

**INFLUENCE OF SUPPLY CHAIN MANAGEMENT PRACTICES ON
VACCINES (KEPI) AVAILABILITY IN PUBLIC HEALTH FACILITIES IN
KISII COUNTY, KENYA**

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REQUIREMENT FOR THE AWARD OF THE DEGREE OF MASTER OF
SCIENCE IN HEALTH SYSTEMS MANAGEMENT
KENYA METHODIST UNIVERSITY**

OCTOBER 2025

DECLARATION

“I declare that this thesis is my original work and has not been presented in any other university”.

Signed..........

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Recommendation by the supervisors

This thesis has been submitted for examination with our approval as university supervisors.

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DEDICATION

I dedicate this thesis to my family for the support and encouragement during the study period.

ACKNOWLEDGEMENT

I want to thank the Almighty God for the gift of life and for enabling me do this thesis. My sincere gratitude goes to my family for the support and patience that they have given me during this period. I also want to acknowledge the efforts of my supervisors Ms Susan Mule and Dr Jonathan Monda, they have reviewed my work several times and guided me throughout the research work. My appreciation also goes to Kenya Methodist University for the opportunity to pursue my studies.

ABSTRACT

Vaccines are crucial in preventing infectious diseases worldwide. The supply chain should ensure that the supply of vaccines is consistent at all times in order to have a good and functional healthcare system. Vaccines stock outs are a serious health concern to the general population as they contribute to low immunization rates. Many children miss vaccination, exposing them to a higher risk of vaccine preventable diseases and the potential for a disease outbreak. Frequent vaccines stock outs were experienced across the country in public health facilities, including Kisii County. These vaccines stock outs were linked to poor and ineffective supply chain management practices. This research therefore aimed at investigating the influence of supply chain management practices on vaccines availability in public health facilities in Kisii County. The specific objectives of the study were to determine the influence of planning, ordering practices, storage practices, and distribution on vaccines availability in public health facilities in Kisii County. A descriptive cross-sectional design was used to collect quantitative data. The target population was 131 healthcare workers who were involved in handling and administration of vaccines (nurses). A census approach was adopted, where all 131 public health facilities that provided immunization services in Kisii County were sampled, with one respondent per health facility. Purposive sampling was utilized to target vaccine handlers from all levels of the health facilities. Researcher-administered questionnaires and an observation checklist tool were used to collect data. Data was analyzed using statistical package for social sciences (SPSS) version 26.0 both descriptively using frequencies, percentages, means, and standard deviations where appropriate and inferentially, through regression and correlation analysis. Data was then presented in tables, graphs and charts. The study findings showed that all four independent variables; planning, ordering practices, storage practices and distribution positively influenced vaccines availability, with statistically significant p-values (Sig.) below 0.05. Storage practices exhibited the strongest standardized coefficient ($\beta = 1.237$), suggesting that it had the greatest impact on vaccines availability, followed by distribution ($\beta = 0.412$). Although planning and ordering practices showed relatively lower β values (0.168 and 0.054 respectively), their statistical significance ($p = .001$ and $.000$ respectively) confirmed that they still contributed meaningfully to vaccines availability. The findings imply that investments in planning and ordering practices are likely to yield practical benefits in vaccines availability. The findings also imply that strengthening storage infrastructure and better understanding of the distribution dynamics are key strategic priorities to maximize reliable vaccine supply. The study recommends that the County government should formalize a specific budget allocation for immunization programs, prioritize the upgrading and expansion of cold chain storage infrastructure and enforce a standardized vaccines ordering and distribution protocol across all public health facilities.

TABLE OF CONTENTS

DECLARATION	ii
COPYRIGHT	iii
DEDICATION	iv
ABSTRACT	vi
TABLE OF CONTENTS.....	vii
LIST OF TABLES.....	x
LIST OF FIGURES.....	xi
ABBREVIATIONS AND ACRONYMS	xii
CHAPTER ONE	1
INTRODUCTION	1
1.0 Introduction.....	1
1.1 Background of the Study	1
1.2 Statement of the Problem.....	5
1.3 Broad Objective	7
1.4 Research Questions.....	7
1.5 Justification of the Study	8
1.6 Limitation of the Study	8
1.7 Delimitation of the Study.....	9
1.8 Significance of the Study-Beneficiaries	9
1.9 Assumptions of the Study	10
1.10 Operational definition of Terms	10
CHAPTER TWO.....	11
LITERATURE REVIEW	11
2.1 Introduction.....	11
2.2 Vaccines Availability.....	11
2.3 Planning Influence on Vaccines Availability	14
2.4 Ordering Practices Influence on Vaccines Availability.....	17
2.5 Storage Practices Influence on Vaccines Availability	19
2.6 Distribution Influence on Vaccines Availability	23
2.7 Theoretical Framework.....	26
2.8 Conceptual Framework.....	29
2.9 Summary and Research Gaps	29

CHAPTER THREE.....	31
RESEARCH METHODOLOGY	31
3.1 Introduction.....	31
3.2 Research Design	31
3.3 Target population.....	31
3.4 Sample Size Determination and Sampling Technique	32
3.5 Inclusion and Exclusion Criteria.....	33
3.6 Instrumentation	33
3.7 Pre-Testing of the Research Instrument.....	33
3.8 Method of Data Collection	34
3.9 Analysis and Presentation of Data.....	35
3.10 Ethical Considerations and Approval	36
CHAPTER FOUR.....	37
RESULTS AND DISCUSSION.....	37
4.1 Introduction.....	37
4.2 Response Rate.....	37
4.3 Pre-test Results.....	37
4.4 Socio-Demographic Information.....	39
4.5 Descriptive Analysis.....	44
4.6 Regression Analysis.....	64
4.7 Correlational Analysis	83
CHAPTER FIVE.....	86
SUMMARY, CONCLUSION & RECOMMENDATIONS.....	86
5.1 Introduction.....	86
5.2 Summary of the Findings.....	86
5.3 Conclusion	90
5.4 Recommendations of the Study	91
5.5 Areas of Further Study.....	93
REFERENCES.....	94
APPENDICES.....	102
APPENDIX 1: INFORMED CONSENT FORM	102
APPENDIX II: RESEARCH QUESTIONNAIRE.....	106
APPENDIX III: OBSERVATION CHECKLIST TOOL.....	112

APPENDIX IV: UNIVERSITY APPROVAL LETTER.....	113
APPENDIX V: NACOSTI LETTER.....	115
APPENDIX VI: AUTHORIZATION LETTER.....	116

LIST OF TABLES

Table 3.1: Target Population.....	32
Table 4.1: Test of Convergent Validity.....	37
Table 4.2: Test of Reliability.....	38
Table 4.3: Planning Practices.....	44
Table 4.4: Ordering Practices	49
Table 4.5: Storage Practices	52
Table 4.6: Lead Time	54
Table 4.7: Mode of Transport	55
Table 4.8: Distribution Practices	56
Table 4.9: Vaccines Stock Outs on the Day of the Study	58
Table 4.10: Vaccines Stock Outs in the Preceding 12 Months	60
Table 4.11: Observation checklist	63
Table 4.12: Test of Normality	65
Table 4.13: ANOVA for Planning and Vaccines Availability	68
Table 4.14: Model Summary for Planning and Vaccines Availability	68
Table 4.15: Coefficients for Planning and Vaccines Availability	69
Table 4.16: ANOVA for Ordering Practices and Vaccines Availability	71
Table 4.17: Model Summary for Ordering Practices and Vaccines Availability	72
Table 4.18: Coefficients for Ordering Practices and Vaccines Availability	72
Table 4.19: ANOVA for Storage Practices and Vaccines Availability	74
Table 4.20: Model Summary for Storage Practices and Vaccines Availability	75
Table 4.21: Coefficients for Storage Practices and Vaccines Availability	76
Table 4.22: ANOVA for Distribution and Vaccines Availability	77
Table 4.23: Model Summary for Distribution and Vaccines Availability	78
Table 4.24: Coefficients for Distribution and Vaccines Availability	79
Table 4.25: ANOVA for Multiple Linear Regression	80
Table 4.26: Model Summary for Multiple Linear Regression	81
Table 4.27: Coefficients for Multiple Linear Regression	82
Table 4.28: Correlational Analysis	84

LIST OF FIGURES

Figure 2.1: Conceptual Framework	29
Figure 4.1: Gender of the Respondents.....	39
Figure 4.2: Age of Respondents	40
Figure 4.3: Education Level of Respondents.....	41
Figure 4.4: Experience of the Respondents.....	42
Figure 4.5: Level of Health Facility.....	43
Figure 4.6: Order done by fifth of every month.....	47
Figure 4.7: Order fill rate for the last vaccine order done.....	48
Figure 4.8: Availability and Functionality of cold chain Equipment.....	51
Figure 4.9: Vaccines Stock Outs on the Day of the Study	58
Figure 4.10: Vaccines Stock Outs in the Preceding 12 Months.....	59
Figure 4.11: Quality of Vaccines.....	61
Figure 4.12: Q-Q Plot Test.....	66
Figure 4.13: Q-Q Plot Test for Normality.....	67

ABBREVIATIONS AND ACRONYMS

BCG	Bacillus Calmette–Guerin
CHAI	Clinton Access Health Initiative
COVID -19	Corona Virus 2019
DTP-HepB-Hib	Diphtheria, Tetanus, Pertussis/Hepatitis B vaccine/ Hemophilus influenza type B vaccine
GAVI	Global Alliance for Vaccines and Immunization
IPV	Inactivated polio vaccine
KEPI	Kenya Expanded Programme on Immunization
LMIC	Low and Middle income Countries
MoH	Ministry of Health
NACOSTI	National Commission for Science Technology and Innovation
NVIP	National Vaccines and Immunization Program
OPV	Oral Polio Vaccine
PVC	Pneumococcal Conjugate Vaccine
SCM	Supply Chain Management
SCOR	Supply Chain Operations Reference
SPSS	Statistical Package for Social Sciences
UNICEF	United Nations International Children’s Emergency Fund
VPDs	Vaccine Preventable Diseases
VVM	Vaccines Vial Monitor
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter reviews the background of the study, statement of the problem and study objectives. It further discusses the justification, significance, limitations and delimitations of the study.

1.1 Background of the Study

Health systems comprise six core components: leadership and governance, health information systems, health workforce, access to medicines, vaccines and technology, health service delivery, and health system financing. In a properly functioning healthcare system, these building blocks work synergistically to ensure that services are high quality, safe, affordable, and timely (European Commission, 2021; World Health Organization [WHO], 2021).

Vaccines have been used successfully to prevent infectious diseases which are a leading cause of both morbidity and mortality in the world. Studies reveal that in 2018, approximately 700,000 children below the age of 5 years mostly from low and middle income countries died of VPDs (Frenkel, 2020). WHO reported that vaccinations could prevent two to three million deaths per year (WHO, 2018).

Immunization Agenda 2030 (IA2030) sets a global vision for the period 2021-2030 with the aim of ensuring that every individual fully benefits from vaccines. This in turn reduces mortality and morbidity from VPDs for every person during their life time. This also increases equitable access to vaccines and strengthens immunization programmes within primary health care. It also contributes to universal health coverage

and progress of 2030 sustainable development goals ensuring healthy lives and promoting well-being for all.

Global Vaccine Action Plan 2011-2020 is a global immunization framework developed to give direction for a “decade of vaccines”. This plan brought together global, regional and national stakeholders and set the goals and functions of immunization programmes with the aim of eradicating VPDs. This framework also ensured universal access to immunization was achieved (WHO, 2020).

Vaccine supply chains are crucial in ensuring immunization services are carried out effectively and therefore they are an essential part of primary healthcare services. The supply chain should ensure that the supply of vaccines is uninterrupted and consistent at all times in order to have a good and functional healthcare system (WHO, 2018).

Vaccination programmes are usually successful when the logistics systems together with supply chain from the manufacturer to the consumer are fully operational. These systems ensure procurement, distribution, handling of vaccines and storage processes are carried out effectively while maintaining the right cold chain temperatures of the supply chain. Consequently, the supply chain system is effectively maintained with continuous availability of vaccines (WHO, 2018).

