UTILIZATION OF DATA FOR DECISION MAKING AND PERFORMANCE OF HEALTH SUPPLY CHAIN MANAGEMENT SYSTEMS IN VIHIGA AND KISUMU COUNTIES OF KENYA

FINAL REPORT

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Disclaimer: Findings contained in this report are not opinions of the funders of the study.

Table of Contents

List of tables

List of Figures

ABBREVIATIONS AND ACRONYMS

AMC	Average Monthly Consumption
eLMIS	Electronic Logistic Management Information System
EMMS	Essential Medicines and Medical Supplies
HPTs	Health Products and Technologies
HSCM	Health Supply Chain Management
KEMSA	Kenya Medical Supplies Authority
KHIS	Kenya Health Information System
NACOSTI	National Commission for Science, Technology and Innovation (NACOSTI)
NHIF	National Hospital Insurance Fund
ODK	Open Data Kit (ODK)
OJT	On the Job Training
SD	Standard Deviation
SDGs	Sustainable Development Goals

DEFINITION OF KEY TERMS

1. Utilization of data: Using data to make decisions on the health commodities' supply chain
2. Approaches in management of health commodities: Models or interventions used to ensure proper management of health commodities
3. Performance of the health supply chain system: ability for a health supply chain system to be resilient, enhance care, increase satisfaction among healthcare service providers and better position health systems to achieve the vision of providing care to all, at all times.
4. Leadtime: Time from ordering commodities to receipt from the suppliers
5. Perfect Order Index: measures the error-free rate of the entire supply chain process
6. Cash to Cash Time: measures the days between (1) the purchase of materials/inventory from a supplier and (2) payment collection for sale of the resulting product(s)
7. Supply Chain Cycle Time: an all-encompassing metric measuring how long it would take to complete a customer's order if all inventory levels were zero at the time the order was placed. This metric is the sum of the longest possible lead times for every stage of the supply chain cycle.
8. Fill Rate: The percentage of customer orders fulfilled completely and on time.
9. Inventory Turnover: The rate that inventory stock is sold, or used, and replaced
10. Essential Medicines and Medical Supplies: health commodities that satisfy the priority health care needs of the population. They can save lives, reduce suffering and improve health. They are selected based on disease prevalence, public health relevance, evidence of clinical efficacy and safety, comparative costs and cost-effectiveness.
11. Health products and technologies includes human medicines, medical products, medicinal substances, vaccines, diagnostics and medical devices. Health technologies means the application of organized knowledge and skills in the form of devices, medicines, vaccines, procedures and systems developed to solve a health problem and improve the quality of life.
12. Data Consistency: The level of accuracy, completeness, congruence and correctness of various types of commodity data (Beginning balance, commodities received, commodities dispensed, negative and positive adjustments, losses and closing balance).
13. Data Concordance: The level of agreement between variables in different data sources (Daily activity register, Monthly summary, KHIS)

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EXECUTIVE SUMMARY

Data is an important asset to health care providers and decision makers. Almost all activities in a modern health system generate data – demographic, clinical, administrative, and financial. These data contain valuable information, including how treatments, drugs, medical devices and medical products perform in routine clinical use. Research shows that data plays the roles of gaining competitive advantage, optimization of resources, cost reduction, value creation, accuracy, accountability and hedging uncertainty. Use of data is specifically very critical in health supply chain management.

This study aimed at assessing the level of utilization of data for decision making and potential effects on the performance of the health supply chain systems in Vihiga and Kisumu Counties of Kenya. Further, the study evaluated best practices in health supply chain risk management and recommendations on how to build resilience. The study compared the situation in Kisumu county vis-a-vis Vihiga county between 2020 and 2022. Specific objectives of the study include: i) To assess availability and accessibility of health supply chain data in Vihiga and Kisumu Counties of Kenya; ii) To assess the quality of health supply chain data in Vihiga and Kisumu Counties; iii) To examine the level of utilization of health supply chain data to make decisions on performance of the supply chain system at various levels (Facility, Subcounty, County) in Vihiga and Kisumu Counties; and iv) To explore best practices, challenges and recommendations for health supply chain systems in Vihiga and Kisumu Counties.

The study employed a cross sectional descriptive comparative survey that utilized mixed methods to unearth the use of data for decision making for health supply chain. The design was critical in enabling the researchers to understand the differences and similarities in management of health commodities in Vihiga and Kisumu Counties. Three data collection techniques used were a questionnaire built on a 5-point Likert scale, qualitative key informant interview guide and data abstraction.

The study found that there was high level of agreement among participants on perceptions of utilization of data on Health Products and Technologies (HPTs) (Vihiga mean score 4.35, SD=0.7 and Kisumu mean score of 4.07, SD=0.79). Moderate levels of agreement were recorded on approaches used for HPT management in the two counties (Vihiga mean score 3.97, SD=0.82; Kisumu mean score 3.86, SD=1.00). The study established that there were relatively high levels of concordance and consistency of various data sets of above 85% in data captured on the summary sheets and the Kenya Health Information System across the three years (2020, 2021, 2022). On performance of the health supply chain systems, the study established moderate levels of agreement in perception (Vihiga mean score of 3.417, SD=0.783; Kisumu mean score 3.515, SD=0.957). Using a linear regression model, the study determined that utilization of data for decision making, quality of data and availability and accessibility could significantly potentially influence performance of health supply chain systems by up to 24% in both Counties based on the perspectives and opinions of the commodity managers interviewed. The study established that there was a statistically significant difference in the lead times for Essential Medicines and Medical Supplies (EMMS) with Kisumu having a lower lead time due to provision of the right for health facilities to do decentralized procurement of health commodities.

This study recommends the need to invest in human resources for management of HPTs in counties. The study calls for increased budgetary allocations to HPTs in both Counties based on estimates in the Quantification and Forecasting Reports. In addition, the study calls for uptake of some best practices such as quarterly integrated commodity supportive supervision, and use of technology in enhancing processes in management of HPTs in the Counties. Generation of high-quality data and its use to make evidence-based decision making is critical for improved performance and resilience of the health supply chain systems.

This report is organized into six key chapters namely 1. Introduction; 2. Literature Review; 3. Research Methods; 4. Key Findings; 5. Interpretation and Discussion of the Results; 6. Conclusion and Key recommendations. The last part of the report (Epilogue) provides a summary of the key deliberations that were held between the research team and top departmental leadership from Vihiga and Kisumu Counties during dissemination and validation of the preliminary findings held on the 8th day of September 2023. The report also provides the annexes including the data collection tools and approvals.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

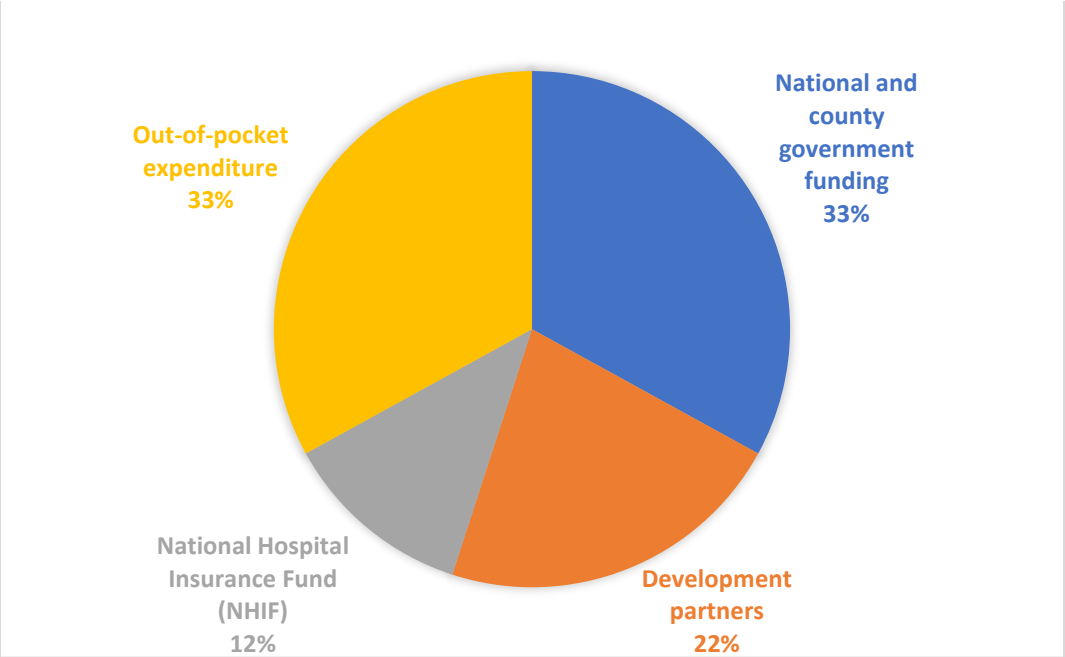
Data is an important asset to health care providers and decision makers. Almost all activities in a modern health system generate data – demographic, clinical, administrative, and financial. These data contain valuable information, including how treatments, drugs, medical devices and medical products perform in routine clinical use. Research shows that data plays the roles of gaining competitive advantage, optimization of resources, cost reduction, value creation, accuracy and accountability and hedging uncertainty. Use of data is specifically very critical in health supply chain management. Prescriptive data collected from routine service provision can inform the health commodities' needs of the population. This information is useful in informing budgeting for commodities, selection, ordering, stocking, distribution and dispensing/use dispensation of the health commodities.

Health Supply Chain Management (HSCM) is key towards assuring the availability of quality Health Products and Technologies (HPTs) that meet the healthcare needs of the targeted populations (Mwencha et al., 2017). Essential medicines are key in achieving goal 3 of Sustainable Development Goals (SDGs) set out by the United Nations. An uninterrupted supply and use of the essential medicines are made possible through an effective HSCM system. Inventory management is an important component of HSCM. Records for inventory management activities and records such as HPT selection, ordering, receiving, storage, use and reverse logistics of HPTs inform data on supply chain performance (Ministry of health Kenya, 2020). Important metrics for HSCM information systems include stock-on-hand (availability of required HPTs), adjustments, demand data, issue data, consumption data, losses or stock wastage data and order lead time data. Descriptive, diagnostic and prescriptive data on the above are important in supporting management decisions in health organizations and protecting the supply chain systems from risks (Watson, et al.,2013). Risks to the supply chain may be as a result of disasters and outbreaks. During such times health systems find themselves suffering from lack of commodities and requisite human resources for the health supply chain. Data is also critical for trend analysis and prediction of future outcomes.

With devolution of health services in Kenya, Counties have been given the mandate to procure/order commodities from the central store at the Kenya Medical Supplies Authority (KEMSA). The Country has adopted a pull system where health facilities prepare orders and submits to the Sub County and County management for upload onto the KEMSA Logistics Management Information System (LMIS). KEMSA then uses the last mile approach to deliver the commodities directly to the health facilities. The County Governments' leadership have a role of allocating resources for the purchase of health commodities required by their health facilities. Out of the total budget allocated to the National Ministry of Health it is estimated that 13 percent is allocated for health products and technologies.

There are four major funding sources for HPTs in Kenya including National and county governments, development partners, National Insurance Fund (NHIF) and out-of-pocket expenditure by households as shown in **Figure 1.**

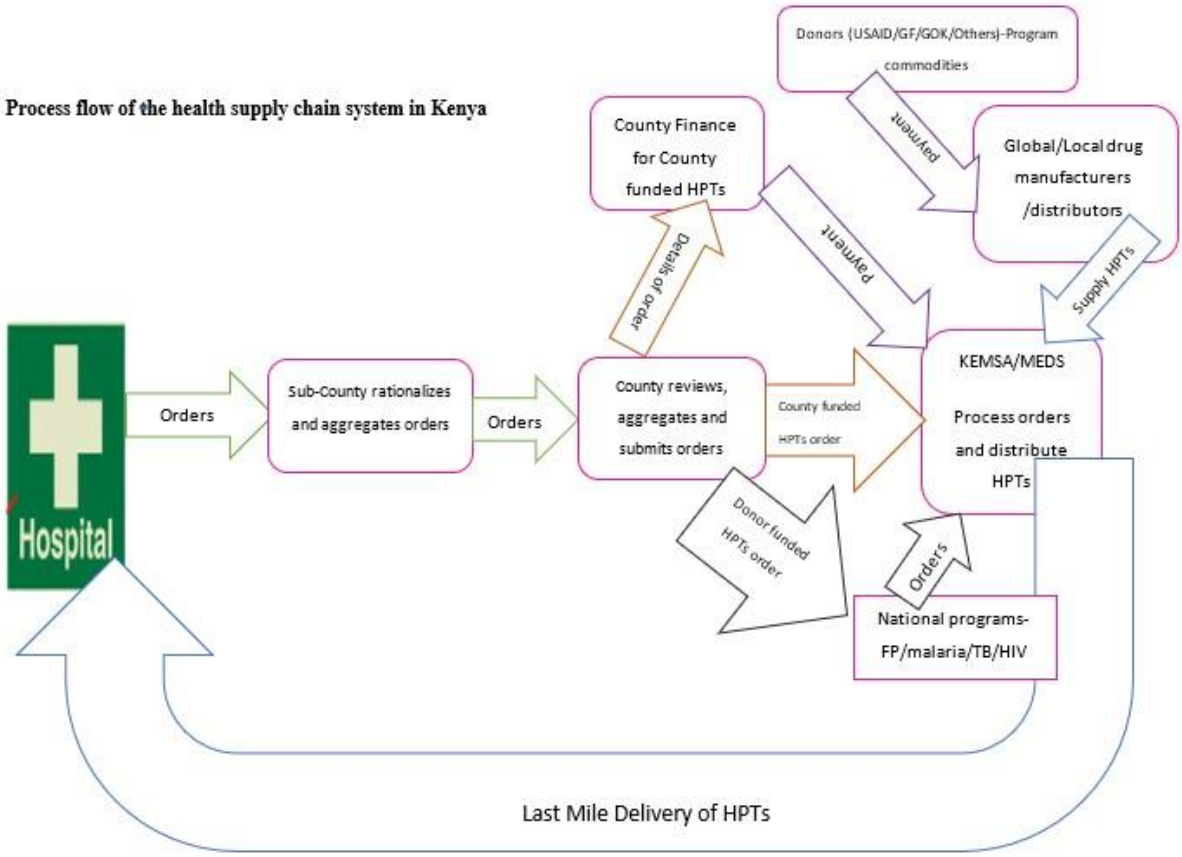
Figure 1: Funding Sources for HPTs in Kenya



Source: Data from Guidelines on Management of HPTs in Kenya (2020)

Development partners through donor investment support specific HPTs that include HIV/AIDS, Tuberculosis, Malaria, Nutrition commodities, vaccines and Family Planning commodities (Ministry of Health Kenya, 2020). The process of ordering and receipt of health commodities is shown in **Figure 2.**

Figure 2: *Process Flow of Commodity Ordering and Receipt in Kenya*



Source: Researchers' perspective

1.2 Study Location

Kisumu County

Kisumu County is one of 47 counties in the Republic of Kenya. Its headquarters is Kisumu City which is the third largest city in Kenya after the capital Nairobi and the coastal city of Mombasa. It has a population of 1,155,574 (according to the 2019 National Census[1]). The population is expected to increase to 1,329,805 by the year 2027. The land area of Kisumu County totals 2,085.9 km^2. Kisumu County's neighbors are Siaya County to the West, Vihiga County to the North, Nandi County to the North East and Kericho County to the East. Its neighbor to the South is Nyamira County and Homa Bay County is to the South West. The county has a shoreline on Lake Victoria. The County has a total of 211 health facilities of which 128 are public (government-owned) while 82 are private and faith-based.

