INFLUENCE OF SUPPLY CHAIN MANAGEMENT PRACTICES ON HEALTH COMMODITY SECURITY AMONG LEVEL FOUR PUBLIC HOSPITALS IN NAIROBI COUNTY, KENYA

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OCTOBER 2022

DECLARATION

"I declare that this research thesis is my original work and has not been presented in any other university"

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DEDICATION

I dedicate this thesis to my family for their valued support and encouragement in making everything possible.

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ABSTRACT

Commodity security issues plague public hospitals in Nairobi County, Kenya, including inconsistent supplies of health materials and technologies. Due to frequent stock-outs of important pharmaceuticals and medical supplies, patients are directed to purchase them elsewhere. As a result, patients are exposed to financial restraints due to out-of-pocket expenses, which may increase their poverty levels. The occurrence of these concerning patterns prompts this study, which focuses on product selection, quantification, procurement, and inventory management, to determine the influence of supply chain management on health commodity security across level four public hospitals in Nairobi County, Kenya. To understand the influence of supply chain management practices on health commodity security, this study derived its theoretical backing from the Supply Chain Operations Reference (SCOR) model, Transaction Cost Theory and Supply Chain Management Theory. It further adopted a cross sectional survey design. The target population was 120 who comprised of top management team, procurement officers, stores clerks, pharmaceutical officers and head of departments who were drawn from four level four public hospitals in Nairobi County that included Mbagathi Hospital, Pumwani Maternity Hospital, Mama Lucy Kibaki Hospital and Mutuini Hospital. A sample of 91 was drawn using stratified method across the four public hospitals. Within each hospital, simple random sampling procedure was adopted. A structured questionnaire was used to collect quantitative data through self-administered method. The collected data was then analyzed through descriptive and inferential methods using the Statistical Package for Social Sciences version 26.0. However, to establish the effect of each of the predictor variables on the dependent variable, binary logistic regression analysis was used. Logistics regression findings showed that apart from procurement practices, all the other Supply Chain Management practices investigated in this study that is product selection, quantification and inventory management practices had a significant relationship with health commodity security. Specifically, it was determined that the effect of quantification on commodity security was the strongest, followed by inventory management and then product selection. However, procurement didn't have a significant effect. Those hospitals which had put in place product selection practices had a significantly higher chance (2.208 times more likely) to achieve health commodity security compared to those that have not ; those hospitals which had put in place quantification practices had a significantly higher chance (0.672 times more likely) to achieve health commodity security compared to those that have not and likewise, those healthcare facilities which had put in place inventory management practices had a significantly higher chance (2.035 times more likely) to achieve health commodity security compared to those that have not. Based on these findings, it is recommended that the management of especially those Level Four Healthcare facilities which had not implemented product selection, quantification and inventory management practices to a high extent to consider putting in place strategies to do so. This is because doing so is significantly associated with achievement of health care security.

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LIST OF ABBREVIATIONS AND ACRONYMS

EML	Essential Medicine List
FIFO	First in First Out
HPT	Health Products and Technologies
KEMSA	Kenya Medical Supplies Agency
MOH	Ministry of Health
MSH	Management science for health
NHS	National Health Services
PAHO	Pan American Health Organization
PCK	Postal Corporation of Kenya
PPAD	Public Procurement and Disposal
SCM	Supply Chain Management
SCOR	Supply Chain Operations Reference
SDG	Sustainable Development Goals
STG	Standard Treatment Guidelines
UHC	Universal Health Coverage
UNPF	United Nations Population Fund
WHO	World Health Organization

CHAPTER ONE: INTRODUCTION

1.0 Introduction

This chapter presents the background of the study, discussing the study concept from a global to a local context. The chapter further presents the statement of the problem, study objectives, research questions, justification, limitations and delimitations of the study. In addition, the significance, assumptions of the study and operational definition of terms are presented.

1.1 Background of the Study

A health system encompasses the organizations, people, and actions that promote, restore, and maintain communities' and individuals' health; its performance is determined by factors beyond those directly related to clinical services. The World Health Organization [WHO], 2010) categorizes these interrelated aspects of health system functioning into six building blocks: service delivery; health workforce; information; medical products, vaccines, and technologies; financing; and leadership and governance. In strong health systems, all six building blocks work together to provide timely, affordable, high-quality services, where and when individuals need them (WHO, 2007).

The pillar of focus in this research is medical products, vaccines and technologies which as a core function of a health system is intended to be available within the context of functioning health systems at all times, in adequate amounts, in the appropriate dosage, with assured quality, safety, and at a price that individuals and the community can afford WHO (2007).

Commodity security is described as the ability of clients or end users to obtain and use health commodities when and where they need them which requires adequate financing,

logistics systems, program coordination, and other factors that make up the enabling environment that supports access and use.

Globally, supply chain management and commodity security in the public health sector has received increasing attention in recent years, as both a priority and a challenge for many countries since governments find themselves stressed with an increasing number of products, programs, and patients to manage (Diniz & Fabbe-Costes, 2007).

In Brazil, De Souza (2014) argued that the supply chain management systems face challenges ranging from poor demand management process, lack of coherent contracts, incomplete information systems, lack of meetings and commitments. In the United Kingdom, Bourlakis et al. (2011) argued that despite the NHS's world-class status, supply chain operations have historically run on an inefficient, inadequate and broken supply chain. As a result, the government has established a process for mapping hospital supply chains, understood by clinicians and operational management and centered on the patient.

Many developing countries face recurring challenges in supply chain management of related health products and technologies (United Nations Population Fund [UNPF], 2010). On the contrary, effective Supply Chain Management systems are critical for ensuring access to affordable but quality healthcare. Although the responsibility for procuring public-sector supplies for developing countries is shifting from donors towards country governments and health systems, the supply chain capacity in many low- and middle-income countries is insufficient to meet this increased responsibility.

In Ghana, Manso et al. (2013) established that the existing supply chain capabilities have failed to translate to consistently high performance on key supply chain indicators, especially in stock-out rates. Currently, up to 47 percent of health centers and

polyclinics are stocked out of essential medicines. For the case of Tanzania, Kariuki et al. (2015) established that availability of supplies on the private market in Tanzania had been improving, but the market shares of medicines and other supplies from Tanzanian manufacturers appeared to be declining, notably because of rising price-based competition from imports. The supply chain performance was poor and erratic supplies were witnessed.

In Kenya, frequent stock outs and erratic supplies in the public hospitals while linking it to poor and ineffective supply chain management practices. Additionally, procurement of health products and technologies in Kenya faces challenges as seen by increased public complaints regarding erratic supplies of the essential drugs and other medical supplies in public hospitals (Kazi, 2012).

Often overlooked, is the need to build effective supply chain management systems which can enable accurate forecast and quantification of needs; identification of suppliers; ensure quality products and monitor performance (Rao et al., 2019). When the supply chain network is inefficient, longer lead times as well as stock outs will be experienced which is mostly the case in public hospitals in Kenya (Jepkosgei, 2018), and thus, the scholars have suggested a need for effective supply chain management in delivery of health products.

In Nairobi County, Kenya Medical Supplies Agency (KEMSA) supplies healthcare commodities to government institutions since its inception in 2000. In 2008 a taskforce was constituted by the Minister for Medical Services to gauge its performance. Its findings showed that KEMSA's performance was below what was expected. The taskforce report largely attributed KEMSA's poor performance to financial and governance problems (Kenya Medical Supplies Agency [KEMSA], 2010).

Another taskforce report on the supply chain efficiency in the Kenyan healthcare systems was conducted in the year 2018 which indicated poor supply chain performance indicators. The average transport lead time of transporting health products and technologies is 5 days compared to industry average of 1 day; the transport costs as a percentage of throughput are 10% compared to industry average of 0.86%; the order fill rate is 50% against an industry average of 85% and the customer order lead time is 4 weeks against an industry average of 2.6 days. The report also indicated stock turn-over of 0.33 compared to industry average of 4.3; obsolescence as a percentage of turn-over of 5% compared to industry average of 0.16% and procurement lead times of 8 to 12 months against the industry average of 1 to 4 months (KEMSA, 2018). This health commodity insecurity led to a need for this study.

1.2 Statement of the Problem

Medicines are critical for high-quality health service delivery and when they are available and used appropriately, they save lives and improve the health of individuals and families. Conversely, lack of access to essential medicines, their inappropriate use or the use of products that are ineffective, poor quality or harmful can compromise patient safety and contribute to poor health outcomes according to Management Sciences for Health (2012).

Public hospitals in Nairobi County, Kenya, often experience commodity security related challenges that range from erratic supply of health products and technologies (Akoko, 2018). There is frequent stock-outs of essential drugs and medical products therefore patients are sent to buy them in other outlets (Jepkosgei, 2018). In so doing, it exposes patients to financial constraints related to out-of-pocket expenditure which may exacerbate their poverty level.

It also exposes the patients to generic drugs which can have a significant influence on morbidity rate. The World Health Organization (2010) report indicates that about 267 million people in Africa lack access to essential medicine, making them vulnerable and highly exposed to high mortality risks (Nguhiu et al., 2017). Some of the factors attributed to this trend are poor supply chain management practices (Akoko, 2018).

When the supply chain network is inefficient, longer lead times as well as stock outs will be experienced (Jepkosgei, 2018; Osengo, 2018). Even so, there exist limited empirical focus on the context of Nairobi County thus creating a contextual research gap. The study by (Aladejebi & Adedeji, 2015; Alemu 2018 Do Rego & de Mesquita,2015; Sharma & Chaudhury, 2015) have demonstrated the importance of effective SCM practices. However, their contextual b;ackgrounds are unrelated to Kenya, specifically Nairobi County, therefore presenting a contextual research gap which this study sought to fill.

The existence of these worrying statistics in addition to limited empirical focus motivated this study to establish the influence of supply chain management practices on health commodity security among level four public hospitals in Nairobi County, Kenya focusing on product selection, quantification, procurement and inventory management.

1.3 Broad Objective

The purpose of this study was to establish the influence of supply chain management practices on health commodity security among level four public hospitals in Nairobi County, Kenya. The study focused on product selection, quantification, procurement and inventory management.

1.4 Specific Objectives of the Study

The study sought to achieve the following specific objectives:

i. To establish the influence of product selection on health commodity security among level four public hospitals in Nairobi County, Kenya
ii. To determine the influence of quantification on health commodity security among level four public hospitals in Nairobi County, Kenya
iii. To examine the influence of procurement on health commodity security among level four public hospitals in Nairobi County, Kenya
iv. To establish the influence of inventory management on health commodity security among level four public hospitals in Nairobi County, Kenya

1.5 Research Questions

Following the research objectives, the study sought to answer the following research questions:

i. How does product selection influence health commodity security among level four public hospitals in Nairobi County, Kenya?
ii. What is the influence of quantification on health commodity security among level four public hospitals in Nairobi County, Kenya?
iii. How does procurement influence health commodity security among level four public hospitals in Nairobi County, Kenya?
iv. What is the influence of inventory management on health commodity security among level four public hospitals in Nairobi County, Kenya?

1.6 Justification of the Study

Commodity security is very important to the success of almost all health institutions as they rely on different kind of health products, vaccines and technologies. In many parts

of the developing countries, there are enormous gaps in meeting the demand for essential drugs and commodities.

In the public health sector, effective SCM practices can enable public hospitals to reduce their procurement lead times, erratic supply of these products as well as stock outs. However, public hospitals in Nairobi experience commodity insecurity.

There is frequent stock-outs of essential drugs and medical products therefore patients are sent to buy them in other outlets (Jepkosgei, 2018). In so doing, it exposes patients to financial constraints both from out-of-pocket expenditure. It also exposes the patients to generic drugs which can have a significant influence on morbidity rate. To unearth these issues, this study is timely.

1.7 Limitations of the Study

The study faced challenges such as some respondents being unwilling to give accurate information for fear of exposing their institutions. This also happened because the respondents are afraid of vindication from their seniors. However, the researcher made introductions to the management of the public hospitals before conducting the studies. Additionally, consent was sought from the respondents before they were included in the study.

Anonymity and confidentiality were upheld as well as a reminder that the process is only an academic process. Another limitation was the challenge of tracing some respondents who were on leave or absent from work. This was because during this COVID-19 times, the hospital employees were working in shifts. In such cases, the researcher booked appointments earlier to schedule meetings as at and when they are available and not busy.

1.8 Delimitations of the Study

The study was confined to level 4 public hospitals in Nairobi County, Kenya. The study was also delimited to the influence of supply chain management practices specifically, product selection, quantification, procurement and inventory management on health commodity security. Any other supply chain management practices outside any of these four were not considered by the study. Additionally, other levels of public hospitals were not factored.

1.9 Significance of the Study

The study findings are expected to be beneficial to KEMSA, which will highlight the key SCM practices critical in ensuring commodity security. Since the authority is mandated to procure and supply health commodities on behalf of the national and county governments, it can benefit from this study by establishing the vital SCM practices, which can enhance its procurement process. This will in turn speed the achievement of UHC.

Given the fact that UHC is on the political agenda, the results of this study will feature policies and recommendations for policy makers and the county government to formulate appropriate SCM frameworks to enhance performance of UHC program through improved commodity security.

