand. Adopting lean principles, such as just-in-time (JIT) inventory, can help organizations reduce carrying costs .

The research gap found in these previous studies shows that the technicality of the healthcare workers is needed to ease the flow of supply chain performance. For instance, if the vaccine refrigerators are not functioning, workers would opt to storing them in ice pack boxes which sometimes carries the risk of freezing the vaccines hence lowering the potency. Therefore, coordination between the logistics managers and healthcare workers is important in easing the performance of supply chains of which this study seeks to fill the research gaps.

2.1.5 Logistics Management Practices and Supply Chain Performance

The operations of vaccines is the efficient incorporation of the raw materials from the original point of production to the people being vaccinated (Oketch, 2019). The significance brought about by the logistics management practices has been increasing all along and noted by both big and small firms involved in manufacturing hence the practices are important to any public hospital dealing with distribution of vaccines. This is because they need to ensure that the final products are delivered to the end users through logistics function by promotion of supply chain performance by bringing about reducing cost, efficiency and effectiveness (Kiplagat, 2020).

Adoption of cold chain technology in the logistics of vaccines has provided easier distribution systems leading to improved accuracy in delivery and tracking ability (Bishara, 2019). Thus, a good coordination among the supply chain components would take a significance of bettering the distribution systems that provide reduced operations

cost, improved logistics efficiency and promotion of supply chain performance on organizations (Timnah, 2017).

The primary reason why firms have been adopting these practices is to manage the cost and competitiveness in the supply chain that increase the profitability and sales in the long run (Samuel, 2016). Thus, the organizations should emphasis taking up logistics management to reduce cost leading to the influence of the supply chain performance positively. When the order is communicated and administered on time, the better administration for the arrangement of distribution and activities of stock by meeting the required consumer satisfaction level (Capacino, 2019).

2.2 Theoretical Framework

Logistics has a growing and significant interest in the supply chain management from the academic researchers over the years. Different views have been initiated to explanin the practices of logistics management and their influence on the performance of supply chain. This study has worked on two theories that relates to the supply of vaccines in public health facilities in Lamu County. The theories are; Agency Theory and Resource Based Theory.

2.2.1 Agency Theory

Agency theory was propounded by Jensen, (1976) as quoted in (Njuguna M. W., 2020). It explains the relationship between the agent and principal where the acts on delegated powers from the principal where the agent acts on the account of the principal and condut operations with a third party. This theory helps in understanding the conditions under which supply chain team may attempt to abuse other members.

Agency theory also gives a guidance on the investigation of the effectiveness of supply chain performance and how it can be reduced to minimize cost. It was promoted with seminal work of Max Weber (Njuguna, 2020) which had the concerns of the conflict between masters of politics and the officians of state. This theory is relevant in this study since supply chain management involves two parties (buyer and the supplier) where the supplier is the agent and the buyer is the principal. The agent is supposed to undertake the contracted activities within a specified period based on defined time lines. This theory is as well important to find out whether suppliers who carry out activities on behalf of public hospitals and the government of Kenya obey the defined timelines and all the privisions of the contract on behalf of the principal who is the Kenyan taxpayer (Charlene, 2019).

2.2.2 Resource Based Theory

This theory was propounded by Wernerfelt, (1984) as quoted in (Njambi, 2018) as one the management theories widely referenced because of its management practices. It emphasized on the inner capability and weaknesses of institutional resources and shows the control of procedures and how resources are distributed and arranged for execution aims of various plans (Mwinzi, 2018). According to Njambi, (2018) resource based theory thus brings about the existence of convinced focus on resources under the organization and different properties that make clear to company supply chain performance that would be long term development.

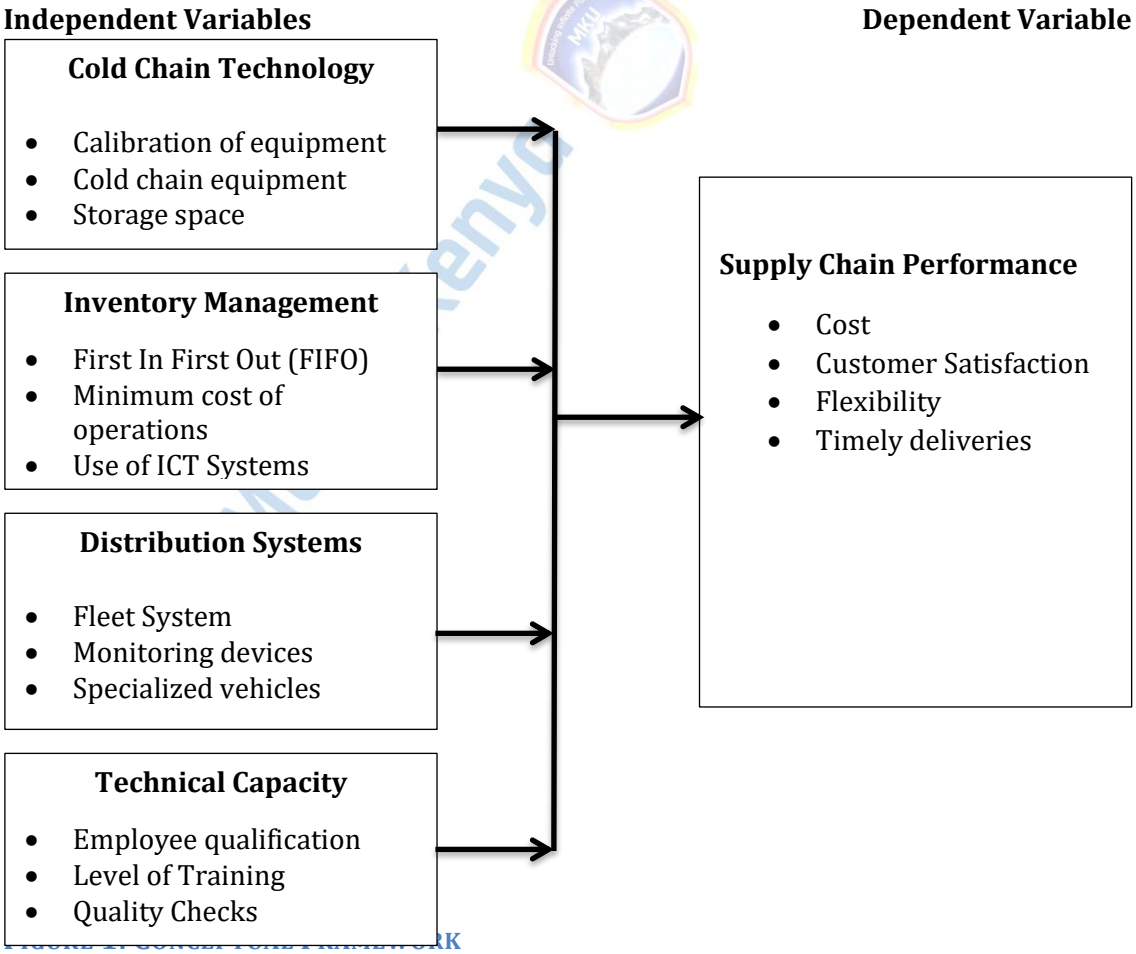
According to Barney (2003) in (Mwinzi, 2018), for the successful implementation of logistics management practices, resources should be strategic. This is because the

viewpoint of resources based on a modern outlook includes the organization's elements like structures within the supply chain. They try to harmonize information disseminated among them to assure the key stakeholders in the organization management to fully ensure that proper logistics management practices in implemented. For the organization to have the best effective practices, they are dependent of the use and manipulation of the currrent resources to an degree of firms having pools of resources that are under-utilized while creating particular firm oriented and unique opportunities for utilization (Mentzer et al, 2019). This view point is fully applicable in this research as it views the proper use of resources (vaccines) that public hospitals has for the purpose of improving distribution of vaccines from the point of production to customers' point of collection.