Any interruption in the supply chain will affect availability of the vaccines resulting in stock outs (Sarigol et al., 2023). Vaccine stock outs have consequences such as low immunization coverage, missed opportunities for vaccination and potential for a disease outbreak. This may result in morbidity and mortality cases associated with VPDs.

Vaccine supply chains around the world vary among countries depending on their economic status, infrastructural differences and health care systems in place. Despite the differences, vaccine supply chains have similar stages which include procurement,

storage, transportation and distribution. According to European Commission (2021), high income countries such as Germany, United States of America, and United Kingdom among others procure vaccines directly from manufacturers or through regional contracts. Procurement of vaccines in low and middle income countries including Kenya is supported by international organisations such as UNICEF, GAVI and WHO among others.

Many developing countries have experienced vaccine stock outs. Despite Ethiopia improving on the vaccination coverage rates, the country still experienced VPDs outbreaks which were attributed to disruption in the supply chain system during procurement, storage and distribution processes that resulted in vaccines stock outs (Bagcchi, 2022).

Despite efforts being made to improve vaccines supply chain in Nigeria, several challenges were identified to affect the supply chain. These challenges included; poor procurement process, poor inventory mechanism, inadequate infrastructure, inadequate finances, insufficient transportation system and inadequate staffing capacity. COVID - 19 outbreaks made the situation even worse resulting in vaccines stock outs (Olutuase et al., 2022).

A study conducted in Tanzania revealed that 16% of the healthcare facilities experienced vaccines stock outs for a minimum of one vaccine and 5% of the healthcare facilities experienced vaccines stock outs for the five vaccines, that is, BCG, Measles-rubella, DTP-HepB-Hib, Rotavirus and sinopharm. The study observed that the five vaccines had been stocked out at one point in time (Nestory et al., 2022).

According to National Immunization Policy Guidelines 2023-2027, Kenya Expanded Programme on Immunization (KEPI) was established in the year 1980. This was later rebranded to National Vaccines and Immunization Program (NVIP). The main goal of

the program was to provide immunization against six childhood killer diseases namely Measles, Polio, Tetanus, Diphtheria, Tuberculosis and Pertussis.

These stock outs were linked to a disruption in the supply chain. Such cases were reported by Kanja et al. (2021) in Nairobi County where it was observed that majority of the health facilities had experienced stock outs of tetanus, measles and oral polio vaccine. Mkamba et al. (2023) also observed that in Tana River County, 62.71% of the health facilities had vaccines stock outs. Vaccines stock outs were attributed to vaccines rationing, lack of transport, poor forecasting, vaccines stock outs at the sub county depot, delay in placing order and faulty cold chain equipment. Similar results were revealed by Sinnei et al. (2023) in Turkana County.

A survey done by Clinton Access Health Initiative (CHAI) across three counties in Kenya namely Kisii, Uasin Gichu and Kwale counties observed that 77% of immunizing health facilities experienced vaccines stock outs of one vaccine and 17% of immunizing health facilities of three vaccines. 41 % of the vaccines stock outs were experienced for one month (CHAI, 2022).

The study by Kanja et al. (2021) highlights how the COVID-19 pandemic exposed significant weaknesses in national supply chain systems, resulting in disruptions to vaccine availability. In particular, delays within these supply chains led to stock-outs of essential vaccines such as the pentavalent vaccine. This situation underscores the critical importance of developing more resilient and adaptable supply chain infrastructures to ensure the consistent delivery of life-saving immunizations, even during global crises.

Existing literature has broadly documented vaccine stock outs across Kenya and other LMICs, attributing them to poor forecasting, inadequate transport, and cold chain failures (Mkamba et al., 2023; Olutuase et al., 2022; Sinnei et al., 2023). However, few

studies have empirically examined how specific supply chain practices, planning, ordering, storage, and distribution, directly affect vaccine availability at the facility level. This study addresses that gap by anchoring its inquiry within the health systems framework and focusing on operational bottlenecks that undermine vaccine access in Kisii County. By doing so, it contributes actionable insights to strengthen immunization logistics and enhance primary healthcare delivery.

1.2 Statement of the Problem

In an optimally functioning public health system, vaccines should be consistently available at all immunizing health facilities (WHO, 2020). This requires a robust supply chain characterized by timely planning, accurate ordering, efficient storage, and reliable distribution. Such a system ensures uninterrupted immunization services, contributing to high coverage rates and protection against vaccine-preventable diseases (WHO, 2020). Despite structured vaccine delivery schedules quarterly dispatches from Kisumu regional depot to sub-county stores and monthly collections by health facilities, Kisii County continues to experience frequent vaccine stock outs (CHAI, 2022; Mkamba et al., 2023). The lower tiers of the supply chain, particularly from sub-county stores to immunizing facilities, are plagued by systemic inefficiencies. These include inadequate cold chain infrastructure, poor temperature monitoring, limited transport resources, insufficient funding, and delays in inventory management and order placement. As a result, 44% of facilities reported tetanus vaccine stock outs, while 34% experienced measles vaccine shortages (CHAI, 2022). These disruptions have far-reaching implications. Stock outs compromise immunization schedules, leading to missed vaccinations among children. This increases vulnerability to VPDs, resulting in preventable disabilities, hospitalizations, and in severe cases, mortality. The ripple effect includes increased healthcare costs and diminished public trust in health systems.

Globally, vaccine stock outs have been acknowledged as a critical issue. In 2016, 38% of WHO member states experienced stock outs lasting over 51 days, affecting countries across income levels (WHO, 2017). Locally, counties such as Nairobi have attempted to address supply chain interruptions (Kanja et al., 2021), and national efforts have focused on improving cold chain systems and logistics coordination. However, these interventions have not fully addressed the granular challenges at facility level, especially in counties like Kisii. Previous studies by Kanja et al. (2021), Mkamba et al. (2023), and Sinnei et al. (2023) have explored general determinants of vaccine availability, such as funding and policy frameworks. However, there remains a significant empirical gap in understanding how specific supply chain management practices, planning, ordering, storage, and distribution directly influence vaccine availability at the facility level.

This study identified that despite structured vaccine delivery schedules, inefficiencies in supply chain practices at the sub-county and facility levels are the primary drivers of vaccine stock outs in Kisii County. These inefficiencies are not merely logistical but stem from systemic weaknesses in supply chain management. This research therefore aimed to examine the influence of supply chain management practices specifically planning, ordering, storage, and distribution on vaccine availability in public health facilities in Kisii County, with the goal of informing targeted interventions to enhance immunization service delivery.

Existing literature has broadly documented vaccine stock outs across Kenya and other LMICs, attributing them to poor forecasting, inadequate transport, and cold chain failures (Mkamba et al., 2023; Olutuase et al., 2022; Sinnei et al., 2023). However, few studies have empirically examined how specific supply chain practices, planning, ordering, storage, and distribution, directly affect vaccine availability at the facility

level. This study addresses that gap by anchoring its inquiry within the health systems framework and focusing on operational bottlenecks that undermine vaccine access in Kisii County. By doing so, it contributes actionable insights to strengthen immunization logistics and enhance primary healthcare delivery.

1.3 Broad Objective

The study's broad objective was to investigate the influence of supply chain management practices on vaccines availability in public health facilities in Kisii County.

1.3.1 Specific Objectives

The specific objectives of the study were:

- i. To determine the influence of planning on vaccines availability in public health facilities in Kisii County.
- ii. To establish the influence of ordering practices on vaccines availability in public health facilities in Kisii County.
- iii. To examine the influence of storage practices on vaccines availability in public health facilities in Kisii County.
- iv. To assess the influence of distribution on vaccines availability in public health facilities in Kisii County.

1.4 Research Questions

The study was guided by the following research questions:

- i. How does planning influence vaccines availability in public health facilities in Kisii County?
- ii. To what extent does ordering practices influence vaccines availability in public health facilities in Kisii County?

- iii. How do storage practices influence vaccines availability in public health facilities in Kisii County?
- iv. To what extent does distribution influence vaccines availability in public health facilities in Kisii County?

1.5 Justification of the Study

Vaccines play a crucial role in preventing infectious diseases worldwide, thereby reducing morbidity and mortality rates associated with these diseases (WHO, 2018). The vaccines supply chain needs to be well maintained from the national level to the end user to ensure vaccines are available, of high quality, and safe thus effective for immunization purposes. This results in a reduction of vaccine-preventable diseases (VPDs) within the general population, which directly decrease the disease burden on families, lowers rates of disability and death, and contribute to increased productivity and educational attainment (Lydon et al., 2017).

Vaccination also serves as an entry point for families into the healthcare system, enabling them to access other basic health services offered at healthcare facilities. This interaction creates opportunities for advancing universal health coverage.

Given the frequent vaccines stock outs experienced in public health facilities often linked to ineffective supply chain systems (Kanja et al., 2021) this study was undertaken to identify and address the underlying issues.

1.6 Limitation of the Study

A major limitation of the study was that some participants were unwilling to respond accurately due to fear of exposing their facilities. The researcher met with the hospital management teams of the public health facilities prior to conducting the study.

Additionally, only participants who consented by signing the consent form were included in the study.

Another limitation involved the availability of accurate and complete records; the researcher used only those records that were verified as accurate and fully completed.

1.7 Delimitation of the Study

The study focused on influence of supply chain management practices on vaccines availability specifically; planning, ordering practices, storage practices and distribution and not any other factor.

1.8 Significance of the Study-Beneficiaries

Public health facilities benefited from understanding the identified gaps in the vaccine supply chain; consequently, they were able to determine the areas requiring improvement to enhance their service delivery.

The findings of the study benefited the county government by providing recommendations that addressed gaps identified in the vaccines supply chain, thereby improving service delivery at the county level.

The findings also benefited implementing partners supporting immunization services by providing recommendations on the gaps identified in the vaccines supply chain, with the aim of improving immunization services.

The study benefited policymakers by offering recommendations to assist in formulating appropriate supply chain frameworks for vaccines within the health sector. These frameworks aimed to ensure the availability of safe, quality, and effective vaccines, ultimately leading to improved service delivery and positive health outcomes.

1.9 Assumptions of the Study

The study assumed that the selected participants were available and that they would give honest and accurate information to the researcher. Additionally, the study assumed that data collection instrumentation would gather the intended data on the influence of supply chain management practices on vaccines availability.

1.10 Operational definition of Terms

Distribution	Refers to the movement of product or service from the producer to the customer.
Ordering Practices	Refers to the activities involved when someone requests for a product or service to actually getting the product or service.
Planning	Refers to the process of deciding beforehand what is to be done, when it is to be done, how it is to be done and who is going to do it.
Public Health Facilities	Refers to a hospital, institution or facility that offers diagnostics interventions, medical, surgical, nursing interventions or other health care services and it' s owned or controlled by an organ of state.
Storage Practices	Refers to the activities involved in keeping goods and supplies at a particular place until they are needed for use.
Supply Chain Management Practices	Refers to the activities included in the flow of a product or service from the manufacture to the delivery of the product or service to the end user.
Vaccines Availability	Refers to presence a preparation that is introduced into a person' s body with the aim of preventing them from getting a particular disease.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The chapter reviews literature which includes empirical literature and theoretical framework. Conceptual framework and research gaps were also be discussed. The empirical review gives the review of previous studies that have been done of similar theme to the study; theoretical review presents the theories that anchor the study while conceptual framework gives the figurative relationship between the variables.

2.2 Vaccines Availability

Vaccines availability is a measure of the time duration when vaccines are available for use at a health facility and no vaccine reaches zero stock at any given time. Mkamba et al. (2023) conducted a study in Tana River County, Kenya on factors that influenced the availability of childhood vaccines in health care facilities. This was a cross sectional study design where census sampling method was used to select all the 61 health care facilities. The study revealed that 63 % of the health care facilities had experienced vaccines stock outs which were majorly attributed to district depot stock outs.