The findings will also be of benefit to public healthcare facilities which may enable them to know the most important SCM practices that can spur commodity security. Since most of the facilities experience commodity insecurity, the findings of this study can help them establish the areas in their Supply Chain to improve in order to enhance commodity availability.

Academicians and researchers can also have a clearer understanding of the influence supply chain management practices on commodity security in the healthcare sector. The model of the study will provide adequate and reliable material for further discussions on the study topic. The findings of the study will also contribute to literature on the role of supply chain management practices on health commodity security among public hospitals in Nairobi County, Kenya.

1.10 Assumptions of the Study

The study assumed that respondents who took part in the study were available to give truthful and accurate information to the researcher without being forced. This was important in establishing the true picture regarding SCM and commodity security among the public hospitals.

Moreover, the study had assumptions on the reliability and validity of the data collection instruments to capture the information intended in regard to the influence of SCM on commodity security. It assumed that the respondents would understand the questions and give accurate responses. Lastly, it was assumed that the sample which was to be chosen would represent the entire targeted population. It would be representative enough of the entire public hospitals in Kenya.

1.11 Operational Definition of Terms

Health Commodity Security	Refers to the ability to choose, obtain and use affordable, quality health commodities when and where they are needed. It entails access to a regular supply of widely available essential health

	commodities as a necessary part of primary healthcare services
Inventory management	Refers to the tracking and management of commodities which includes the monitoring of commodities moved into and out of stockroom locations and the reconciling of the inventory balance
Level four Public Hospitals	Are public health facilities capable of providing advanced trauma life support (ATLS) prior to transfer of patients to a higher-level trauma center. They can provide evaluation, stabilization, and diagnostic capabilities for injured patients.
Procurement	Refers to the process of finding and agreeing to terms, and acquiring healthcare commodities as quantified from an international, regional, or local sources of supply, often via a tendering or competitive bidding process.
Product selection	Refers to the process of coming up with a list of the required health commodities in a facility. This is done by a group of a national formulary and therapeutics committee, pharmaceutical board, board of physicians, or other government-appointed group.

Quantification	Refers to the process of estimating the quantity and cost of the products required for a specific health program (or service), and, to ensure an uninterrupted supply for the program, determining when the products should be procured and distributed.
Supply chain management practices	Refers to the activities that entail optimization of products creation and flow from raw material, sourcing to production, logistics and delivery to the final customer.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

In this section, there is a review of the theoretical framework which the study anchors on in deriving its variables. The theoretical framework presents the theories that explain the influence of supply chain management practices on health commodity security. There is also a presentation of empirical literature to explain other studies that have interrogated the link between various study themes. This helps to build the research gap for this study. The review of literature has been presented per variables and indicators.

2.2 Health Commodity Security

According to the Kenya MoH 2020 guidelines on Health Products and Technologies (HPT) Supply Chain Strategy 2020-2025, the Government is implementing Universal Health Coverage (UHC) which is in line with Sustainable Development Goals (SDG) 3. Its major goal is to ensure that all citizens have access to safe, effective, quality essential health care services, including affordable essential medicines and vaccines without suffering catastrophic expenditure. Ensuring that effective, safe, and affordable health products and technologies are available and rationally used, is pivotal to a functioning health care system that supports the UHC agenda. As such, the policies, regulations, systems and practices regarding health products and technologies have a direct bearing on access to, quality and safety of healthcare services delivered to citizens in need.

Commodity security exists when clients can obtain and use essential health commodities when and where they need them. Availability of health commodities is fundamental to diagnosis and treatment of illnesses in primary health care settings. Inadequate availability of and access to essential health commodities are major barriers

to the delivery of essential health care in developing countries (WHO, 2010). A recent survey in Nepal found that the availability of 32 selected essential commodities in public sector outlets was less than 25 percent (Rao et al., 2019). Health commodities include health products, vaccines, medical supplies and other products that may be needed for the provision of health services.

The WHO (2010) global strategy highlights the importance of equitable access to life saving medicines and other health commodities. At least one third of the world's population does not have regular access to medicines, which makes health care highly inequitable Abolghasem et al. (2018). A survey of the national AIDS programs in 12 countries by the Pan American Health Organization (PAHO) found that between January 2011 and April 2012, over 67% of countries reported experiencing stock-outs of at least one drug, lasting an average of 40 days each.

Another study in Kenya reported that over 75% of health facilities had shortages of one component of the combination of drugs used to treat malaria, while one in four reported a lack of all related drugs .The logistics cycle must be supported by an effective policy and legal framework, addressed at the national level by political leadership which is a necessary instrument to establish a legal and regulatory framework that supports commodity availability, including affordable prices, tariff exemptions for essential medicines, adequate financing, sound supply chain management, and transparent procurement mechanisms.

Any developing countries spend sizeable sums on the purchase of health commodities yet an estimated 60-80% of their populations, particularly in rural areas do not have constant access to even the most essential health commodities. The regular provision

of adequate amounts of appropriate health commodities is crucial if health services are to be effective and credible.

2.2.1 Availability of Quality Health Commodities

According to WHO (2010), fully one-third of the world's population does not have access to essential medicines. In Sub-Saharan Africa and South Asia, the figure closer to 50 percent, problem being financial challenges. The combination of donor support, multilateral loans, country financing, and out-of-pocket expenditures is inadequate to meet the growing need among poor populations for essential medicines, including contraceptives and other health products.

The main aim of a functioning health systems is the availability of essential medicines in adequate amounts, appropriate dosage forms, assured quality and at a price that is affordable to the community which meets their needs. Lack of access to medicines and other commodities have been linked to increase in morbidity and mortality across a number of diseases. According to WHO (2007), access to medicines is determined by rational use of medical products, affordable pricing, sustainable financing and reliable health and supply systems consisting of procurement and distribution of these commodities. A good distribution system ensures timely availability of commodities across all levels of healthcare system and prevention of stock outs therefore attaining commodity security and meeting the clients', patients' and customer needs.

A strong supply chain management is supported by effective logistics system that ensures that the six rights are observed and the components of product selection, quantification, procurement and inventory management are effective in attaining commodity security. Another way to reduce stock outs and making product available is to introduce a better tracking system. In Kenya, the Tupange project introduced an

SMS/web-based commodity tracking system to collect consumption data from facilities. The data were then transmitted to a central server using a mobile phone. There were frequent stock outs, resulting in missed opportunities and poor procurement, distribution, and supply chain management at both the national and facility level. After Tupange's contraceptive security intervention, the government and donors committed to increasing funding for commodities, from US$5.97 million in 2011 to $6.2 million in 2013 (government) and from $1.32 million in 2011 to $12.9 million in 2013 (donor). This led to improved inventory management practices that led to minimization of wastage, pilferage, loss and expiries, which in turn led to better commodity availability at the facility level, improved method mixes availability and increased family planning uptake (Kahiri et al., 2015).

2.2.2 Meeting Customer Need/ Demand

In order to meet the customers' needs, the logistic system has to ensure that the right goods, in right quantities, in the right conditions are delivered to the right place, at the right time, for the right cost. Health commodities are ordered and obtained to ensure that commodity security exists for every customer to obtain the health commodities when they need them. If a logistics system provides a reliable supply of commodities, more people are likely to use health services. Customers feel more confident about the health program when they have a constant supply of commodities, which therefore motivates them to seek and use services.

A well-supplied health programs can provide superior service, while poorly supplied programs cannot. Likewise, well-supplied health workers can use their training and expertise fully, directly improving the quality of care for clients (Kahiri et al., 2015).

Customers are not the only ones who benefit from the consistent availability of commodities. An effective logistics system helps provide adequate, appropriate supplies to health providers, increasing their professional satisfaction, motivation, and morale. One way of reducing stock outs is to use the Informed Push Model, implemented by Senegal, to successfully reduce stock outs and to meet customer need at the facility level. This model brings the supplies closer to the health facility and streamlines the steps through task sharing supply chain responsibilities from service providers to logistics professionals (Wang et al., 2014).

This is achieved when a dedicated logistician brings the commodities on a truck from the regional warehouse to the facilities. The logistician also restocks facilities monthly to maintain a minimum stock level to meet estimated supply needs, eliminating the need for facilities to place and pick up orders. Facilities pay only for the quantities sold and this therefore ensures that the customer need is met. Everyone who works in logistics must remember that they select, procure, store, or distribute products to meet customer needs.

Over the past eight-and-a-half years, the Rwanda MOH has elevated commodity security to ensure it remains a priority focus in the country. The project's focus on policy, coordination, and financing strategies helping strengthen Rwanda's commodity security status. The project helped the logistic committee working group improve multi-sectoral and collaboration between key stakeholders. This led to the yearly forecasting and quantification exercise to respond to the enormous increase in demand for contraceptives experienced in recent years (Kahiri et al., 2015)

2.3 Product Selection and Health Commodity Security

Product selection is the process by which health programs as a whole identify, evaluate, and eventually buy the items that will be utilized and consumed in service delivery. Product selection is an important part of the logistics cycle since it determines what items are procured and used in the health system as well as the range of items that a consumer can obtain. Selection is an integral part of the application of the concept of value analysis.

Value analysis is the systematic and organized application of recognized techniques and criteria to identify the benefits derived from the use of a specific product (or service). The process seeks to enhance the benefit by providing the performance needed at the lowest overall cost. Product selection therefore leads to the efficient use of resources, reduces the opportunity for error, and increases patient-centered outcomes.

Kahiri et al. (2015) conducted a study on procurement policies and implementation of effective procurement practices in tertiary public training institutions in Kenya. The study findings showed that some of the procurement policies elements that influenced effective procurement practices were poor product selection, cost estimation and non-adherence to procurement plans.

In another study by Kahiri et al. (2015), it was indicated that product selection, large number of items, huge monetary volume involved, need for an audit trail, severe consequences of poor performance, and the potential contribution to effective organizational operations associated with the procurement function are five major factors affecting procurement performance in the public sector.

The success of the process is dependent on multiple supply chain actors working together to make decisions. Ideally, an interdisciplinary committee with explicit terms

of reference, governance structures, policies and procedures, and selection criteria is formed to establish an approved list of products, with the output being a defined list of goods. Product selection ensures that the right product to meet the needs of the customers is selected. Criteria for the selection of the right products must be clear and based on quality, effectiveness, and affordability. In many cases, selection decisions do not include the right products necessary for an effective treatment regimen. Selection guidance is provided through WHO's model standard treatment guidelines (STGs) and list of essential medicines (Faisal et al., 2017).

2.3.1 Formation of Selection Committees

Product selection activities involve formation of selection committees, needs assessment and development of essential list (Nzioka, 2010). The formation of selection committees is one of the most important processes in product selection. After products are selected, detailed product specifications should be developed by program staff with a specialized knowledge and expertise in pharmaceuticals, in coordination with a logistics or procurement unit.

These experts should be involved throughout the process to ensure that all product details are developed correctly. A functional selection committee, which comprises clinicians, pharmacists, supply chain managers, nurses, and policymakers, is frequently used to choose products. They provide advice that finally leads to product availability.

2.3.2 Needs Assessment

Wang et al. (2004) argued that needs assessment is an important practice in product selection because standard treatment guidelines influence supply chain management and hence, every country should have clear guidelines. These are suggested treatment protocols for the most optimal treatment of specific clinical problem in a given setting

based on consensus by experts. Treatment for specific clinical problems is selected based on needs assessment on common diseases in the area or level of treatment facility. Wang argued that development of an essential list should also be factored among other practices during product selection.

2.3.3 Development of Essential Medicine List (EML)

A national EML is a list of medicines that have been approved for usage across the country and that meet a population's top health-care needs. The core list of the WHO model list contains only around 300 effectives, safe and cost-effective active ingredients which cover the health care needs of the majority of the population.

Countries frequently identify which levels of care in the health system each product will be used at as part of the establishment of national EMLs, based on illness patterns and consequences that are regularly treated at each level. Achieving access to essential medicines is also defined by the concept of commodity security, which is described as the ability of clients or end users to obtain and use health commodities when and where they need them (Faisal et al., 2017).

2.4 Quantification and Health Commodity Security

Quantification is the process of predicting the quantities and costs of items necessary for a certain health program (or service), as well as establishing when the items should be delivered to assure the program's continuous supply. Quantification is a vital supply chain management activity that connects facility-level data on services and commodities with national program objectives and goals to predict the quantities and costs of commodities necessary for a health program.

Quantification is crucial for supply chain choices such as product selection, finance, procurement and delivery. According to the HPT-Supply Chain Strategy, 2020-2025,

accuracy and reliability of quantification outputs remains a challenge. For instance, KEMSA's accuracy for demand forecasting is estimated at 59% against a target of 95%.

In terms of application of essential lists, 73% of pharmaceuticals and 94% of non-pharmaceuticals in KEMSA's warehouse commodities are on the Kenya's KEML and KEMSL lists. County governments' capacity for quantification of HPT is also inadequate - only 23% (11 out of 47) counties undertook adequate quantification for UHC, ahead of the UHC program scale.