2.3 Conceptual Framework

This is the association between study variable(s) illustrated in form of a diagram. The independent variables include cold chain technology, inventory management, distributed systems and technical capacity and the dependent variable is the performance of supply chain vaccines. Most of the remote areas like Lamu in Kenya find it hard in the transportation of vaccines and other cold chain medicine. The supply chain performance of vaccines in public hospitals is hugely determined by the changes at the time of distribution, handling, storage and packaging (Bishara, 2019).

Figure 2.1 below shows the link between the dependent and independent variables among Lamu County public healthcare facilities in this study.



Source: Researcher (2023)

2.3.1 Cold Chain Technology

Immunization programs in Lamu County faces a major challenge of maintaining quality of vaccines. Cold chain technology is the process of keeping and distributing vaccines at an acceptable degree of temperatures from the manufacturers to the end users (WHO, 2018). It is recommended by the World Health Organization; the storage of vaccines has to be maintained in the range of 2°C – 8°C, use thermometers, charts for temperature and the shake test. Therefore, calibration of equipment used is essential in the cold chain to make sure that the supply chain performance is at par. Further, these guidelines are often practically hard to implement due to different factors like problems of infrastructure and workload pressures (Weir E, 2020).

2.3.2 Inventory Management

Inventory management is a significant representation practice by entities in a logistics due to the obligation of storing goods that are expected in production, shipping or delivery to the final consumer (Emmanuel U., 2021). However, Gavi, (2018) in the Vaccine Alliance of 2016 progress report pointed out that public hospitals have their inventory function provided by either Kenya Medical Suplies Agency (KEMSA), the warehouses or other distribution centres. It has been noted from the previous researchers that inventory management uses ICT systems and First In First Out (FIFO) method in its operations to make the performance vaccines supply chain better.

2.3.3 Distribution Systems

Distribution system is the overseeing of various events that are engaged in transportation of goods from the vendor to the firm, all the way to the end user. Gunaseakaran & Ngail (2018) indicated that dispatch of products from the vendor to the place of collection has a huge cost of production hence to gain competitive advantage, firms must ensure that the logistics cost is reduced in the supply chain. Mwinzi (2018) found out that distribution systems usually depend on the types of transport used as the per the goods to be transported, delivery points and distribution centres. These ranges from the fleet systems, specialized vehicles and the monitoring devices. For instance, vaccines are transported using modern devices to reach remote areas like Lamu through the Kenya Medical Supplies Agency (KEMSA) in Mombasa.

2.3.4 Technical Capacity

The interest of various governments has been on how to develop new vaccines for emerging illness and gauging their effect on the human body. However, Mwinzi (2018) found out that the most effective vaccines can only have impact by reaching the human body. Cooper (2017) found out that the supply chain of vaccines is a complex process that involves various equipment, distribution system, location involved in getting vaccines (bearing in mind some are perishable and sensitive to temperature) from the producer to the final consumer. Therefore, human capacity is required to achieve this goal.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

The description of methodologies in this study is given including the research design, population of interest, sampling procedures and sample size, procedures and tools used in data collection and lastly ethical considerations. The study majored on public hospitals in Lamu County that dealt with supply chain of vaccines within the county.

3.1 Research Design

Descriptive survey was the method adopted in this study because of it is suitability to collect data and answer the research questions (Kothari, 2004). A well-structured questionnaire was the tool for data collection. For the purpose of this study, the researcher used quantitative research.

3.2 Target Population

All the public health facilities in Lamu County met the inclusion criteria as the target population. Thus, all the 32 public health facilities in Lamu county were the target population of the study. These facilities were the units of analysis for the study. However, the unit of observation were the 96 respondents who comprised of 32 facility managers, 32 procurement officers and 32 vaccine managers in each public health facility. Therefore, the study targeted 96 respondents (Department of Health, 2023).

3.3 Sampling Procedure and Sample Size

The census survey helped in determining the sample size. This is whereby information is collected from the entire population of 96 respondents to get accurate information. According to (Kothari, 2004), census survey often offers the best solution. The unit of research observation was the procurement officers, facility and vaccine managers at various health facilities in Lamu County by the time of conducting the study where three questionnaires were issued per the facility. This category of staff fell under the inclusion criteria. The list of health facilities is attached in appendix III.

3.4 Instruments of Data Collection

The researcher chose questionnaire as the instrument of data collection in this study. Both closed and open ended questions were used for the respondents to express themselves easily. The questionnaire was divided into five areas of study: demographic characteristics of the respondents, cold chain technology, inventory management, distribution systems and the technical capacity. The instrument was pretested in the neighbouring Tana River County Referral Hospital. Adjustments were made before the real collection of data. The respondents who were used for pretesting did not appear in the final study since it was conducted in Lamu County health care facilities.

The structured questionnaire aided in collecting both quantitative and qualitative data (Wayne & Stuart, 2007). The researcher delivered questionnaires to the participants and collected them back after a period of one week.

3.5 Validity of the Research Instruments

Research instruments validity was used to ascertain their accuracy. A well-structured questionnaire was tested prior to the research for the purpose of ensuring that the study results were accurate. However, the validity of the questionnaire tool was for the purpose of the current research and within the period of three months when the research was conducted. Content validity was gotten from the discussion with the University supervisor.

3.6 Reliability of Research Instrument

A test for reliability is considered when it determines what it intends to measure consistently. The questionnaire reliability was achieved by using Cronbach's Alpha Model to run the reliability test how the instruments would consistently produce results or data (Sovacool, 2018). This model is frequently used in social and behavioural sciences to gauge the internal coherence. It was popularized by Cronbach in 1951 by acknowledging its extensive utility. It is used to calculate the variance attributable to the subject owing to the subject-item interface where the acceptable alpha should be at least 0.60 which implies a high level of internal reliability. The findings of the reliability are well explained in chapter four. The pilot study was conducted to 10 employees from Tana River County Referral Hospital and the findings were used to measure the reliability of the instrument for research. Tana River County Referral Hospital was chosen for the pilot study because it had the same characteristics with the area of study.

3.7 Data Collection Procedure

Respondents were physically issued with structured questionnaire in the healthcare facilities within Lamu County to get appropriate information for the study. After the questionnaire had been administered to the participants, the completed ones were used for analysis.

3.8 Data Analysis

After collecting the questionnaires from the participants, checking was done for accuracy and later analysis done and findings summarized. The data was categorized and entered into the Statistical Package for Social Sciences Version 25 (SPSS V.25). Presentation of the data collected was through frequency tables using means and standard deviation. Multiple regression was used to predict values of dependent variables. The suitability of the multiple regression model was analyzed using determination of coefficient R square while real data points were approximated using predictions. The regression was considered to perfectly fit in the data where the R square is equal to 1. Multiple regression model suitability was tested using F-test in the ANOVA table.