Kanja et al. (2021) conducted a study in Nairobi County, Kenya on factors that affected vaccines availability in public health facilities. The researcher adopted a descriptive cross sectional research design in 68 public health facilities. Research administered questionnaires were used to collect data. The findings indicated vaccines that were mostly stocked out were tetanus, measles-rubella and oral polio vaccines.

Ngcobo and Kamupira (2017) investigated the status of vaccines and associated factors in South Africa. This was a cross sectional survey that was conducted in 31 public clinics. The findings revealed that all vaccines had been stocked out at different time durations in the preceding one year of the study. All the 31 public clinics had a

minimum of one vaccine stock out. The vaccines that were mostly stocked out were rotavirus, PCV and pentaxim. Stock outs of vaccines lasted from less than 2 days to more than 2 weeks

2.2.1 Stock Status of Vaccines

Vaccines stock outs are mainly measured by the absence of a specific vaccine or different vaccines within a given time duration (SAGE, 2016). Filia et al. (2022) conducted a study on vaccines stock outs in 21 European countries from 2016 to 2019. The findings of the study showed that 90% of the countries had experienced one vaccine stock out. The vaccines that were mostly stocked out were BCG, DPT-HepB-Hib and hepatitis A which lasted up to 5 months and were mainly attributed to vaccines supply chain disruptions.

Nestory et al. (2022) investigated vaccines management practices among health workers in Tanzania. The researcher utilized a descriptive cross sectional design that included 77 health facilities. The results revealed that 16 % of the health facilities had stock outs of one vaccine and 5% had stock outs of five vaccines that were being studied, that is, BCG, Measles-rubella, DTP- HepB- Hib, Rotavirus and sinopharm.

Iwu et al. (2020) conducted a study on vaccines availability in health facilities in South Africa. This was a descriptive cross sectional study done in 64 facilities. The researcher observed that 77% of the facilities had a minimum of one vaccine stock out during the day of the study. The vaccines that were mostly out of stock were BCG and OPV vaccines followed by rotavirus vaccine and measles vaccines. BCG and OPV had the longest duration of stock outs.

2.2.2 Quality of Vaccines

Vaccines supply chain should ensure availability of high quality vaccines in the right quantity, right form, at the right place, at the right time and they should be stored and distributed under the right conditions. Quality of vaccines is maintained by keeping them at the recommended WHO refrigerators and monitoring temperatures to ensure is remains between 2°C and 8°C.

Gebretnsae et al. (2022) conducted a study on vaccines cold chain management in primary health care facilities in Northern Ethiopia. This was an institutional based cross-sectional study done in 50 facilities. The findings revealed that 14% of the facilities had vaccines properly arranged in the refrigerators, 16% had expired vaccines in the refrigerators while 34 % of the facilities kept vaccines with VVM that had reached discarding stage.

Feyisa (2021) investigated vaccines cold chain maintenance and vaccines stock management practices in public health facilities in Ethiopia. This was a mixed method approach of both institutional based cross sectional study with qualitative method done in 41 health facilities. The researcher observed that 78% of the facilities stored the vaccines correctly in the refrigerators. 20% of the facilities had vaccines that were beyond the usable VVM in the refrigerator. 27% and 5% of the facilities had expired vaccines and frozen vaccines in the refrigerator respectively.

Iwu et al. (2020) investigated the stock management practices and quality of vaccines in government facilities in OR Tambo, South Africa. The researcher observed that 11% of the facilities had expired vaccines in the refrigerator, 20% had frozen vaccines while 11% had vaccines with VVM beyond the usable point.

2.3 Planning Influence on Vaccines Availability

Moodley et al. (2021) conducted a qualitative study exploring stakeholders' perceptions of pharmaceutical budget allocations in South Africa. Their findings indicated that inadequate planning and misaligned budget allocations contributed to drug shortages, particularly in public healthcare facilities. The study emphasized the need for transparent and needs-based budgeting processes to enhance drug availability.

Akunne et al. (2023) examined the implications of the South African National Drug Policy on prescribing patterns in Limpopo province. The study found that discrepancies between policy guidelines and actual prescribing practices, often due to insufficient planning and training, led to inconsistent drug availability. This underscores the importance of aligning planning practices with policy implementation to ensure consistent drug supply.

Onyango (2024) proposed supply chain solutions to enhance essential medicines availability during the COVID-19 pandemic. The study emphasized the role of innovative planning approaches, such as integrating technology and data analytics, to improve inventory management and forecasting accuracy, thereby reducing stock outs.

Asewe (2022) conducted a case study on Cosmos Limited, revealing that strategic planning practices such as mission and vision statements, SWOT analysis, strategy implementation, and strategic control significantly influence organizational performance. The study found a moderate positive correlation between these planning practices and performance metrics, emphasizing the importance of structured strategic planning processes in the pharmaceutical sector.

2.3.1 Budgeting

A study by Karamshetty (2022) in Tana River County, revealed that the availability of tracer health commodities was found to be moderate, influenced by factors such as staff training in commodity management, facility level, timely budget allocation, and the presence of pharmaceutical technicians. The study emphasized the need for capacity building and timely budgeting to enhance drug availability in public facilities.

Lydon et al. (2017) observed that stock outs of vaccines affected all countries worldwide irrespective of their economic status. The stock outs in low and middle income countries were mainly attributed to financial constraints, poor procurement due to poor forecasting and stock management.

According to Ngcobo and Kamupira (2017), stock outs of vaccines in South Africa were attributed to inadequate finances in most of the public clinics while few of the clinics had adequate budgetary allocation for vaccines activities.

Feyisa (2021) observed that in public health centres in Ethiopia, 53.7 had financial support from their management. Only 50% of the public health centres had funds available for cold chain maintenance. The frequency and funding regularity was observed not being consistent.

2.3.2 Supervision

Supervision refers to the act of watching a person or activity to ensure that everything is done correctly. In supply chain, supervision is an effective way of providing support, reducing risks, improving standards and addressing poor performance. Supervision gives direction, guidance, and control of working force to ensure they are working according to plan and time schedule.

Ngcobo and Kamupira (2017) observed that supervision of vaccines was carried out mostly monthly at 77% of the facilities while 20 % on quarterly basis in South Africa. Expanded programme on immunization specific supervision was done in most of the public clinics though it did not address the stock outs gap.

Feyisa (2021) conducted a qualitative study in 41 health centres that offered vaccination services in Ethiopia. The findings revealed that supervision by the district health team was done one month prior to the study in 32% of the facilities. 88% of the facilities received feedback of the supportive supervision done. It was reported that there was lack of consistency in expanded programme on immunization based supervision.

2.3.3 Forecasting

Forecasting estimates the vaccines quantities that are adequate for consumption for a given target population and in this case forecasting estimates the vaccine needs of a given health facility to optimally offer the service.

The study by Mkamba et al. (2023) emphasizes the critical role of effective vaccine forecasting in maintaining a steady supply of vaccines. Conducted in Tana River County, the research revealed that poor forecasting practices, particularly the failure to utilize target population data, were a major factor contributing to frequent vaccine stock-outs. In contrast, health facilities that integrated target population data into their forecasting processes reported significantly fewer stock-outs. This finding underscores the importance of accurate demand estimation methods in ensuring vaccine availability and highlights the need for systematic forecasting approaches in healthcare planning.

A study by Filia et al. (2022) carried out in European countries showed that vaccines stock outs were attributed by inaccurate forecasting where there was a higher than expected demand for vaccines.

A study by Ojo et al. (2019) done in Nigeria showed that forecasting was done in some of the facilities with various considerations used during vaccine forecasting as follows: immunization data, target population data, service statistics, distribution data and based on stock on hand data. Though vaccines stock outs were still experienced.

2.4 Ordering Practices Influence on Vaccines Availability

The study by Ouma et al. (2023) highlights that inefficient stock management and poor forecasting are major factors driving vaccine shortages in Tana River County, where more than half of healthcare facilities reported stock outs of routine childhood vaccines. The research identifies critical issues such as underestimating vaccine needs, delays in ordering supplies, and insufficient training in vaccine inventory management as key contributors to these shortages. Additionally, the study reveals a notable knowledge gap among healthcare workers, evidenced by only 23.73% of facilities having accurately completed vaccine forecasting sheets. These findings underscore the urgent need to improve both the technical capacity and procedural systems in vaccine supply chains to ensure consistent availability and better health outcomes.

The study by Wanyonyi et al. (2024) similarly found that in Vihiga County, although all health facilities used standard requisition forms, significant knowledge gaps among healthcare workers regarding vaccine sensitivity and proper storage practices were apparent. This deficiency in understanding poses a risk to the integrity of vaccine ordering and handling processes, potentially disrupting consistent vaccine availability. Such challenges highlight the need for targeted training and capacity-building

initiatives to ensure that logistical systems are not only procedurally sound but also supported by well-informed personnel.

The study by Chandani et al. (2016) highlights how systemic challenges, particularly in governance and data management, significantly impact vaccines availability. In a case study from Kenya, the researchers demonstrated that addressing these challenges by implementing integrated data dashboards and strengthening governance mechanisms can effectively resolve bottlenecks within public health supply chains. This, in turn, facilitates more efficient vaccine ordering practices and underscores the importance of institutional reforms and digital tools in improving health system performance.

Ayako et al. (2023) on factors that influenced the availability of childhood vaccine in healthcare facilities at Tana River County, Kenya revealed that proper stock management is crucial for vaccine availability. In Tana River County, only 23.73% of facilities had correctly filled vaccine forecasting sheets, and delays in placing orders were common. In Nairobi City County, poor forecasting and knowledge gaps in ordering processes contributed to frequent stock outs, with 93% of facilities experiencing vaccine unavailability at depots.

2.4.1 Timeliness of ordering

Kapologwe et al. (2014) conducted a study in Tanzania that involved public health facilities. The study used a cross sectional design to collect data on availability of essential medicines. The study looked at the timeliness and correctness of essential medicines orders using the requisition and issue forms. Late orders were those that were done after 5th of every quarter while on time orders were those done by 5th of every quarter. The findings indicated that most of orders were timely done, however, most of the orders were not correctly done. The findings showed that accuracy of the orders was a major issue as compared to timeliness.

A survey done by CHAI (2022) in Kisii County, Kenya observed that of the public health facilities assessed, an average of 73% of vaccine orders were timely based, 56% were complete and 62 % were accurate. This showed that accuracy and completeness of orders was still a challenge.

2.4.2 Order fill rates

Order fill rate indicator is a measure of the percentage of the amount of vaccines ordered and the amount received at each health facility. It is a measure of the percentage of total orders that have been filled.

Melaku et al. (2023) investigated the extent to which COVID-19 outbreak affected the availability vaccines and accessories in five hospitals in Ethiopia. The researcher utilized an institutional based cross sectional design. The findings showed that COVID-19 affected vaccines availability from 62 % before the outbreak to 55% after the outbreak whereas the monthly orders fill rates reduced from 70 % to 60 % after the outbreak.

Sinnei et al. (2023) observed that order fill rate for health facilities in Turkana County, Kenya was at 73%. Vaccine deliveries that had been done on time in the previous 6 months prior to the study was at 73%.

According to Ngcobo and Kamupira (2017), only 19% of the public clinics had their order fill rate at 100% as 81% of the public clinics had their orders reduced and given less amounts than what they had requested. This revealed that there were challenges with order fill rates that were as a result of stock outs at the central stores. Vaccines that were mainly affected included rotavirus, pentaxim and PVC.

2.5 Storage Practices Influence on Vaccines Availability

Kanja et al. (2021) on factors that affected vaccines availability in public health facilities in Nairobi County revealed that effective vaccine storage relies heavily on

maintaining the cold chain, which ensures vaccines are kept within recommended temperature ranges. In Turkana County, a study found that while most refrigerators met WHO specifications, only 80% had functional temperature monitoring devices, and routine maintenance plans were lacking in many facilities. Similarly, in Nairobi County, despite all facilities having temperature-monitoring tags, only 62% consistently monitored temperatures, and over 40% lacked contingency plans for equipment failures.