Vihiga County

Vihiga County is the second smallest County in Kenya. Its headquarters is in Mbale town. According to the 2019 census, Vihiga County had a population count of 590,013 individuals. Projections suggest that the population is expected to increase to 634,074 individuals by the year 2027. The land area of Vihiga totals 531.3Km^2. Vihiga County neighbors Kisumu County to the South, Nandi County to the East, Kakamega County to the North and Siaya County to the West. The County has a network of 147 health facilities. Among these, 75 are public (government-owned) health facilities, 9 are faith-based facilities and 63 are private healthcare facilities, collectively contributing to the overall accessibility and availability of healthcare services for the residents of Vihiga County.

Kisumu (with malaria prevalence of 18%) and Vihiga (malaria prevalence of 9%) are among the malaria lake endemic counties which have higher prevalence than the national average. Other malaria lake endemic counties in Kenya are: Siaya, Migori, Homabay, Kakamega, Bungoma and Busia. **Figure 3** presents the location of both Vihiga and Kisumu counties in Keya.

Figure 3: *Location of Kisumu and Vihiga Counties on the Map of Kenya*

Source: Wikipedia

1.3 Research Goal

This study aimed at assessing the level of utilization of data for decision making and potential effects on the performance of the health supply chain systems in Vihiga and Kisumu Counties of Kenya. Further, the study evaluated best practices in health supply chain risk management and recommendations on how to build resilience. The study compared the situation in Kisumu county visa-vis Vihiga county between 2020 and 2022.

1.4 Specific Objectives

1. To assess availability and accessibility of health supply chain data in Vihiga and Kisumu Counties of Kenya;
2. To assess the quality of health supply chain data in Vihiga and Kisumu Counties;
3. To examine the level of utilization of health supply chain data to make decisions on performance of the supply chain systems in Vihiga and Kisumu Counties;
4. To explore best practices, challenges and recommendations for health supply chain systems in Vihiga and Kisumu Counties.

1.5 Research questions

1. To what extent is data on health supply chain available and accessible in Vihiga and Kisumu Counties of Kenya?
2. What is the quality of health supply chain data in terms of concordance and consistency in Vihiga and Kisumu Counties?
3. What is the level of utilization of health supply chain data to make decisions on performance of the supply chain systems in Vihiga and Kisumu Counties?
4. What are some of the best practices, challenges and recommendations for health supply chain systems in Vihiga and Kisumu Counties?

1.6 Performance of health supply chain systems

Supply chain performance refers to how effective each stage of the supply chain is in optimizing costs, reducing inefficiencies, improving speed and meeting customer expectations. There are five key measures of performance of a supply chain system namely: Perfect Order Index (measures the error-free rate of the entire supply chain process); Cash-to-Cash Time; Supply Chain Cycle Time; Fill Rate; and Inventory Turnover. This study measured performance of the health supply chain system in Vihiga and Kisumu Counties based on lead times, order fill rate (quantity ordered vs quantity delivered by supplier), days of stock out, inventory management and perceptions of commodity managers and key decision makers on the performance of the health supply chain system.

1.7 Theoretical Framework

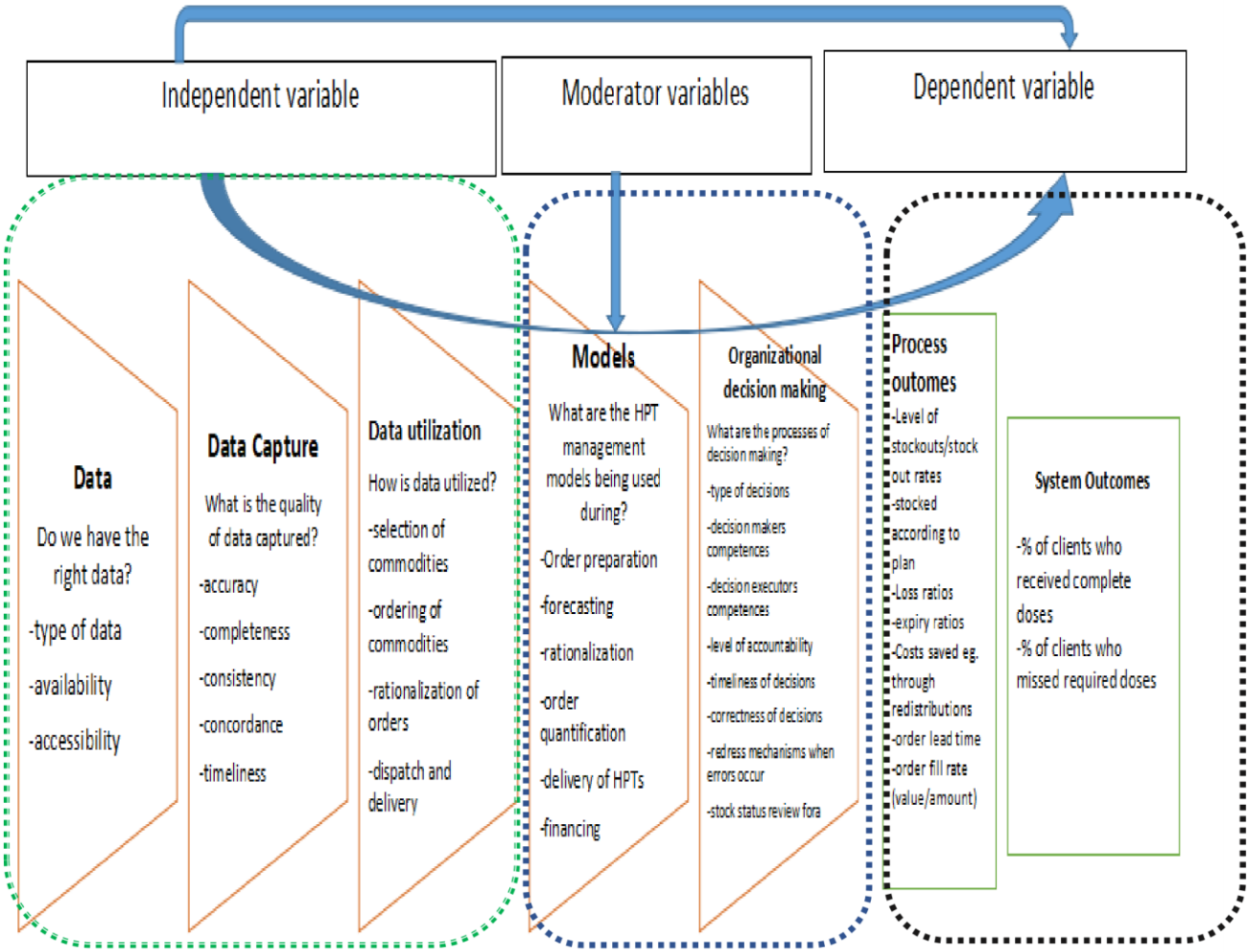
The study was based on the rational choice theory. According to Eisenhardt & Zbaracki, (1992) the theory assumes that decision makers have clear goals, have all the data they need to analyze multiple alternatives and that they desire to maximize the effectiveness of their institution by making the optimum choice. The study assumed that stakeholders or individuals working within the health supply

chain systems in the two counties have all the necessary information and that the decisions they make are logically arrived at based on the data available.

1.8 Logical framework of the study

The study examined the relationships between two key variables namely: i) utilization of data for key decision making within the health supply chain (the independent variable) and ii) performance of the supply chain systems (the dependent variable). To fully make sense of the independent variable, the study examined the type of data available and accessible, the quality of data (consistency and concordance) and various aspects of data utilization such as during selection, ordering, rationalization and dispatch. Performance of the supply chain systems was examined in terms of level of stockouts/stock out rates, loss/expiry ratios, costs saved e.g. through redistributions and lead time on delivery. The study also considered the models or approaches employed during processes within the supply chain and decision-making processes as some of the key variables that could affect the relationship between the independent and dependent variables. **Figure 4** presents the logical framework of the study.

Figure 4: *Logical Framework for the Study*



Source: *Researchers' perspective*

CHAPTER TWO:

LITERATURE REVIEW

2.1 Introduction

This chapter presents both empirical and theoretical evidence or information related to the study. The chapter provides literature on definition and aspects of health supply chain management systems, utilization of data to make decisions in health supply chain systems, health supply chain systems during emergencies and performance of health supply chain systems. The information is provided in terms of the situation globally, in sub-Saharan Africa and in Kenya.

2.2 Definition and aspects of health supply chain systems

The healthcare supply chain is an extensive network of systems, components, and processes that collectively work to ensure medicines and other healthcare supplies are selected, quantified, manufactured, distributed and provided to patients. Globally, this complex system is established with ample built-in protections to ensure that medications and other medical supplies are manufactured and delivered in a timely fashion – even through pandemics or natural disasters. The most vital of these protections is the supply chain's ability to predict, plan, and react to potential disruptions in one or more links of the chain through a diverse pre-established global network.

There are many players in the healthcare supply chain, such as manufacturers, distributors, retail outlets, health care institutions, product quality control agencies, health insurance providers and regulators. Manufacturers are the first link in the supply chain and make the medicines and healthcare supplies that supply chain actors depend on. Manufacturers manage the distribution of their product from the point of production to wholesalers and in some instances, directly to a pharmacy or hospital. Distributors are the second link in the healthcare supply chain. Distributors purchase drugs and medical products in bulk from manufacturers, and meticulously maintain large stocks in strategic locations across the country. Some wholesalers specialize in dealing with a particular range of products, such as biologics or to specific types of customers, such as nursing care facilities.

Healthcare supply chains take a great deal of time and effort to construct – many beginning years before a medical product is even approved for patient use. For example, developing a supply chain for medicine includes everything from contracting with various suppliers, to ensuring the availability of a manufacturer's highly skilled labor force, to maintaining the critical quality control and testing systems needed to ensure quality, safety and efficacy of the health products. Over decades, the healthcare supply chain has painstakingly assembled substantial global networks to ensure that if one area or link of the chain is compromised, another can fill the gap. Additionally, the supply chain network is constantly investing in the design and ongoing maintenance and modernization of the system itself. These efforts ensure successful delivery of health commodities and help avoid disruptions no matter the current environment.

2.3 Utilization of data to make decisions on health supply chain systems

The sustainability of the supply chain system is pegged on the availability of data to inform supply chain decisions (Badreldin & Atallah, 2021). This is key to enhance evidence-based decision making and limit poor supply chain outcomes that can emerge from heuristic decision making. For a supply chain system to be effective in responding to the needs of consumers at heath facilities and planners, quality consumption data of the health commodities need to be available. Decision making based on supply chain data can help classify the level of supply chain data interrogation and use. Healthcare supply chain data can be pictured as a form of big data due to the potential for big volume, value, velocity and variety of data generated (Alotaibi & Mehmood, 2018). The analysis and use of such data can take a descriptive, predictive and prescriptive analytics approach to inform decision making (Schmarzo, 2015). Descriptive data displays information on what happened regarding supply chain systems and commodities. Predictive data gives a picture of what may happen based on the described data (Schmarzo, 2015). Prescriptive data analysis goes further to recommend what can be done based on available descriptive and predictive data. The latter forms the advanced form of data use. Therefore, the quality of primary data availed through descriptive analytics should have the quality and rigor to assist decision-makers appropriately. However, the availability and utilization of supply chain data is hampered by factors such as accuracy and timeliness of reporting, tracking of supply chain indicators, data archiving and data use (Lugada et al., 2022).

A number of studies have been done on the use of HSCM data for decision making. However, this is more common for what are described as program items or development partner supported essential commodities such as antiretrovirals (Johnson et al., 2021). According to Johnson et al., 2021, demand forecasting and quantity to order were determined based on available consumption data records in all the eight public health facilities assessed in Nyamira county, Kenya. Inventory management tools such as stock-control cards were commonly in use in generating monthly summary reports and making routine ARV orders (Johnson et al., 2021).

Another study in Uganda demonstrated that health facilities often over-ordered or under-ordered health commodities (Okiria & Mpaata, 2016). The same study also found that essential medicines stock outs were more associated with hospitals that did not rely on average monthly consumption (AMC) data than those that relied on AMC data. This suggests failure to utilize consumption data to forecast and quantify for their orders (Okiria & Mpaata, 2016). The study also identified that budgetary allocation was also a determinant of facility stock status level and frequency of stock outs.

2.4. Barriers associated with Supply Chain systems

Supply chain system faces various barriers and challenges in assuring its efficiency. A study done by Lugada et al., (2022) suggests that the assessment of performance of health supply chain systems in countries such as Uganda is hampered due to the presence of many actors in the supply chain system of Uganda. The different actors have different performance assessment matrices, goals, indicators and measures that bring about diversity in evaluation of health supply chain systems in Uganda. In addition, the existence of parallel supply chains (different supply chains operating independent of each other) for similar commodities introduces challenges in harmonization of supply chain performance

measurement. Concerns regarding inadequate data availability to inform supply chain assessment were also an issue in Uganda (Muyingo et al., 2019).

In Kenya, health supply chain systems in various counties are faced with challenges such as frequent stockouts, poor inventory management practices, inadequacies of personnel to manage the health products, weak logistics management system, poor communication, lack of trained health professionals, funding inadequacies, government policy changes that limit task-sharing, poor infrastructure such as non-conducive road networks and poor commodity storage facilities (Barasa et al. (2018); (Mukasa et al., 2017).