The role of t-test of the regresson coefficient was when all the independent variables had influence on the dependent variable. The results of the study was summarized by the use of frequency tables, mean, percentages, standard deviation and regression model. The following regression model was adopted in this study:

$Y= \beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\varepsilon$ Where:

Y is the performance of supply chain

The β_0 is the intercept

β_1 is the cold chain technology coefficient

β_2 is the inventory management coefficient

β_3 is the distribution systems coefficient

β_4 is the technical capacity coefficient

ε = the error term

Whereas, X is the set of logistics management practices measured against the performance of supply chain vaccines at the public health applications in Lamu County.

Therefore: -

X_1: Cold Chain Technology

X_2: Inventory Management

X_3: Distributed Systems

X_4: Technical Capacity

3.9 Ethical Considerations

Ethical issues that rose while conducting the research included the approval to conduct the study, consent from Department of Health, Lamu County and informed consent from the respondents. The role to be played by the researcher and the respondents as well as confidentiality were addressed (Kline, 2018). Mount Kenya University granted permission letter to proceed with the data collection. Permission to gather data was granted by National Council for Science and Technology (NACOSTI) while the public health care facilities in Lamu County gave the clearance letter before the questionnaires were distributed to the respondents. It was made clear to the respondents the objectives to be achieved in the study and they were required to sign the informed consent form. No respondent was required to write their identities but only their signatures were needed for integrity. The respondents had the right to leave the study without suffering any consequences.

CHAPTER FOUR

RESEARCH FINDINGS AND DISCUSSIONS

4.0 Introduction

Data analysis, findings, presentations and discussion of the findings are covered in this chapter. The main purpose of this study was to find out the relationship between logistics management practices and supply chain performance of vaccines in Lamu County healthcare facilities. The study was segmented into four independent variables which were cold chain technology, inventory management, distribution systems and lastly the technical capacity. All these variables are believed to have influence on supply chain performance of vaccines.

4.1 Response Rate

This study had targeted 96 respondents from among 32 healthcare centres in Lamu County. Researcher issued 3 questionnaires to each of the 32 facilities and 92 responses were gotten giving a response rate of 95.8%. The study could not attain a 100% since one questionnaire was not completely filled and three had varying information and were rejected by the researcher. However, Kothari, (2004) points out that a 70% and above response rate is enough for research and data analysis, thus this response rate gave the researcher a reason to do data analysis. The table 1 below shows the response rate.

TABLE 1: RESPONSE RATE

Response	Frequency	Percentage
Response	92	95.8%
Non – Response	4	4.2%
Total	**96**	**100%**

Source: Field Data (2023)

4.2 Pilot Study Results

The reliability test was conducted to ascertain the dependability of the variables and the findings indicated that the Cronbach alpha correlations ranged between 0.580 and 0.965. Inventory management scored the highest with 0.965 while technical capacity was the lowest with 0.580. The results are tabulated in the table 2 below.

TABLE 2: RELIABILITY FINDINGS

Variables	Frequency	Cronbach Alpha Coefficient Values
Inventory Management	10	0.965
Cold Chain Technology	10	0.916
Distribution System	10	0.817
Technical Capacity	10	0.580

Source: Field Data (2023)

The table 2 above indicates that Cronbach alpha values ranged between 0.580 to 0.965 for the independent variables of the study. Based on the previous studies, it should at least be greater than 0.60 but the technical capacity did not measure what it was intended to measure. Therefore, the items for the technical capacity were reviewed by the researcher to ensure consistency of the variables to be measured.

4.3 General Demographic Information

The biographic data of the respondents in this study included the gender, age bracket, education and the duration service from various health facilities in Lamu County.

4.3.1 Gender of the Respondents

The respondents indicated their gender and findings are in the table 3 below.

TABLE 3: GENDER OF THE RESPONDENTS

Gender	Frequency	Percentage
Male	54	58.7%
Female	38	41.3%
Total	**92**	**100%**

Source: Field Data (2023)

It was found out that male respondents were more than females by 58.7% to 41.3%. The findings indicate that their more males were working in Lamu health facilities than their female counterparts by 17.4%. The reason could be that of the culture barring women from working but just tender to family chores.

4.3.2 Age of the Respondents

The respondents indicated their age and the responses are as shown in the table 4 below.

TABLE 4: AGE OF THE RESPONDENTS

Age	Frequency	Percentage
18 – 25 years	6	6.5%
26 -32 years	32	34.8%
33 – 40 years	46	50%
41 years and above	8	8.7%
Total	**92**	**100%**

Source: Field Data (2023)

The findings in the table 4 above shows that half of the respondents were between 31 – 35 years closely followed by the age bracket of 26 -34 years with 34.8% and 41 years and above were represented by 8.7%. Lastly, the respondents aged between 20 – 25 years had a mere percentage of 6.5%. the findings show that the employees working in Lamu county health facilities were above 26 years who were mature enough to provide answers sought by the researcher.

4.3.3 Level of Education of the Respondents

It was a requirement for the respondents to indicate their highest level of education. The findings of the study are shown in table 5 below.

TABLE 5: RESPONDENTS' LEVEL OF EDUCATION

Education Level	Frequency	Percentage
High School	0	0%
College	14	15.2%
University Degree	46	50%
Masters and above	32	34.8%

Total	**92**	**100%**

Source: Field Data (2023)

The findings tabulated above shows that 15.2% of the respondents were diploma and certificate holders, half were degree holders and 34.8% had masters' degrees and above. None of the respondents had less than a certificate course of education. The results established that all the respondents had appropriate education background and their responses could be used sufficiently for the study since they were all learned and were in a position to share information as far as logistics practices and supply of vaccines was concerned.

4.3.4 Work Experience of the Respondents

It was a requirement for the respondents to indicate the number of years they had worked in the same health facilities. The table below represents the results of their responses.

TABLE 6: WORK EXPERIENCE OF THE RESPONDENTS

Duration of Service	Frequency	Percentage
Below 5 years	12	13%
6 – 10 years	32	34.8%
11 – 15 years	26	28.3%
16 – 20 years	18	19.6%
Over 20 years	4	4.3%
Total	**92**	**100%**

Source: Field Data (2023)

The results above show 34.8% of the respondents had worked in the facility between 6 – 10 years, 28.3% had worked for a period between 11 – 16 years and 19.6% had an experience of between 16 – 20 years. It was further noted that 13% of the respondents had an experience of 5 years and below and 4.3% had worked in the same facility for over 20 years, forming the minority. The results above show that most of the respondents had adequate experience in their field of work and had adverse knowledge on the data sought concerning the logistics practices and supply performance of vaccines.

4.4 Descriptive Analysis

Cold chain technology, inventory management, distribution systems and the technical capacity were identified as the independent variables while supply chain performance of vaccines was the dependent variable of this study. In order to analyze the data from the respondents, descriptive statistics like mean and standard deviations were used. Statistical Package for Social Sciences (SPSS) was used to define and compare variables as well as obtaining the descriptive statistics.