2.4.1 Estimation of Quantities

The quantification process is an iterative process that involves analyzing and updating quantification data and assumptions, as well as recalculating total commodity requirements and costs to reflect actual service delivery and consumption, as well as changes in program policies and plans. Every six months, or more frequently for fast growing or changing projects, the findings of a quantification exercise should be revisited (Faisal et al., 2017).

The results of a quantification exercise can help program managers identify funding needs and gaps for commodity procurement, leverage the sources, amounts, and timing of funding commitments to maximize the use of available resources, advocate for additional resources as needed, and develop a supply plan to coordinate procurements and shipment delivery schedules to economize (Faisal et al., 2017).

The study established that among the key processes of the quality management system, the process of procurement and management of material resources directly affects the quality of the final products, and therefore the performance of the organization. The study also established that quantity specification was important in enhancing SCM performance.

2.4.2 Cost Estimation

The goal of Quantification is to consistently provide patients with the best products, as efficiently as possible, and at the lowest cost. Cost estimation entails forecasting the costs of the products to be procured. Faisal et al. (2017) says that cost is one of the most important performances of a supply chain. When measuring supply chain costs, it is important to know what you would like to measure.

Cost estimation can be guided by the average market price of the products therefore reducing hidden costs when procuring. To maintain the procurement cycle, it is essential that adequate financing is available for the purchase of quantities that have been forecasted and quantified. Financing arrangements should be secured well in advance of planned procurements to avoid product stock outs and to reduce emergency shipments.

2.4.3 Setting Procurement Dates

During quantification, setting of procurement time is also vital. Top performers in procurement take fewer hours to place a purchase order and wait fewer days to receive materials from suppliers. Top-performing organizations may achieve this shorter cycle time because they focus on improving their procurement processes and eliminating activities that can add unnecessary time when completing tasks. These organizations may also implement technology solutions such as e-procurement systems that reduce cycle time by automating much of the process (Munoz & Dunbar, 2015).

KEMSA has recently created a portal that enables e-procurement of health products and technologies, which is effective and efficient in making orders. Aseka (2010) did a study on procurement practices and performance of manufacturing firms found out that, firms considered quantitative factors such as the suppliers' technical expertise,

commitment to quality and ability to meet delivery due dates in supplier selection than qualitative factors such as suppliers' willingness to share confidential information.

2.5 Procurement and Health Commodity Security

The Kenya Health Policy 2014-2030 underscores the importance or need to improve procurement processes to ensure availability of Health Products and Technologies (HPTs), according to essential HPT lists. The public procurement process in Kenya is generally guided by the Public Procurement and Disposal Act 2015. Procurement is the process of locating, analyzing, and forming relationships with vendors who will offer goods and services.

It is an important element of the logistics cycle because it ensures that the correct products are procured, that the items are of good quality, that value for money is maximized, that product supply is reliable and meets demand, and that the procurement process adheres to the government's and funding agency's rules and regulations.

Procurement should be carried out within the confines of applicable laws, policies, regulations and good procurement practices as provided for in the Public Procurement and Disposal (PPAD) Act 2015 and PPAD Regulations 2020 to ensure transparency, accountability and efficiency of its processes. However, there is a need to have effective and rigorous procurement policies, processes, and procedures in order to ensure reliable flow of commodities into the supply chain for consumption when and where needed.

2.5.1 Product Sourcing

Before devolution**,** KEMSA used to order, store, and distribute the bulk of health care commodities to public sector health providers. Kenya’s new governance structure began devolving certain roles and functions, including health services, from the national government to 47 newly-created counties. Among other responsibilities, county

governments could now purchase their health care supplies from sources other than KEMSA**.** This led to quality of health products being compromised due to flock of commodities in the Kenyan market**.**

Sharma and Chaudhury (2015) conducted a study focusing on improving availability and accessibility of medicines as a tool for increasing healthcare coverage, established that centralized procurement of carefully selected priority essential medicines along with SCM by an outsourced agency improved the availability and access to essential medicines.

Alemu (2018) conducted a study to establish the factors affecting pharmaceutical procurement practices and availability of life saving pharmaceuticals in the case of Public Hospitals of Ethiopia. The study revealed that there is a positive association and a significant effect of procurement institutional organization, procurement staff competency, procurement internal controls and public procurement regulations on pharmaceutical procurement practices and availability of life saving pharmaceuticals in Public Hospitals of Ethiopia.

2.5.2 Order Placement

Selecting suppliers in the public sector is based on value for money, quality, reliability and service which should follow a competitive process as outlined in the Public Procurement and Disposal Act 2015 and other applicable laws. In a study by Tarty (2011), on the influence of logistics management on lead time in public healthcare in Nairobi, it was concluded that, poor order listing can also increase the lead time in the public healthcare.

A rational listing of order leads to a better supply, lower costs and a more effective prescription and use of drugs in the hospitals. Orders that are poorly selected and listed will increase the costs of holding those orders supplies and increase an unnecessary waiting time for essential supplies that are needed by the target population whereas, poor order sorting occur when the medical supplies and drugs sorted are not arranged in sequence or by appropriate prescription pattern to remedy prevailing health condition in provide effective healthcare operation.

A study by Mbau et al. (2018) focused on a critical analysis of health care purchasing arrangements in Kenya taking a case study of the county departments of health. The study findings demonstrated that county departments of health did not practice strategic purchasing. The government's (national and county) role as a steward for the purchasing function was characterized by poor accountability and inadequate budgetary allocations for service delivery. Health products are ordered as per need or as the stock levels run low and should be in line with the procurement plan. This is done early enough to prevent stock outs of commodities which may interfere with service delivery.

2.5.3 Payments of Health Commodities Expenses

Allocation and management of finances directly affect all parts of the supply chain management cycle, including the quantities of products that can be procured, the amount of storage space that may be available, the number of vehicles that can be maintained, and the number of staff working in SCM. Mobilizing resources and securing a budget line item for health commodities and logistics activities is extremely important to ensure that products are available for consumption.

A study by the Management science for health (MSH) showed that in a drug analysis, commodities purchased by the MOH were on average 81 percent of the price of the

MEDS drugs on the open market. Thus, after a markup for the costs for the sale of the commodities, the price of the commodities provided by the government was likely to be much higher than the MEDS price.

Muhia et al. (2017) focused on the factors affecting the procurement of pharmaceutical drugs: a case study of Narok County Referral Hospital (NCRH), Kenya. The study established that some of the major challenges were bureaucracy, poor quantification, inadequate transportation options and lack of skilled personnel. The main factors facing the procurement of drugs in NCRH were inadequate funding which resulted in delay in paying the suppliers and poor quantification.

2.6 Inventory Management and Health Commodity Security.

Inventory management refers to the processes involved in ensuring that adequate stocks of products are kept, quality maintained and that programs and service delivery points have the needed products available when they need them (Singh et al., 2018). It is essential to monitor stock levels and ensure product availability. Good inventory management reduces costs and increases the effectiveness of programs. Poor inventory management makes control complicated and leads to losses and shortages.

Good inventory management ensures that the right products are available at the right time and in the right quantity, and facilitates the monitoring of consumption and quality (Cachon & Fisher, 2019). The decision to keep inventory of a specific items in the healthcare sector serves both strategic and tactical objectives. Holding inventory strategically allows businesses to balance supply and demand. Organizations strive to meet their consumers' needs while functioning efficiently and keeping costs under control (Singh et al., 2018).

2.6.1 Transportation Practices

KEMSA got into partnership in 2020, with the Postal Corporation of Kenya (PCK) in readiness for a scale up of universal health care coverage to all the counties. The contract was reached so as PCK could use the capacity it commands in large fleet of vehicles, motorcycles and strategic warehouses making it easier to transport the health products to different hospitals. Distribution is an important activity in the integrated supply chain management of medical products and health technologies.

All parties involved in the distribution of medical products and health technologies have a responsibility to ensure that the quality of the products and the integrity of the distribution chain are maintained throughout the distribution process from the site of manufacture to the entity responsible for dispensing the product to the end user. Medical products from KEMSA are delivered by road at no costs to reach all public health hospitals, rural health centers and dispensaries countrywide.

2.6.2 Storage Practices

In inventory management, storage practices are important. Upon receiving products from the warehouse, they are inspected by the inspection committee observing the six rights. Products are stored at every facility according to the storage guidelines in the pipeline for safety and physical integrity.

These products should be made readily available for distribution in order to maximize on the products' shell life which is specified by the manufacturer (Oballah et al., 2015). Handling and storage of medical products and health technologies should be in accordance with established procedures designed to prevent contamination or deterioration, damage to packs or confusion of products.

2.6.3 Retrieval Practices

Retrieval practices is also critical. It is essential that products that are the first to expire are first products to be issued regardless of when they arrived at the storage facility. The aim of this is to ensure that the customer doesn't receive expired products or the products don't expire on the shelves. Where no expiry dates exist for the medical products and health technologies, the first in, first out (FIFO) principle should be applied. Physical inventory count is done annually, bi annually, quartet or monthly depending on the capacity or level of the facility. This enables the supply chain manager confirm stock at hand and whether records are up to date.

Oballah et al (2015) in their study investigated the effect of inventory management practices on organization performance in the public hospital in Kenyatta National Hospital. The study revealed that inventory investment and inventory accuracy have a positive influence on organization performance. Also, the results showed that inventory shrinkage have a negative effect with could be reduced by inventory accuracy. The study recommended that the hospital ensures that losses resulting to inventory shrinkage related to medicine are reduced and the hospital needs to manage its inventory investment by ensuring right amount of stock is kept at all times.

2.7 Theoretical Framework

To understand the influence of supply chain management practices on health commodity security, this study derives its theoretical backing from Supply Chain Operations Reference (SCOR) model, Transaction Cost Theory and Supply Chain Management Theory.

2.7.1 Supply Chain Operations Reference (SCOR) Model

The Supply Chain Operations Reference (SCOR) model propounded by the Council of Supply Chain Operations Reference provides a unique framework that links performance metrics, processes, best practices and people into a unified structure. The framework supports communication between supply chain partners and enhances the effectiveness of supply chain management, technology, and related supply chain improvement activities.

SCOR metrics provide the basis for an organization to measure how successful it is in achieving its desired supply chain management objectives. The key success of SCM will rely on the incorporation of the activities of the supply chain, meaning cooperation, information flow and organization throughout the entire supply chain.

The SCOR model describes high-level business processes associated with all phases of satisfying customer demand. At the highest level the SCOR model is organized around four business process types (Plan, Source, Make, & Deliver). These processes represent the vertical-neutral abstractions from all demand/supply planning, purchasing/procurement, manufacturing, order entry and outbound logistics, and returns processing activities. The model, therefore, provides a business process framework with standard descriptions and interdependencies among processes. The aim is to meaningfully map supply chains and supply chain activities with varying complexities across multiple industry-verticals (Chehbi-Gamoura et al., 2020).

The hierarchical process framework decomposes to the third level. The Process Element Level, activity definitions are still generalized, so they still apply to a variety of product and information flows (including services). The model, for the top three

levels, provides the framework for analyzing, designing, and implementing actual operational supply chain execution or planning processes.

This framework is a strategic tool for describing, communicating, measuring, implementing and controlling, and fine-tuning complex SCM processes. The model offers the benefits of standardization if all value chain participants implementing the SCOR model adhere to the framework. This model explicitly explains the application and relevance of supply chain management in the logistics business in this research as the independent variable.

2.7.2 Transaction Cost Theory

The transaction cost theory was proposed by Williamson (1993) is useful in unraveling sources of barriers to firms intending to participate in public procurement. Such costs include among other things the cost incurred in obtaining and verifying information about the quantity and quality of goods and services and the quality of property rights to be transferred including legal and contractual framework.

Transaction costs relating to public procurement are those cost that Enterprises incur in trying to access a contract. In most cases, communication costs are higher for small than large organizations which hinder effective, fair and open competition among suppliers. Therefore, to minimize these costs, there is a need for effective product quantification and selection. It is argued that proper planning including an insight into the necessary costs as a result of information asymmetry are key to a better performing procurement system. The theory can specifically be linked to quantification and product selection.

2.7.3 Supply Chain Management Theory

Lavassani et al. (2009) explain supply chain management as a cross-function approach including: managing the movement of inventory into an organization, certain aspects of the internal processing and the movement of products in and out of the organization. As organizations strive to focus on core competencies and becoming more flexible, they reduce their ownership of distribution channels.

These functions are increasingly being outsourced to other entities that can perform the activities better or more cost effectively. The effect is to increase the number of organizations involved in satisfying customer demand, while reducing management control of daily logistics operations. Less control and more supply chain partners lead to the creation of supply chain management concept. The purpose of supply chain management is to improve trust and collaboration among supply chain partners, thus improving inventory visibility and the velocity of inventory movement (Lavassani et al., 2009).