Sinnei et al. (2023) on evaluation of vaccines storage and distribution practices in rural healthcare facilities in Kenya illustrated that competence of healthcare workers in managing vaccine storage significantly impacts vaccines availability. In Tana River County, facilities where staff had more than two years of experience were 6.25 times more likely to have vaccines available compared to those with less experienced staff . Additionally, in Vihiga County, while 88.4% of healthcare workers knew how to condition ice packs, 57% lacked comprehensive knowledge of vaccine sensitivities, indicating a need for improved training.

2.5.1 Cold Chain

Cold chain refers to the equipment that is used for storage and transportation of vaccines. This includes the refrigerators, freezers, vaccine carriers and cold boxes.

The study by Sinnei et al. (2023) highlights that storage and distribution practices play a crucial role in determining vaccine availability. In Turkana County, the research identified inadequate storage and inefficient distribution, especially in the last mile of delivery, as key drivers of vaccine stock-outs. These shortcomings within the immunization supply chain significantly disrupt the consistent availability of vaccines, ultimately impairing the delivery of effective immunization services. The findings

underscore the importance of strengthening stock management systems to ensure reliable vaccine access and enhance overall public health outcomes.

The study by Gavi (2022) on the implementation of its Immunization Supply Chain Strategy in Kenya revealed that, although advancements were made in cold chain equipment, vaccine stock-outs continued to occur. This ongoing challenge indicates that merely upgrading infrastructure is sufficient to ensure consistent vaccine availability. The persistence of stock-outs points to deeper systemic issues, including inefficiencies in the distribution network and national-level supply shortages. These findings underscore the need for a more holistic approach that addresses both logistical and systemic factors to strengthen vaccine delivery and availability.

The study by Wanyonyi et al. (2024) in Vihiga County revealed that although most healthcare workers demonstrated an understanding of how to condition icepacks, many lacked in-depth knowledge regarding vaccine sensitivities. This disparity highlights a critical gap in comprehensive cold chain management, emphasizing the importance of continuous and targeted training programs to ensure proper vaccine handling and storage. Strengthening this aspect of healthcare worker education is essential for maintaining vaccine efficacy and safeguarding public health.

A study by Ojo et al. (2019) done in Nigeria showed that out of 35 health facilities, only 31% had a functional refrigerator while 46% facilities had cold boxes. This revealed a major gap in cold chain infrastructure which contributed to vaccines stock outs.

2.5.2 Stock record keeping

Stock keeping records refers to the records that are kept on products or commodities in storage. They include stock registers and requisition and issue forms. The stock balances in the registers should always reflect the stock at hand.

Gebretnsae et al. (2022) conducted a study in primary health facilities in Northern Ethiopia. The findings revealed that only 30% of the facilities used vaccine requisition and issue forms. Only 48% had vaccines stock registers while 32% had vaccines requisition and issue forms. A similar scenario was observed by Mulatu et al. (2020) who carried out a study in Northwest Ethiopia using an interviewer administered, pre-tested and structured questionnaire in 14 facilities. The results revealed that 50% of the health facilities had vaccines ordering and requisition forms.

Ojo et al. (2019) conducted a study in 35 facilities in Nigeria. The researcher observed that 86% of the facilities used requisition and issue records. Use of stock keeping records was observed to be at 79%.

Ngcobo and Kamupira (2017) investigated vaccines status in clinics in South Africa. The results showed that stock cards that had correct vaccine quantities as the stock at hand were at 52% of the clinics. Some clinics were stocked out of various vaccines in the preceding 12 months as the stock card balance read zero.

A study by Mkamba et al. (2023) revealed that only 49% of health facilities in Tana River County used vaccines order form. 68 % of health facilities had accurately filled the vaccines ledger books. Monthly vaccine physical count was conducted in 76 % of the health facilities.

2.5.3 Routine Maintenance

For proper functioning of the equipment, routine maintenance is crucial to avoid frequent breakdowns that will affect vaccines availability.

Wanyonyi et al. (2024) conducted a descriptive cross sectional study in public facilities in Vihiga County, Kenya using census method. The findings showed that only 7% facilities had someone assigned for routine equipment maintenance purposes whereas Sinnei et al. (2023) observed that in Turkana County it was at 47%. These findings demonstrated a critical gap in the maintenance of the cold chain infrastructure.

A study by Mkamba et al. (2023) in Tana River County, showed that the availability of adequate biomedical engineers was at only 2% while only 20 % of the facilities had routine equipment maintenance plan in place. A similar scenario was observed by Feyisa (2021) in Ethiopia where only 14% of the public health centres had an equipment routine maintenance plan in place.

2.6 Distribution Influence on Vaccines Availability

The study by Kanja et al. (2021) highlights significant logistical challenges in vaccine distribution, revealing that only 1% of health facilities had access to reliable government utility vehicles, which frequently resulted in stock outs of critical vaccines such as tetanus, measles-rubella, and oral polio. This situation was further compounded in Turkana County, where the average distance to the nearest health facility was 15 kilometers, three times greater than the World Health Organization's recommended maximum of 5 kilometers posing a major barrier to timely vaccine access. These findings underscore the urgent need for improved transportation infrastructure and better health facility accessibility to ensure consistent vaccine availability and coverage in underserved regions.

The study by Gavi (2025) revealed that transportation challenges remain a major obstacle to vaccine availability. In Nairobi County specifically, it was found that 91% of public health facilities depended on public transportation such as buses, vans, taxis, and motorcycles to collect vaccines from sub-county depots. This heavy reliance on informal and often unreliable means of transport can disrupt timely vaccine delivery, increase the risk of spoilage due to inadequate cold chain maintenance, and limit the ability of health facilities to meet immunization demands efficiently. The findings underscore the need for more sustainable, reliable transport infrastructure and logistics support to strengthen vaccine supply chains.

The study by Gavi (2025) highlights innovative efforts to overcome distribution challenges in vaccine logistics through technological advancements. In collaboration with DHL company, Gavi is establishing a "transport support hub" in Kenya designed to optimize the vaccine supply chain. This hub seeks to offer comprehensive, end-to-end visibility across the entire distribution network, enabling better tracking and management of vaccine stocks. By improving transparency and coordination, the initiative aims to significantly reduce vaccine wastage and enhance the efficiency of delivery to target populations. Such a model not only addresses logistical bottlenecks but also strengthens the overall healthcare infrastructure, potentially serving as a scalable solution for other regions facing similar distribution hurdles.

2.6.1 Delivery schedules/Lead time

Lead time refers to the time duration when an order of a product is requested to when the product is received. A study by Ngcobo and Kamupira (2017) in South Africa revealed that there were delays in delivery of vaccines. The delivery schedules of vaccines for the clinics was observed at 16% of the clinics took 1 day and majority of

them took more than three days to receive vaccines. It was also noted that emergency orders took lead time of more than one week which resulted in vaccines stock outs.

According to CHAI (2022), it was observed that distribution channels at the health facility level were often ineffective or non-existent. As a result, they did not deliver vaccines to the facilities in good time. Prior to CHAI's involvement in Uganda and Kenya, timely vaccine deliveries were at 15% and 38% respectively which contributed to stock outs of vaccines.

2.6.2 Transportation Means

Transportation means refers to the operations involved in order to ensure safe movement of vaccines from one point to the other. Kanja et al. (2021) observed that 99% of facilities in Nairobi County used public transportation means which included motor bikes, taxis and vans. Only 1 % of facilities had a functional government vehicle for collection of vaccines. A similar observation was made by Ojo et al. (2019) in Nigeria, out of 35 health facilities, only 3 facilities (8.6%) had an operational vehicle for transportation of vaccines while Turkana County was at 39% by car, 53% by motorcycles and 8% by boat (Sinnei et al. 2023).

Wanyonyi et al. (2024) on vaccine storage and stock management practices in Vihiga County, Kenya found that transportation challenges hinder timely vaccine delivery, affecting availability. In Nairobi City County, 91% of facilities relied on public transport to collect vaccines, with only 1% having access to reliable government vehicles. In Turkana County, the average distance to the nearest health facility was 15 km, triple the WHO recommendation, contributing to vaccine stock outs.

2.6.3 Reverse Logistics

Reverse logistics refers to the movement of products from the end user backward until it reaches the manufacturer. This includes excess inventory, damages, expired products

or recalled products. Dias et al. (2023) investigated reverse logistics of unused and expired drugs in pharmacies in Belem, Para. Interviews were conducted to both pharmacy owners and the residents on how they disposed drugs. The findings showed that most of pharmacy owners were knowledgeable on reverse logistics and had put in place mechanisms for disposal where 80% of the waste was incinerated. On the other hand, 96% of the residents had no knowledge on reverse logistics and disposal of drugs where majority at 70% threw the waste together with general waste and 4 % flushed them in toilets.

Riberio et al. (2021) conducted a study in hospitals in Rio de Janeiro on reverse logistics in hospitals. The researcher observed that reverse logistics for medicines did not exist in majority of the hospitals. There were no channels of communication between the hospitals and suppliers and also between health workers and patients on reverse logistics. The hospitals also lacked policies and structures for reverse logistics. These findings revealed a huge knowledge gap on reverse logistics.

2.7 Theoretical Framework

This subsection reviewed the theories that the study was anchored on. They included supply chain operations reference (SCOR) model and supply chain management (SCM) theory.

2.7.1 Supply Chain Operations Reference (SCOR) Model

The SCOR model is a framework that evaluates the various activities entailed in a supply chain identifying both the gaps and strengths of a system. This model was first implemented in 1996 by Pittiglio Rabin Todd contributing to major advancements in the supply chain system which improved efficiency in operations of businesses (Stewart, G. 1997).

The structure of this model comprises of six processes. Each component is crucial at various steps of a supply chain. The first component is planning which entails estimation of resources needed and making plans for proper functioning of the supply chain. The second component is sourcing which involves sourcing of products or goods from suppliers, placing of product orders, receiving of orders among others. The third component is making which focuses on production activities. The next component is delivery which entails stock management of products, storage of products and transportation of products. The other component is return which entails the mechanisms which will effectively allow for products movement from the end user backwards in the supply chain for excess products, damaged goods, recalled products, poor quality products among other reasons that will necessitate return of products. The last component is enable which entails the activities that will ensure the company's plans for the supply chain processes are carried out effectively to obtain optimal results and improve on performance.

SCOR Model has four levels of functioning. Each level is further divided into specific activities. Level 1 which is the strategic level entails setting up of the goals, objectives and targets and strategizing on how these will be achieved in improving performance of the supply chain. Level 2 which is the tactical level entails coming up with action plans for the various processes of the supply chain to ensure the set objectives are achieved. Level 3 which is the operational level, as the name suggests, this level is involved in the activities that ensure the supply chain is operating according to deliver products timely. Finally, Level 4 which is detailed level entails developing standard operating procedures, manuals and guidelines which ensures all the supply chain processes are carried out effectively. The SCOR model illustrates how supply chain management

practices (planning, ordering practices, storage practices and distribution) influence vaccines availability in government owned facilities.

2.7.2 Supply Chain Management Theory

SCM comprises of the activities that ensure supply chain operations are effectively managed to produce products and goods that are of good quality, affordable cost to the customers and satisfy the needs of the population.

Lambert and Cooper (2000) described eight processes that were crucial in a supply chain. The first component being customer relationship which explains how the customers need to be treated in a supply chain. The next is customer service which describes how the business creates an image to their customers. The other process is demand management which explains how the business is supposed to cope with supply and demand of products. The other component is order fulfilment which aims at supplying orders fully and timely. The next process is manufacturing flow management which looks at the flow of products and goods throughout the supply chain. The other process is product development and commercialisation which explains on development of new products and branding in order to make sales and profits. The next component is procurement which describes the processes required during the procurement of products and goods. The last process is return of products to the manufacturer or supplier in case of damages, excess, recalls among other reasons.