4.4.1 Cold Chain Technology

The study sought to establish the influence of cold chain technology on the supply chain performance of vaccines. The results were obtained from the respondents as follows: functional storage equipment (mean 2.158, SD 1.53445), measures in place to ensure vaccines are in good condition (mean 2.0105, SD 1.3329), enough storage space (mean 1.9684, SD 1.3872), storage practices in line with cold chain technology (Mean 2.2316, SD 1.5050). The findings are presented in the table 7 below

TABLE 7: COLD CHAIN TECHNOLOGY

Cold Chain Technology	Mean	Std. Deviation
Functional storage equipment	2.158	1.5345
Measures in place to ensure vaccines are in good condition	2.0105	1.3329
Enough storage space	1.9684	1.3873
Storage practices in line with cold chain technology	2.2316	1.5050

Source: Field Data (2023)

Table 7 above showed that all the means of the reported variables were below 3 which meant that the respondents did not agree with the items raised. It was clear that cold chain technology has not been utilized in Lamu County. A study conducted by Bishara, (2019) found out that there are some barriers that pertains to the adoption of cold chain technology like poor equipment, storage space and lack of will from the management. Internal issues were found to be the biggest determinant to the success of utilizing cold chain technology. While vaccines can only be distributed by Kenya Medical Supplies Agency (KEMSA), mantaining the right quality has been a nightmare because of the transport issues, security, corruption and the tedious bureaucracies of the government.

A study conducted in seven sub counties of Turkana couny between january to February 2022 revealed that vaccines require cold chain technology and good distribution systems throughout the supply chain to maintain the quality and potency (Kanja, 2022). However, these requirements may not be guaranteed because of the preventable morbidity and

mortality of the vaccines taken to areas like Turkana and Lamu. The study concluded that remote areas do not have icepacks for storage and distribution and optimal supply of vaccine carriers. Just like what was found in Lamu, the vaccine fridges did not have functional tags for monitoring the temperature. There was a challenge of routine maintenane and contigency plans that would ensure optimal service delivery.

4.4.2 Inventory Management

The second objective sought to determine the influence of inventory management on the performance supply chain of vaccines in Lamu County health care facilities. The respondents were given the opportunity to describe the extent of how this logisitcal management practice influence supply chain performance and the findings are as indicated. Management makes sure of enough storage facilities (mean 3.4632, SD 1.2099), handling equipment of vaccines are available (mean 3.3474, SD 1.1829), there is availability of inventory management systems (mean 3.5684, SD 1.1638), and inventory practices are satisfactory (mean 3.5580, SD 1.2439). The results above show that inventory management is low as far as the supply chain performance of vaccines in Lamu County is concerned. However, as indicated in the table 8 below, the means of the items are above 3 which means that the respondents generally agreed with the items.

TABLE 8: DESCRIPTIVE STATISTICS ON INVENTORY MANAGEMENT

Inventory Management	Mean	Std. Deviation
Management makes sure of enough storage facilities	3.4632	1.2099
Handling equipment of vaccines are available	3.3474	1.1829
There is availability of inventory management systems	3.5684	1.1638
Inventory practices are satisfactory	3.5580	1.2439

Source: Field Data (2023)

The supply chain performance is influenced by how the inventory management is carried out. For the inventory management to be effective, the products should be available when needed which is essential for an efficient supply chain performance (Cooper, 2017). In contrary, poor inventory management may result into stock outs, delays, exaggerated costs and therefore negatively affecting the entire supply chain. In the presence of adequate storage facilities, proper handling of vaccines and implementing inventory

practices such as management software and adoption of lean inventory practices helps in improving and enhancing the overall performance of the vaccine supply chain.

An effective inventory management has benefits like cost savings which minimize excess inventories, reduction of inventory holding cost like handling and storage costs. The accuracy of demand forecasting as well as proper inventory planning helps the businesses to avoid stock outs and cost reduction of rush orders (Emmanuel U., 2021). The other benefit of inventory management is that there is increased efficiency in the supply chain operations. Further, the effective inventory management helps the firm to minimize the need for manual inventory tracking and data entry, freeing up time as well as resources to be used in other company departments. The last benefit of using inventory management is that it leads to improved customer service because the products are available in stock and customer needs are met. The organizations that have accurate demand forecasting avoids stock outs and therefore increase customer satisfaction and increased sales (Lee, 2017). These previous studies are in relation to the inventory management of vaccines in Lamu county were in agreement that the items identified were practices although their opinions varied as shown in the standard deviation results.

4.4.3 Distribution Systems

The third objective examined the influence of distribution systems on the performance of supply chain of vaccines among health care centres in Lamu County. When the respondents were asked about this logistic management practice, the following findings emerged: Execution of the movement of vaccines (mean 2.1789, SD 1.6176), optimization of the daily operations of fleet systems to manage distribution (mean 4.3579, SD 1.2793), use of specialized vehicles (mean 4.8002, SD 0.6620) and planning and monitoring of the transport systems (mean 4.6843, SD 0.7755). All the items with the exception of item 1 had means above 4 where the respondents totally disagreed with the execution of the movement of vaccines. The three items with means above 4 meant that the respondents overwhelmingly agreed with the statements. The findings from the respondents shows that the distribution systems are averagely used in the health care centres in Lamu County as shown in the table 9 below.

TABLE 9: DESCRIPTIVE STATISTICS ON DISTRIBUTION SYSTEMS

Distribution Systems	Mean	Std. Deviation
Execution of the movement of vaccines	2.1789	1.6176
Daily operations of fleet systems to manage distribution	4.3579	1.2793
Use of specialized vehicles	4.8002	0.6620
Planning and monitoring of the transport systems	4.6843	0.7755

Source: Field Data (2023)

From the data findings above, it is clear that distribution systems have an important impact on the supply chain performance of vaccines. For the health care centres in Lamu

county to be efficient and effective, there should be a good distribution management process that would convey vaccines from the suppliers (KEMSA) to the final consumers (patients). Successful vaccination programs are built on working end-to-end supply chain systems. These systems brings about effective storage of vaccines, distribution, handling, management and rigorous control in the cold chain technology and efficient logistics management systems (Timnah, 2017). The main objective is to ensure there is availability of vaccines from the manufacturers to the delivery levels so that the people to be vaccinated do not miss the opportunity because of unavailable vaccines.

Success stories of vaccination programmes in Kenya has been reported but there is an increasing pressure to effectively manage the need of new vaccines introduction in remote areas like Lamu where there are transport issues (Gunaseakaran and Ngail, 2018). Distribution systems ensures that vaccines are available, in the right quantity and quality. Promotion of integration with other supply chains should be key and investing in effective systems that manages, treats and disposes the vaccine wastes for reducing environmental degradation.

4.4.4 Technical Capacity

The fourth and last objective sought to determine the influence of technical capacity on the influence of supply chain performance of vaccines among health care centres in Lamu County. The respondents were expected to respond to various items on the level of agreements and these were the outcomes: Employees are specifically trained to handle cold chain vaccines (mean 4.2000, SD 1.1904), there is enough equipment to handle increasing demand (mean 3.3474, SD 1.3973), there are quality checks of ensuring compliance with cold chain technology (mean 3.6001, SD 1.3079) and there is constant power supply for cold chain equipment (mean 3.8737, SD 1.1508). The findings above show that there is technical capacity among the health care centres in Lamu County. As seen in the table 10 below, all the items had a mean greater than 3 indicating that the respondents averagely agreed on the statements posed to them.