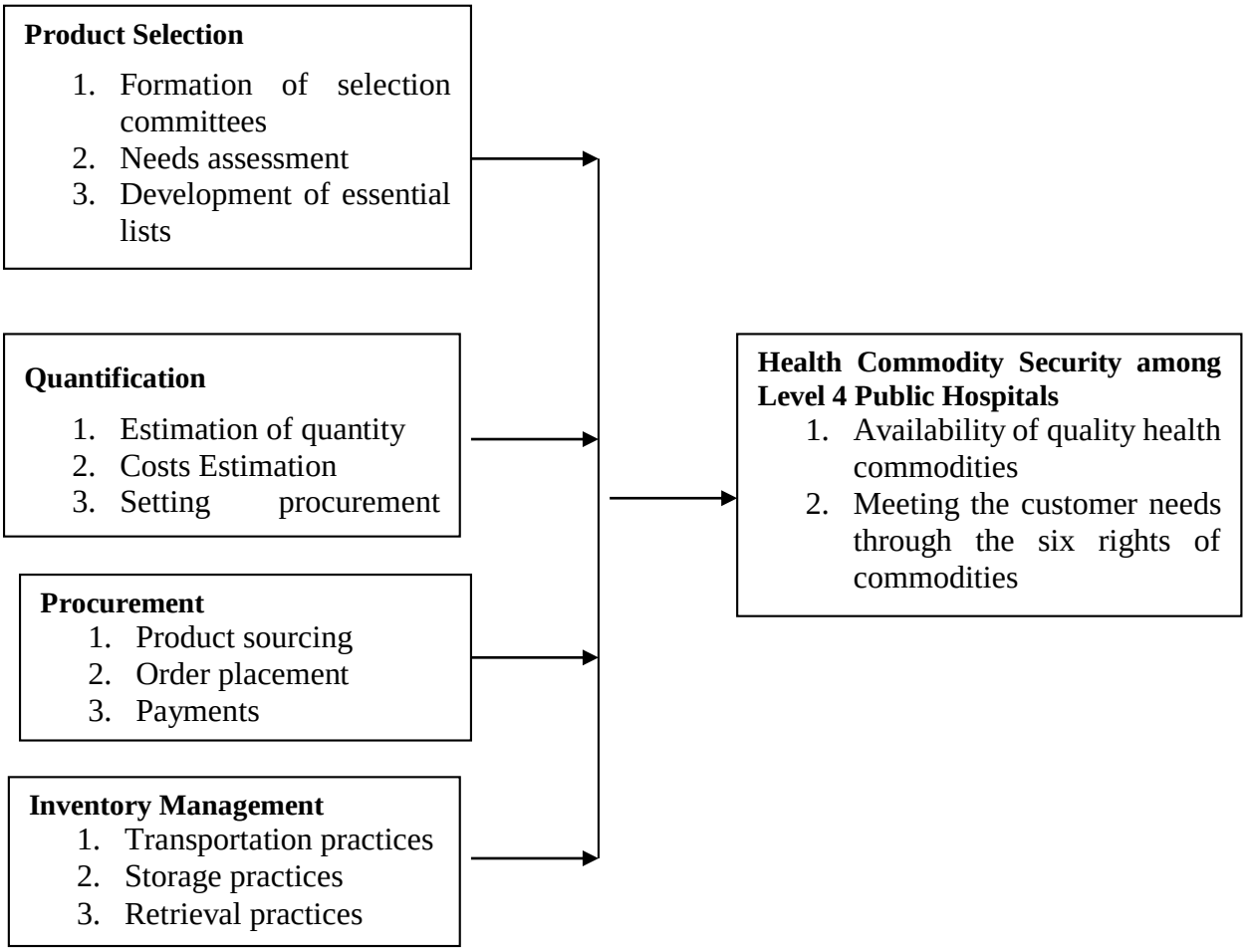
The theory is thus relevant to the study as it explains the whole concept of supply chain and thus touches on the entire set of predictor variables in the study. Management of internal processes such as procurement, quantification, inventory management and product selection can either be internally done or outsourced to ensure effective service delivery.

2.8 Conceptual Framework

The review and analysis of past literature, theories and current state of the SCM in the healthcare sector in Kenya and globally has led to development of a conceptual framework which not only links the study variables, but also shows their indicators. Figure 2.1 shows the link between the study variables.

Figure 2.1

Conceptual Framework



2.9 Chapter Summary

In this section, there has been a review of theoretical framework which the study anchors on in deriving its variables. To understand the influence of supply chain management practices on health commodity security, this study derives its theoretical backing from Supply Chain Operations Reference (SCOR) model, Transaction Cost Theory and Supply Chain Management Theory as discussed in this subsection. The

chapter has also presented an empirical literature to explain other studies that have interrogated the link between various study themes.

From the literature review, it has been demonstrated that the study variables, that is, procurement, inventory management, quantification and product selection play an important role in ensuring better supply chain performance that can lead to health care commodity security. The chapter has also presented the conceptual framework and chapter summary.

2.10 Literature Review Gaps

However, the findings of the previous studies cannot be generalized to Kenya because of the contextual research gaps. The study by (Aladejebi & Adedeji, 2015; Alemu, 2018; Do Rego & de Mesquita, 2015; Sharma & Chaudhury, 2015) have demonstrated the importance of effective SCM practices. However, their contextual backgrounds are unrelated to Kenyan hence presenting a contextual research gap which this study sought to fill.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

In this chapter, there is a presentation of the various methodologies adopted in order to achieve the research objectives. This chapter highlighted the design, target population, inclusion criteria, sampling and the research instruments. It also gave the methods of data collection and analysis as well as the ethical considerations.

3.2 Research Design

The study adopted a cross sectional survey research design. Cross sectional design was justified on grounds that data of different level four public hospitals was collected at a defined period (Diniz & Fabbe-Costes, 2007). Kumar (2018), research design is a plan that guides the research in the process of collecting, analyzing and interpreting observations; the researcher's blueprint for the methods and instruments used in collecting data and evaluating it, in order to respond to the research questions of the study. The design was suitable because of the need to conduct a survey of the 4 level four hospitals (Ngozwana, 2018 ;Mohajan, 2018).

3.3 Target Population

A population is defined as the total collection of all the elements about which the study wishes to make some inference (Mohajan, 2018). The target population was 120 who comprised of the top management team, procurement officers, stores clerks, pharmaceutical officers and head of departments who are involved in procurement of health products and commodities drawn from the four level four public hospitals in Nairobi County (Mbagathi Hospital, Pumwani Maternity Hospital, Mama Lucy Kibaki Hospital and Mutuini Hospital). These hospitals operate under some defined level of

semi-self-autonomy that allows them to manage their own inventory and supply chains. Table 3.1 gives a summary of the target population.

Table 3. 1

Target Population

Category	Population
Hospital Management Team	14
Procurement officers	22
Stores Clerks	31
Pharmaceutical officers	21
Head of departments	32
Total	**120**

Source: Human Resource Records of the Level Four Public Hospitals, 2021

3.4 Sample Size and Sampling Procedure

3.4.1 Sample Size Determination

The number of target respondents was 120 as per the Human Resource Records of the Four Public hospitals. To obtain the required sample size from these target populations the study adopted the formula below.

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

Where s = is the required sample size,

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

P = the population proportionate (assumed to be .50 since this would provide the maximum sample size), d = the degree of accuracy expressed as a proportion (0.05). By substituting the formulae, therefore, the study obtained;

$$s = 1.96^2 \times 120 \times 0.5(1-0.5) \div 0.05^2(120-1) + 1.96^2 \times 0.5(1-0.5)$$

$$s = 91$$

3.4.2 Sampling Technique

The respondents were stratified based on the positions. The features of stratified random sampling provided each respondent with an equal chance of inclusion while on the same note, keeping the manageable size. Respondents were selected by use of simple random sampling from the healthcare facilities. Simple random sampling was used to enhance the generalization of data obtained in the study. The sample size was then proportionally allocated according to the targeted population in respective positions as shown in Table 3.2.

Table 3. 2

Sample Size

Category	**Frequency (F)**	**Ratio (91/120)**	**Sample size (F*91/120)**
Hospital Management Team	14	0.76	11
Procurement officers	22	0.76	17
Stores Clerks	31	0.76	24
Pharmaceutical officers	21	0.76	16
Head of departments	32	0.76	24
Total	**120**		**91**

3.5 Inclusion and Exclusion Criteria

This section presents the criteria used to include the respondents in the study. The inclusion criteria for participation were the willingness of the respondents to participate in the study by signing an informed consent form. Therefore, only those who were

willing to participate in the study by signing a consent letter were included. On the contrary, those unwilling were excluded.

The other criteria was the work experience of the respondents whereby the study participants were required to have a work experience of more than six months in the facility or more than one year in the public health sector either working as procurement officers, stores clerks, pharmaceutical officers, hospital management team or head of departments. Those who didn't meet these criteria were excluded from the study.

3.6 Instrumentation

The main data collection tool for the study was a structured questionnaire with closed-ended questions to have quantitative data easy to score, clean and analyze. The questionnaire was structured based on a Five-point likert scale namely where 1 = Strongly Disagree; 2 = Disagree; 3= Neutral; 4= Agree and 5= Strongly Agree.

The questionnaire was further divided into six sections where section A had general information, Section B had information on product selection, section C had questions on quantification, section D had questions on procurement, section E had information on inventory management while section F had information on health commodity security.

3.7 Pre test

The instrument of data collection was validated and proofread before its use. The research committee at Kenya Methodist University Nairobi campus was allowed to approve the instrument before use. A pretest was also conducted to ensure that the instrument is reliable and valid. The pretest test was conducted on 30 respondents from Machakos Level 5 health facility.

According to Ngozwana (2018), a pretest sample size should not be less than 30 respondents. Machakos Level 5 was suitable because of its proximity to Nairobi County. Additionally, it has an urban setting thus good to share the challenges facing those level 4 facilities in Nairobi County.

3.7.1 Reliability of the Research Instrument

Reliability refers to the extent to which independent administration of the same instrument yields the same results under comparable conditions. The less variation the instrument produces in repeated measurements of an attribute the higher the reliability (Kumar, 2018). Reliability analysis was used to assess internal consistency among the variables of study. The reliability of the study measures was assessed by computing Cronbach's Alpha coefficient for all items in the questionnaire and the overall assessment was given. A Cronbach's alpha coefficient of 0.7 was used as a threshold (Kumar, 2018).

3.7.2 Validity of the Research Instrument

Validity is used to check whether a questionnaire is measuring what it purports to measure (Ragab & Arisha, 2018). To establish content validity, the study used professionals/experts in the supply chain field to assess the concept the instrument was trying to measure and also determined whether the set of items or checklist accurately represented the concepts under the study. In addition, the study drew responses from the population on the design and content instrument and suggestions for more efficient and practical ways of administering it.

In determining whether the study instrument reflects construct validity, the study first specified the theoretical and the empirical relationship between the measures of the

concept that are examined. Finally, the empirical evidence was interpreted in terms of how it clarified the construct validity of the particular measures that were tested.

3.8 Method of Data Collection

The questionnaires were administered by the researcher. Before administration of the questionnaire, permissions were sought from the hospital administration, the purpose of the survey explained and its importance to the administration. In addition, the respondent's consent was sought in written form (See Appendix I) before they could participate in the study.

During this period of COVID 19, the government's stipulated safety measures were adhered to strictly. Social distancing was ensured during the process of data collection. Other measures such as wearing a mask, washing hands and sanitizing were also adhered to. Additionally, the researcher sought ethical clearance from KEMU (See appendix III) as well as a permit for research from National Commission for Science, Technology and Innovation (NACOSTI) (Appendix IV).

3.9 Method of Data Analysis

The quantitative data obtained was analyzed statistically using SPSS version 26.0. Both descriptive and inferential statistics were used since the data was quantitative. Descriptive analysis entailed frequencies and percentages. However, to establish the effect of each of the predictor variables (SCM practices) on the dependent variable, Spearman Rank Correlation as well as multivariate Binary Logistic Regression Model was adopted.

Logistic regression is used when the dependent variable is categorical and therefore, in order to undertake the multivariate logistic regression analysis, the Likert based questions were re-coded from five-point Likert scale to binary variables. This data was

re-coded into two main categories after establishing weighted mean of the responses as suggested by Kumar (2018). Based on the work by Kumar a Five-Point Likert Scale can be re-grouped into a binary form by using weighted mean of the responses whereby, an average score between 1 and 3.50 to be disagree and a score between 3.51 to 5 to be agree. Other scholars who have suggested a similar approach are Davidson et al. (2012) and Lee and Nam (2019). After that, a binary logistic model was considered. The binary logit model was of the general form:

$$p(y_i = 1/x_i) = x_1^3\beta + \mu$$

Where:

p represents the probability odds

$\mathbf{y_i}$ is a binary variable representing **1** if the healthcare facility had achieved health commodity security and **0** otherwise

$\mathbf{x_i}$ represents the vector of the SCM practices (procurement, quantification, inventory management and product selection)

$\boldsymbol{\beta}$ is a vector of parameters that were to be estimated

$\boldsymbol{\mu_i}$ is the error term, which has a symmetric distribution that is either normal or logistic. Overall, the following binary logit regression model was used:

$$\frac{\Pr(y_i = 0)}{\Pr(y_i = 1)} := \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

Where:

y_i – dependent variable defined by $y = 1$ healthcare facility had achieved health commodity security practices and $y = 0$ if its otherwise

X_1 = Product Selection

X_2 = Quantification

X_3 = Procurement

X_4= Inventory Management

ε – Is the error term

β – Predictor variables coefficients

3.9.1 Diagnostic Tests

Before running the multivariate logistic model, diagnostic tests were conducted to ensure that regression assumptions are adhered to before estimation. In this study, the diagnostic tests conducted included test for multicollinearity, link test and Hosmer-Lemeshow (H-L) Test. To test for the presence of multicollinearity in the estimated model, Variance Inflation Factor (VIF) was used. VIF which ranges between 1 and 10 identifies the correlation between regressors and also the strength of that correlation. As a rule of thumb, Multicollinearity is deemed to be present if a variable has a VIF in excess of 10 (Field, 2009).