Van der Vorst and Beulens (2002) came up with various strategies of improving the supply chain effectiveness. These included reduction of customer order lead times, creation of information transparency through demand/supply inventory, redesigning the activities performed by the supply chain among other strategies. The key processes of SCM theory gives an illustration of the supply chain management practices that

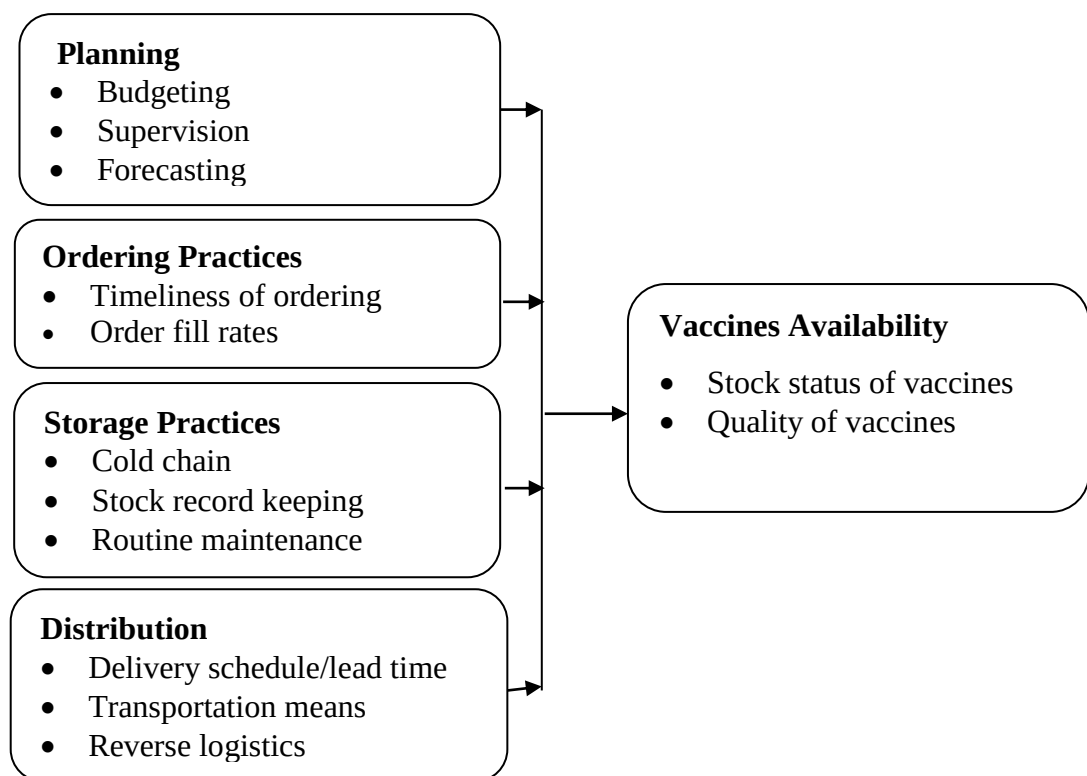
influence vaccines availability in government owned facilities aiming at avoiding vaccines stock outs.

2.8 Conceptual Framework

The conceptual framework illustrated the relationship between the dependent variable of this study, vaccines availability, and the independent variables, which were supply chain management practices, namely planning, ordering practices, storage practices, and distribution.

Figure 2.1

Conceptual Framework



2.9 Summary and Research Gaps

Prior studies such as Mkamba et al. (2023) and Kanja et al. (2021) focused on broad determinants of vaccine availability, including funding, staffing, and policy issues. However, they did not isolate or empirically analyze specific supply chain management

practices—such as planning, ordering, storage, and distribution—which are critical operational drivers of vaccine availability. This leaves a conceptual gap in understanding how these practices directly influence vaccine stock levels at facility level. Studies by Ngcobo and Kamupira (2017) in South Africa and Melaku et al. (2023) in Ethiopia offer valuable insights into vaccine availability challenges, but their findings are shaped by distinct health system structures, economic conditions, and logistical frameworks. These contextual differences limit the applicability of their conclusions to Kisii County, Kenya, where vaccine distribution follows a unique quarterly and monthly tiered system. Melaku et al. (2023) examined vaccine availability during the COVID-19 pandemic, emphasizing emergency disruptions rather than routine supply chain inefficiencies. While important, such situational analyses do not address persistent, non-pandemic-related supply chain challenges that affect vaccine availability in normal operational contexts. None of the reviewed studies conducted a focused empirical investigation into the operational supply chain practices at the county level in Kenya. Kisii County’s unique vaccine distribution structure from regional depots to sub-county stores and then to health facilities requires localized analysis to identify bottlenecks and propose targeted interventions.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This section presents the research design, target population, sample size, inclusion and exclusion criteria, instrumentation, pre-testing of research instrumentation, methods of data collection, analysis and presentation and ethical consideration and approval.

3.2 Research Design

The research design provided the structure within which the study was conducted. Kothari (2004) describes a research design as the framework that guides the research activity by effectively outlining the processes of data collection and data analysis. This study adopted a descriptive cross-sectional design to collect quantitative data. This research design was justified on the basis that data was collected from different levels of public health facilities within a defined period. Additionally, this design allowed the researcher to observe variables without influencing them.

3.3 Target Population

Fraenkel and Warren (2002) describes population as a set of individuals with similar features in which a researcher has interests in. The study target population was 131 healthcare workers who were involved in handling and administration of vaccines (nurses) in all levels of public health facilities that offered immunization services in Kisii County as shown in Table 3.1.

Table 3.1*Target Population*

Level of Health Facility	Frequency
Dispensaries	84
Health Centres	29
Hospitals	17
Teaching and Referral Hospital	1
Total	131

3.4 Sample Size Determination and Sampling Technique

The researcher determined the sample size as described in the sub themes below.

3.4.1 Sample Size Determination

Census approach was used in selecting sample size where all 131 public health facilities offering immunization services in Kisii County were sampled. One respondent per health facility was selected. According to Singh and Masuku (2014), census method is more suitable for small populations (200 or less) where the entire population is sampled. This method reduces sampling error.

3.4.2 Sampling Technique

Purposive sampling was utilized in selecting study respondents from all levels of the health facilities. Health workers (nurses) who were involved in handling and administration of vaccines were purposively selected in this study. Rai and Thapa (2015) described purposive sampling as a method that focuses on specific features of a population of interest and serves a very specific purpose in research. This explained why this sampling technique was utilized in the study.

3.5 Inclusion and Exclusion Criteria

Vaccine handlers at all levels of the health facilities in Kisii County were included in the study. Those respondents who voluntarily agreed to sign the consent were included, while those who refused to give consent were excluded.

3.6 Instrumentation

The researcher used structured questionnaires and an observation checklist tool to collect data. According to Kothari (2004), a structured questionnaire has well-defined questions that are simple to administer and are relatively inexpensive to analyze. Researcher-administered structured questionnaires with both close-ended questions and Likert scale statements were utilized. The questionnaire had different sections where Section A contained questions on socio-demographic data. The other sections B, C, D, E, and F contained questions on the dependent and independent variables, namely planning, ordering practices, storage practices, distribution and vaccines availability in that order.

3.7 Pre-Testing of the Research Instrument

A pre-test was carried out to check for the reliability and validity of the research instrument. The researcher pre-tested the questionnaire in the neighboring Nyamira County. Nyamira County was chosen because of its proximity to Kisii County and their shared rural setting. The pre-test was conducted in 10 health facilities, with one respondent per facility. Pretesting the questionnaire ensured that any ambiguity was corrected and improved the logical flow of the questions. The time taken to complete one questionnaire was recorded to inform the planning of the data collection process.

3.7.1 Reliability of the Research Instrument

Reliability was crucial as it looked at the stability and consistency of the research instrument (Huck, 2007). The researcher intended to subject the data that was collected to Cronbach's alpha coefficient to test for internal consistency. A coefficient of above 0.7 indicated internal consistency of the data (Whitley, 2002).

3.7.2 Validity of the Research Instrument

Validity is when the research instrument achieves the purpose of measuring data correctly (Field, 2005). To ensure the validity of the questionnaire, the researcher sought for input on the content of the instruments from the research supervisors. The feedback was used to review the instruments to make them more valid. The researcher also asked for input from selected professionals in the health facilities to ensure comprehensiveness of the questions. The input also ensured that all the necessary information for the purpose of this study was collected from the participants of the study.

3.8 Method of Data Collection

Data collection started by seeking permission from the County Health Management Team leadership, in this case, the County Director of Health, Kisii County. At the health facility level, the researcher explained the need for the research to the hospital management team and sought permission to collect data, followed by identification of the right persons to administer the questionnaires to. The participants had to consent in order to be considered part of the study. To enable data to be collected easily, the questionnaire tool was short and easy to answer. An observation checklist tool was used to abstract data from vaccine management tools such as vaccine ledger books and vaccine order sheets.

3.9 Analysis and Presentation of Data

According to Peersman (2014), data analysis involves organizing, structuring, and packaging collected information in a manner that allows for clear and effective communication of findings. In this study, quantitative data gathered through questionnaires was coded and entered into the Statistical Package for Social Sciences (SPSS) Version 26.0. The data was then analyzed descriptively using frequencies, percentages, means, and standard deviations where appropriate and inferentially, through regression and correlation analysis. The study employed linear regression and correlational analysis as its primary inferential statistical models. The analytical structure began with defining the dependent and independent variables, followed by testing key assumptions such as linearity, normality, and homoscedasticity to ensure model validity. Correlational analysis was used to assess the strength and direction of relationships between variables, typically reported using Pearson's correlation coefficient (r) alongside p -values to determine statistical significance. Collectively, these models offered both descriptive and predictive insights into variable associations, enabling robust, evidence-based conclusions. The following regression model was used to estimate the overall effect of supply chain management practices on vaccines availability in public health facilities in Kisii County:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

Where: Y is the dependent variable (vaccines availability), β_0 is the Y -intercept, β_1 , β_2 , β_3 , and β_4 are the regression coefficients of the four variables which are:

X_1 is of planning,

X_2 is ordering practices,

X_3 is storage practices and

X_4 is distribution while ε is an error term at 95% confidence level.

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

3.10 Ethical Considerations and Approval

Data was only collected after approvals from the relevant authorities in Kenya were sought. These included approvals from the Kenya Methodist University Scientific and Ethical Review Committee, the National Commission for Science Technology and Innovation (NACOSTI), and approval letters from the Department of Health Systems Management and the Department of Health at Kisii County. Respondents voluntarily took part in the study by signing the consent form. Those who refused to participate in the study were not victimized in any manner. Confidentiality of the data collected from the participants was maintained.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This section presents the response rate, the pre-test results, social demographic information, descriptive analysis, regression analysis and correlational analysis.

4.2 Response Rate

A total of 131 questionnaires were distributed to the target respondents for data collection. However, only 117 questionnaires were filled and returned yielding a response rate of 89.3% on whose basis this analysis was based. This was evidence that the data analysis was based on a relatively high response rate of 89.3%, indicating strong participant engagement and suggesting that the results were likely to be representative of the target population (Saldivar, 2012).

4.3 Pre-test Results

The study sought to assess the convergent validity and reliability of the measurement instruments during the pre-test phase. Results indicated strong convergent validity, with significant correlations between related constructs as shown in Tables 4.1 and 4.2.

Table 4.1

Test of Convergent Validity

Inter-Item Correlation Matrix					
	Planning	Ordering	Storage	Distribution	Vaccine Availability
Planning	1.000	.897	.984	.937	.713
Ordering	.897	1.000	.935	.926	.679
Storage	.984	.935	1.000	.944	.734
Distribution	.937	.926	.944	1.000	.649
Vaccine Availability	.713	.679	.734	.649	1.000

Source: The Researcher (2025)

The inter-item correlation matrix shows strong positive correlations among the items Planning, Ordering, Storage and Distribution, with values ranging from .897 to .984, indicating high internal consistency and suggesting these items reliably measure related aspects of a common construct. Vaccines Availability, while still positively correlated with the other items (.649 to .734), shows somewhat lower correlations, which may indicate it is related but somewhat distinct from the other factors. Overall, the high inter-item correlations support good construct validity for the main process-related items, but vaccines availability might represent a slightly different dimension or require further examination to confirm its alignment within the scale.