TABLE 10: DESCRIPTIVE STATISTICS ON TECHNICAL CAPACITY

Technical Capacity	Mean	Std. Deviation
Employees are trained to handle cold chain vaccines	4.2000	1.1904
There is enough equipment to handle increasing demand	3.3474	1.3973
There are quality checks of ensuring compliance	3.6001	1.3079
There is constant power supply for cold chain equipment	3.8737	1.1508

Source: Field Data (2023)

Though the technical capacity items in the construct were low, the results were consistency with the literature from the previous studies. Emmanuel Habumugisha, (2022) did a study in the Rwanda Journal of Medicine and Health Sciences. He found out that the interest of various governments has been on how to develop new vaccines for emerging illness and gauging their effect on the human body. However, Mwinzi (2018) in his study found out that the most effective product can only have impact by getting to the final consumer. Cooper (2017) found out that the supply chain of vaccines is a complex process that involves various equipment, distribution system, location involved in getting vaccines (bearing in mind some are perishable and sensitive to temperature) from the producer to the final consumer. Therefore, the technical capacity of the people involved in the supply chain is very important as there are many issues to be considered before the vaccine gets to the market to help in designing vaccines that matches the needs of the end user.

Assi (2021) did the study on influenza vaccination policy affecting vaccine logistics. It was found that the development of clinical and vaccines testing involve many decisions which are connected with the vaccine supply chains. For instance, when HERMES modelling work in Thailand was established and found out that the delivery of vaccines to selected population affected not only influenza vaccine but other vaccines as well. Cervantes-Apolinar, (2021) in his Arch Medical research noted that it was important for the technical capacity of the vaccine clinical trialists to be involved since choosing a general vaccination rather than a more focused higher risk population for the seasonal influenza vaccine like health workers, children, old people and pregnant women would lead to more volumes of vaccines during flue vaccination season leading to impediment of the flow of the program. Clinical trialists are involved in making decisions like identifying the population to be targeted, consider the system-wide effects and the potential need for supply chain strengthening in order to accommodate such targets (Cooper, 2017).

The technical capacity of the vaccine package designers is equally important as the package of the vaccine greatly affect supply chain. This is evidenced when in 2020 the preliminary packaging for COVID-19 vaccines was too large for supply chains in Italy and Latin America to handle (Cervantes-Apolinar, 2021). Pfizer and Johnson and Johnson's Rotarix worked on filling greater cold chain volumes than other routine vaccines, thereby creating bottlenecks that ultimately disrupted the flow of all other vaccines due the pandemic.

WHO (2020) in the study to develop a vision of immunizing supply systems in 2020: landscape analysis summaries noted that healthcare workers have the mandate of adapting the logistics management practice because of the accessibility of vaccines. The issues of supply chain can bring about stock outs that would eventually push the healthcare workers to turn people away without vaccination (World Health Organization., 2020).

4.5 Model Summary

The study further sought to find out the relationship between logistics management practices and supply chain performance of vaccines among public healthcare centres in Lamu County. Regression analysis was used to find out the relationship between the inventory management, distribution systems, cold chain technology and technical capacity and the dependent variable to illustrate the expected relationship between the two variables. The findings are as indicated in the figure 11 below.

TABLE 11: MODEL SUMMARY

Model	R	R Square	Adjusted R Square	Std Error of the Estimate
1	729[a]	.531	.473	.36393

Source: Field Data (2023)

a. Predictors: (Constant), inventory management, distribution systems, cold chain technology and technical capacity.

R-square from the regression model above indicated the variation in the dependent variable explained by the independent variables under study. The R-square in this study was 0.531, an indication that all the independent variables combined are 53.1% of the dependent variable while the remaining 49.1% variation is explained by other factors not included in the model. Therefore, the conclusion of this study is that there are more factors that could be influencing the supply chain performance of vaccines in Lamu county other than the ones in the study.

The Analysis of Variance (ANOVA) was carried out and the findings are as indicated in the table 12 below.

TABLE 12: ANALYSIS OF VARIANCE (ANOVA)

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	6.016	5	1.185	9.070	.000[b]
Residual	5.278	41	128		
Total	**11.294**	**46**			

Source: Field Data (2023)

a. Supply Chain Performance of Vaccines (dependent variables)

b. Cold chain technology, inventory management, distribution systems and technical capacity (independent variables or the constant).

It was out of the regression model that the ANOVA was carried out and the findings are as shown in the table 12 above. The F value was at 9.070 indicating that the model can be used to predict how the independent variables influence the dependent variable. The

results further in the ANOVA shows that the overall model was significant at 95% confidence level.

The study further sought to find the specific influence of the study objectives on the supply chain performance of vaccines among healthcare centres in Lamu County. To achieve this, the regression coefficients were used to show how each of the independent variables influence the dependent variable, which was the supply chain performance of vaccines in Lamu County. The table 13 below shows the regression analysis.

TABLE 13: REGRESSION COEFFICIENTS

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.445	0.897		1.611	0.115
Distribution Systems	0.384	0.122	0.447	3.146	0.003
Cold Chain Technology	0.883	0.149	0.890	5.947	0.000
Technical Capacity	0.020	0.096	0.023	0.206	0.838
Inventory Management	0.076	0.096	0.094	0.792	0.533

Source: Field Data (2023)

The regression coefficient models in the table 13 above illustrates that when all the variables are held constant at 0, the worth of supply chain performance of vaccines would stand at 1.445. In addition to this, distribution systems influenced the supply chain performance of vaccines among healthcare centres in Lamu county at β_1 = .384 and p-value =.003. Therefore, these figures shows that the increase in the utilization of distribution systems on the supply of vaccines would increase to 0.384 among the healthcare centres in Lamu County. The findings of this study further shows that cold chain technology had a positive influence on the supply chain performance of vaccines among healthcare centres in Lamu County at β_2 = .883 and p-value =.000. This means that for every unit increase in the use of cold chain technology would lead to the improved supply chain performance of vaccines among health care centres in Lamu County by 0.883 units. However, the findings in this study indicated that the inventory management and

technical capacity had little influence on the supply chain performance of vaccines among healthcare centres in Lamu County. This is because their p-value was 0.533 and 0.838 respectively which is far much bigger than 0.05. However, inventory management had more influence on the supply chain performance of vaccines than technical capacity because their standardized coefficients stood at 0.076 and 0.020 respectively. Thus, the findings show that distribution systems and cold chain technology were the independent variables that proved to be suitable predictors of the supply chain performance of vaccines among healthcare centres in Lamu County. These two variables were followed by the inventory management and lastly the technical capacity.

4.6 Regression Model

The regression model overall results are shown in the output table 14. The model was based on the equation that compared the variables.

TABLE 14: REGRESSION MODEL

Model	R	R Square	Adjusted R Square	Std Error of the Estimate
1	729[a]	.531	.473	.36393

Source: Field Data (2023)

The multiple regression function is as shown below:

$$Y= \beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\varepsilon$$

Where**:**

Y is the supply chain performance

The β_0 is the intercept

β_1 is the cold chain technology coefficient

β_2 is the inventory management coefficient

β_3 is the distribution systems coefficient

β_4 is the technical capacity coefficient

ε = the error term

Whereas, X is the set of logistics management practices measured against the supply chain performance of vaccines in Lamu County.