In regard to Link test, it is based on the view that if a model is correctly specified, any additional independent variables cannot be found except by chance. Link Test creates two new variables, the prediction variable (*hat*) and squared prediction variable *(*$hatsq$). For a correctly specified model, the prediction variable (*hat*) should be significant while *hatsq* should not.

To establish the goodness of fit of the fitted multivariate logistic model, Hosmer - Lemeshow (H-L) test was carried out. The test determines whether observed binary responses, conditional on vector of covariates (confounding factors), are consistent with

predictions. That is, whether the number of outcomes in the regression indicated the number of observed outcomes in the data. When the predictions in the model fit the data well, then the probability value of H-L is statistically not significant.

3.10 Ethical Clearance

After presentation of the proposal to the department, the research proposal was sent to the Kenya Methodist Scientific Ethics Review Committee (KeMU SERC) (See Appendix IV) for review and approval. After approval, the university wrote a letter which was used to seek a NACOSTI research permit, Appendix III. Using the letter and the permit, the researcher proceeded to seek permission from the department of health at the Nairobi city county before making formal introductions at the administration of the hospitals to approve data collection.

In the data collection process, participation of the respondents was voluntary. No one was forced, neither were they promised money to participate. A written informed consent (see Appendix I) was also sought from the respondents before any information was sought from them. The data were treated with confidentiality and used solely for academic purposes and not any other purpose. Additionally, the rights of the respondents to withdraw from the study were respected. They were allowed to withdraw at any given time and were not forced to participate.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Introduction

The study established the influence of supply chain management practices on health commodity security among level four public hospitals in Nairobi County, Kenya focusing on product selection, quantification, procurement and inventory management. The results present the demographic characteristics of the respondents, followed by the descriptive statistics of the study variables then inferential analysis, that is, multivariate analysis. This chapter presents the presentation, explanation and discussion of the study findings based on the data collected from the field.

4.2 Response Rate

A total of four level four public hospitals based in Nairobi County (Mbagathi Hospital, Pumwani Maternity Hospital, Mama Lucy Kibaki Hospital and Mutuini Hospital) were targeted in the study. A total of 91 questionnaires were distributed and administered to at least 5 representatives of each healthcare facility; Top management team, procurement officers, stores clerks, pharmaceutical officers and head of departments. Out of the target, a total of 82 respondents filled the questionnaires which gave a response rate of 90%.

Table 4.1

Response Rate

Response Rate	Frequency	Percent
Response	82	90%
Non-response	9	10%
Total	**91**	**100.00**

Given the thresholds for response rate given by Baruch and Brooks (2008) that a response rate above 50% is acceptable while a 70% response rate is very good, there is the conclusion that the response rate achieved in this study, that is, 90% is very good for comparison and generalization to the main study population.

4.3 Pretest Results

The data collection instrument was validated and proofread before its use. A pretest was also conducted on 30 randomly sampled respondents from Machakos Level 5 health facility. The data from the 30 was used to test for reliability of the research tool.

4.3.1 Reliability Test Results

The reliability of the study measures was assessed by computing Cronbach's Alpha coefficient for all items in the questionnaire and the overall assessment was given. A Cronbach's alpha coefficient of 0.7 was used as a threshold (Kumar, 2018).

Table 4.2

Reliability Test Results

Variables	Number of items	Cronbach's Alpha	Decision
Product selection	11	0.777	Greater than 0.7 hence reliable
Quantification	9	0.700	Greater than 0.7 hence reliable
Procurement	12	0.933	Greater than 0.7 hence reliable
Inventory management	9	0.766	Greater than 0.7 hence reliable
Health commodity security	11	0.844	Greater than 0.7 hence reliable

The results indicated in Table 4.2 show that all the 5 study variables had a Cronbach Alpha above 0.7 hence the tool was considered reliable. Specifically, product selection had a coefficient alpha value of 0.777, quantification had a coefficient alpha value of 0.700, Procurement had a coefficient alpha value of 0.933, inventory management had

a coefficient alpha value of 0.766 while Health commodity security had a coefficient alpha value of 0.844.

4.3.2 Validity Test

Validity is the extent to which a measure measures what it is supposed to measure. Kumar (2018) suggests that to achieve face validity, the following processes are important in a research study: reviewing a large body of literature to carefully identify concepts, ideas, relationships and issues under study; developing the questionnaire from existing related studies, and pre-testing the questionnaire formally to evaluate whether individual items were valid.

These measures were undertaken in this pretest and all suggestions and comments regarding the structure, wording and questions have been considered in the final draft of the questionnaire. In addition, the supervisor's suggestions were considered and used to improve the content validity of the research tool.

4.4 Demographic Characteristics of the Respondents

The study determined the demographic characteristics of the respondents. There was a description of the respondent's age, gender; position and work experience. Even though this doesn't affect the relationship between the study variables, it was important to describe the respondents so as to establish their experience in the industry as well as education which are important aspects of their understanding of SCM practices and health commodity security in the industry. The results on these are summarized in Table 4.3.

Table 4.*3*

Demographic Characteristics of the Respondents

Gender		**Frequency**	**Percent**
	Female	46	56.1
	Male	36	43.9
	Total	**82**	**100.0**
Age			
	20-30	17	20.7
	31-40	24	29.3
	41-50	25	30.5
	51-60	16	19.5
	Total	**82**	**100.0**
Position			
	Management team	17	20.7
	Procurement	22	26.8
	Stores clerk	14	17.1
	Pharmaceutical officer	12	14.6
	Head of department	17	20.7
	Total	**82**	**100.0**
Work Experience			
	Less than 5 years	16	19.5
	Between 6-10 years	22	26.9
	More than 10 years	44	53.7
	Total	**82**	**100.0**

The findings in Table 4.3 show that majority 46 (56.1%) of the respondents were female. Most of them 66 (80.5%) were aged between 20-50 years and most of the respondents 44 (53.7%) had more than 10 years of work experience. The results also showed that 22 (26.8%) of the respondents occupied the position of a procurement officer, 17 (20.7%) indicated management team and head of department each, 12 (14.6%) indicated pharmaceutical officer while 14(17.1%) indicated stores clerk.

The results indicate that there were few pharmacy personnel at the hospitals under study. There is a need for recruiting more pharmacy personnel because they are vital as they are involved in the efficient management of the supply chain either directly or indirectly (Aladejebi & Adedeji, 2015).

4.6 Descriptive Statistics

In this section, the presentation of the descriptive statistics is presented. There is presentation of the frequency and percentage responses on the study variables.

4.6.1 Descriptive Statistics of Product Selection

The first objective of the study sought to investigate the influence of product selection on health commodity security among level four public hospitals in Nairobi County, Kenya. The descriptive findings on the responses are presented in Table 4.4.

Table 4.4

Descriptive Statistics of Product Selection

Product Selection Practices	Agree n (%)	Disagree n (%)
Product selection committee is available in the facility	65(79.3)	17 (20.8)
User departments are involved in product selection	69(84.1)	13(15.8)
The NEML (National Essential Medicine List) copy is always available and accessible in the facility	28(34.1)	54(65.9)
Product selection committee uses the EML to select products	47(57.3)	35(42.7)
Content of the EML is well mastered	44(53.7)	38(46.3)
Products selected are all registered for use in the country	61(74.4)	21(25.6)
Products selected are not always available in the EML	24(29.3)	58(70.7)
Some commodities are sometimes selected based on stock availability in KEMSA	72(87.8)	10(12.2)
Effectiveness, safety and cost are key consideration in product selection	72(87.8)	10(12.2)
Most of the Medical products, vaccines and technologies in the facility are selected and ordered from KEMSA and Central Medical Stores	67(81.7)	15(18.3)
A needs assessment is conducted to establish the products for local disease patterns	11(13.4)	71(86.6)

In view of Table 4.4, 65(79.3%) of the respondents agreed that product selection committee is available in the facilities. Product selection activities involve formation of selection committees, needs assessment and development of essential list (Nzioka, 2010). The formation of selection committees is one of the most important processes in product selection. After products are selected, detailed product specifications should be

developed by program staff with a specialized knowledge and expertise in pharmaceuticals, in coordination with a logistics or procurement unit. These experts are involved throughout the process to ensure that all product details are developed correctly (Toba et al., 2020).

69(84.1%) of the respondents agreed that user departments are involved in product selection. According to Toba et al. (2020), a functional selection committee, which comprises clinicians, pharmacists, supply chain managers, nurses, and policymakers, is frequently used to choose products. They provide advice that finally leads to product availability, 28(34.1%) agreed that NEML (National Essential Medicine List) copy is always available and accessible in the facility, 47(57.3%) agreed that product selection committee uses the EML to select products, 61(74.4%) of the respondents agreed that products selected are all registered for use in the country.

A few 24(29.3%) of the respondents agreed that products selected are not always available in the EML. Majority 72(87.8%) of the respondents agreed that some commodities are sometimes selected based on stock availability in KEMSA. Majority of the respondents 67(81.7%) agreed that most of the medical products, vaccines and technologies in the facility are selected and ordered from KEMSA and Central Medical Stores. According to Munoz and Dunbar (2015) a national EML is a list of medicines that have been approved for usage across the country and that meet a population's top health-care needs.

The core list of the WHO model list contains only around 300 effectives, safe and cost-effective active ingredients which cover the health care needs of the majority of the population. Countries frequently identify which levels of care in the health system each product will be used at as part of the establishment of national EMLs, based on illness patterns and consequences that are regularly treated at each level. Achieving access to

essential medicines is also defined by the concept of commodity security, which is described as the ability of clients or end users to obtain and use health commodities when and where they need them.

Respondents 63(76.8%) agreed that needs assessment is conducted to establish the products for local disease patterns, 49(59.8%) agreed that the NEML (National Essential Medicine List) copy is always available and accessible in the facility, 47(57.3%) of the respondents agreed that Product selection committee uses the EML to select products, 72(87.8%) agreed that some commodities are sometimes selected based on stock availability in KEMSA, 72(87.8%) agreed that effectiveness, safety and cost are key consideration in product selection. Lastly, 67(81.7%) agreed that most of the medical products, vaccines and technologies in the facility are selected and ordered from KEMSA and Central Medical Stores.

The findings are in line with Wang et al. (2004) who argued that needs assessment is an important practice in product selection because standard treatment guidelines influence supply chain management and hence, every country should have clear guidelines. These are suggested treatment protocols for the most optimal treatment of specific clinical problem in a given setting based on consensus by experts. Treatment for specific clinical problems is selected based on needs assessment on common diseases in the area or level of treatment facility.

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Moons et al. (2019) argued that development of an essential list should also be factored among other practices during product selection.

4.6.2 Descriptive Statistics of Quantification

The second objective of the study sought to investigate the influence of quantification on health commodity security among level four public hospitals in Nairobi County, Kenya. The descriptive findings on the responses are presented in Table 4.5.

Table 4.5

Descriptive Statistics of Quantification

Quantification Practices	Agree n (%)	Disagree n (%)
The facility has a quantification team of expertise	61(74.4)	21 (25.7)
Quantification of essential health products and technologies required in the facility is done annually	63(76.8)	19(23.2)
Quantification of essential health products and technologies required in the facility is done quarterly	63(76.8)	19(23.2)
Quantification of essential health products and technologies required in the facility is done monthly	45(54.9)	37(45.1)
User department is involved in quantification of the commodities needed	12(14.6)	70(85.4)
The committee factors in the cost of commodities before procurement	68(82.9)	14(17.1)
Before procurement, costs are compared with available funds	8(9.8)	74(90.3)
Costs of commodities and drugs are affordable to the patients and clients	43(52.4)	39(47.6)
Records on medical products, vaccines and technologies are regularly updated in the inventories for future quantification	19(23.2)	62(75.6)

Majority of the respondents 71(86.6%) agreed that before procurement, costs are compared with available funds. Cost is one of the most important performances of a supply chain. When measuring supply chain costs, it is important to know what to measure. Cost estimation can be guided by the average market price of the products therefore reducing hidden costs when procuring. To maintain the procurement cycle, it

is essential that adequate financing is available for the purchase of quantities that have been forecasted and quantified. Financing arrangements should be secured well in advance of planned procurements to avoid product stock outs and to reduce emergency shipments.