2.5 Enablers of health supply chain systems

Health supply chain systems require the existence of qualified and sufficient staff to operationalize them efficiently (Cometto et al., 2014). The availability and performance of human resources has a contribution to health supply chain outcomes. Although there are studies that examine the relationship between human resource and supply chain outcomes, such studies that have a focus on health are limited. The existence of National Logistics Working Groups composed of Ministry of Health and partner organizations for the health supply chain is reported to enhance coordination and decision making for commodity security (Kasonde & Steele, 2017). The existence of relevant human resource policy tends to guide the provision and use of human resources to support supply chain services. However, Kasonde & Steele (2017) report that most of the supply chain roles in health facilities in Africa are performed by staff who lack supply chain-related qualifications. Health staff interviewed cited that a lack of supply chain related curriculum content affected their understanding of supply chain matters in their early service days (Kasonde & Steele, 2017). Human resource capacity development is highlighted as key in enhancing supply chain-related technical and managerial skills. Possible challenges associated with human resource in health supply chain include inadequate skills in commodity management and shortage of personnel. The performance of health supply chain systems depends ultimately on knowledge, skills and motivation of people responsible for managing the supply chain.

Supportive supervision is equally key in enhancing health service provision. It is described as the process of enhancing quality of services through strengthening intra-system relationship by identifying problems and resolving them (Marquez & Kean (2002). It is meant to improve collaboration, teamwork and sustain high standards of service provision. Documentation of gaps, actions and decisions planned to address the gaps, monitoring and evaluation of actions and improvements, and routine follow up on action points are key attributes of supportive supervision (Marquez & Kean, 2002). Madede et al. (2017) demonstrated that supportive supervision can improve the productivity and performance of healthcare workers. The performance improvement was also associated with higher levels of motivation and enhanced healthcare workers voice (Madede et al., 2017). Similarly, Mudogo et al. (2023) showcased how supportive supervision could progressively improve commodity management outcomes at primary health facility level. During supportive supervision, key considerations include planning and establishment of purpose, problem identification, effective communication, participative discussions, effective interpretation of data, solving emerging problems, use of appropriate supervisory tools, setting realistic targets and provision of education where needed (Henry et al., 2017).

2.6 Best Practices linked to health supply chain system

The use of technology to facilitate service provision in health is gaining acceptance worldwide. This is partly informed by the suggested effectiveness and efficiency of service delivery that technology introduces. In Malawi, the introduction of an SMS and a web-based reporting platform for health commodities dubbed cStock used in the community by community health workers saw an improvement in reporting rates for health commodities, increase in report completeness, reduction in lead time for resupply of health commodities and in the stock out rate of health commodities in the communities (Shieshia et al., 2014). The success of the technology applied was influenced by the integration of services in the community and health facility teams, seamless, simplified and prompt flow of information that all contributed to data visibility and availability.

The use of technology allows faster sharing of commodity related data. Some technology such as the use of electronic logistic management information system (eLMIS) and having an operational logistics management unit impacts positively on supply chain outcomes. In Tanzania, the introduction of an eLMIS system to support the supply chain management of certain health commodities such as antiretrovirals, reproductive health commodities, essential medicines and malaria commodities resulted in positive supply chain outcomes (Mwencha et al., 2017). Notable improvements included accessibility and visibility of data, data use, transparency, reduced stock out rates, reduced duration of stock out, reduction in forecast error and commodity expiry. Despite the new eLMIS costing more than the manual capturing of supply chain data, its high cost was partly defrayed by the savings accrued by minimizing losses and enhancing supply chain performance.

CHAPTER THREE:

RESEARCH METHODS

3.1 Introduction

This chapter provides information on the study design, data collection procedures and tools, sampling, data analysis, ethical consideration and study findings dissemination plan.

3.2 Study Design

This study was a cross sectional descriptive comparative survey that utilized mixed methods to unearth the use of data for decision making for health supply chain. The design was critical in enabling the researchers to understand the differences and similarities in management of health commodities in Vihiga and Kisumu Counties.

3.3 Data Collection procedures

The study involved one-on-one interviews with participants. In addition, data were abstracted from key documents (delivery notes, bin cards, daily activity registers, monthly summary forms) and Kenya Health Information System (KHIS) on specific supply chain indicators to be able to corroborate with findings from primary data.

3.3.1 Data Collection tools

The study used the following tools

i) **Structured Questionnaire**

The study used an open-ended questionnaire to collect largely qualitative data which was quantified using a standardized Likert scale where 1=strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree. The questionnaire allowed for narrative explanations. The questionnaire enabled the researchers to collect a wide range of data within the shortest time possible.

ii) **Key informant interview guide**

The study used key informant interview guides to collect qualitative data. The participants in the qualitative study were individuals purposively sampled with the understanding that they have the needed information on the health supply chain management or in positions of decision making.

iii) **Data abstraction forms**

The study reviewed data records at selected facilities and the county level. The type of data abstracted included: quantities ordered by facilities, quantities forwarded by sub county and county, quantities received by KEMSA, quantities delivered at facilities, quantity captured in the bin-cards, date of order, date received at facility, date ran out of stock, beginning balance, quantity dispensed, losses,

negative/positive adjustments, ending balance, quantities expired and budget allocations for HPTs at County level.

Data sources included facility records (delivery notes, bin cards, daily activity registers, monthly summary forms), Kenya Health Information System (KHIS), commodity orders, delivery notes, budgets, annual work plans and Medium-Term Expenditure Framework. Data for years 2020-2022 was abstracted and analyzed.

3.4 Geographical locale

The study was conducted in two Counties in Kenya namely Vihiga and Kisumu. These are two neighboring counties in Western Kenya. The study provided an opportunity for cross learning between Vihiga and Kisumu Counties.

3.5 Sampling

Vihiga and Kisumu have respectively 75 and 146 public health facilities totaling to 221. To determine the sample size for frequency in population we used the formula as shown in **Table 1:**

Table 1: *Sample Size Calculation*

Sample Size for Frequency in a Population

Population size(for finite population correction factor or fpc)(*N*):	221
Hypothesized % frequency of outcome factor in the population (*p*):	50%+/-5
Confidence limits as % of 100(absolute +/- %)(*d*):	5%
Design effect (for cluster surveys-*DEFF*):	1

Sample Size(*n*) for Various Confidence Levels

ConfidenceLevel(%)	Sample Size
95%	141
80%	95
90%	122
97%	151
99%	166
99.9%	184
99.99%	193

Equation

Sample size $n = [DEFF*Np(1-p)]/ [(d^2/Z^2_{1-\alpha/2}*(N-1)+p*(1-p)]$

The sample size was 95 health facilities using a confidence level of 80% as derived from the OpenEpi Table 1. The 95 facilities were proportionately allocated between Vihiga and Kisumu Counties. A

sampling framework of all facilities in each level (Level IV-hospitals, III-health facilities and II-dispensaries) was developed for the two counties. A representative proportionate sample in each level was arrived at as shown in **Annex 1.** Participants in the randomly sampled facilities were purposively selected. They included personnel involved in management of HPT's and key decision makers at the departments of Health, Finance and County Assembly Health committee.

3.6 Inclusion criteria

1. Government owned facilities
2. Health commodity managers
3. Sampled commodities based on specific categories of interest
4. Facilities must have been in operation before 2020

3.7 Exclusion criteria

1. Private and faith-based health facilities because most of them are not supplied with program commodities
2. Health facilities opened from 2020 onwards for lack of data needed to be abstracted.

3.8 Data analysis

a) Quantitative data was analyzed at two levels:

I) Descriptive analysis

This involved analysis on measures of central tendencies such as means, modes and median and measures of dispersion such as standard deviations.

II) Inferential analysis

The analysis examined the relationship between key variables of the study. Inferential statistics involved use of linear regression models to ascertain the influence of the independent variables on the dependent variable of the study.

III) Qualitative data analysis

Qualitative data was analyzed as per the key themes of the study using an appropriate and common thematic framework that was developed iteratively.

All the tools used are presented in **Annex 4.**

3.9 Ethical Considerations

All participants provided consent. The study protocol was approved by the Jaramogi Oginga Odinga University Ethics and Research Committee. A research permit was acquired from the National Commission for Science, Technology and Innovation (NACOSTI). Additional approvals were granted by the departments of health in the two Counties. The approvals are presented in **Annex 3**.

CHAPTER FOUR:

KEY FINDINGS

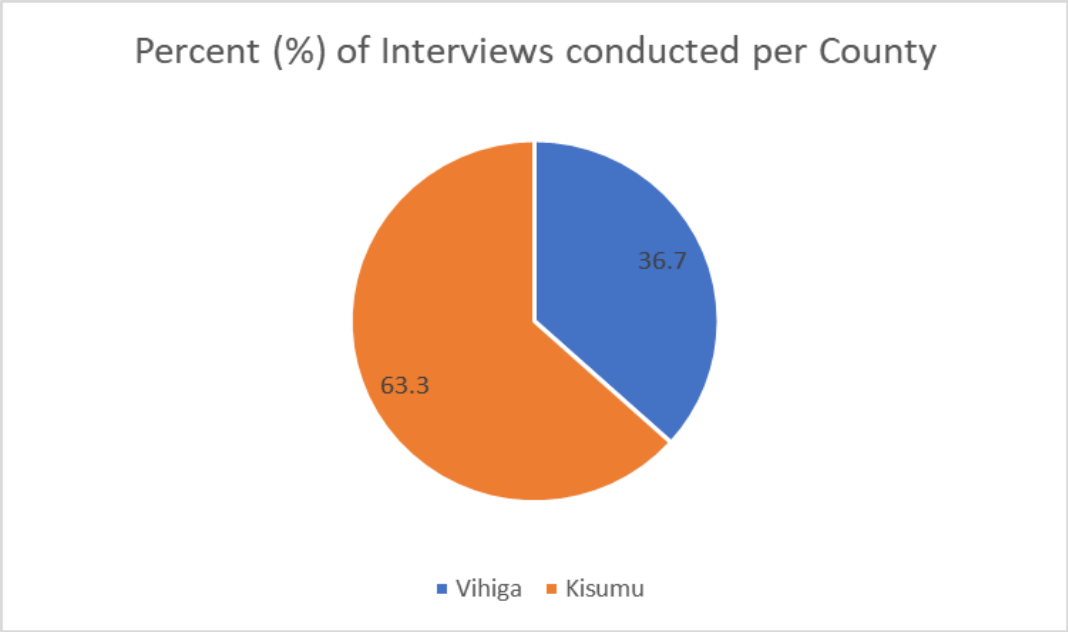
4.1 Introduction

This chapter presents the findings of the study. The findings are categorized and presented as descriptive, inferential and qualitative. Findings address the key objectives of the study.

4.2 General response rate by county

Using the survey questionnaire, the study targeted individuals managing health products and technologies across 95 health facilities (62 in Kisumu and 33 in Vihiga). **Figure 5** presents the distribution of participants who were recruited from the two counties.

Figure 5: *Proportion of Interviews Conducted per County*



The study recruited 46 (36.7%) of the respondents from Vihiga County and 76 (63.3%) of the respondents from Kisumu County. This was based on proportional sampling of facilities in the two Counties. In some cases, especially in high level health facilities, more than one participant was recruited depending on the number of individuals involved in management of health products and technologies for example the facility in charge, the nursing officer in charge of non-pharmaceuticals and the Pharmacy in charge.

4.3 Socio-demographic characteristics of HPT Managers

Data on basic socio-demographic characteristics of the respondents was collected. **Table 2** shows results on some of the socio-demographic characteristics.

Table 2: *Sociodemographic Characteristics of the Participants*

		County			
		Kisumu		Vihiga	
		Frequency (f)	Percent (%)	Frequency (f)	Percent (%)
Gender	Female	47	61.8%	27	61.4%
	Male	29	38.2%	17	38.6%
Age category	25-29	10	13.2%	4	9.1%
	30-34	20	26.3%	6	13.6%
	35-39	21	27.6%	14	31.8%
	40-44	10	13.2%	10	22.7%
	45-49	8	10.5%	4	9.1%
	50-54	4	5.3%	4	9.1%
	55-60	3	3.9%	2	4.5%
Cadre category	Clerical officer	1	1.3%	0	0.0%
	Clinical Officer	4	5.3%	7	15.9%
	Laboratory officer	5	6.6%	6	13.6%
	Nursing officer	41	53.9%	18	40.9%
	Pharmaceutical Technologist	19	25.0%	12	27.3%
	Pharmacist	5	6.6%	1	2.3%
	Public health officer	1	1.3%	0	0.0%
Current position	Clinical Officer	0	0.0%	1	2.3%
	Commodity Nurse	11	14.5%	4	9.1%
	Facility In charge	35	46.1%	20	45.5%
	Laboratory In charge	4	5.3%	6	13.6%
	Pharmacy In charge	22	28.9%	13	29.5%
	Public Health Officer	1	1.3%	0	0.0%
	Store manager	1	1.3%	0	0.0%
	Sub-County Pharmacist	2	2.6%	0	0.0%
Highest education level	Certificate	4	5.3%	1	2.3%
	Degree	14	18.4%	9	20.5%
	Diploma	57	75.0%	33	75.0%
	Masters	0	0.0%	1	2.3%
	PhD	1	1.3%	0	0.0%
	1-9 years	54	71.1%	28	63.6%

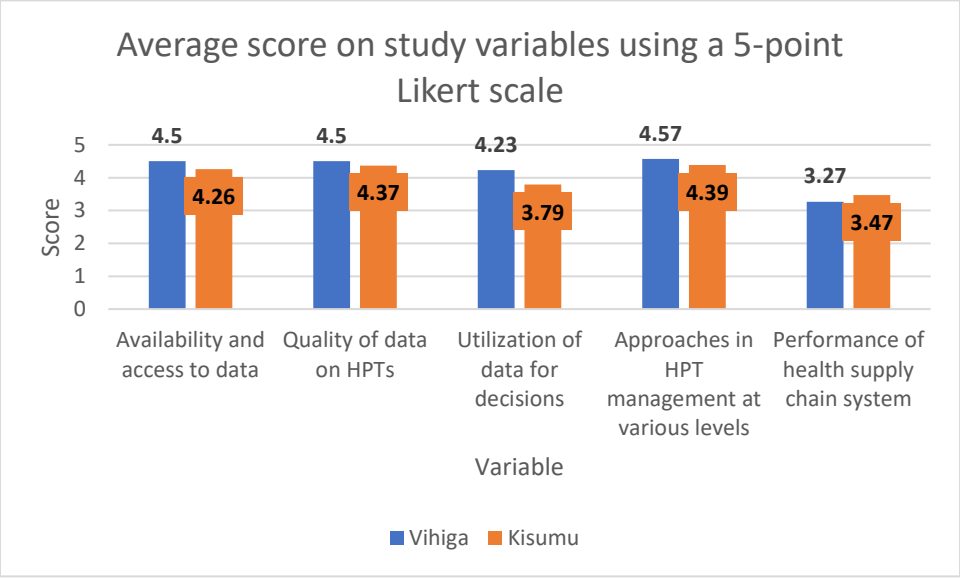
Categories of years of work	10-19 years	18	23.7%	11	25.0%
	20-29 years	2	2.6%	3	6.8%
	30-39 years	2	2.6%	2	4.5%

Most of the respondents interviewed were female in both counties (61.8% in Kisumu and 61.4% in Vihiga County). The most common age category for the respondents was 35-39 years in both counties (27.6% in Kisumu and 31.8% in Vihiga). Notably, nursing officers comprised the most common cadre of personnel managing HPTs in both Kisumu County (53.9%) and Vihiga County (40.9%). Pharmaceutical technologists ranked second at 25% in Kisumu and 27.3% in Vihiga. Most of the personnel managing commodities were found to be facility incharges in both counties (46.1% in Kisumu and 45.5% in Vihiga). Interestingly, the majority of the respondents had a diploma as the highest education level (75% in both counties) while 1-9 years of work formed the majority in both counties (71.1% in Kisumu and 63.6% in Vihiga).