Therefore: -

X_1: Cold Chain Technology

X_2: Inventory Management

$\mathbf{X_3}$: Distributed Systems

$\mathbf{X_4}$: Technical Capacity

$Y = 1.445+0.883X_1+0.076X_2+0.384X_3+0.020X_4+\varepsilon$

The equation above shows that the explanatory variables holding constant the health care centres in Lamu County would be 1.445 units. The results would be the variables which are lateral and not related to the focus of this study. When all other variables are kept constant, the 0.883 rise in cold chain technology would result to the improved supply chain performance of vaccines. Further, it is found in the model that when all other variables are kept constant, the increased performance of vaccine supply chain would be explained by 0.076 units of the inventory management. In addition to this, when all other factors are held constant, the improvement of supply chain performance of vaccines would have been attributed to the increase in the distribution system of 0.384 units. Finally, there was found to be a significant different when it came to the technical capacity in relation to the supply chain performance of vaccines among health care facilities in Lamu County. There were a mere 0.020 increase in units. The results either shows that technical capacity did not have influence when it came to the supply chain performance of vaccines or this logistic management practice was not taken into consideration in Lamu county health care facilities.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This study intended to find out the influence of logistics management practices on the supply chain performance of vaccines among healthcare centres in Lamu County. The summary of the study, conclusion, recommendations and replicate the responses gotten from the field for possible actions by the stakeholders and finally recommendations for further research are contained in this chapter.

5.1 Summary of the Findings

This section contains the summary of the analysed data from the previous chapter. 96 questionnaires were distributed to the facility managers, procurement officers and the personnel in-charge of vaccines who gave information concerning the logistics management practices in Lamu County healthcare centres. Out of the total 96 questionnaires distributed, 92 were completed and returned for analysis which was 95.8% response rate. Descriptive analysis was used to analyse for the purpose of meeting the objectives of the study.

The data findings indicated that most of the respondents were graduates and others were at least college level graduates. The respondents were qualified to fill the questionnaires and their responses could be sufficiently used since they had knowledge as far as logistics management practices were concerned. Further, the study revealed that most

respondents were males accounting to up to 58.7% while their female counterparts were 41.3%. The reason for this was that there could be a possibility most women in the area of study do not embrace white collar jobs due to the traditions. It was noted that most respondents had worked in the facilities between 6 – 10 years which was an indication that most of the respondents had adverse experiences in the health centres and had enough knowledge on the matter of logistics management practices and supply chain performance. In terms of the age bracket, most of the respondents were aged between 31 -35 years closely followed by those between 26 – 30 years and then those above 41 years. The respondents between the ages 20 and 25 years were the least represented by 6.5%. This was an indication that most of the respondents working in healthcare centres in Lamu County were above 26 years of age and thus mature enough to respond to the questions being sought.

The study sought to find out how the logistics management practices was implemented among healthcare centres in Lamu County. The findings showed that inventory management was the highest with a mean of 4.3478, distribution systems with a mean of 4.2174, cold chain technology had a mean of 4.0000 and technical capacity was the last with a mean of 3.8261. This study concluded that all the four variables had been implements in healthcare centres in Lamu County. However, technical capacity had been moderately implemented as compared to other three logistical management practices.

The relationship between the variables was sought and the regression results revealed the relationship between the dependent and independent variables. The findings revealed R-square of 0.531 which implied that all the independent variables brought together influenced the dependent variable at 53.1% while the remaining 46.9% could be explained by other factors not included in the model. The ANOVA (analysis of variance) was as well carried out and the results shown that the overall model was statistically significant at 95% confidence level.

It was indicated in the regression coefficients that when all the variables were held constant at 0, the value of the supply chain performance would stand at 1.445. Distribution systems had a positive influence on the supply chain performance of healthcare centres in Lamu County at β_1 = .447 and p-value =.003. Therefore, the increase in the use of distribution systems could lead to 0.447 increase in the supply chain performance of the healthcare centres in Lamu County. Further, the findings showed that the cold chain technology had a positive influence on the supply chain performance of vaccines among healthcare centres in Lamu County at β_2 = 0.890, p-value = 0.000. The results revealed that for every unit increase in the use of cold chain technology would improve supply chain performance of vaccines by 0.890 among healthcare centres in Lamu County. These findings revealed that distribution systems and cold chain technology were the most suitable predictors of the supply chain performance of vaccines among healthcare centres in Lamu County than the other two variables.

5.2 Conclusion

The conclusion in this study was that the implementation of logistics management practices among healthcare centres in Lamu County had great impact on the improvement of supply chain performance of vaccines. Therefore, the centres should ensure that the supply chain management of vaccines is fully adopted. This is because, the

results of this study found out that logistics management practices had great impact on the supply chain performance of vaccines among healthcare centres in Lamu County.

In conclusion, this study purposed to find out the extent to which logistics management practices had been implemented by healthcare centres within Lamu County and their influence on the supply chain performance of vaccines. The results indicated that all the four variables had been adopted by the healthcare centres. There were positive mean values above three indications that all the four variables had been implemented and adopted.

The regression analysis showed that the management practices had moderate effect on the supply chain performance of vaccines among healthcare centres in Lamu County. Further, there was a positive correlation between the independent variables and supply chain performance. The value of Multiple Determination of 0.531 implied that 53.1% of the changes in the level of supply chain performance of vaccines is as a result of various logistics management practices. Additionally, the p-value that was 0.000 indicated that the various logistics management practices implemented were statistically significant based on the fact that the value was less than 0.05 level with 95% confidence level.

5.3 Recommendations

It was established from the study that most healthcare centres in Lamu county had implemented the logistics management practices. However, some dispensaries had not implemented the inventory management and technical capacity and therefore there is need for the government to incorporate practices into their systems for the purpose of improving their supply chain performance.

The procurement team in the healthcare centres should be further trained on the logistics management to boost overall firm performance. Facility managers should lead all the trainings to ensure that there would cutting of cost and boost supply chain performance of vaccines.

5.5 Recommendations for Further Studies

Further research should be carried out on the supply chain of other drugs (apart from the vaccines) to find out if the same results would be gotten.

Further studies should be carried to consider other management practices with the purpose of finding out other performance indicators. This means that other sectors of the economy apart from health should be considered by future researchers.

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APPENDICES

Appendix I: Research Letter

Athman Haji Kale

Mount Kenya University

P.O. Box 42702-80100

Mombasa.

+254 729 855623

The Administrators,

Health Facilities

Lamu County

Dear Sir/Madam,

RE: RESPONDENTS' QUESTIONNAIRE

Kindly refer to the above matter.

I am a student at Mount Kenya University pursuing Master of Science in Procurement and Supplies Management. Permission has been granted to me by the University to conduct research and choose your institution. To qualify for masters' degree, I am required to conduct a field research which is part of my course study. This requires me to issue questionnaires to selected members of staff to get some information that would support my research on the "**LOGISTICS MANAGEMENT PRACTICES AND SUPPLY CHAIN PERFORMANCE OF VACCINES IN PUBLIC HOSPITALS IN LAMU COUNTY**". The data provided by the respondents will be confidential. The research findings will assist the Ministry of Health on performance of supply chain in Lamu and the whole country in general.

I hereby request you to allow me to contact some of your staff in order to fulfil this mandate.

I will sincerely appreciate your assistance.

Thank you anticipating a positive response.

Yours Faithfully,

Athman Haji Kale,

Masters' Student,

Mount Kenya University.

Appendix II: Consent Form

ACADEMIC RESEARCH PROJECT

My name is Athman Haji Kale, pursuing Master of Science in Procurement and Supplies Management from Mount Kenya University. I am kindly requesting you to support me by participating in a field research which is part of my course study. The main purpose is to gather information on the effect of logistics management practices on the supply chain performance of vaccines in Lamu County.