Majority 68(82.9%) of the respondents agreed that the committee factors in the cost of commodities before procurement. Majority 66(80.5%) agreed that user department is involved in quantification of the commodities needed. Majority 63(76.8%) agreed that quantification of essential health products and technologies required in the facility is done annually, 63(76.8%) agreed that quantification of essential health products and technologies required in the facility is done quarterly. Faisal et al. (2017) indicate that the quantification process is an iterative process that involves analyzing and updating quantification data and assumptions, as well as recalculating total commodity requirements and costs to reflect actual service delivery and consumption, as well as changes in program policies and plans. Every six months, or more frequently for fast growing or changing projects, the findings of a quantification exercise should be revisited.

Most of the respondents 61(74.4%) agreed that the facility has a quantification team of expertise. Most of the respondents 62(75.6%) disagreed that records on medical products, vaccines and technologies are regularly updated in the inventories for future quantification. According to Faisal et al. (2017), the results of a quantification exercise can help program managers identify funding needs and gaps for commodity procurement, leverage the sources, amounts, and timing of funding commitments to maximize the use of available resources, advocate for additional resources as needed, and develop a supply plan to coordinate procurements and shipment delivery schedules to economize.

Lastly, most of the respondents 45(54.9%) agreed that quantification of essential health products and technologies required in the facility is done monthly. The findings are in line with Aseka (2010) findings that, quantification of essential health products and technologies should be done on monthly basis.

4.6.3 Descriptive Statistics of Procurement

The third objective of the study sought to investigate the influence of procurement on health commodity security among level four public hospitals in Nairobi County, Kenya. The descriptive findings on the responses are presented in Table 4.6.

Table 4.6

Descriptive Statistics of Procurement

Procurement Practices	Agree n (%)	Disagree n (%)
The facility has an annual procurement plan that is strictly adhered to	67(81.7)	15(18.3)
Procurement planning and process are vital activities that ensure correct products are ordered, received and ready for consumption by the users	71(86.6)	11(13.4)
e-procurement tool from KEMSA is regularly uploaded on their website for requisitions	39(47.6)	43(52.5)
The procurement process in the facility is regulated according to the public laws and regulations.	66(80.5)	16(19.5)
There is competitive bidding to ensure capable suppliers are selected	52(63.4)	30(36.5)
Clear procurement timelines are always set to ensure delivery within lead time	58(70.7)	24(29.3)
A delivery schedule is always agreed upon on time to avoid delays and stock outs	52(63.4)	30(36.6)
The facility ensures that the needs are well clarified, samples and specifications given, before making orders	69(84.1)	13(15.8)
The tenders are published publicly in a competitive process	52(63.4)	30(36.6)
The facility has a tender opening and evaluation committee	63(76.8)	19(23.1)
The tender evaluation procedure is competitive and transparent to reduce chances of corruption	51(62.2)	31(37.8)
After award of contracts, there is a continuous monitoring process to ensure timely delivery of quality products	58(70.7)	24(29.2)

In view of Table 4.7, majority 67(81.7%) of the respondents agreed that the facility has an annual procurement plan that is strictly adhered to. According to Mbau et al. (2018) an annual procurement plan is essential for health commodity security in public facilities and should therefore be strictly adhered to. The plan allows easy allocation and management of finances that directly affect all parts of the supply chain management cycle, including the quantities of products that can be procured, the amount of storage space that may be available, the number of vehicles that can be maintained, and the number of staff working in SCM. Mobilizing resources and securing a budget line item for health commodities and logistics activities is extremely important to ensure that products are available for consumption.

Majority of the respondents 71(86.6%) agreed that procurement planning and process are vital activities that ensure correct products are ordered, received and ready for consumption by the users. Selecting suppliers in the public sector is based on value for money, quality, reliability and service which should follow a competitive process as outlined in the Public Procurement and Disposal Act 2015 and other applicable laws.

In a study by Tarty (2011), on the influence of logistics management on lead time in public healthcare in Nairobi, it was concluded that poor order listing can also increase the lead time in the public healthcare. A rational listing of order leads to a better supply, lower costs and a more effective prescription and use of drugs in the hospitals. Orders that are poorly selected and listed will increase the costs of holding those orders supplies and increase an unnecessary waiting time for essential supplies that are needed by the target population whereas, poor order sorting occur when the medical supplies and drugs sorted are not arranged in sequence or by appropriate prescription pattern to remedy prevailing health condition in provide effective healthcare operation.

Majority of the respondents 66(80.5%) agreed that the procurement process in the facility is regulated according to the public laws and regulations, 69(84.1%) also agreed that the facility ensures that the needs are well clarified, samples and specifications given, before making orders. The Kenya Health Policy underscores the importance or need to improve procurement processes to ensure availability of Health Products and Technologies (HPTs), according to essential HPT lists.

According to Sharma and Chaudhury (2015) Procurement should be carried out within the confines of applicable laws, policies, regulations and good procurement practices as provided for in the Public Procurement and Disposal (PPAD) Act 2015 and PPAD Regulations 2020 to ensure transparency, accountability and efficiency of its processes. However, there is a need to have effective and rigorous procurement policies, processes, and procedures in order to ensure reliable flow of commodities into the supply chain for consumption when and where needed.

Majority 63(76.8%) of the respondents agreed that the facility has a tender opening and evaluation committee, most of the respondent 58(70.7%) agreed that after award of contracts, there is a continuous monitoring process to ensure timely delivery of quality products and lastly, 52(63.4%) of the respondents agreed that a delivery schedule is always agreed upon on time to avoid delays and stock outs. These findings are in line with Sharma and Chaudhury (2015) study that established that centralized procurement of carefully selected priority essential medicines along with SCM by an outsourced agency improved the availability and access to essential medicines.

4.6.4 Descriptive Statistics of Inventory Management

The fourth objective of the study sought to investigate the influence of inventory management on health commodity security among level four public hospitals in Nairobi County, Kenya. The descriptive findings on the responses are presented in Table 4.7.

Table 4.7

Descriptive Statistics of Inventory Management

Inventory Management Practices	Agree n (%)	Disagree n (%)
The facility has a well-defined and clear procedure of ordering commodities from the general store/ pharmacy	71(86.0)	11(13.4)
The facility has an inspection and acceptance committee	68(82.9)	14(17.1)
The inspection and acceptance team confirms orders against the delivery notes upon receiving commodities from the suppliers	12(14.6)	70(85.3)
The inventory tools are available, accessible and regularly updated (stock/ bin cards, control cards)	11(13.4%)	71(86.6)
The facility has guidelines, policies and rules on storage of health products, vaccines and technologies	66(80.5)	16(19.6)
First In First Out (FIFO) practice is well used in inventory management	12(14.6)	70(85.3)
First Expiry First Out (FEFO) practice is well used in inventory management	11(13.4)	71(86.6)
Physical stock count is always conducted to update inventory and ensure continuous supply of commodities	23(28.0)	59(72.0)
Inventory performance monitoring is always conducted to ensure records are up to date	2(26.8)	60(73.2)

According to Table 4.7, majority of the respondents 71(86.0%) agreed that the facility has a well-defined and clear procedure of ordering commodities from the general store/ pharmacy, 68(82.9%) agreed that the inspection and acceptance team confirms orders

against the delivery notes upon receiving commodities from the suppliers, however, 68(82.9%) agreed that the inspection and acceptance team confirms orders against the delivery notes upon receiving commodities from the suppliers.

Good inventory management reduces costs and increases the effectiveness of programs. Poor inventory management makes control complicated and leads to losses and shortages. Good inventory management ensures that the right products are available at the right time and in the right quantity, and facilitates the monitoring of consumption and quality. The decision to keep inventory of a specific items in the healthcare sector serves both strategic and tactical objectives. Singh et al. (2018) are of the opinion that holding inventory strategically allows businesses to balance supply and demand. Organizations strive to meet their consumers' needs while functioning efficiently and keeping costs under control.

Majority of the respondents 71(86.6) disagreed that the inventory tools are available, accessible and regularly updated (stock/ bin cards, control cards). Regarding the statement that the facility has guidelines, policies and rules on storage of health products, vaccines and technologies. Handling and storage of medical products and health technologies should be in accordance with established procedures designed to prevent contamination or deterioration, damage to packs or confusion of products.

According to Oballah et al. (2015) in inventory management, storage practices are important. Upon receiving products from the warehouse, they are inspected by the inspection committee observing the six rights. Products are stored at every facility according to the storage guidelines in the pipeline for safety and physical integrity. These products should be made readily available for distribution in order to maximize on the products' shell life which is specified by the manufacturer.

Majority of the respondents 70(85.3) disagreed that First Expiry First Out (FEFO) practice is well used in inventory management. Majority of the respondents 59(72.0) disagreed that physical stock count is always conducted to update inventory and ensure continuous supply of commodities. Lastly, 60(73.2) disagreed that inventory performance monitoring is always conducted to ensure records are up to date.

4.6.5 Descriptive Statistics of Health Commodity Security

The study sought the respondent's opinion regarding statements related to health commodity security among level four public hospitals in Nairobi County, Kenya. The descriptive findings on the responses are presented in Table 4.8.

Table 4.8

Descriptive Statistics of Health Commodity Security

Indicators of Health Commodity Security	Agree n (%)	Disagree n (%)
The facility doesn't experience customer complaints in regard to inadequate health products, vaccines and commodities	23(28.0)	59(71.9)
There is access to regular supply of widely available essential health commodities from KEMSA	33(40.2)	49(59.8)
The facility has a great ability to obtain affordable quality health commodities from KEMSA	40(48.8)	42(51.3)
Suppliers are efficient and effective in delivery of health commodities to the facility	35(42.7)	47(57.3)
The facility does not often experience frequent stock outs of essential medicines and vaccines	21(25.6)	61(74.4)
The facility does not often experience frequent stock outs of essential non-pharmaceutical supplies	24(29.3)	58(70.7)
Flexibility and reliability are considered during selection of suppliers	52(63.4)	30(36.6)
Patients and clients can afford and access health commodities as per need/ prescriptions in the facility	45(54.9)	37(45.2)
Commodities and drugs can be accessed at any time by the users from the facility's pharmacy, medical / surgical store	55(67.1)	27(33.0)
The facility has a procurement policy that governs the procurement activities	67(81.7)	14(17.1)

It was established that 23(28.0%) of the respondents agreed that the facility doesn't experience customer complaints in regard to inadequate health products, vaccines and commodities, 33(40.2%) disagreed that There is access to regular supply of widely available essential health commodities from KEMSA, 40(48.8%) agreed that the facility has a great ability to obtain affordable quality health commodities from KEMSA, 35(42.7%) agreed that suppliers are efficient and effective in delivery of health commodities to the facility, 21(25.6%) agreed that the facility does not often experience frequent stock outs of essential medicines and vaccines, 52(63.4%) agreed that flexibility and reliability are considered during selection of suppliers, 45(54.9%) agreed that patients and clients can afford and access health commodities as per need/ prescriptions in the facility, 55(67.1%) agreed that commodities and drugs can be accessed at any time by the users from the facility's pharmacy, medical / surgical store, 67(81.7%) agreed that their facilities have a procurement policy that governs the procurement activities.

4.7 Correlation Analysis

Spearman Rank correlation was used to establish the relationship between the study variables. The correlation coefficient can range from -1 to +1, with -1 indicating a perfect negative correlation, +1 indicating a perfect positive correlation, and 0 indicating no correlation at all. The correlation analysis results are presented in Table 4.9.

Table 4.9

Correlation Results

		Y	X_1	X_2	X_3	X_4
Health Commodity Security (Y)	Correlation Coefficient	1.000				
	Sig. (2-tailed)	.				
Product Selection (X_1)	Correlation Coefficient	.769**	1.000			
	Sig. (2-tailed)	.000	.			
Quantification (X_2)	Correlation Coefficient	.424**	.404**	1.000		
	Sig. (2-tailed)	.000	.000	.		
Procurement (X_3)	Correlation Coefficient	.374**	.487**	.451**	1.000	
	Sig. (2-tailed)	.001	.000	.000	.	
Inventory Management (X_4)	Correlation Coefficient	.498**	.525**	.341**	.561**	1.000
	Sig. (2-tailed)	.000	.000	.002	.000	.
	N	82	82	82	82	82

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

The results in Table 4.9 indicated that product selection is positively and significantly associated with health commodity security (rho = 0.769; $p < 0.05$). This implies that adoption of product selection practices such as formation of selection committees, needs assessment and development of essential lists is associated with enhanced health commodity security.

The findings are in line with Kahiri et al. (2015) findings that showed that product selection positively affected health commodity security. In another study by Munoz and Dunbar (2015), it was indicated that product selection, large number of items, huge monetary volume involved, need for an audit trail, severe consequences of poor performance, and the potential contribution to effective organizational operations associated with the procurement function are five major factors affecting procurement performance in the public sector.

It was also established that quantification is positively and significantly associated with health commodity security (rho = 0.424; $p < 0.05$). This implies that adoption of quantification practices such as estimation of quantity, costs estimation and setting procurement is associated with enhanced health commodity security.