4.4 Overall scores on the study variables

The study explored four key variables. **Figure 6** shows the aggregate scores on the key variables of the study.

Figure 6: *Aggregate Scores on the Key Study Variables*

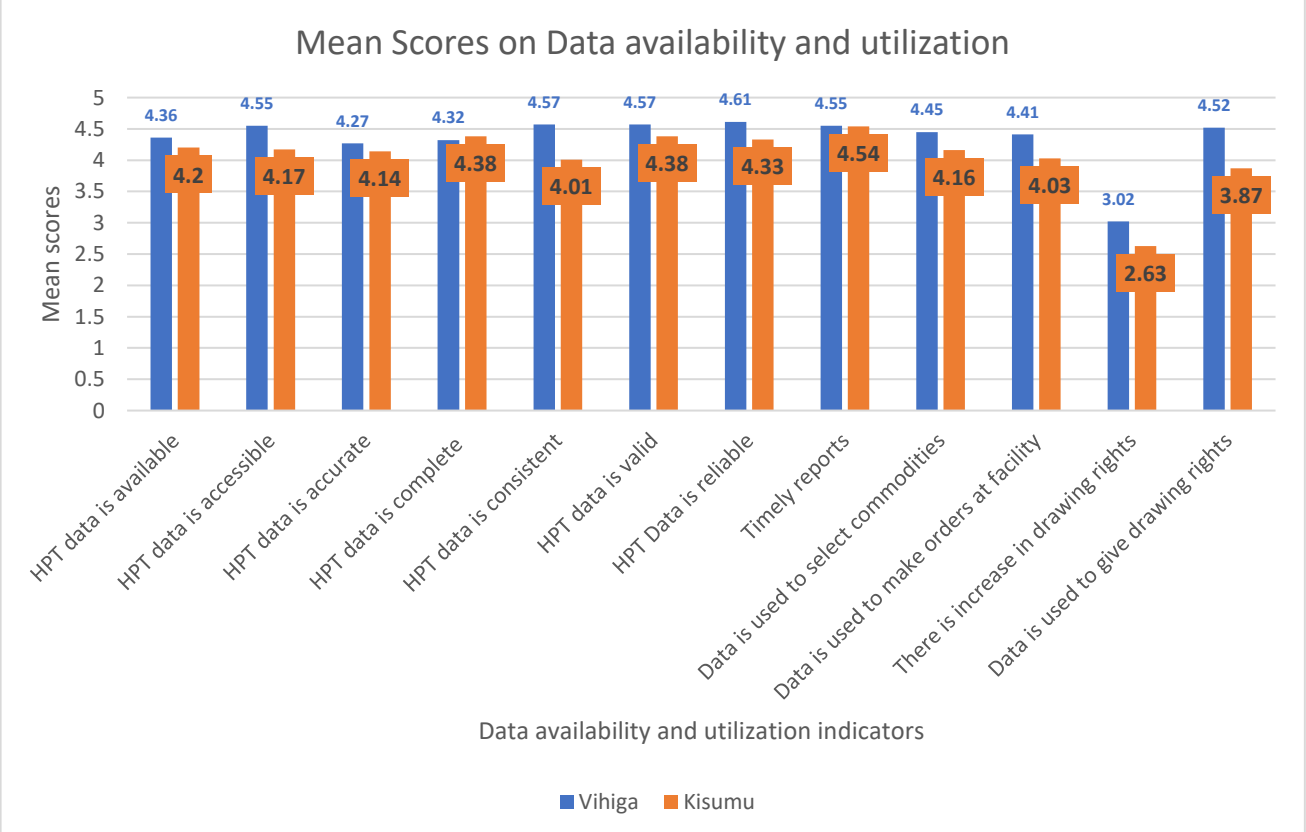


Results show that there was similarity between the two counties on how participants scored on the study variables. On availability and access to data Vihiga had a mean score of 4.5 while Kisumu had a mean score of 4.26. On quality of data Vihiga had a mean score of 4.5 while Kisumu had a mean score of 4.37. As regards utilization of data for decision making Vihiga had a mean score of 4.23 while Kisumu had a mean score of 3.79. On application of best approaches for management of HPTs, Vihiga had a mean score of 4.57 while Kisumu had a mean score of 4.39. Both Counties scored means of below four on performance of the health supply chain systems (Vihiga=3.27; Kisumu=3.47).

4.5 Utilization of data for decision making

The study examined the perspectives of respondents on the key independent variable namely utilization of health supply chain data for decision making. The perspectives were measured using a 5-point Likert scale where 1=strongly disagree, 2=agree, 3=neutral, 4=agree and 5= strongly agree. Various aspects such as availability and access to data, quality of data and utilization of data were assessed using standardized statements. **Figure 7** presents the mean and standard deviation scores of the respondents.

Figure 7: Mean *Scores on Utilization of Data for HPTs*

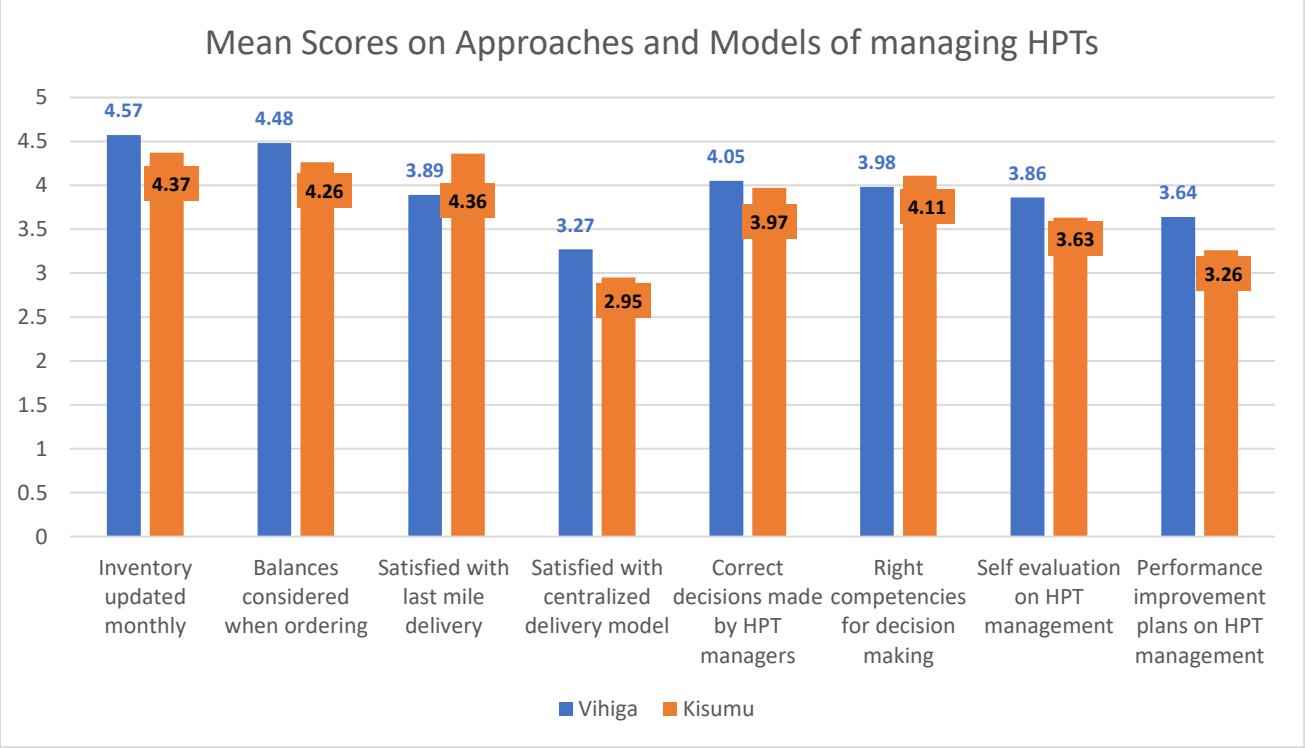


Results show that in Vihiga County the highest score was on the statement that the data generated on HPTs is always reliable with a specific mean score of 4.61 (SD=0.493). Participants from Kisumu scored the highest on the statement that they always submit reports in a timely fashion with a mean score of 4.54 (SD=0.528). The lowest score in both Counties was on the statement that there has been an increase on the facilities' drawing rights for commodities (Vihiga mean score 3.02, SD=1.229 and Kisumu mean score 2.63, SD=1.187). The composite mean scores for the two counties on utilization of data for HPTs were 4.35 (SD=0.7) for Vihiga and 4.07 (SD=0.79) for Kisumu. The quality of data is critical in determining the quality of decisions that can be made. It was important to understand the perceptions of the people handling data as regards its quality so as to know how to work on their knowledge and attitudes to improve the quality if need be.

4.6 Approaches in supply chain management

The researchers examined perceptions among respondents on various approaches used in management of health products and technologies. The perspectives were measured using a 5-point Likert scale where 1=strongly disagree, 2=agree, 3=neutral, 4=agree and 5= strongly agree. The statements were framed on aspects such as performance improvement plans, decision making on HPT management, centralized and last mile delivery models of HPTs as shown in **Figure 8**.

Figure 8: *Mean Scores on Application of Approaches and Models of Managing HPTs*

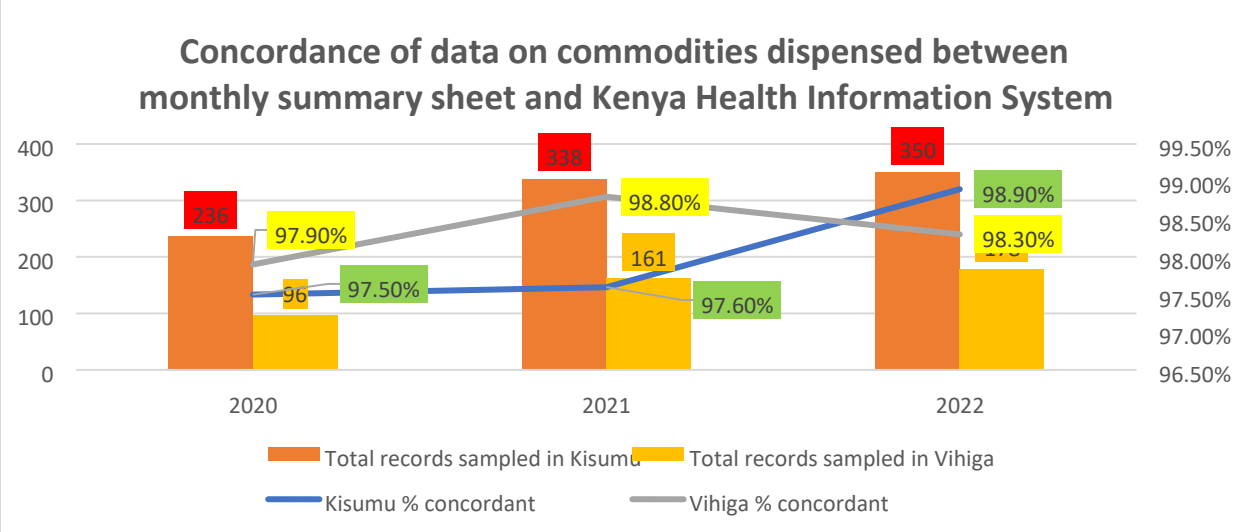


In both Counties, the statement with the highest score was updating of HPT inventory on a monthly basis (Vihiga mean score 4.57, SD=0.818; Kisumu mean score 4.37, SD=0.608). Consequently, in both counties, the statement with the lowest score was that they were satisfied with the centralized mode of delivery of some commodities e.g. For TB and HIV (Vihiga mean score 3.27; SD=1.02; Kisumu mean score 2.95; SD=1.478).

4.7 Concordance in data on commodities across data sources

Data on HPTs is first recorded in primary sources such as daily activity registers. At the end of every month the data is summarized into standard summary reports before being uploaded into the Kenya Health Information System which provides aggregate data. The researchers focused on determining the quality of data by abstracting data from various sources to examine the level of concordance. Data for the last three complete calendar years 2020, 2021 and 2022 were abstracted for analysis. Results on concordance of data on commodities dispensed as recorded on the monthly summary sheet and KHIS are presented in **Figure 9.**

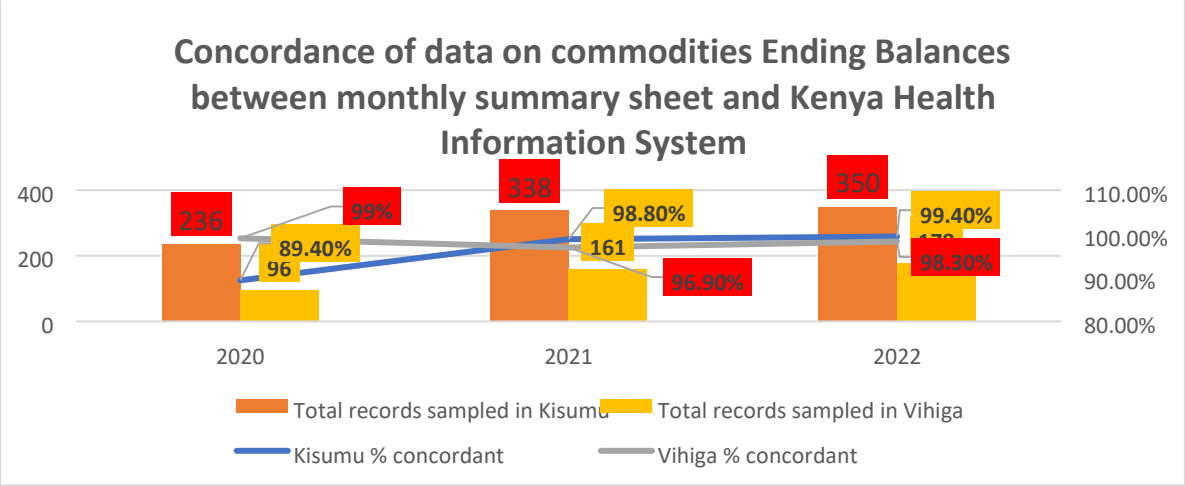
Figure 9: *Concordance in data from data sources*



Results show that across the three years the two counties sustained high levels of concordance of commodities dispensed data as reported on the monthly summary sheet and the KHIS. For Kisumu county 236 records were abstracted in 2020, 338 in 2021 and 350 in 2022. Of all the records abstracted 97.5%, 97.6% and 98.9% were concordant for the three years respectively. For Vihiga County, 96 records were abstracted in 2020, 161 in 2021 and 178 in 2022. Of these, 97.9%, 98.8% and 98.3% were concordant for the three years respectively.