Table 4.2

Test of Reliability

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item- Total Correlation	Cronbach's Alpha if Item Deleted
Planning	11.2910	13.308	.961	.930
Ordering practices	11.5869	14.044	.931	.934
Storage practices	11.2479	13.920	.983	.925
Distribution	11.6467	13.677	.947	.932
Vaccines Availability	11.0196	19.993	.910	.983

Source: The Researcher (2025)

The reliability analysis shows that all items demonstrate high internal consistency, as evidenced by their high Corrected Item-Total Correlation values (all above 0.90), indicating strong relationships with the overall scale. The item “Storage” has the highest corrected item-total correlation (0.983) and contributes most positively to scale reliability, as its removal would result in the lowest Cronbach’s Alpha if Item Deleted (0.925), suggesting it is essential to the scale’s coherence. Conversely, removing “Vaccines Availability” would drastically reduce internal consistency, as indicated by the highest Cronbach’s Alpha if Item Deleted (0.983), implying this item may not align

as well with the overall construct and could be considered for revision or removal. The low Scale Variance if Item Deleted values for most items (especially “Planning” and “Storage”) suggest good homogeneity, while “Vaccines Availability” again stands out with a notably higher variance, reinforcing its inconsistency. In summary, the findings support the overall reliability of the scale but suggest that “Vaccines Availability” may be weakening internal consistency.

4.4 Socio-Demographic Information

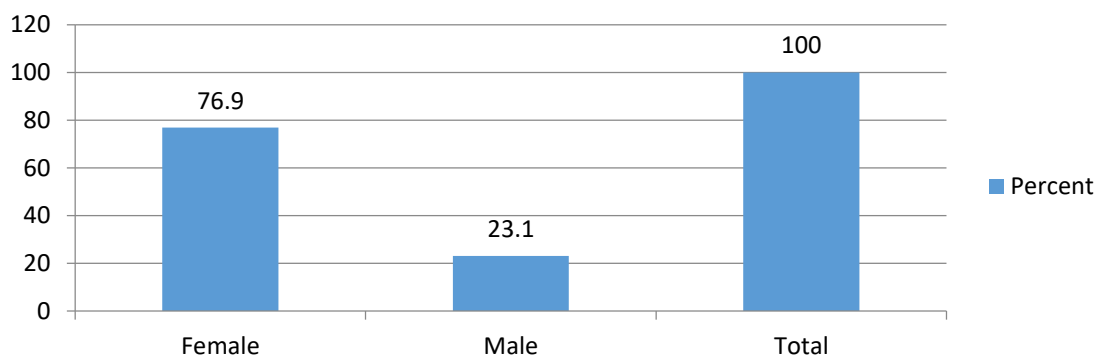
The study sought to examine the socio-demographic characteristics of the respondents, as these factors play a crucial role in shaping perspectives and influencing outcomes. Key variables such as age, gender, education level, and occupational status were analyzed to provide a comprehensive understanding of the respondent profile and its potential impact on the study findings.

4.4.1 Gender

The study sought to find out the gender demographics of the responders. Figure 4.1 captured the results.

Figure 4.1

Gender of the Respondents



Source: The Researcher (2025)

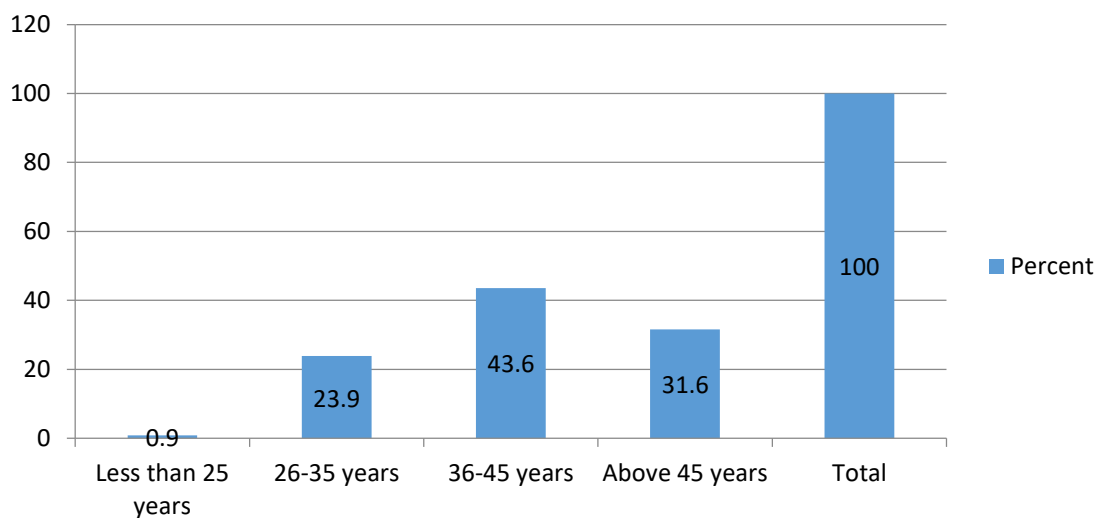
The data shows a significant gender disparity, with females comprising 76.9% (90 out of 117) of the total sample, while males represent only 23.1% (27 out of 117). This suggests that females are over three times more prevalent in this group compared to males. The substantial difference in frequency and percentage indicates a potential gender imbalance in the context or population being studied, which may have implications for the generalizability of findings or may reflect gender-specific factors influencing participation or representation.

4.4.2 Age of Respondents

The study sought to find out the age demographics of the responders. Figure 4.2 captured the results.

Figure 4.2

Age of Respondents



Source: *The Researcher (2025)*

The age distribution of the sample shows that the majority of respondents fall within the 36-45 years age group, representing 43.6% of the total, followed by those above 45 years at 31.6%. The 26-35 years group accounts for 23.9%, while those less than 25 years are the smallest group at only 0.9%. This suggests that the population is

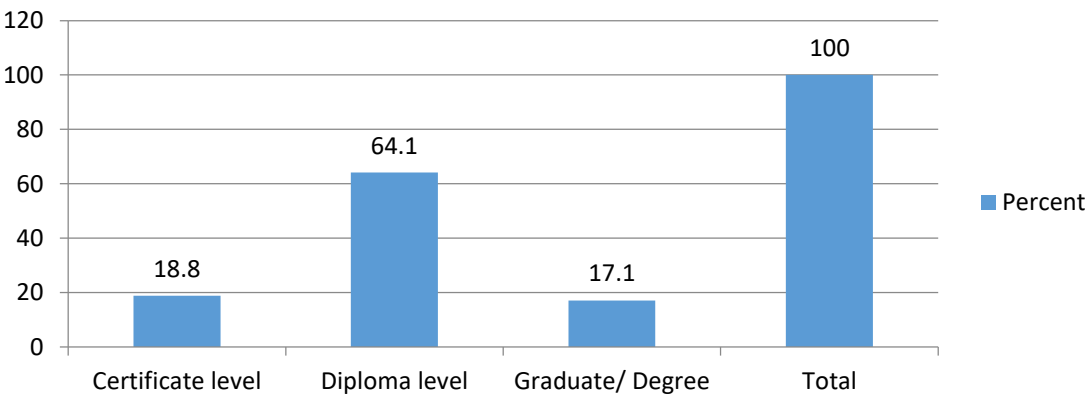
predominantly middle-aged to older adults, with relatively few younger individuals participating. The data may imply that the subject or activity surveyed is more relevant or accessible to people in their mid-career or later stages of life rather than younger adults.

4.4.3 Education Level

The study sought to find out the age demographics of the respondents. Figure 4.3 captured the results.

Figure 4.3

Education Level of Respondents



Source: The Researcher (2025)

The data on education levels shows that the majority of respondents hold a diploma level qualification, accounting for 64.1% (75 individuals) of the total sample, indicating that this is the predominant educational attainment within the group. Certificate level holders represent 18.8% (22 individuals), while those with a graduate or degree qualification comprise the smallest portion at 17.1% (20 individuals). This distribution suggests that while higher education (degree level) is less common, most individuals have attained at least a diploma, highlighting the importance or accessibility of diploma programs in this population. The relatively low percentage of degree holders might

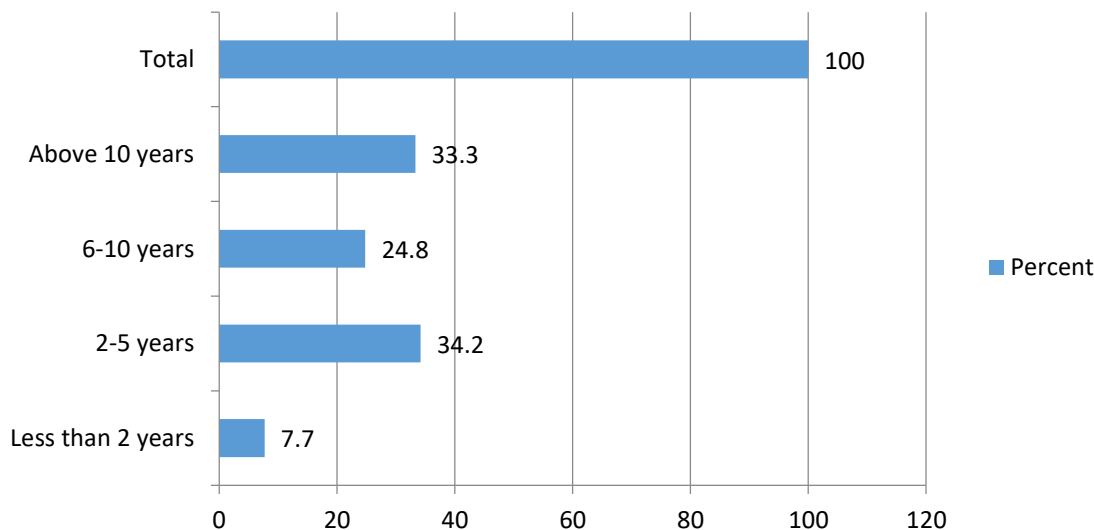
indicate potential barriers to higher education or a workforce focused more on vocational or technical training.

4.4.4 Experience of the Respondents

The study sought to find out the experience demographics of the responders. Figure 4.4 captured the results.

Figure 4.4

Experience of the Respondents



Source: The Researcher (2025)

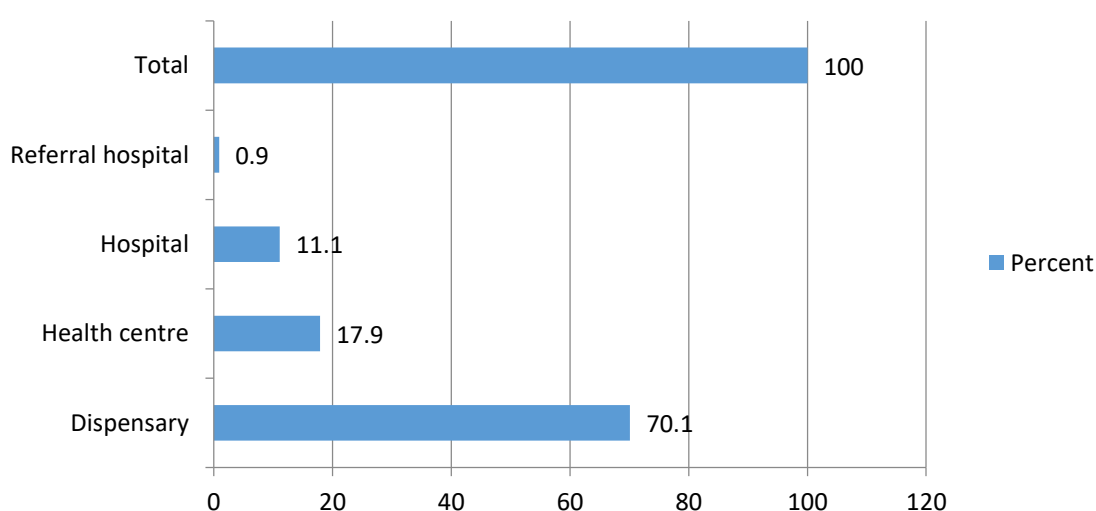
The data on respondents’ experience reveals that the majority possess moderate to extensive work experience, with 34.2% having 2-5 years, 24.8% having 6-10 years, and 33.3% having more than 10 years of experience, while only a small fraction (7.7%) have less than 2 years. This distribution suggests a relatively experienced group overall, with over 90% having at least two years in their field, indicating that insights gathered from this sample are likely grounded in substantial practical exposure. The balanced spread across mid to senior experience levels implies that the findings can reflect both emerging and well-established perspectives within the population studied.