The findings concur with Lavassani et al. (2014) findings from their study in Romania Bucharest focusing on quality and quantity management in procurement and management of material resources. The study established that among the key processes of the quality management system, the process of procurement and management of material resources directly affects the quality of the final products, health commodity security and therefore the performance of the organization. The study also established that quantity specification was important in enhancing SCM performance.

In regard to procurement, it was similarly established that it is positively and significantly associated with health commodity security (rho = 0.374; $p < 0.05$). This implies that adoption of procurement practices such product sourcing, order placement and timely payment is associated with enhanced health commodity security.

The findings concur with Alemu (2018) that there is a positive association and a significant effect of procurement institutional organization, procurement staff competency, procurement internal controls and public procurement regulations on pharmaceutical procurement practices and health commodity security in Public Hospitals of Ethiopia.

Lastly, the study findings showed that inventory management is positively and significantly associated with health commodity security (rho = 0.498; $p < 0.05$). This implies that adoption of inventory management practices such transportation practices,

storage practices and retrieval practices is associated with enhanced health commodity security.

The findings agree with Oballah et al (2015) findings that confirmed inventory investment and inventory accuracy have a positive influence on health commodity security and organization performance. Also, the results showed that inventory shrinkage have a negative effect with could be reduced by inventory accuracy.

4.8 Regression Analysis

A multivariate logistic regression analysis was conducted to establish the relationship between SCM and health commodity security. The model predicts the odds (chance) of the predictor variables predicting the dependent variable. However, prior to the estimation of the model, the study conducted diagnostics tests that established the suitability of adopting the model.

4.8.1 Multivariate Logistic Regression Model Diagnostic Tests

In this study, the diagnostic tests specific to a multivariate logistic model were conducted including multicollinearity, link test, Hosmer-Lemeshow (H-L) test and test for heteroskedasticity.

Multicollinearity Test Results

To test for the presence of multicollinearity in the estimated model, Variance Inflation Factor (VIF) was used. VIF which ranges between 1 and 10 identifies the correlation between regressors and also the strength of that correlation. As a rule of thumb, Multicollinearity is deemed to be present if a variable has a VIF in excess of 10 (Field, 2009).

Table 4.10

Multicollinearity Test

Variable	VIF	1/VIF
Procurement	3.17	0.32
Quantification	2.96	0.34
Product Selection	1.52	0.66
Inventory Management	1.39	0.72
Dependent Variable: Health Commodity Security		

The results of the multicollinearity test presented in Table 4.10 showed that there was absence of multicollinearity among the predictor variables used in the logistic model since VIF of all the variables was less than 10.

Link Test Results

Model misspecification may occur when one or more variables are omitted from the model or irrelevant variables are included in the model. If relevant variables are erroneously omitted, the common variance shared with the variables included may be incorrectly ascribed to those variables hence inflating error term (Obebo, 2018). Generally, model misspecification can substantially affect the estimates of the regression coefficients. To establish if the model was correctly specified, Link test was conducted.

The test is based on the view that if a model is correctly specified, any additional independent variables cannot be found except by chance. Link Test creates two new variables, the prediction variable (*hat*) and squared prediction variable $(hatsq)$. For a correctly specified model, the prediction variable (*hat*) should be significant while *hatsq* should not.

Table 4.11

Link Test Results

				Number of Observation	82	
				LR Chi2 (2)	66.601	
				Prob > Chi^2	0.000	
				Pseudo R^2	0.561	
				Log Likelihood	-117.825	
Health Commodity Security	**Coef.**	**Std. Err.**	**z**	**P>|z|**	**[95% Conf.**	**Interval]**
Hat	0.932	0.115	8.090	0.000	0.706	1.157
Hatsq	(0.126)	0.091	(1.380)	0.167	(0.305)	0.053
Cons	0.110	0.136	0.810	0.415	(0.155)	0.376

The results in Table 4.11 showed that the prediction variable (*hat*) was statistically significant since its p-value was 0.000 while *hatsq* was not since its p-value was 0.167. Therefore, the model was correctly specified.

4.8.2 Multivariate Logistic Regression Estimation

Binomial Logistic Regression Model Summary

The model summary results in Table 4.12 indicated that the four predictor variables (inventory management, procurement, product selection and quantification) account for up to 62.3% of the variation in health commodity security among level 4 health care facilities in Nairobi County, Kenya (Nagelkerke R Square = 0.623). This implies that the four factors are important in explaining health commodity security and other factors other than the four account for the remaining percentage (37.7%). Probably, other studies can focus on establishing the other factors.

Table 4.12

Multivariate Logistic Regression Model Summary

-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square	McFadden
100.498	0.561	0.623	0.456

Hosmer-Lemeshow Test of Goodness of fit of the Logistic Model

Unlike ANOVA and adjusted R-square in Ordinary Least Square, a logistic regression model fitness is tested using Hosmer-Lemeshow statistic. The test determined whether observed binary responses, conditional on vector of covariates (confounding factors), are consistent with predictions. That is, whether the number of outcomes in the regression indicates the number of observed outcomes in the data. When the predictions in the model fit the data well, then the probability value of H-L is statistically not significant.

As indicated in table 4.13, the multivariate logistic regression model estimated was a good fit implying that it was closer to the actual model hence a good predictor. This is because showed that the p-value of the test was insignificant (0.9841) and hence concluding that the data fitted well in the model.

Table 4.13

Hosmer-Lemeshow Test of Goodness of fit of the Logistic Model

Number of Observations	82
Number of Groups	8
Hosmer-Lemeshow Chi^2 (8)	66.601
Prob > Chi^2	0.9841

Multivariate Logistic Regression Model Coefficients

The regression model coefficients were also established as shown in Table 4.14. These were used to show the magnitude of the relationship between the study variables indicating the odds (chance) of achieving health commodity security given the Supply Chain Management practices.

Table 4.14

Multivariate Logistic Regression Model Coefficients

	B	SE	Sig.	Exp (B)
Procurement				
No clear Procurement procedures (Ref)				
Clear Procurement procedures	.040	.118	.735	1.991
Quantification				
No clear quantification procedures (Ref)				
Clear quantification procedures	.397	.134	.003	.672
Product Selection				
No clear product selection (Ref)				
Clear product selection	.792	.403	.049	2.208
Inventory Management				
No Inventory management process (Ref)				
Clear Inventory management process	.711	.338	.036	2.035

Regression Equation:

Health commodity security = 2.525 + 0.792 (product selection) + 0.397 (Quantification) + 0.711(Inventory management)

The regression equation demonstrates that only three SCM practices, that is, inventory management, quantification and product selection can predict heal commodity security significantly. Procurement does not have a significant effect hence it has been eliminated from the equation.

From the results in Table 4.14, it was established that inventory management has a significant effect on health commodity security (P value < 0.05). In addition, it was

established that those healthcare facilities which had implemented inventory management practices had a higher chance of achieving health commodity security compared to those that had not (Odds = 2.035). Specifically, the healthcare facilities which had implemented inventory management practices were 2.035 times more likely to achieve health commodity security compared to those that had not implemented inventory management practices.

It was also established that product selection has a significant effect on health commodity security (P value < 0.05). Furthermore, the findings showed that those healthcare facilities which had implemented product selection practices had a higher chance of achieving health commodity security compared to those that had not (Odds = 2.208). Specifically, the healthcare facilities which had implemented product selection practices were 2.208 times more likely to achieve health commodity security compared to those that had not implemented inventory management practices.

The regression findings further indicated that quantification has a significant effect on health commodity security (P value < 0.05). Moreover, the findings showed that those healthcare facilities which had implemented quantification practices had a higher chance of achieving health commodity security compared to those that had not (Odds = 0.672). Specifically, the healthcare facilities which had implemented quantification practices were 0.672 times more likely to achieve health commodity security compared to those that had not implemented inventory management practices.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary, conclusion and recommendations of the study as per the study objectives. Specifically, the chapter presents a descriptive and inferential findings summary, followed by conclusions, recommendations for policy, and recommendations for practice and suggestions for further studies.

5.2 Summary of the Findings

This study sought to establish the influence of supply chain management practices on health commodity security among level four public hospitals in Nairobi County, Kenya. Specifically, the study sought to establish the influence of product selection, quantification, procurement and inventory management on health commodity security among level four public hospitals in Nairobi County, Kenya. This study was anchored on the Supply Chain Operations Reference (SCOR) model, Transaction Cost Theory and Supply Chain Management Theory. It further adopted a descriptive research design. The target population was 120 who comprised of top management team, procurement officers, stores clerks, pharmaceutical officers and head of departments who were drawn from four level four public hospitals in Nairobi County that included Mbagathi Hospital, Pumwani Maternity Hospital, Mama Lucy Kibaki Hospital and Mutuini Hospital. The study adopted a stratified sampling method and a structured questionnaire was used to collect quantitative data which were analyzed through descriptive and inferential methods that included Spearman Rank Correlation as well regression analysis. A summary of the key findings is discussed in the following sub-sections.

5.2.1 Influence of Product selection on Health Commodity Security

Correlation analysis results indicated that there existed a positive and significant relationship between product selection and health commodity security. The logistics regression analysis results indicated that product selection positively and significantly influenced health commodity security among level four public hospitals in Nairobi County, Kenya.

5.2.2 Influence of Quantification on Health Commodity Security

Correlation analysis results indicated that the relationship between quantification and health commodity security was positive and statistically significant. The regression analysis results indicated that quantification positively influenced health commodity security among level four public hospitals in Nairobi County, Kenya.

5.2.3 Influence of Procurement on Health Commodity Security

Correlation analysis results indicated that the relationship between procurement and health commodity security was positive and statistically significant. However, in a combined set up, the logistics regression analysis results indicated that procurement did not significantly influence health commodity security among level four public hospitals in Nairobi County, Kenya.

5.2.4 Influence of inventory management on Health Commodity Security

Correlation analysis results indicated that the relationship between inventory management and health commodity security was positive and statistically significant. The multiple regression analysis results indicated that inventory management positively influenced health commodity security among level four public hospitals in Nairobi County, Kenya.

5.3 Conclusion

The study concludes most level 4 public hospitals in Nairobi County had put in place some product selection practices although other practices had been implemented to a low extent. Some of the practices adopted were product selection committees were available in the facilities, the user departments were involved in product selection, the NEML (National Essential Medicine List) copy was always available and accessible in the facility, and product selection committee used the EML to select products which were all registered for use in the country. Furthermore, it can be concluded that adopting these product selection practices is associated with higher chances of achieving health commodity security.

Another conclusion is that most level 4 public hospitals in Nairobi County had put in place some quantification practices although other practices had been implemented to a low extent. Some of the practices adopted include having a quantification team of expertise, quantification of essential health products and technologies required in the facility was done annually and quarterly, user department was involved in quantification of the commodities needed. In addition, it can be concluded that adopting these quantification practices is associated with higher chances of achieving health commodity security.

The study also concludes that most level 4 public hospitals in Nairobi County had put in place some inventory management practices although other practices had been implemented to a low extent. Some of the practices which had been implemented were having a well-defined and clear procedure of ordering commodities from the general store/ pharmacy, the facilities had inspection and acceptance committee, the inspection and acceptance team confirmed orders against the delivery notes upon receiving

commodities from the suppliers, the inventory tools were available, accessible and regularly updated (stock/ bin cards, control cards). Moreover, it can be concluded that adopting these inventory management practices is associated with higher chances of achieving health commodity security. Lastly, it can be concluded that adoption of procurement practices is not associated with higher chances of achieving health commodity security.

5.4 Recommendations

Based on the study findings that implementation of product selection practices is significantly associated with higher chances of achieving health commodity security, the study recommends the SCM departments of the current level 4 hospitals in Nairobi County to focus on enhancing adoption of these practices. Some of the product selection practices which have been adopted to a low extent and need improvement include needs assessment of products for local disease patterns and having an easily accessible NEML copy.

Given the findings that implementation of quantification practices is significantly associated with higher chances of achieving health commodity security, the study recommends the SCM departments of the current level 4 hospitals in Nairobi County to focus on enhancing adoption of these practices. Some of the quantification practices which have been adopted to a low extent and need improvement include involvement of the user department in quantification of the commodities needed and regular update of records on medical products.

Since it was established that implementation of inventory management practices is significantly associated with higher chances of achieving health commodity security, the study recommends the SCM departments of the current level 4 hospitals in Nairobi

County to focus on enhancing adoption of these practices. Some of the inventory management practices which have been adopted to a low extent and need improvement include the inspection and acceptance team confirming orders against the delivery notes upon receiving commodities from the suppliers, availability, Accessibility and regular update of inventory tools (stock/ bin cards, control cards), FIFO and FEFO practices.

The study findings are expected to be beneficial to KEMSA, which will highlight the key SCM practices critical in ensuring commodity security. Since the authority is mandated to procure and supply health commodities on behalf of the national and county governments, it can benefit from this study by establishing the vital SCM practices, which can enhance its procurement process. This will in turn speed the achievement of UHC. Given the fact that UHC is on the political agenda, the results of this study will feature policies and recommendations for policy makers and the county government to formulate appropriate SCM frameworks to enhance performance of UHC program through improved commodity security.