In addition, the researchers examined the level of concordance of data on ending balances as captured on the monthly summary sheet and the Kenya Health Information System. **Figure 10** presents the results.

Figure 10: *Concordance in Data on Commodities Ending Balances*

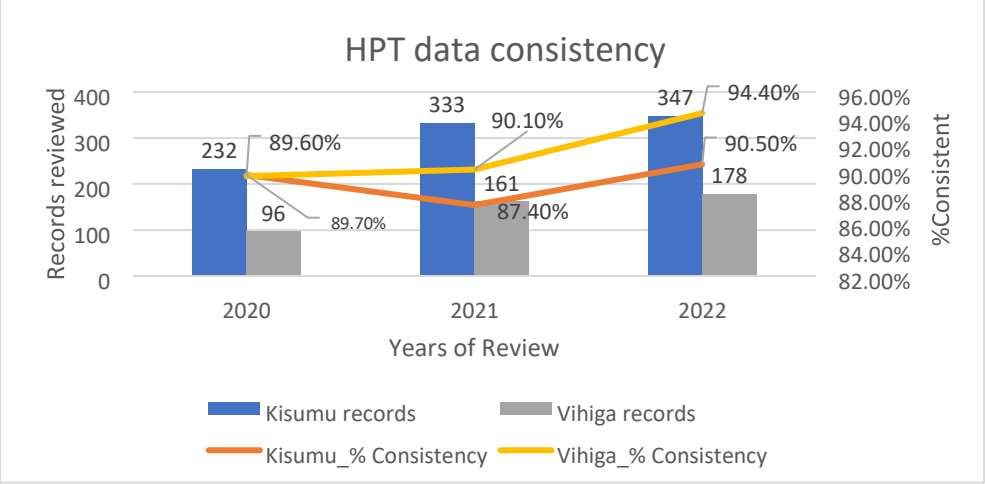


In Kisumu, 236, 338 and 350 records were abstracted for the three years of the study. Of the records abstracted in Kisumu, 89.4%, 98.8% and 99.4% were concordant across the three years respectively. In Vihiga, 96, 161 and 178 records were abstracted across the three years. Of these, 99%, 96.9% and 98.3% were concordant across the three years respectively.

4.8 Consistency in data

The researchers assessed the levels of consistency (correctness and completeness) in data sets across the continuum of inventory management from beginning balances, commodities received, commodities dispensed, positive/negative adjustments, losses and ending balances. **Figure 11** presents the summary of the results.

Figure 11: *Consistency in Data*

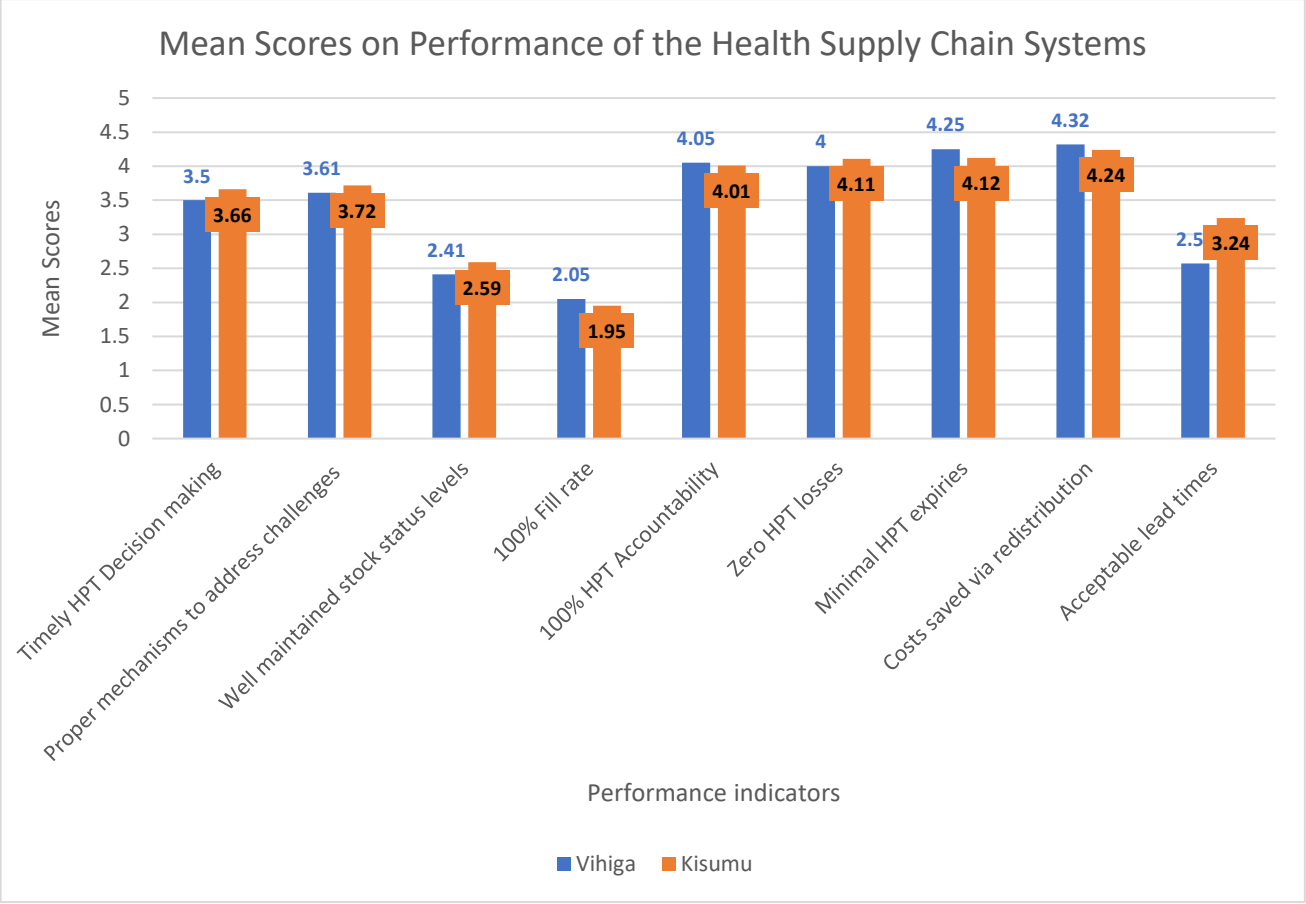


In Kisumu county 232 records were abstracted in 2020, 333 records in 2021 and 347 records in 2022. Of these, 89.7%, 87.4% and 90.5% were consistent across the three years. In Vihiga County 96, 161 and 178 records were abstracted for the three years. Of these, 89.6%, 90.1% and 94.4% of the records were consistent. The data shows some widening gap in the levels of consistency in data between the two counties. There is need for regular commodity supportive supervision and data quality assessments to ensure high levels of consistency are maintained.

4.9 Performance of the health supply chain systems

The researchers assessed performance of the health supply chain systems in the two counties in two ways. One, the researchers used the 5-point Likert scale where 1=strongly disagree, 2=agree, 3=neutral, 4=agree and 5= strongly agree to measure self-assessment of the HPTs' managers on performance of the systems as shown in **Figure 12**.

Figure 12*: Performance of the Health Supply Chain Systems*



The findings show that participants in both counties observed that they were not receiving 100% of the orders. The statement scored the least across all the statements used to assess performance of the health supply chain systems. Participants from Vihiga scored it at a mean score of 2.05 (SD=0.608) and participants from Kisumu also scored it the least with a mean of 1.95 (SD=1.106). On the other hand, participants from both counties scored the aspect of having saved huge amounts and value of commodities as a result of redistribution. Participants from Vihiga had a mean score of 4.32 (SD=0.471) while participants from Kisumu had a mean score of 4.24 (SD=0.586).

The researchers went further to determine whether there were any statistical relationships between key variables of the study namely utilization of data, approaches for HPT management and performance of the health supply chain systems based on the perspectives of the respondents. First, two tests of assumption were conducted on the data, namely multi-collinearity tests and the Linearity tests, to determine the suitability of linear regression models.

4.9.1 Tests of assumption

I) Multicollinearity

Low tolerance values of less than 0.2 are deemed problematic while Variance Inflation Factor (VIF) values of greater than 10 implied presence of multicollinearity between variables. The dependent variable was the composite mean score on performance of the health supply chain systems in Figure 12. Results on multi-collinearity test conducted on the variables of the study are shown in **Table 3**.

Table 3: *Multicollinearity Test*

		Collinearity Statistics	
County	Study variables	Tolerance	VIF
Vihiga	(Constant)		
	Zscore: Availability and access to data	0.603376	1.657341
	Zscore: Quality of data on HPTs	0.665191	1.503328
	Zscore: Utilization of data for decisions	0.954896	1.047234
	Zscore: Approaches in HPT management at various levels	0.85596	1.168279
Kisumu	(Constant)		
	Zscore: Availability and access to data	0.686695	1.456251
	Zscore: Quality of data on HPTs	0.698348	1.431952
	Zscore: Utilization of data for decisions	0.876585	1.140791
	Zscore: Approaches in HPT management at various levels	0.905091	1.104862
Dependent Variable: Performance of supply chain system			

The findings in the table show that there was no multi-collinearity amongst the four variables of the study hence the data was good for assessment of statistical inferential statistical relationships.

II) Linearity

If p value of the deviance from linearity is greater than 0.05 the assumption is that the relationship between independent and dependent variables is linearly dependent hence linear regression analysis can be conducted on the variables (Flatt & Jacobs, 2019). **Table 4** presents the results of the Linearity tests conducted on the variables of the study.

Table 4: *Linearity Tests Tables*

ANOVA Table

County				Sum of Squares	df	Mean Square	F	Sig.
Vihiga	Zscore: Performance of supply chain system * Zscore: Availability and access to data	Between Groups	(Combined)	2.819	2	1.410	1.707	0.194
			Linearity	0.912	1	0.912	1.104	0.300
			Deviation from Linearity	1.908	1	1.908	2.310	0.136
		Within Groups		33.863	41	0.826		
		Total		36.682	43			
Kisumu	Zscore: Performance of supply chain system * Zscore: Availability and access to data	Between Groups	(Combined)	10.872	3	3.624	3.860	0.013
			Linearity	8.447	1	8.447	8.997	0.004
			Deviation from Linearity	2.424	2	1.212	1.291	0.281
		Within Groups		67.598	72	0.939		
		Total		78.469	75			

ANOVA Table

County				Sum of Squares	df	Mean Square	F	Sig.
Vihiga	Zscore: Performance of supply chain system * Zscore: Approaches in HPT management at various levels	Between Groups	(Combined)	2.765	2	1.383	1.671	0.201
			Linearity	2.706	1	2.706	3.271	0.078
			Deviation from Linearity	0.060	1	0.060	0.072	0.789
		Within Groups		33.917	41	0.827		
		Total		36.682	43			
Kisumu	Zscore: Performance of supply chain system * Zscore: Approaches in HPT management at various levels	Between Groups	(Combined)	15.983	3	5.328	6.139	0.001
			Linearity	15.218	1	15.218	17.535	0.000
			Deviation from Linearity	0.765	2	0.382	0.441	0.645
		Within Groups		62.486	72	0.868		
		Total		78.469	75			

ANOVA Table								
County				Sum of Squares	df	Mean Square	F	Sig.
Vihiga	Zscore: Performance of supply chain system * Zscore: Approaches in HPT management at various levels	Between Groups	(Combined)	2.765	2	1.383	1.671	0.201
			Linearity	2.706	1	2.706	3.271	0.078
			Deviation from Linearity	0.060	1	0.060	0.072	0.789
		Within Groups		33.917	41	0.827		
		Total		36.682	43			
Kisumu	Zscore: Performance of supply chain system * Zscore: Approaches in HPT management at various levels	Between Groups	(Combined)	15.983	3	5.328	6.139	0.001
			Linearity	15.218	1	15.218	17.535	0.000
			Deviation from Linearity	0.765	2	0.382	0.441	0.645
		Within Groups		62.486	72	0.868		
		Total		78.469	75			

Results from the linearity test as presented in **Table 4** show that the data was good for linear regression modelling. Thus, the researchers conducted a linear regression model to determine the extent to which the independent variables (utilization of data, quality of data and access and availability of data) could predict the dependent variable (performance of the health supply chain systems).

4.9.2 Relationship between utilization of data and performance of health supply chain system

The study tested the null hypothesis below:

> *H_0=There was no statistically significant relationship between the independent variables (access and availability of data, approaches in managing HPTs, utilization of data,) and the dependent variable (performance of the health supply chain systems based on the perspectives of the participants).*

Model equation $y=\beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4+\varepsilon$ y= performance of health supply chain systems

β_0 = the constant

$\beta_1, \beta_2, \beta_3, \beta_4$ = coefficients for independent variables

X_1= Availability of data on HPTs

X_2= Quality of data on HPTs

X_3= Utilization of data for decisions

X_4= Approaches in HPT management at various levels

ε = random error

The model summary results are shown in **Table 5**.

Table 5: *Linear Regression Model*

Model Summary

County		R	R Square	Adjusted R Square	Std. Error of the Estimate
Vihiga	1	.490[a]	0.240	0.183	0.83470396
Kisumu	1	.499[a]	0.249	0.218	0.90455407

a. Predictors: (Constant), Z score: Availability and access to data, Quality of data, Utilization of data for decisions, approaches of managing HPTs,

b. Dependent variable: Performance of health supply chain systems

The results on the summary of the linear regression model show that in both Vihiga and Kisumu the perspectives of the respondents were that utilization of data for decision making, quality of data on HPTs and availability and access to data could potentially predict 24% of the changes in performance of the supply chain systems. The ANOVA test was used to demonstrate whether the relationships between the independent variables and the dependent variables in linear regression modes were statistically significantly as shown in **Table 6**.

Table 6: *ANOVA Test*

ANOVA[a]

County			Sum of Squares	df	Mean Square	F	Sig.
Vihiga	1	Regression	8.813	3	2.938	4.216	.011[b]
		Residual	27.869	40	0.697		
		Total	36.682	43			
Kisumu	1	Regression	19.558	3	6.519	7.968	.000[c]
		Residual	58.912	72	0.818		
		Total	78.469	75			

a. Dependent Variable: Z score: Performance of supply chain system

b. Predictors: (Constant), Z score: availability and access to data, quality of data, utilization of data for decisions, approaches in managing HPTs:

Results show that for Vihiga County $F_{(3,40)} = 4.216$; p value< 0.05 and for Kisumu $F_{(3,72)} = 7.968$; p value <0.05 the influence of change that could potentially be caused by the independent variables on the dependent variable was statistically significant both counties.