4.4.5 Level of Health Facility

The study sought to find out the Level of health facility in the study area. Figure 4.5 captured the results.

Figure 4.5

Level of Health Facility



Source: The Researcher (2025)

The data on the level of health facility shows that the majority of cases, 70.1% (82 out of 117), were handled at dispensaries, indicating that dispensaries serve as the primary point of care for most patients. Health Centres accounted for 17.9% (21 cases), while hospitals managed 11.1% (13 cases), and referral hospitals had the least involvement at 0.9% (1 case). This distribution suggests that primary healthcare facilities like dispensaries and health Centres play a crucial role in service delivery, with higher-level facilities such as hospitals and referral hospitals being used less frequently, likely reserved for more severe or complex cases. The data underscores the importance of strengthening dispensaries to manage the bulk of healthcare needs efficiently.

4.5 Descriptive Analysis

It was essential to articulate how descriptive analysis had been interpreted. The scale had been categorized as follows: 4.3–5 denoted Strongly Agree, 3.5–4.2 indicated Agree, 2.5–3.4 represented Undecided, 1.9–2.6 signified Disagree, and 1–1.8 reflected Strongly Disagree. Mean scores had been computed to summarize the central tendency of each variable, offering a more comprehensive overview of the data compared to the median. Additionally, standard deviations had been calculated to assess the variability of responses around the mean, illustrating the extent to which individual scores had diverged from the average.

4.5.1 Planning

Based on the descriptive statistics provided, we can interpret the findings and analyze the responses to each statement on the planning practices using the 1–5 Likert scale and the results were recorded in Table 4.3.

Table 4.3

Planning Practices

Statement	N	Min	Max	Mean	Std. Dev
Facility is actively involved in vaccine budgeting process	117	1	5	2.90	1.269
Facility is adequately funded to collect vaccines from the sub county store	117	1	5	2.80	1.240
Facility is adequately funded for cold chain equipment routine maintenance	117	1	5	2.46	1.221
Facility is supervised by county/sub county teams quarterly	117	1	5	2.95	1.258
Facility is supervised by county/sub county teams monthly	117	1	5	3.11	1.237
Immunization programme specific supervision is done regularly.	117	1	5	2.95	1.312
Facility is involved in forecast planning for their vaccine needs	117	1	5	3.10	1.234
Facility is satisfied with their current target population for vaccination	117	1	5	2.98	1.225

Source: The Researcher (2025)

Table 4.3 revealed that the statement "Facility is actively involved in vaccine budgeting process" received a mean score of 2.90 with a standard deviation of 1.269. This score suggests a generally neutral stance, leaning slightly towards disagreement. While some facilities may participate in budgeting, the average response implies a lack of consistent involvement across most facilities. The relatively high standard deviation further indicates varied experiences among respondents, suggesting disparities in facility-level engagement in budgeting processes.

For the statement "Facility is adequately funded to collect vaccines from the sub county store," the mean score is 2.80 with a standard deviation of 1.240. This reflects a perception of inadequate funding for this activity, as the mean is below the neutral midpoint of 3. This score implies disagreement among most respondents regarding the sufficiency of funding for vaccine collection, which may impact timely vaccines delivery and overall immunization effectiveness.

The lowest mean score (2.46) is associated with the statement "Facility is adequately funded for cold chain equipment routine maintenance." This indicates clear disagreement with the statement and points to a widespread funding gap for maintaining critical infrastructure. The standard deviation of 1.221, while moderate, suggests that this concern is relatively consistent across facilities, underscoring a systemic issue in maintaining cold chain systems vital for vaccine preservation. The findings concur with those of Feyisa (2021) that indicated facilities had financial constraints cold chain maintenance.

Regarding the statement "Facility is supervised by county/sub county teams quarterly," the mean score is 2.95 with a standard deviation of 1.258. This result falls just short of a neutral rating, implying that while some facilities may receive quarterly supervision,

many do not. The data suggests inconsistent supervision patterns, which may affect oversight and performance in vaccine delivery and planning.

The statement "Facility is supervised by county/sub county teams monthly" received a slightly higher mean score of 3.11 with a standard deviation of 1.237. This score suggests mild agreement, indicating that monthly supervisory visits may be more common than quarterly ones. However, the closeness to the neutral point and the variation in responses highlight that this practice is not uniformly implemented.

For "Immunization programme specific supervision is done regularly," the mean score is 2.95 with a higher standard deviation of 1.312, indicating a generally neutral position with some leaning toward disagreement. The wider standard deviation suggests significant variability in how often facilities receive targeted supervisory support for immunization, reflecting inconsistencies that could hinder program performance. Ngcobo and Kamupira (2017) also noted inconsistency in immunization based supervision activities.

The statement "Facility is involved in forecast planning for their vaccine needs" achieved a mean of 3.10 and a standard deviation of 1.234. This result reflects slight agreement, implying that a number of facilities are engaged in planning for vaccine forecasting. However, the overall weak level of agreement and variability in responses point to room for improvement in ensuring all facilities are involved in this critical planning aspect. According to Ojo et al. (2019) forecasting was done in majority of the facilities though inaccurate forecasting was still a challenge that contributed to stock outs.

Finally, the statement "Facility is satisfied with their current target population for vaccination" yielded a mean of 2.98 and a standard deviation of 1.225. This score suggests a largely neutral perception, indicating mixed levels of satisfaction with

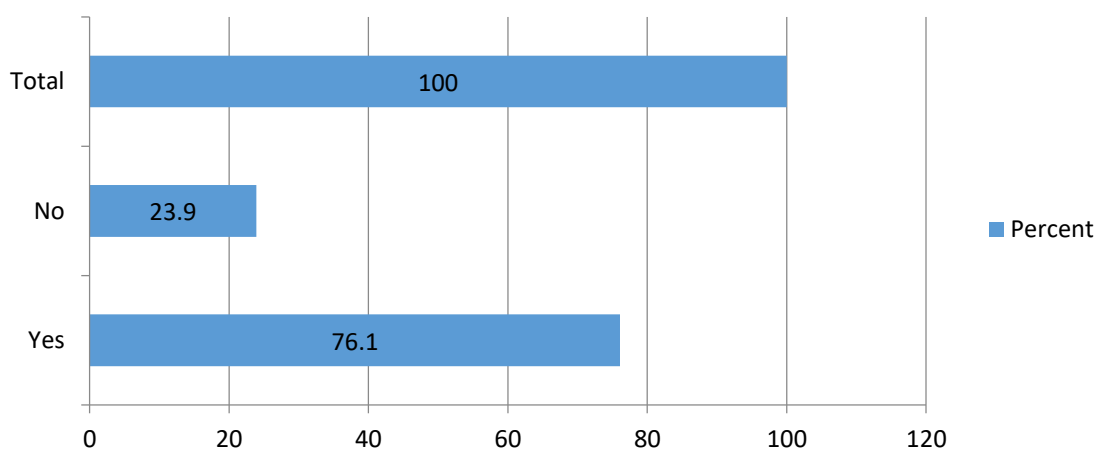
population targets. The response pattern may reflect issues with data accuracy, population estimates, or alignment of targets with actual service needs. In summary, the data reflects a planning process that suffers from inconsistent implementation and funding challenges. While there are some areas with moderate agreement, especially in supervisory support and forecast planning, the overall trend leans toward dissatisfaction or neutrality, signaling a need for policy and operational reforms to strengthen planning, funding, and supervision within immunization programs.

4.5.2 Ordering Practices

The study sought to examine the ordering practices in public health facilities in Kisii County, Kenya. It focused on how vaccines were requested, approved, and delivered within the county's health system as captured in Figure 4.6.

Figure 4.6

Order done by fifth of every month



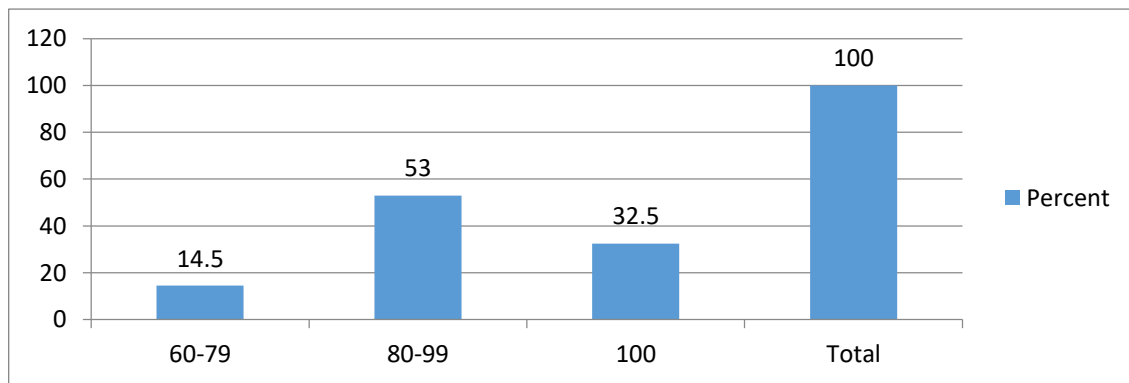
Source: The Researcher (2025)

The data indicates that a significant majority of respondents (76.1%) reported that orders were done by the fifth instance, while only 23.9% indicated otherwise. This suggests a generally positive trend in timely ordering, implying that the system or process in place is effective for the majority of cases. However, the 23.9% did not make

orders by the fifth attempt highlights a potential inefficiency that warrants attention. The findings are in line with those of Kapologwe et al. (2014) that indicated that majority of drug orders were timely done at 90% though the major challenge was correctness of the orders. Improving follow-up mechanisms or addressing underlying issues causing delays could enhance overall performance and customer satisfaction. The findings infer that while the process is largely successful, there remains room for improvement to achieve higher consistency.

Figure 4.7

Order fill rate for the last vaccine order done



Source: The Researcher (2025)

The order fill rate for the last vaccine order done by the facility is distributed across three categories: 60–79%, 80–99%, and 100%. The majority of orders (53%) fell within the 80–99% range, indicating a relatively high but not perfect fulfillment rate. Meanwhile, 32.5% of orders achieved a 100% fill rate, demonstrating strong supply chain efficiency in a significant portion of the orders. However, 14.5% of orders had a lower fill rate between 60–79%, highlighting potential supply or logistical constraints affecting order fulfillment. The findings concur with those of Ngcobo and Kamupira (2017) that suggested that order fill rate was less than 100% for most of the facilities. This data suggests that there is room for improvement in ensuring a consistently optimal order fulfillment process.

The analysis below interprets each statement according to its mean score on a 5-point Likert scale, where 1 represents strong disagreement and 5 indicates strong agreement.

Table 4.4

Ordering Practices

	N	Min	Max	Mean	Std. Dev
Vaccine orders are usually placed monthly	117	1	5	2.57	1.037
Emergency orders are placed immediately any vaccine reaches the minimum level	117	1	5	2.67	1.174
At no given time the facility has stock outs of vaccines which are available at the sub county store	117	1	5	2.52	1.264
Vaccine orders are usually supplied as per the order requested	117	1	5	2.68	1.127

Source: The Researcher (2025)

Table 4.4 the first item, “Vaccine orders are usually placed monthly,” has a mean of 2.57 and a standard deviation of 1.037. This suggests that respondents generally disagree with this statement, although the average leans slightly toward neutrality. It indicates that monthly vaccine ordering is not consistently practiced across the facilities. The relatively moderate standard deviation shows some variation in responses, implying that while some facilities may place monthly orders, others do not follow this schedule.