5.5 Areas for Further Research

While the study successfully established the influence of supply chain management practices on health commodity security among level four public hospitals in Nairobi County, Kenya, it presents areas that need further analysis. There is a need for a similar study focusing on other 46 Counties in Kenya and see whether the results will be replicated. A study can be conducted in the future to establish the other supply chain practices.

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APPENDICES

Appendix I: Informed Consent form

Kenya Methodist University
P.O Box 267-60200
MERU, KENYA

SUBJECT: INFORMED CONSENT

Dear Respondent,

My name is Fridah Kaitany a student at Kenya Methodist University pursuing Master's degree in Health Systems Management. I am conducting a study that seeks to find out the ***influence of supply chain management practice on commodity security among level four public hospitals in Nairobi County, Kenya***. I wish to request for permission from you to participate in this study by providing information that will allow me complete the study.

Study purpose

The study aims at finding out the influence of supply chain management practices on health commodity security among level four public hospitals in Nairobi County, Kenya. The study results will help strengthen supply chain management practices to attain commodity security among all level four public hospitals in Nairobi County.

Procedure to be followed

Participation in this study involves answering questions which will be asked in a research questionnaire. You are required to fill in your responses in the spaces provided or be interviewed by the researcher. Participation in this study is voluntary and you have a right to refuse to participate, refuse to respond to any questions, stop the

interview and ask any questions related to the study at any time. Therefore you shall not be penalized or victimised for declining to participate.

Risks or Discomfort: There will be no risks or harm involved if you participate in the study. The exercise may interfere with your daily work routine, however, I will be glad if you take your time to participate in the study.

Benefits of this study: The respondents are expected to benefit from the study through the recommendations which is expected to inform decision making, by promoting a better understanding of the influence of supply chain management practices on health commodity security among level four public hospitals in Nairobi County, Kenya which can spur policy recommendations for improvement.

Rewards

There is no reward for anyone who chooses to participate in this study.

Confidentiality: Your work and contribution in this study will be confidential. For confidentiality and privacy, no name will be recorded on the questionnaires. All records will be maintained in secure database at the university. Your part in this study is confidential within legal limits. Your privacy will be protected unless they are required by law to report information to county or national authorities, or to give information to a court of law. Otherwise, none of the information will identify you by name.

Contact Information

If you have any questions you may contact the following supervisors:

1. Dr. Muthoni Mwangi,

   Kenya Methodist University, Nairobi campus

   Department of health systems management

   Mobile No. 0722986349

2. Dr. Keziah Njoroge**,**

   Kenya Methodist University, Nairobi campus

   Department of health systems management

   Mobile No. 0738970746

Participant's Statement

The above statement regarding my participation in the study is clear to me. I have been given a chance to ask questions and my questions have been answered to my satisfaction. My participation in this study is entirely voluntary. I understand that my records will be kept private and that I can leave the study at any time. I understand that I will not be victimized at my place of work whether I decide to leave the study or not and my decision will not affect the way I am treated at my workplace.

Name of Participant…….

Date…….. Signature…….

Investigator's Statement

I, the undersigned, have explained to the volunteer in a language s/he understands the procedures to be followed in the study and the risks and the benefits involved.

Interviewer…… Date…….

Interviewer Signature……

Appendix II: Study Questionnaire

INSTRUCTIONS TO RESPONDENTS

This questionnaire seeks to establish **Influence of supply chain management practices on health commodity security among level four public hospitals in Nairobi County, Kenya.** This is an academic survey and the information obtained through this questionnaire will be treated confidentially and not used for any other purpose other than academic research. Please attend to all the questions in this questionnaire by ticking in the brackets or filling in the required information on the spaces provided.

Questionnaire number _____

SECTION A: GENERAL INFORMATION

1. Name of facility _____
2. What is your gender?
   a) Female [ ]
   b) Male [ ]
3. What is your age bracket?
   a) 20- 30 [ ]
   b) 31- 40 [ ]
   c) 41-50 [ ]
   d) 51-60 [ ]
4. Position of the respondent
   a) Management team [ ]
   b) Procurement [ ]
   c) Stores Clerk [ ]

d) Pharmaceutical Officer [ ]

e) Head of Department [ ]

5. Work Experience

a) Less than 5 Years [ ]

b) Between 6 – 10 Years [ ]

c) More than 10 Years [ ]

PART B: PRODUCT SELECTION (PS)

6. Kindly indicate your level of agreement with the following statements on product selection. Use a scale of 1-5 where 1 = Strongly Disagree; 2 = Disagree; 3= Neutral; 4= Agree and 5= Strongly Agree.

	Statements	1	2	3	4	5
PS1	Product selection committee is available in the facility					
PS2	User departments are involved in product selection					
PS3	The NEML (National Essential Medicine List) copy is always available and accessible in the facility					
PS4	Product selection committee uses the EML to select products					
PS5	Content of the EML is well mastered					
PS6	Products selected are all registered for use in the country					

PS7	Products selected are not always available in the EML					
PS8	Some products are selected in line with donor requirement					
PS9	Some commodities are sometimes selected based on stock availability in KEMSA					
PS10	Effectiveness, safety and cost are key consideration in product selection					
PS11	Most of the Medical products, vaccines and technologies in the facility are selected and ordered from KEMSA and Central Medical Stores					
PS12	A needs assessment is conducted to establish the products for local disease patterns					

PART C: QUANTIFICATION (QU)

7. Kindly indicate your level of agreement with the following statements on quantification. Use a scale of 1-5 where 1 = Strongly Disagree; 2 = Disagree; 3= Neutral; 4= Agree and 5= Strongly Agree.

	Statements	1	2	3	4	5
QU1	The facility has a quantification team of expertise					
QU2	Quantification of essential health products and technologies required in the facility is done annually					
QU3	Quantification of essential health products and technologies required in the facility is done quarterly					
QU4	Quantification of essential health products and technologies required in the facility is done monthly					
QU5	Frequent stock outs of essential medicines and products is not experienced in the facility					
QU6	User department is involved in quantification of the commodities needed					
QU7	The committee factors in the cost of commodities before procurement					
QU8	Before procurement, costs are compared with available funds					

QU9	Costs of commodities and drugs are affordable to the patients and clients					
QU10	Records on medical products, vaccines and technologies are regularly updated in the inventories for future quantification					

PART D: PROCUREMENT (PR)

8. Kindly indicate your level of agreement with the following statements on procurement. Use a scale of 1-5 where 1 = Strongly Disagree; 2 = Disagree; 3= Neutral; 4= Agree and 5= Strongly Agree.

	Statements	1	2	3	4	5
PR1	The facility has an annual procurement plan that is strictly adhered to					
PR2	Procurement planning and process are vital activities that ensure correct products are ordered, received and ready for consumption by the users					
PR3	e-procurement tool from KEMSA is regularly uploaded on their website for requisitions					
PR4	The procurement process in the facility is regulated according to the public laws and regulations.					
PR5	There is competitive bidding to ensure capable suppliers are selected					
PR6	Clear procurement timelines are always set to ensure delivery within lead time					

PR7	A delivery schedule is always agreed upon on time to avoid delays and stock outs					
PR8	The facility ensures that the needs are well clarified, samples and specifications given, before making orders					
PR9	The tenders are published publicly in a competitive process					
PR10	The facility has a tender opening and evaluation committee					
PR11	The tender evaluation procedure is competitive and transparent to reduce chances of corruption					
PR12	After award of contracts, there is a continuous monitoring process to ensure timely delivery of quality products					

PART E: INVENTORY MANAGEMENT (INV)

9. Kindly indicate your level of agreement with the following statements on inventory management. Use a scale of 1-5 where 1 = Strongly Disagree; 2 = Disagree; 3= Neutral; 4= Agree and 5= Strongly Agree.

	Statements	1	2	3	4	5
INV1	The facility has a well-defined and clear procedure of ordering commodities from the general store/ pharmacy					
INV2	The facility has an inspection and acceptance committee					
INV3	The inspection and acceptance team confirms orders against the delivery notes upon receiving commodities from the suppliers					
INV4	The inventory tools are available, accessible and regularly updated (stock/ bin cards, control cards)					
INV5	The facility has sufficient space for storage of health products					
INV6	The facility has guidelines, policies and rules on storage of health products, vaccines and technologies					
INV7	First In First Out (FIFO) practice is well used in inventory management					
INV8	First Expiry First Out (FEFO) practice is well used in inventory management					

INV9	Physical stock count is always conducted to update inventory and ensure continuous supply of commodities					
INV10	Inventory performance monitoring is always conducted to ensure records are up to date					

PART F: HEALTH COMMODITY SECURITY (HSC)

10. Kindly indicate your level of agreement with the following statements on health commodity security. Use a scale of 1-5 where 1= Strongly Disagree; 2 = Disagree; 3= Neutral; 4= Agree and 5= Strongly Agree.

	Statements	1	2	3	4	5
HSC1	The facility doesn't experience customer complaints in regard to inadequate health products, vaccines and commodities					
HSC2	There is access to regular supply of widely available essential health commodities from KEMSA					
HSC3	The facility has a great ability to obtain affordable quality health commodities from KEMSA					
HSC4	Suppliers are efficient and effective in delivery of health commodities to the facility					
HSC5	The facility does not often experience frequent stock outs of essential medicines and vaccines					
HSC6	The facility does not often experience frequent stock outs of essential non pharmaceutical supplies					

HSC7	Flexibility and reliability is considered during selection of suppliers					
HSC8	Patients and clients can afford and access health commodities as per need/ prescriptions in the facility					
HSC9	Commodities and drugs can be accessed at any time by the users from the facility's pharmacy, medical / surgical store					
HSC10	The facility has the Pharmacy and Poisons board guidelines for good distribution practices for medical products and health technologies in Kenya					
HSC11	The facility has a procurement policy that governs the procurement activities					

-------THE END-------

Appendix III: Research Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **369144**

Date of Issue: **26/August/2021**

RESEARCH LICENSE

This is to Certify that Ms.. Fridah Chebet Kaitany of Kenya Methodist University, has been licensed to conduct research in Nairobi on the topic: Influence of supply chain management practices on health commodity security among level four public health facilities in Nairobi City County, Kenya for the period ending : 26/August/2022.

License No: **NACOSTI/P/21/12497**

369144

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

Appendix IV: Ethical Clearance

KENYA METHODIST UNIVERSITY
P. O. BOX 267 MERU - 60200, KENYA FAX: 254-64-30162
TEL: 254-064-30301/31229/30367/31171 EMAIL: serc@kemu.ac.ke

August 13, 2021 KeMU/SERC/HSM/44/2021

Fridah Chebet Kaitany
Kenya Methodist University

Dear Fridah,

SUBJECT: INFLUENCE OF SUPPLY CHAIN MANAGEMENT PRACTICES ON HEALTH COMMODITY SECURITY AMONG LEVEL FOUR PUBLIC HEALTH FACILITIES IN NAIROBI CITY COUNTY, KENYA

This is to inform you that Kenya Methodist University Scientific Ethics and Review Committee has reviewed and approved your above research proposal. Your application approval number is KeMU /SERC/HSM/44/2021. The approval period is 13th August 2021 –13th August 2022.

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 Kenya Methodist University Scientific Ethics and Review committee.

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 KeMU SERC within 72 hours of notification.

IV. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to KeMU SERC 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 KeMU SERC.

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

Yours sincerely,

Dr. A. WAMACHI
Chair, SERC

REPUBLIC OF KENYA

EXECUTIVE OFFICE OF THE PRESIDENT
NAIROBI METROPOLITAN SERVICES

Telegraphic Address
Telephone +3313002/4
When replying please quote

Kenyatta International Convention Centre
P. O. Box 49130-00100
NAIROBI

REF: EOP/NMS/HS/025

DATE: 26th August 2021

FRIDAH KAITANY
KENYA METHODIST UNIVERSITY
NAIROBI

Dear Ms. Fridah,

RE: RESEARCH AUTHORIZATION

This is to inform you that the Nairobi Metropolitan Services - Health Directorate's Research Technical Working Group (RTWG) reviewed the documents on the study titled "Influence of supply chain management practices on health commodity security among level four public health facilities in Nairobi City county, Kenya.."

I am pleased to inform you that you have been authorized to undertake the study in Nairobi County specifically at Mbagathi Hospital, Mama Lucy Kibaki Hospital, Pumwani Maternity Hospital and Mutuini Hospital. The researcher will be required to adhere to the ethical code of conduct for health research in accordance to the Science Technology and Innovation Act, 2013 and the approval procedure and protocol for research for Nairobi.

On completion of the study, you will submit one hard copy and one copy in PDF of the research findings to the RTWG. In addition, you will disseminate recommendations of the research at a virtual meeting organized by the RTWG. By copy of this letter, the Medical Superintendents – Mbagathi Hospital, Mama Lucy Kibaki Hospital, Pumwani Maternity Hospital and Mutuini Hospital are to accord you the necessary assistance to carry out this research study.

Yours sincerely,

DR. OUMA OLUGA - OGW
DIRECTOR HEALTH SERVICES

-Medical Superintendents – Mbagathi Hospital, Mama Lucy Kibaki Hospital, Pumwani Maternity Hospital and Mutuini Hospital