Table 7 shows the coefficients of each of the independent variables to illustrate the statistical significance of each of the variable in the model. The standardized Beta values indicate the percentage increase that a unit increase in the independent variables could cause on the dependent variable.

Table 7: *Coefficients Table*

Coefficients						
County				Standardized Coefficients	t	Sig.
		Variable	Std. Error	Beta		
Vihiga	1	(Constant)	0.147		3.366	0.002
		Zscore: Availability and access to data	0.184	0.103	0.585	0.562
		Zscore: Quality of data on HPTs	0.149	0.291	1.736	0.091
		Zscore: Utilization of data for decisions	0.196	0.387	2.768	0.009
		Zscore: Approaches in HPT management at various levels	0.145	0.191	1.291	0.204
Kisumu	1	(Constant)	0.099		2.639	0.010
		Zscore: Availability and access to data	0.112	0.053	0.465	0.643
		Zscore: Quality of data on HPTs	0.119	0.198	1.752	0.084

		Zscore: Utilization of data for decisions	0.094	0.283	2.799	0.007
		Zscore: Approaches in HPT management at various levels	0.100	0.356	3.577	0.001
a. Dependent Variable: Zscore: Performance of supply chain system						

For Vihiga, a unit increase in availability and access to data could lead to 10.3% increase in performance of the supply chain system. A unit increase in the quality of data could result in 29.1% increase in performance of the supply chain system while a unit increase in utilization of data could result in 38.7% increase in performance of the supply chain system. A unit increase in applying the best approaches for managing HPTs could result in 19.1% increase in performance of health supply chain system.

For Kisumu a unit increase in availability and access to data could lead to 5.3% increase in performance of the supply chain system. A unit increase in the quality of data could result in 19.8% increase in performance of the supply chain system while a unit increase in utilization of data could result in 28.3% increase in performance of the supply chain system. A unit increase in applying the best approaches for managing HPTs could result in 35.6% increase in performance of health supply chain system.

It is critical to note that in both Vihiga and Kisumu Counties, utilization of data for decision had statistically significant relationship with performance of the supply chain systems with p values< 0.05. Application of best approaches for HPT management was also statistically significant in Kisumu with a p value<0.05.

Using the linear regression model results we rejected the null hypothesis and accepted the alternative hypothesis that:

There was statistically significant relationship between the independent variables (access and availability of data, application of the appropriate approaches in managing HPTs, utilization of data,) and the dependent variable (performance of the health supply chain systems based on the perspectives of the participants).

The second measure of performance was based on the aspect of Leadtime in days from the time facilities send their orders to the time they receive the commodities in the two counties for comparison purposes. One of the key aspects was to assess the lead time from ordering to receipt of commodities. Data was collected on eight types of commodities including essential medicines (e.g. paracetamol and amoxicillin), family planning commodities, antimalarials, antiretrovirals, non-pharmaceuticals and tuberculosis drugs. **Table 8** shows performance on general lead time in days involving all the types of commodities.

Table 8: *General Lead Time*

Lead time from order to receipt of commodities		
Kisumu	N (records)	253
	Mean (days)	32.81
	Median (days)	26
Vihiga	N(records)	157
	Mean (days)	57.2
	Median (days)	20

The results show that 253 records were abstracted in Kisumu while 157 records were assessed for lead time. These were records with all the appropriate dates. The data shows that Kisumu had an overall mean lead time of 32 days and a median of 26 days while Vihiga had a mean lead time of 57 days and a median of 20 days.

The researchers analyzed data on the lead time in days from order placement to receipt of commodities for each of the specific types of commodities under study. Figure 13 and 14 show simple box plots used to present data on lead time for each of the type of commodities per county.

Figure 13: *Box plot for Lead Times for Various Types of Commodities in Kisumu County*

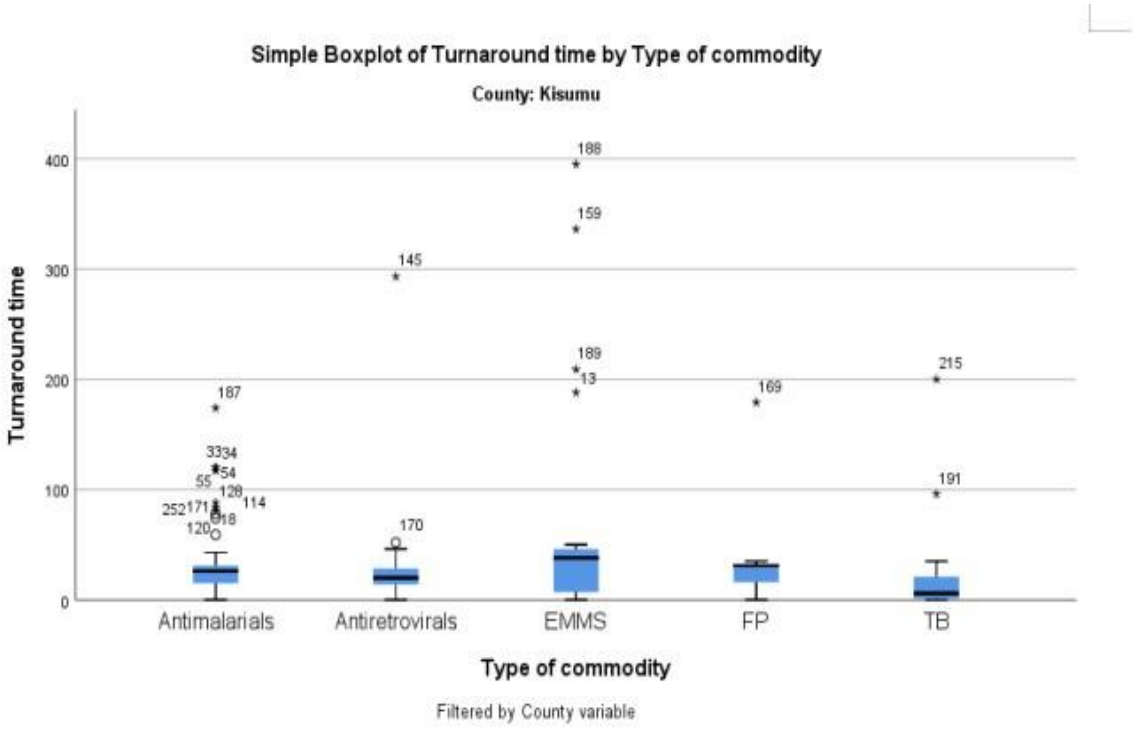
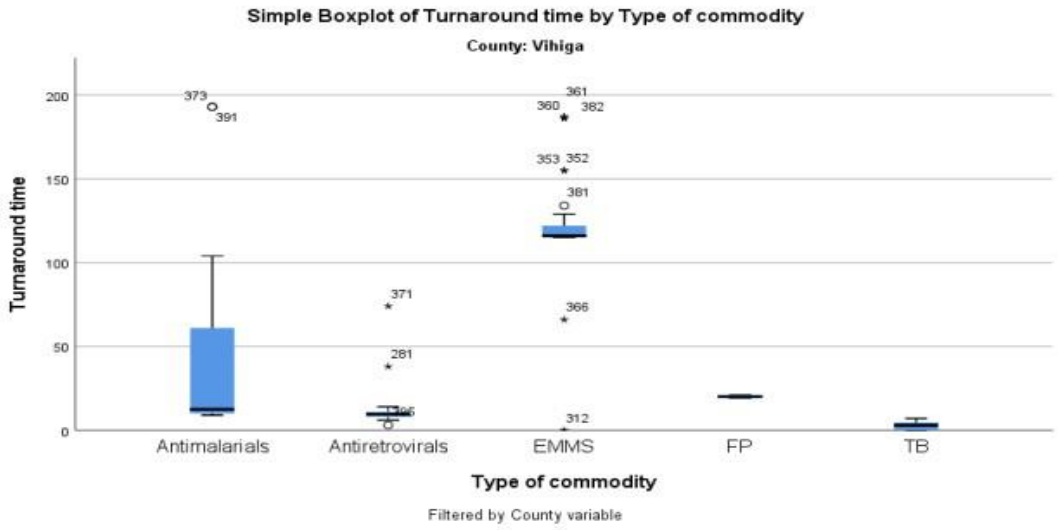


Figure 14: *Box plot on the lead time for various types of commodities in Vihiga county*



The data presented in the two box plots show that there was no much difference on median lead time across all the program commodities. However, there was huge difference in the lead time on the

EMMS commodities between the two counties as shown which was attributable to the fact that in Kisumu County health facilities are allowed to used funds generated at the facility to purchase their own commodities from suppliers while in Vihiga the large majority of the supplies are ordered at County level on a quarterly basis.

4.9.3 Statistical differences in order lead time between Kisumu and Vihiga

The independent sample t-test for equality of means was used to assess whether the difference in the overall lead time was statistically significant between Kisumu and Vihiga as shown in **Table 9.**

Table 9: *Independent Samples T-Test for Equality of Means on Lead Times between the Two Counties*

Independent Samples Test										
				t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2tailed)	Mean difference	Std. Error difference	95% Confidence Interval of the difference	
									Lower	Upper
Lead ti me	Equal variances assumed	56.545	0.000	-4.873	408	0.000	-24.390	5.005	-34.229	-14.550
	Equal variances not assumed			-4.679	288.298	0.000	-24.390	5.212	-34.649	-14.130

The Levene's test for equality of variances determined that the variations in the overall mean lead time between the counties was significant F=56.545, p-value<0.001. Furthermore, the t-test for equality of means at 95% confidence interval showed that the differences in the mean were statistically significant with a p-value <0.001.

4.10 Qualitative Findings

The researchers conducted 31 key informant interviews among participants involved in management of HPTs and key decision makers at county level. **Table 10** shows the breakdown of the respondents in the qualitative study by their responsibility.

Table 10: *Respondents in the Qualitative Study*

Role	No. interviewed	Description
Facility In charges	12	Facility managers of HPTs
Managers at sub county level and County level	14	12 Sub County Pharmacists 2 County Pharmacists
County decision makers	5	County Executive Committee member, Directors of Health, County Assembly Chair of Health Committee, Chief Officer Health, Facility Improvement Fund Manager

Data from the qualitative interviews are presented under key themes that were generated using a thematic framework developed iteratively by the researchers.

4.10.1 Knowledge on the health supply chain

The first theme of the qualitative study was to try and unearth the perceptions of the respondents in terms of their knowledge as regards the health supply chain system. The key informant interview questions on this theme focused on understanding how the respondents perceived an effective health supply chain system.

The results show that there were various aspects of the health supply chain that managers could look at and assess whether the system was effective or non-effective. One of the critical aspects was the lead time. Respondents observed that when there are shorter lead times from ordering of commodities to receipt of the commodities then facilities are able to have commodities at all times

and are able to provide clients with the needed medication. Longer lead times compromises availability of commodities and delivery of services. This calls for the need for players and stakeholders to create efficiencies in the system so that HPT managers can be satisfied with the time it takes to receive commodities. When asked to comment on what an effective health supply chain system is, a respondent noted:

> *"When the lead time is not long that is about 1 month" "A shorter lead time" then we can say the system is functioning well."*

Majority of the respondents reported that the key aspect of an effective health supply chain system is the stock levels in health facilities. This implied that when health facilities are well stocked then patients are able to receive the needed commodities and services all the time. Stockouts compromise service delivery and lead to frustrations among service providers as well as discouragement among patients to access health services. The stock levels also go hand in hand with the order fill rate. The fill rate is a good measure of performance of a health supply chain as it indicates the ability for a system to sustain its clients' demands without running out of stock unnecessarily. Asked to state how they would know if the health supply chain was functioning optimally, some respondents said:

> "*When there are no stock outs and supplies are delivered in a timely manner to reduce days out of stock".*
>
> "*When the fill rate is 80-100%".*

Some of the participants also noted that it was critical for people managing the health supply chain to collect data and listen to feedback from the patients/clients. Good feedback from patients would imply that the clients were satisfied with the availability of commodities at the facilities at any given time. When the comments are negative then it is implied that there could be challenges within the supply chain system that need to be addressed. A respondent reported:

> *"Satisfactory feedback from patients through patient exit surveys done by the county. Good comments from the suggestion box".*

Furthermore, some of the respondents said that effective health supply chain systems could as well be determined by how well the inventories were being managed. When inventory management practices are poor then the supply chain system experiences numerous challenges. However, good practices such as updating tools and ensuring data is similar across various data sources could result in high-level of accountability hence good performance of the supply chain system. A respondent observed as follows:

"Good inventory management practices being utilized means the system is working well. But when the facilities lack good inventory management practices then the system is poor".

4.10.2 Data availability and utilization

The qualitative study examined the aspects of data availability and utilization by the HPT managers and decision makers. Results show that there are several types of datasets on HPTs that are available for different users. Some of the data sets include for example the data contained in the forecasting and quantification reports, service delivery data in both the primary and secondary sources and reports from the health products and technologies units in the two counties. The study shows there were varying levels of access to data depending on participants roles and needs. Asked to state the type of data on HPTs accessible for use at their level a respondent said:

"Quantification/forecasting data available up to 2025, report validated by National Ministry of Health and copies readily available. Also, consumption data available on a monthly basis for the reported commodities".

On utilization of data the results show that there are many ways in which data on HPTs was being used at health facility level and at the county level for management and decision making. This was largely dependent on the roles of the respondents. Nonetheless, most respondents stated that data on HPTs were being used to allocate commodities to facilities, for ordering of the commodities, for preparation of annual work plans, redistribution of commodities, identifying gaps and opportunities for building capacities as well as monitoring the performance of the health supply chain systems.

4.10.3 Best practices being implemented

The researchers were interested in determining what the participants viewed as the best practices in managing HPTs in the counties. The following practices were mentioned by the majority of the respondents as what they termed as best practices that could improve performance of the health supply chain systems.

1. Feedback to health facilities: Regular communication between managers and health facilities was critical. The health products and technologies' leadership at County level always or should always communicate to facilities the situation regarding commodities in good time. Effective communication ensures that facilities can plan well in advance and put in place mitigation measures such as locally purchasing for their own commodities.

"Feedback is given whenever there is any update on HPTs. This is a good practice because it keeps us updated".

2. Data sharing and review meetings: Some facilities were conducting monthly data review meetings before submission to the sub-County level for entry into the Kenya Health Information System. Review of the data is a critical data quality control measure to ensure there is clean and quality data being submitted. The reports are then supposed to be submitted in a timely fashion to ensure the data can be used for timely decision making.