Your participation in this study will be to respond to a questionnaire that will be provided to you. This research does not have any known risks. It will help the stakeholders on better decision making for the supply chain of vaccines not only in Lamu County but also other public hospitals in Kenya.

Your privacy will be protected and your name will not appear anywhere in the final findings of this study. Your participation will be voluntary. It will be your right not to participate or even withdraw in the process of data collection and there will be no penalty in case you refuse to participate or withdraw midway.

In case you have any queries concerning this study, please contact me on +254 729 855623.

CONSENT

I confirm to have read this form and understood its contents. Further, I got the opportunity to ask questions and was respondent to with satisfaction. I agree to participate in this study without coercion.

Respondent's Signature…….. Date……..

Appendix III: List of Public Health Facilities in Lamu County

	Facility Name	Ownership	Level of Care
1	Manda Dispensary	GOK	Level 2
2	Matondoni Dispensary	GOK	Level 2
3	Kipungani Dispensary	GOK	Level 2
4	Lamu county hospital	GOK	Level 5
5	Mokowe Health Centre	GOK	Level 3
6	Hindi Magogoni Dispensary	GOK	Level 2
7	Hindi GOK prison dispensary	GOK	Level 2
8	Baragoni NYS dispensary	GOK	Level 2
9	Dide waride dispensary	GOK	Level 2
10	Witu Health Centre	GOK	Level 3
11	Pandanguo Dispensary	GOK	Level 2
12	Katsaka kairu Dispensary	GOK	Level 2
13	Mapenya Dispensary	GOK	Level 2
14	Muhamarani Dispensary	GOK	Level 2
15	Mkunumbi Dispensary	GOK	Level 2
16	Mpeketoni Sub county hospital	GOK	Level 4
17	Uziwa Dispensary	GOK	Level 2
18	Tewe Dispensary	GOK	Level 2
19	Kiunga Health Centre	GOK	Level 3
20	Ndau dispensary	GOK	Level 2
21	Kiwayuu Dispensary	GOK	Level 2
22	Mkokoni Dispensary	GOK	Level 2
23	Shanga-ishakani dispensary	GOK	Level 2

24	Mangai dispensary	GOK	Level 2
25	Faza Sub county Hospital	GOK	Level 2
26	Tchundwa dispensary	GOK	Level 2
27	Siu Dispensary	GOK	Level 2
28	Patte Dispensary	GOK	Level 2
29	Mtangawanda Dispensary	GOK	Level 2
30	Shanga Dispensary	GOK	Level 2
31	Kizingitini Health Centre	GOK	Level 2
32	Mbwajumwali Dispensary	GOK	Level 2

Appendix IV: Questionnaire for the Respondents

Kindly go through the questionnaire carefully and respond to the questions and statements with honesty. The data collected will not be used for any other purpose besides for academics and will be treated with confidentiality it deserved. Tick in the box and fill the spaces provided. You may include more information to the research if need be.

SECTION A: DEMOGRAPHIC INFORMATION

1. Gender

   Male ( ) Female ( )

2. Age

   18 – 25 years ( ) 26 – 32 years ( ) 33 – 40 years ( ) 41 years and above ( )

3. Highest level of education

   High school ( ) College ( ) University degree ( )

   Masters level and above ( )

4. Duration of working in this hospital?

Below 5 years ( ) 6 – 10 years ( ) 11 – 15 years ( ) 16 – 20 years ( ) Over 20 years ( )

SECTION B: LOGISTICS MANAGEMENT IMPLEMENTED IN HOSPITALS

5. Kindly tick the level at which the following practices are implemented in your hospital. Use **1** – Very low extent, **2** – Low extent, **3** – Not sure, **4** – High extent, **5** – Very high extent.

LOGISTICS MANAGEMENT PRACTICES	**1**	**2**	**3**	**4**	**5**
COLD CHAIN TECHNOLOGY					
Functional storage equipment					
Measures in place to ensure vaccines are in good condition					
Enough storage space					
Storage practices in line with cold chain technology					
INVENTORY MANAGEMENT					
Management makes sure of enough storage facilities					
Handling equipment of vaccines are available					
There is availability of inventory management systems					
Inventory practices are satisfactory					
DISTRIBUTED SYSTEMS					
Execution of the movement of vaccines					
Optimization of the daily operations of fleet systems to manage distribution.					
Use of specialized vehicles.					
Planning and monitoring of the transport systems.					
TECHNICAL CAPACITY					
Employees are specifically trained to handle cold chain vaccines					
There is enough equipment to handle increasing demand					

There are quality checks of ensuring compliance with cold chain technology					
There is constant power supply for cold chain equipment					

6. Kindly share any other information that could have been left out in the Likert scale

……

SECTION C: LOGISTICS MANAGEMENT PRACTICES AND PERFORMANCE OF SUPPLY CHAIN

7. Kindly indicate with a tick the extent to which you agree how the following logistics management influence supply chain management in your hospital. Use the scale of **1 – 5**, where; **1** – strongly disagree, **2** – disagree, **3** – Neutral, **4** – agree, **5** – strongly agree.

LOGISTICS MANAGEMENT PRACTICES	**1**	**2**	**3**	**4**	**5**
COLD CHAIN TECHNOLOGY					
Cold chain technology is used for managing supply chain					
There is an automated ordering system from major suppliers					
Vaccines reach consumers in this hospitals while in good condition					
INVENTORY MANAGEMENT					
There are enough inventory personnel for the operations					
Inventories are monitored to ensure reorder points					
There are systems that ensures operations flow smoothly					
DISTRIBUTION SYSTEMS					
The hospital is concerned with minimizing the cost of distribution					
There is fleet tracking and management systems					
There is good systems to ensure quick maintenance of distribution materials					
This hospital subcontracts vehicles for distribution of vaccines					
TECHNICAL CAPACITY					

There are highly skilled drivers on new technologies					
The hospital has qualified procurement staff					
Quality checks to ensure compliance with the current supply chain performance					

8. Kindly share any other information that could have been left out in the Likert scale

   ……

SECTION D: SUPPLY CHAIN PERFORMANCE

9. The statements below describe the supply chain performance. Kindly tick your level of agreement as per the scale below.

   Use the scale of **1 – 5**, where; **1** – not at all, **2** – low extent, **3** – Not sure, **4** – high extent, **5** – very high extent.

Statement	**1**	**2**	**3**	**4**	**5**
This hospital has experienced higher vaccinations in the last one year					
There is increased customer satisfaction in the last one year					
There is a high efficiency in terms of assets utilization					
This hospital has experienced increased productivity					
There is high efficiency in the hospital					
The vaccines provided in this hospital have not had any negative effects on patients					
We have improved developed vaccines					
There is increased flexibility that influences operations in this hospital					
We have experienced cost reduction of vaccines					
Our patients' needs have a high response to dynamics.					

10. Kindly share any other information that could have been left out in the Likert scale

……

……

THANK YOU FOR YOUR PARTICIPATION.

Appendix V: ERC Letter

Mount Kenya University

REF: **MKU/ISERC/2834**
TO: **ATHMAN HAJI KALE**

Date: 16 June 2023

REG: **MPSM/2018/79223**

Dear Sir/Madam,

RE: LOGISTICS MANAGEMENT PRACTICES AND SUPPLY CHAIN PERFORMANCE OF VACCINES IN PUBLIC HOSPITALS IN LAMU COUNTY

This is to inform you that **Mount Kenya University** has reviewed and approved your above research proposal. Your application approval number is **1878**. The approval period is **16/06/2023 - 15/06/2024**.