> *"Data review and sharing meetings where in case of any gaps in HPTs is realized and addressed immediately before submission of reports".*

3. Integrated commodity supportive supervision: There were regular/quarterly integrated commodity supportive supervisions being conducted especially in Vihiga County where 100% of the public health facilities were being covered every quarter. These activities are critical in ensuring that commodities are being managed well and that services are being offered as per standards and guidelines. The supportive supervisions focus on building the capacity of the facility staff to manage health commodities properly through mentorship and coaching. One respondent said:

> *"Integrated supportive supervision has been key in the monitoring and evaluation on the usage of HPTs".*

4. Application of technologies: Digitization of commodity management, supportive supervision data capture and generally reporting on the KHIS. Use of technology ensures that data is available in real time for decision making. Some processes within the supply chain systems have been digitized but there is need to have most, if not all processes digitized for faster and reliable decision making. In Kisumu county for example there was the digitization of dispensing health products and technologies for managing health products and technologies - supported by Maisha Meds system. In Vihiga County there was utilization of the digitized supportive supervision tool in Vihiga - use of the Open Data Kit (ODK) to key in supervision data, provide real time progress and performance of the activity even before the end of the exercise. Results from the supervision visits are tracked, reviewed, feedback given to health facilities and also used to rank facilities to motivate and develop a culture of accountability and ownership. In addition, Vihiga County had piloted the end to end stock visibility system which was critical in enhancing downstream transparency in stock management. Respondents reported:

> *"Digitization of dispensing health products and technologies in Kisumu county counts as the best practice in managing health products and technologies".*
>
> *"End to end visibility of supply chain by the use of digital system in Vihiga would have been very useful".*

5. Staff recognition and awards: Recognizing and rewarding best performers was critical in ensuring that they are motivated to continue performing well. This also encourages those who still have challenges in managing commodities to work harder so as to be recognized and awarded. Recognition and award created positive competition thus overall improved health commodities' management in Vihiga County which was not happening in Kisumu. A participant noted:

> *"Recognition and award of best performing health facilities coupled with sustained mentorship and on the job training (OJT) to all facilities".*

6. Commodity redistribution: Pulling commodities from facilities that are overstocked to those that are understocked. The commodity managers have to be vigilant and monitor the stock levels across health facilities. This enables them to identify facilities that are overstocked with most commodities likely to expire vis-a-vis those that are understocked. As such, the managers are able to pull commodities from the overstocked facilities and redistribute to those that are understocked. This leads to saving huge costs of commodities that could otherwise have expired as well as ensuring that all facilities have at least some commodities. Technologies that could enhance real-time visibility of the stocks in real time could be very useful in future.

> *"One of the best practices is redistribution of excess and short expiry to minimize loses and ensure that facilities that are out of stock are helped".*

4.10.4 Challenges and Barriers to improved performance of health supply chain systems

The qualitative study explored the possible challenges and barriers that affect performance of the health supply chain systems in the two counties. The following are some of the challenges highlighted by participants across the two counties:

1. Inadequate staff both in numbers and qualification to manage health products and technologies

> *"We have inadequate human resource with too much task shifting and over delegation to other cadres other than those trained on commodity management".*

2. Long lead times which affect stock levels and delivery of services.

> *"Long lead times especially for essential medicines make our work very difficult".*

3. Poor infrastructure especially in terms of lack of storage space for HPTs leading to theft of commodities

> *"No enough storage facilities for HPTs in this facility".*
>
> *"There is shortage of storage infrastructure including buildings and equipment".*

4. Lack of logistical support to conduct HPT management activities

> *"Poor logistical support for the centralized system of delivery of commodities".*

5. Poor documentation and inventory management practices

> *"There is poor documentation from staff handling HPTs as some are not trained on HPT management".*

6. Unreliable supply from currently approved suppliers who have very low fill rates. This leads to facilities receiving lower quantities of commodities than what they order.

> *"Challenges arising from the supplier (XXXX) not all commodities ordered are delivered".*
>
> *"The county to source for an alternative supplier other than the current ones who have low fill rates".*

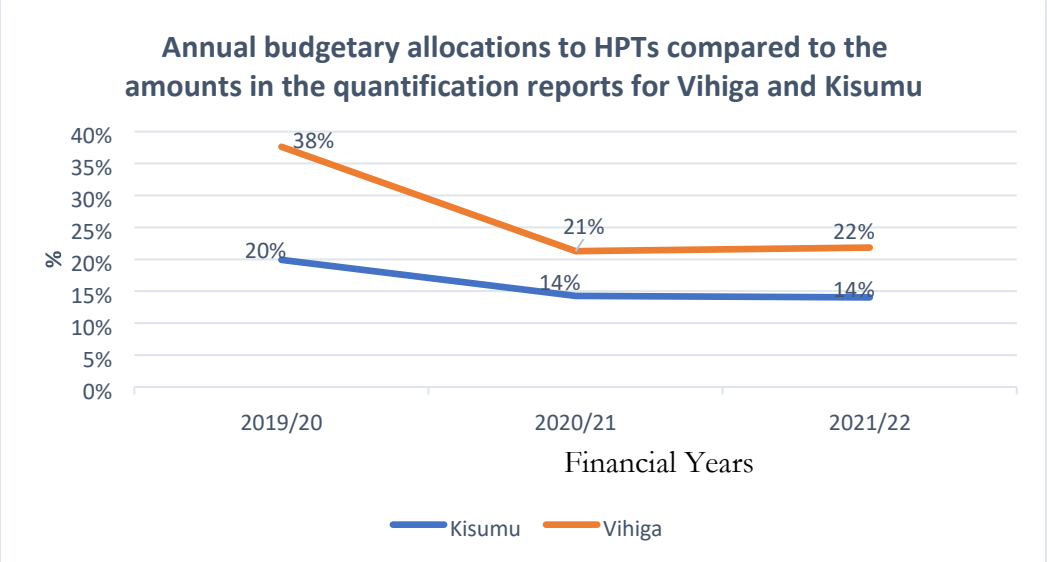
7. Limited budgetary allocations to HPTs at county and facility levels. Very small proportions of budget are allocated to HPTs.

> *"Inadequate budgetary allocation for the department of health that affects overall health service from human resource, supplies and physical infrastructure".*
>
> *"Inadequate financial resources: own source revenue is too low, at the same time release of the exchequer from national treasury delays so much".*

4.11 Financing for Health Products and Technologies

The researchers reviewed records to ascertain financing levels for health products and technologies in the two Counties as shown in **Figure 15.**

Figure 15: *Budgetary Allocations to HPTs*



The study revealed that both counties were allocating far below what the forecasting and quantification reports had suggested. In the financial year 2019/20 Vihiga County allocated 38% while Kisumu allocated 20% of what the quantification reports had suggested. The financial year 2020/2021 saw the allocations in both counties go down with Vihiga having allocated 21% while Kisumu allocated 14% of what the quantification reports had suggested. The study noted that in the year 2021/2022 Vihiga County had allocated 22% while Kisumu County had allocated 14%. The low budgetary allocations have direct influence on the relatively poor performance of the health supply chain systems as rated by participants in the two counties.

CHAPTER 5

INTERPRETATION AND DISCUSSION OF THE KEY FINDINGS

One of the key findings of this study is on generation and availability of quality data for decision making. This study places a lot of emphasis for all stakeholders at all levels to use data so as they can make data-driven decisions. Many studies (Chanyalew et al., 2023; Kavita R et al., 2017; Nemser et al., 2018; Nemser & Maliqi, 2021) have found out that data driven decisions are more likely to be logical and lead to sustainable improvements in management of HPTs and generally healthcare service delivery. There is need to invest in health information systems that can enhance data management and display for faster consumption and decision making.

The study established that in both counties, the staff managing HPTs were limited both in numbers and requisite skills. Human resources are a key factor in determining how well a health supply chain system works. The Human Resources for Health Strategy for Kenya (2017) prioritized the need to train and employ adequate numbers of Pharmacists. The strategy calls for the need to re-evaluate the norms and appropriately scale up production of this critical cadre. The strategy projected that by the year 2026, the Country will have achieved 75% of the needs for Pharmacists(Ministry of Health and Sanitation, 2020). The Health Products and Technologies Strategy (2020-2025) notes that the current staffing levels are still below norms for all cadres other than nurses, in addition to having large disparities in distribution. Although various cadres of healthcare staff are involved in the management of Health Products and Technologies (HPTs), majority are involved in ensuring rational use through prescribing and dispensing (Ministry of Health, 2019). There is therefore an urgent need to build capacity of the current staff managing HPTs as well as proper planning for hiring of the Pharmacists and Pharmaceutical technologists to enhance service delivery in the Pharmacy department.

The qualitative part of the study revealed that there were gaps in the infrastructure used for management of HPTs. Infrastructure for HPTs include good storage and dispensing facilities that are spacious, well aerated and with adequate security measures. Facilities require refrigeration facilities to ensure proper storage of vaccines and other cold chain health commodities. Most of the participants reported lack of adequate storage facilities and possibility of theft due to lack of security measures. It is critical that a good health supply chain considers proper infrastructure that can as well cater for storage and disposal of wastes. Storage facilities for pharmaceutical waste should be labeled on the outside with the hazard sign of a skull and 2 crossbones and with the 'No Entry for Unauthorized Persons' signage (Ministry of Health, 2020).

The issue of low budget allocation for HPTs is prominent in the findings of this study. The large majority of the participants reported that the budgetary allocations on HPTs were way far below the needs. This situation negatively affects the drawing rights, stock levels and lead times for facilities every time commodities are to be ordered hence inadequate HPTs to take care of the needs of the patients. Further, the analysis of budgetary allocation vs. the quantification needs showed that both counties were allocating below the desired amounts. This study urges County Governments to utilize the quantification and forecasting reports to ensure that enough resources are allocated for HPTs. The

Kenya Health Policy 2014-2030, under health financing calls for the need to establish a mechanism for sustainable financing for HPTs (Ministry of Health, 2014).

Respondents in the qualitative study reported that in some cases what they ordered was not what was received in terms of quantity of commodities. The situation was affecting the stock levels for the required HPTs hence sub-optimal service delivery. This could be a result of the suppliers not having the required products or sufficient quantities of the commodities. The call for alternative suppliers needs to be assessed so as to provide alternative sources of HPTs. The limited number of suppliers was also partly responsible for low fill rate, hence prolonged stockouts. In Kisumu County facilities had the right to procure health commodities on their own from suppliers within their reach. This had a positive impact on their lead time for EMMS compared to Vihiga which mostly depends on quarterly orders done at County level even though facilities are allowed to purchase their own small orders using a proportion of the facility improvement fund.

The two approaches being used to deliver commodities were the last mile delivery by the suppliers straight away to the health facilities and the centralized supply at the sub-county stores especially for TB and HIV/AIDS commodities. Based on the scoring of the statements on approaches as shown in Figure 8, the participants were not satisfied with the centralized models which causes them logistical expenditures to collect commodities at the central stores. There is need for stakeholders to re-evaluate the benefits and costs of the centralized model of supplies so as to either strengthen it or deliver all commodities through the last mile delivery model.

Quarterly integrated commodity supportive supervision was mentioned as one of the best practices being implemented especially in Vihiga County. Through this activity, capacity is built at the health facility level through mentorship and coaching on how best to manage HPTs. Enhanced with technology through digitization of data collection and display of results in real time, both facilities and managers are able to monitor performance of health facilities and provide the necessary support where need be in a timely manner.

This study calls for the need to embrace technology in management of HPTs. Vihiga County had piloted the end to end stock visibility system to enhance transparency of commodities downstream. County governments need to invest in such technologies so as to increase accountability for HPTs(Christos et al., 2014; Ledlow et al., 2017).

Redistribution of commodities appears to have been appreciated by most participants for having saved huge amounts of commodities in quantities and value that would have otherwise expired. This study calls for the need for proper planning and quantification based on data so as to avoid losses through expiries. Nonetheless, County governments need to provide logistical support for redistribution of commodities where need arises. Currently, redistribution has fully relied on partner support.

The study considered data for the last three years (2020-22). It is critical to note that this was during the COVID-19 pandemic. The analysis of the budgetary allocation showed that there was relatively high allocation for the year 2020 and a dip in 2021 with very small or no significant increment in allocation for the year 2022. This could be a result of the allocations that were necessitated by the existence of the COVID-19 pandemic in 2020 which significantly declined in 2021 thus the decline in

budget allocation. This study calls for the need for the County Government to consider emergencies such as pandemics when allocating funds for HPTs.

A limitation of this study was that it did not reach the suppliers of the HPTs for a complete view of the supply chain system. It would have been interesting to interview the suppliers to understand aspects of fill rates and lead times. However, the research team used the commodity dashboard to access data on lead time that involves when orders reach the suppliers.

CHAPTER SIX

CONCLUSION AND KEY RECOMMENDATIONS

This study concludes that there is need to sustain high quality of data and improve utilization of data on HPTs for decision making at all levels. For instance, commodity managers at health facilities need to make use of consumption data while preparing orders while decision makers at county levels who are responsible for allocation of budgets, should make use of the quantification and forecasting reports to allocate resources. Key conclusions from the study findings:

1. Availability, access, and utilization of quality data for decision making are significant predictors of performance of health supply chain systems.

2. Regular integrated commodity supportive supervision, data review meetings, prompt feedback and staff motivation through recognition and award could be high impact best practices for the health supply chain systems

3. Limited budgetary allocations, prolonged lead times, limited storage infrastructure, inadequate staffing and lack of logistical support for system strengthening activities could negatively affect the performance of the health supply chain systems.

In addition, this study recommends the following measures to improve performance of health supply chain systems:

1. There is need to increase budgetary allocations for HPTs in the two counties based on the quantification reports.
2. There is need for capacity building and recruitment of additional staff for management of health commodities.
3. There is need to improve infrastructure for storage of health commodities.
4. Decision makers and managers need to institutionalize feedback mechanisms including opinions from clients.
5. The departments of health in the two counties need to provide support for health supply chain system strengthening activities.
6. The two counties need to allocate funds for operational research in health.

EPILOGUE

DELIBERATIONS WITH THE TWO COUNTIES TOP LEADERSHIP

On the 8th of September 2023, the research team held a dissemination meeting with top leaders from the County Assemblies, Finance and Health departments of the two Counties. The meeting targeted the Chairmen of the Health Committees in the County Assemblies, the Executive Committee Members, the Chief Officers, Directors of Health and Directors of Budget. In attendance were also representatives from USAID Afya Ugavi, a partner supporting management of health products and technologies in the two Counties. Some of the key issues discussed with the leaders were as follows:

1. The views of the commodity managers as regards management of health commodities in the two Counties were interesting and of great concern. Specifically, the issues of stock outs and rating on performance of the respective supply chain systems were discussed at length. It was agreed that these concerns were to be taken seriously so as to improve the availability of HPTs in the health facilities.
2. The issue of long lead times for commodities was as a result of many factors including inadequate budgetary allocation, delays in payment of debts owed to suppliers, unavailability of required supplies by the recommended suppliers as well as low levels of own revenue generation to enable health facilities to use own revenue to purchase commodities. The departmental leadership of the two counties agreed to progressively increase budgetary allocation for HPTs and speed up debt settlement with suppliers.
3. The need for suppliers to improve on their stock levels of the required commodities and cut down on long lead times for delivery of commodities was also discussed. Moreover, there was discussion on the possibility of having alternate suppliers.
4. It was noted that Essential Medicines and Medical Supplies were specifically problematic with regards to stock levels unlike program commodities. Using the commodity dashboard, it was demonstrated to the leadership that most of the health facilities were in the red zone where they were almost stocked out on essential medicines. To address this, there was need for regular ordering.
5. To address most of the issues that had been raised, it was observed there is need to reconsider the budget allocations to the health products and technologies. This should be guided by the quantification reports which were already available. There is therefore need for both the Finance and Health departments in the two Counties to work together in harmonizing budget allocations in the future.
6. It was also noted that the two counties need to support operational research to generate evidence for decision making. There is need for allocation of resources necessary for operational research in future in the two counties.
7. The leaders from the two Counties agreed to continue working together on such critical matters as research, inter county redistribution of health commodities and benchmarking for best practices.

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Annexes

Annex 1: Sampled facilities

Kisumu County

Sub-county	Facility	Sub County	Facility
Kisumu Central	Administration Police Dispensary	Nyakach	Bonde Dispensary
	Kisumu CRH		Cherwa Dispensary
	Lumumba SCH		Gari Dispensary
	Nyalenda Health Centre		Katito Sub County Hospital
	Police line Dispensary		Kodingo Health Centre
	Railways Dispensary		Nyakach County Hospital
Kisumu East	Chiga Dispensary		Oboch Dispensary
	Gita CH		Onyuongo Dispensary
	Kibos Prison Dispensary		Pedo Dispensary
	Kowino Dispensary		Rae Dispensary
Kisumu West	Kuoyo Health Center	Nyando	Absalom Wangulu Dispensary
	Nyalunya Health Centre		Ahero CRH
	Simba Opepo Health Centre		Bunde Health Centre
	Airport Health Centre (Kisumu)		Hongo Ogosa Health Centre
	Chulaimbo County Hospital		Katolo manyatta Dispensary
	Dago Kokore Health Centre		Kinasia Health Centre
	Nyahera Sub Sub County Hospital		Koduol Reru Dispensary
	Riat Disp		Okana Dispensary
	Rota Health Centre		Rabuor Sub county Hospital
Muhoroni	Siriba Dispensary	Seme	Asat Beach Dispensary
	St. Mark's Health Centre		Bongu Konyango Dispensary
	Usoma HC		Dago Jonyo Dispensary
	Chemelil Disp		Kolenyo Health Centre
	Kandenge HC		Kombewa CRH
	Kasongo Dispensary		Kuoyo Kaila Health Centre
	Kibigori Dispensary		Manyuanda Sub county Hospital
	Mashambani Health Centre		Onyinjo Dispensary
	Masogo SCH		Otieno Owala Health Cetre
	Migere Health Centre		Rodi Health Centre
	Miwani Health Centre		
	Mnara Dispensary		
	Muhoroni CRH		
	Tamu Health Centre		

Vihiga County

Sub-County	Facility
Emuhaya	Ebukanga Level 2
	Ebusiratsi Health Centre
	Emusire Health Centre
	Ipali Health Centre
Hamisi	Banja Health Centre
	Givole Level 2
	Hamisi Sub County Hospital
	Jebrok
	Jepkoyai Level 2
	Kapchemwani
	Kaptechi
	Kaptis
	Likindu Health Centre
	Serem HC
	Shiru HC
	Tigoi HC
Luanda	Ebusyubi Dispensary
	Ekamanji Dispenary
	Ekwanda Health Centre
	Emuhaya SCH
	Luanda Town Dispensary
	Musitinyi Dispensary
Sabatia	Bugina Health Centre
	Inyali Dispensary
	Kegondi Health Centre
	Sabatia Sub County Hospital
Vihiga	Bugamangi Level 2
	Enzaro Health Centre
	Iduku Dispensary
	Lyanaginga Health Centre
	Mbale Rural HC
	Vihiga CRH
	Vihiga Health Centre

Annex 2: Data Collection tools

CONSENT FORM/CERTIFICATE

I have been asked to take part in the study. I have read and understood the Information Sheet and I agree to participate.

Name of participant:

*Participant Signature (or thumb print) *: Date:* _____

**Name of Researcher* _____

Researcher signature: _____

Date _____

County:
Subcounty:
Facility:
Age of the HPT manager:
Gender:
Cadre:
Number of work-year experience in commodity management:
Highest education level:
Current position:

A. Survey Questionnaire

SD=strongly disagree	**D= Disagree**	**N=Neutral/ I do not know**	**A=Agree**	**SA= Strongly Agree**

Independent variable: Utilization of data for decision making

Statement	**Score**				
Independent variable: utilization of data on HPTs	**SD**	**D**	**N**	**A**	**SA**
1. The data you generate on HPTs is ALWAYS available for consumption and use					
2. You ALWAYS have access to data on HPTs					
3. The data you generate on HPTs is ALWAYS accurate					
4. The data you generate on HPTs is ALWAYS complete					
5. There is high level of similarity between the doses administered and the number of patients treated for a given condition e.g. Al 24 doses vs confirmed malaria cases over 35 Kg					
6. The data generated on HPTs ALWAYS makes sense to you					
7. You generate data on HPTS that is ALWAYS reliable					
8. You ALWAYS submit reports in a timely fashion					
9. Your facility ALWAYS uses data to make selection of commodities					
10. You ALWAYS use data to prepare HPT orders					
11. There has been an increase in your facility's drawing rights for commodities					

Approaches in Managing HPTs	**SD**	**D**	**N**	**A**	**SA**
1. You ALWAYS use the consumption data to prepare orders					
2. You ALWAYS update your inventory on a monthly basis					
3. You ALWAYS consider your balances when quantifying for your commodity orders					
4. You are satisfied with the current model of delivery of commodities/HPTs by the suppliers (KEMSA and MEDS)					
5. You have an emergency plan in place to ensure uninterrupted supply of commodities					
6. Your managers ALWAYS make the right type of decisions on HPT management					
7. Your decision makers have the right competencies on HPT management					
8. You ALWAYS do self-evaluation on your performance regarding HPT management					
9. You ALWAYS develop performance improvement plans after self-evaluation on HPT management					
10. Decisions on HPT management are usually made in a timely manner					
11. You have proper mechanisms to address challenges in HPT management					
Dependent variable: Performance of the health supply chain system	**SD**	**D**	**N**	**A**	**SA**
1. You have been able to maintain the required stock status /levels					
2. You ALWAYS receive 100% of your orders from the suppliers					
3. You have achieved at least 80% of accountability for health commodities based on recent data					
4. You have eliminated HPT losses in your facility					
5. You have managed to minimize expiries in HPTs					
6. You have saved huge costs of HPTs that would have expired as a result of redistribution					
7. You experience acceptable lead time for delivery of HPTs (1 month for program items and 2months for EMMS)					
8. All your clients ALWAYS receive the HPTs prescribed					

B. Data abstraction forms

Note: on Commodities and balance tools -question 4 and 5 should be linked I.e. if you pick category "antimalarial" on question 4, question 5 should only give you the specific list of antimalarials following the categorization below:

Category - Commodity(ies)

- ★ Antimalarials - AL 24s, MRDT (choose latest six months)
- ★ Antiretrovirals- TLD 90s,
- ★ TB - TB Patient packs
- ★ FP DMPA IM
- ★ EMMS - Paracetamol 500mg tbs, amoxicillin 250mg DT, Clean gloves pairs,

I) **Measuring the performance in terms of effectiveness of the supply chain system**

Selected commodities on which data to be abstracted

- ★ Antimalarials - AL 24s, MRDT (choose latest six months)
- ★ Antiretrovirals-, TLD 90s,
- ★ TB - TB Patient packs
- ★ FP - DMPA IM
- ★ EMMS - Paracetamol 500mg tbs, amoxicillin 250mg DT, Clean gloves pairs,

County:

Sub-County:

Facility Name:

Type of commodity	Commodity	Unit of issue	Date of order	Quantity ordered by facility	Quantity forwarded by sub-county	Quantity forwarded by county	Quantity received by KEMSA	Quantity delivered at the facility	Date delivered at the facility	Quantity captured in the Bin card	Date ran out of stock	Date received next stock	
Program													
EMMS													

II) II) Measuring the performance in terms of accountability and data quality of the supply chain system

Selected commodities on which data to be abstracted

- ★ Antimalarials - AL 24s, MRDT (choose latest six months)
- ★ Antiretrovirals-TLD 90s
- ★ TB - TB Patient packs
- ★ FP - DMPA IM
- ★ EMMS - Paracetamol 500mg tbs, amoxicillin 250mg DT, Clean gloves pairs,

	2020	2021	2022	Stock on hand on date of date collection
Indicator				
Unit of issue				
Beginning balance				
Quantity received				
Quantity dispensed in DAR				
Quantity dispensed in Monthly summary sheet				
Quantity dispensed in KHIS				
Losses				
-ve adjustment				
+ve adjustment				
Ending balance in Summary sheet				
Ending balance in KHIS				

Quantity expired in summary sheet				
Quantity Expired in KHIS				

C. Key informant interview guide

1. How do you know when the supply chain system is functioning effectively within your facility?

Probe -Level of stockouts/stock out rates, -Loss/expiry ratios, -Costs saved e.g. through redistributions, -lead time on delivery

2. What are the practices employed to improve the management of the HPTS in your facility?

Probe: utilization of data, Allocation of funds/budget based on evidence or not

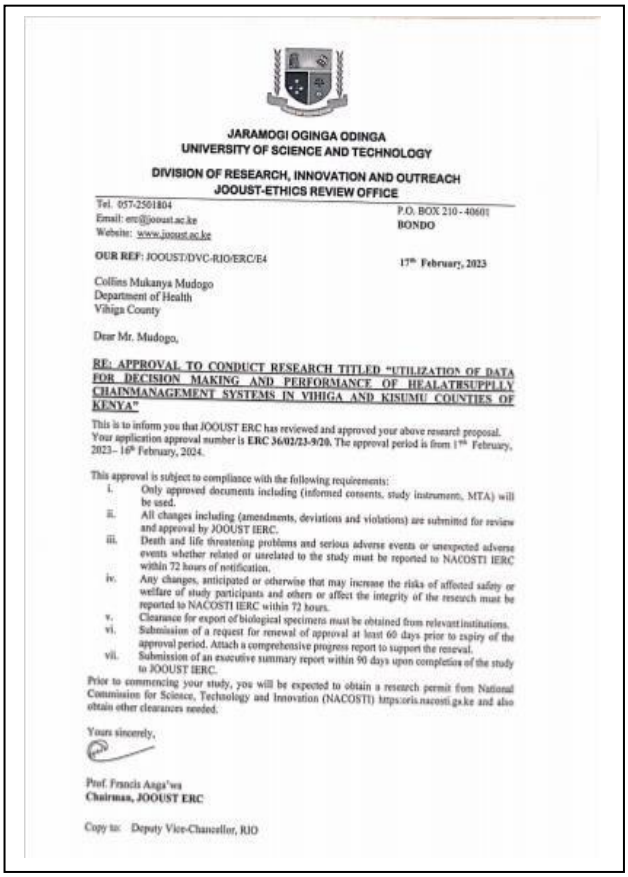
3. What are the challenges experienced in relation to HPT management in this facility?

Probe stockouts, lack of skills to forecast,

4. What are the solutions/recommendations to the challenges discussed?

Building capacity, infrastructure, budget allocation, participation in decision making

Annex 3: Study approval from Ethics and Research Committee



JARAMOGI OGINGA ODINGA
UNIVERSITY OF SCIENCE AND TECHNOLOGY

DIVISION OF RESEARCH, INNOVATION AND OUTREACH
JOOUST-ETHICS REVIEW OFFICE

Tel. 057-2501804
Email: erc@jooust.ac.ke
Website: www.jooust.ac.ke

P.O. BOX 210 - 40601
BONDO

OUR REF: JOOUST/DVC-RIO/ERC/E4

17th February, 2023

Collins Mukanya Mudogo
Department of Health
Vihiga County

Dear Mr. Mudogo,

RE: APPROVAL TO CONDUCT RESEARCH TITLED "UTILIZATION OF DATA FOR DECISION MAKING AND PERFORMANCE OF HEALATHSUPPLLY CHAINMANAGEMENT SYSTEMS IN VIHIGA AND KISUMU COUNTIES OF KENYA"

This is to inform you that JOOUST ERC has reviewed and approved your above research proposal. Your application approval number is **ERC 36/02/23-9/20.** The approval period is from 1st February, 2023– 16th February, 2024.

This approval is subject to compliance with the following requirements:

i. Only approved documents including (informed consents, study instrument, MTA) will be used.
ii. All changes including (amendments, deviations and violations) are submitted for review and approval by JOOUST IERC.
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 NACOSTI IERC within 72 hours of notification.
iv. Any changes, anticipated or otherwise that may increase the risks of affected safety or welfare of study participants and others or affect the integrity of the research must be reported to NACOSTI IERC 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 JOOUST IERC.

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

Yours sincerely,

Prof. Francis Aoga'wa
Chairman, JOOUST ERC

Copy to: Deputy Vice-Chancellor, RIO

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 720650

Date of Issue: 10/March/2023

RESEARCH LICENSE

This is to Certify that Mr., Collins Mudogo Mukanya of County Government of Vihiga, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev. 2014) in Kisumu, Vihiga on the topic: UTILIZATION OF DATA FOR DECISION MAKING AND PERFORMANCE OF HEALTH SUPPLY CHAIN MANAGEMENT SYSTEMS IN VIHIGA AND KISUMU COUNTIES OF KENYA for the period ending : 10/March/2024

License No: NACOSTI/P/23/23977

720650

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.

See overleaf for conditions

Annex 4: Photos

Training for data collectors

A data collector headed to a flooded facility in Kisumu

Participants during results dissemination

Training of data collectors

The Executive Committee Member for Health -Vihiga- giving comments during dissemination

Chief Officer for Health-Vihiga giving comments during dissemination

Afya Ugavi Representative addressing participants during dissemination

Chief Officer-Health Kisumu addressing participants during dissemination

Director of Budget-Kisumu follows presentation on the study during dissemination