This approval is subject to compliance with the following requirements;

i. Only approved documents including informed consents, study instruments, MTA will be used
ii. All changes including amendments, deviations and violations are submitted for review and approval by **Mount Kenya University**
iii. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to **Mount Kenya University** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affect the safety or welfare of study participants and others or affect the integrity of the research must be reported to **Mount Kenya University** within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal
vii. Submission of an executive summary report within 90 days upon completion of the study to **Mount Kenya University**

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://research-portal.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely,

The Chairman
Mount Kenya University
Ethics Review Committee
P. O. Box 342 - 0100, Thika

Dr. Alfred Owino, PhD
Chairman, Mount Kenya University ISERC

Main Campus, General Kago Road, P.O. Box 342-01000 Thika.
Tel: 020-2878 000, Cell: +254 709 153 000
Email: info@mku.ac.ke, Web: www.mku.ac.ke

Appendix VI: Introduction Letter

Mount Kenya University

DIRECTORATE OF GRADUATE STUDIES

MPSM/2018/79223

16th June, 2023

National Commission for Science Technology & Innovation (NACOSTI)
Off Waiyaki Way, Upper Kabete,
P.O Box 30623- 00100
NAIROBI, KENYA

Dear Sir/Madam,

RE: ATHMAN HAJI KALE- REGISTRATION NO. MPSM/2018/79223

The purpose of this letter is to introduce the above named student who is pursuing **Master of Science in Procurement and Supplies Management** in the Department of **Management** in the school of **Business and Economics**

The title of the research is "**Logistics Management Practices and Supply Chain Performance of Vaccines in Public Hospitals in Lamu County.**" It has been cleared by the University's Ethics Review Committee (Certificate attached) and now has to proceed to the field to collect data between **June, 2023 and August, 2023.**

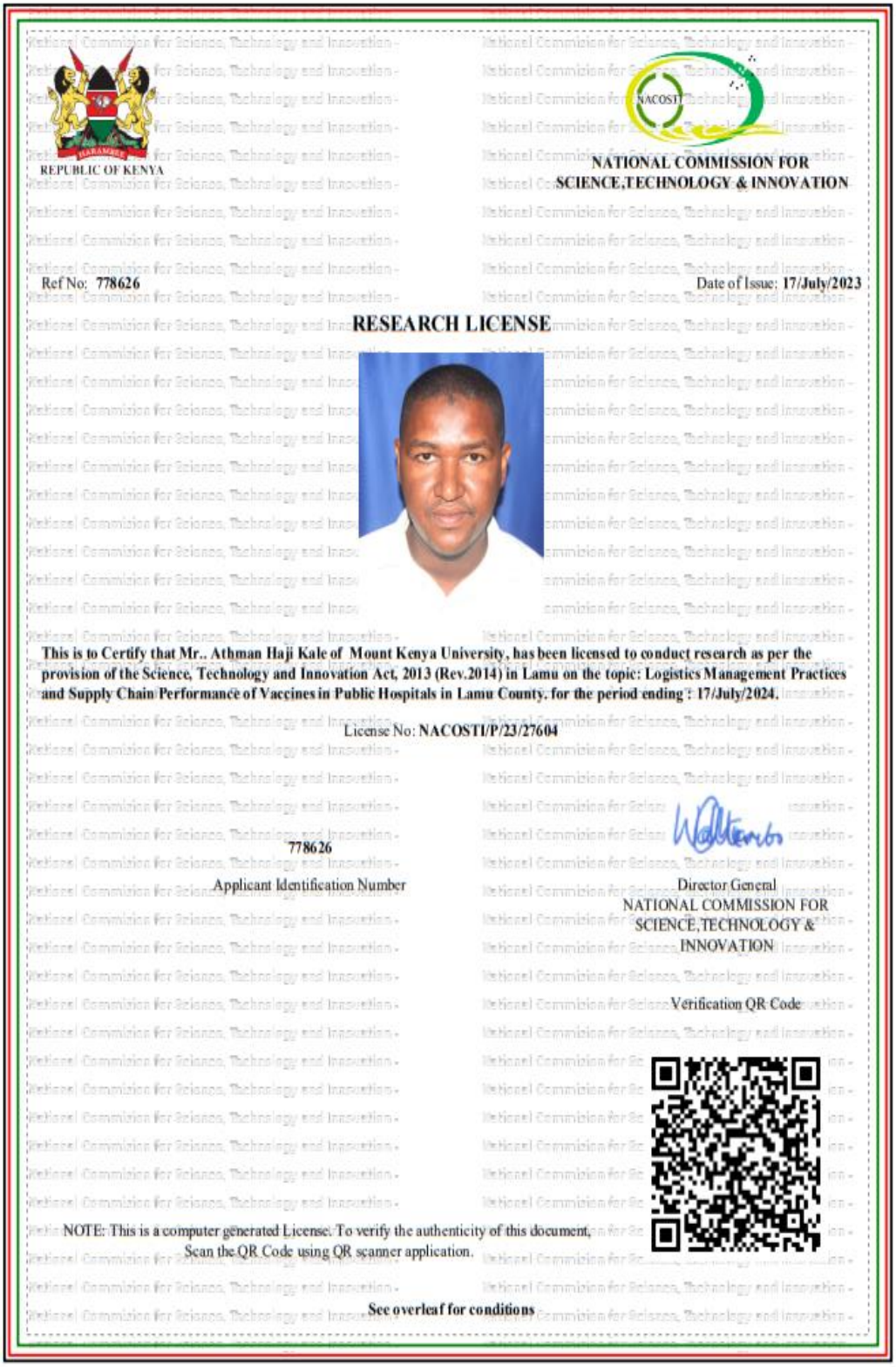
Any assistance accorded to the student will be highly appreciated.

Thank you.

Mount Kenya University
P. O. Box 342 - 01000, THIKA
Office of the Director
Graduate Studies

Dr. Samuel M. Karenga, Ph.D
Director, Graduate Studies
Enc.

Appendix VII : NACOSTI Authorization



REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 778626

Date of Issue: 17/July/2023

RESEARCH LICENSE

This is to Certify that Mr.. Athman Haji Kale of Mount Kenya University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Lamu on the topic: Logistics Management Practices and Supply Chain Performance of Vaccines in Public Hospitals in Lamu County. for the period ending : 17/July/2024.

License No: NACOSTI/P/23/27604

778626

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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See overleaf for conditions

Appendix VIII: Plagiarism Report

FACTORS INFLUENCING THE LOGISTICS MANAGEMENT PRACTICES ON THE SUPPLY CHAIN PERFORMANCE OF VACCINES IN PUBLIC HOSPITALS IN LAMU COUNTY.

by ATHMAN HAJI

Submission date: 27-Apr-2024 11:44PM (UTC+0300)
Submission ID: 2363722505
File name: turnitin.docx (1.87M)
Word count: 20109
Character count: 115563

FACTORS INFLUENCING THE LOGISTICS MANAGEMENT PRACTICES ON THE SUPPLY CHAIN PERFORMANCE OF VACCINES IN PUBLIC HOSPITALS IN LAMU COUNTY.

ORIGINALITY REPORT

19%	15%	6%	9%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

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