The second item, “Emergency orders are placed immediately any vaccine reaches the minimum level,” shows a mean of 2.67 with a standard deviation of 1.174. The interpretation here is similar, respondents tend to disagree with the statement, albeit again leaning toward neutrality. This could suggest a lack of responsiveness or procedural delays in placing emergency vaccine orders, which could have serious implications for vaccines availability and public health management.

For the third item, “At no given time the facility has stock outs of vaccines which are available at the sub county store,” the mean is 2.52, with a relatively high standard deviation of 1.264. This reflects a general disagreement with the statement, indicating that stock-outs do occur even when vaccines are available at higher administrative levels. The higher variability in responses suggests inconsistency among facilities, some may experience frequent stock-outs, while others manage their inventory more effectively.

The final item, “Vaccine orders are usually supplied as per the order requested,” has the highest mean among the four statements at 2.68, but still falls within the disagreement to neutral range. The standard deviation is 1.127, indicating some variability in how this process is experienced across different facilities. This score implies that the fulfillment of vaccine orders is often incomplete or does not fully align with the quantities requested.

In summary, all the statements received mean scores below 3.0, indicating a general tendency toward disagreement across the board. This suggests there are significant challenges and inefficiencies in the vaccine ordering and supply process, such as irregular ordering schedules, delayed emergency responses, occurrences of preventable stock-outs, and partial order fulfillment. These issues may reflect systemic logistical or administrative barriers that require attention for improved vaccine management. The study by Chandani et al. (2016) highlights how systemic challenges, particularly in governance, data management and ordering processes significantly impact vaccines availability.

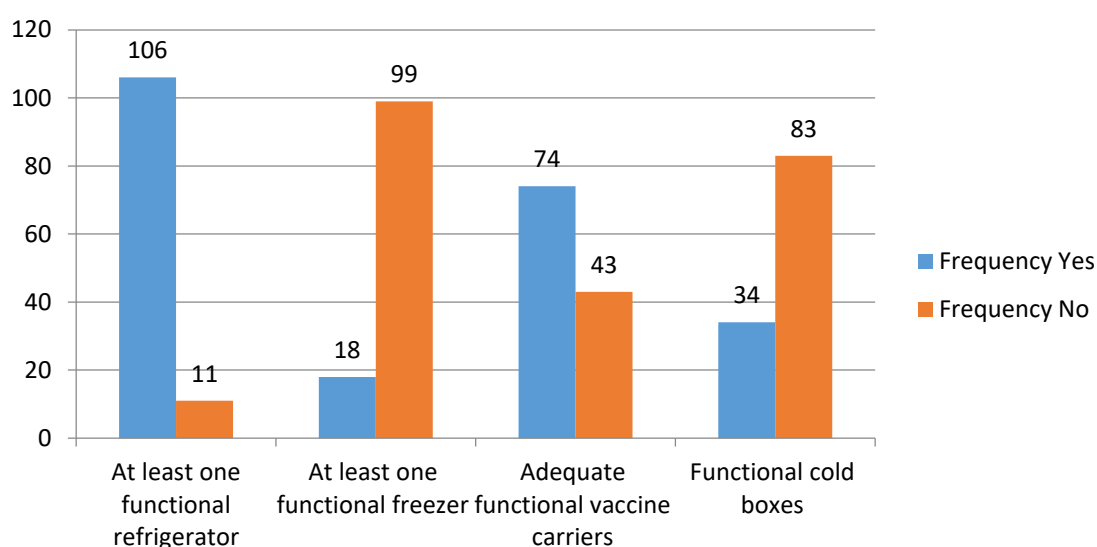
4.5.3 Storage Practices

The study sought to assess storage practices in public health facilities in Kisii County, Kenya. It focused on evaluating the conditions under vaccines are stored, including

infrastructure, inventory management, and adherence to safety standards. The findings aimed to identify gaps in storage practices that could affect vaccines availability and propose recommendations for improvement.

Figure 4.8

Availability and Functionality of Cold Chain Equipment



Source: The Researcher (2025)

The data highlights notable disparities in the availability and functionality of cold chain equipment at the facility. While functional refrigerators were widely available (90.6%), ensuring stable vaccine storage, the availability of freezers was significantly low, with only 18 out of 117 facilities (15.4%) having at least one operational unit. Vaccine carriers show better functionality, with 63.2% of facilities possessing adequate equipment. However, functional cold boxes remain limited (29.1%), possibly affecting the safe transport of vaccines over extended durations. Similarly, Sinnei et al. (2023) identified inadequate storage as one of the key drivers to vaccines stock outs. These findings emphasize the need to strengthen cold chain infrastructure, particularly by addressing the shortage of freezers and cold boxes, to enhance vaccine storage and distribution efficiency.

The data provided offers insight into perceptions of storage practices in health facilities, particularly in relation to vaccine management and cold chain systems. The analysis of each item based on the descriptive statistics (mean and standard deviation) and a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree) is as follows:

Table 4.5

Storage Practices

Statements	N	Min	Max	Mean	Std. Dev
Cold chain equipment has adequate storage capacity of vaccines	117	1	5	2.62	1.120
Availability of correctly and completely filled vaccine ledger books	117	1	5	3.07	1.081
Monthly vaccine physical count is conducted	117	1	5	3.57	1.155
Vaccines usually tally with what is documented in the ledger book at all times	117	1	5	2.83	1.116
Availability of a routine maintenance plan for cold chain equipment at the facility	117	1	5	2.90	1.199
Availability of a trained person responsible for cold chain equipment routine maintenance	117	1	5	2.71	1.300

Source: The Researcher (2025)

Table 4.5 the first item on cold chain equipment has adequate storage capacity of vaccines: With a mean score of 2.62 and a standard deviation of 1.120, the responses indicate a general disagreement with the adequacy of cold chain storage capacity. Most respondents lean toward the view that storage capacity may be insufficient, though the relatively wide spread suggests variation in perceptions across facilities.

Availability of correctly and completely filled vaccine ledger books: The mean score of 3.07 indicates a neutral to slightly positive perception, suggesting that, on average, respondents are somewhat satisfied with the accuracy and completeness of vaccine ledger books. However, the moderate standard deviation (1.081) implies a range of responses, with some facilities likely performing better than others in this regard.

Monthly vaccine physical count is conducted: This item scored a mean of 3.57, the highest among all, with a standard deviation of 1.155. This suggests a general agreement that monthly physical counts are conducted. While there is a positive perception, the moderate variability shows that this practice is not universally applied or perceived the same across all settings.

Vaccines usually tally with what is documented in the ledger book at all times: A mean of 2.83 indicates disagreement to neutrality, implying some inconsistencies between physical stock and recorded data. This points to potential issues in record-keeping or inventory management with a standard deviation (1.116) again reflecting diverse experiences among respondents.

Availability of a routine maintenance plan for cold chain equipment at the facility: The mean score of 2.90 reflects a neutral stance, bordering on disagreement, about the existence of routine maintenance plans. This suggests that many facilities may lack structured, consistent maintenance procedures, which can impact cold chain reliability. The relatively higher standard deviation (1.199) supports the idea of inconsistency in maintenance practices across facilities. Studies by Wanyonyi et al. (2024) and Sinnei et al. (2023) demonstrated a critical gap in the maintenance of the cold chain infrastructure and availability of a trained personnel for equipment maintenance.

Availability of a trained person responsible for cold chain equipment routine maintenance: With a mean of 2.71 and the highest standard deviation (1.300), there is a general disagreement regarding the availability of trained personnel for maintenance. This finding underscores a critical gap in human resource capacity, with considerable variation between facilities in terms of staffing for cold chain equipment upkeep. Overall, the data suggest that while some foundational practices like monthly physical counts are moderately well-established, significant challenges remain in areas such as

cold chain capacity, equipment maintenance planning, and the availability of trained personnel. These gaps point to areas that require policy and operational attention to strengthen vaccine storage and management systems.

4.5.4 Distribution

The study sought to examine vaccines distribution in public health facilities in Kisii County, Kenya. Key areas of investigation included delivery schedules, transportation logistics, and reverse logistics and results were captured as shown below.

Table 4.6

Lead Time

	Percent
1 day	18.8
2-3 days	34.2
>3 days-1 week	34.2
>1 week	12.8
Total	100.0

Source: The Researcher (2025)

The data in Table 4.6 reveals that 18.8% of the orders were delivered in one day and 34.2% within 2–3 days, suggesting a relatively efficient supply chain. Another 34.2% took between 3 days and one week, while 12.8% exceeded one week indicating long delays. The findings support Ngcobo and Kamupira (2017) that revealed that there were delays in delivery of vaccines in South Africa. The delivery schedules of vaccines was observed at 16% of the clinics took 1 day and majority of them took more than three days.

Table 4.7*Mode of Transport*

Mode of Transport	Percent
Government utility vehicle	23.1
Motor cycles	49.6
Personal cars	17.9
Vans/taxis	9.4
Total	100.0

Source: The Researcher (2025)

The data in table 4.7 reveals that majority of the facilities used a public mode of transport for vaccine delivery with motorcycles accounting the highest at 49.6%. Government utility vehicles follow at 23.1%, indicating significant reliance on official transportation for logistics. Personal cars contributed 17.9% while vans and taxis accounted for 9.4%. Overall, the distribution emphasizes on a critical gap in transportation that may lead to delays in vaccines delivery leading to vaccines stock outs. The findings concurred with those of Wanyonyi et al. (2024) in Vihiga County, Kenya which suggested that transportation challenges hindered timely vaccine delivery, affecting availability.

The data presents insights into the perceptions of healthcare facility staff regarding the effectiveness of vaccine distribution practices, using a Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree). The interpretation of each item is as in Table 4.8:

Table 4.8*Distribution Practices*

Statement	N	Min	Max	Mean	Std. Dev
There no delays experienced for supply of vaccines once orders are placed	117	1	5	2.85	1.243
Facility does not experience any transportation challenges of vaccines from the sub county store	117	1	5	2.24	1.194
Sometimes the facility has excess or expired commodities	117	1	5	2.99	1.349
Reverse logistics mechanism for distribution of excess and expired vaccines to higher levels is working effectively	117	1	5	2.13	1.263

Source: The Researcher (2025)

The first statement, "There are no delays experienced for supply of vaccines once orders are placed," has a mean score of 2.85 with a standard deviation of 1.243. This average, which is slightly below the neutral midpoint of 3, indicates a general disagreement among respondents, though not strongly so. It suggests that delays in vaccines supply are a somewhat common experience, and there is room for improvement in the timeliness of vaccines delivery after orders are placed.

The second item, "Facility does not experience any transportation challenges of vaccines from the sub-county store," records a lower mean of 2.24 and a standard deviation of 1.194. This reflects a clear disagreement with the statement, indicating that most respondents perceive transportation challenges as a significant issue. The relatively low mean points to consistent problems in logistics between the sub-county store and the facilities, which may hinder timely vaccines availability. Similarly, Kanja et al. (2021) highlighted significant logistical challenges in vaccine distribution which frequently resulted in stock outs of critical vaccines.

The third statement, "Sometimes the facility has excess or expired commodities," has a mean of 2.99 and a standard deviation of 1.349. This mean is very close to neutral, suggesting mixed experiences among respondents. While some facilities might occasionally encounter surplus or expired vaccines, others may not. The higher standard deviation reinforces the variability in experiences across different facilities.

The final statement, "Reverse logistics mechanism for distribution of excess and expired vaccines to higher levels is working effectively," scores the lowest mean of 2.13 with a standard deviation of 1.263. This indicates a strong disagreement among respondents, suggesting that the mechanisms for returning or redistributing excess or expired vaccines are generally perceived as ineffective. This could pose a risk to supply chain efficiency and proper inventory management. The findings are in line with Riberio et al. (2021) who observed that reverse logistics for medicines did not exist in majority of the hospitals in Rio de Janeiro.

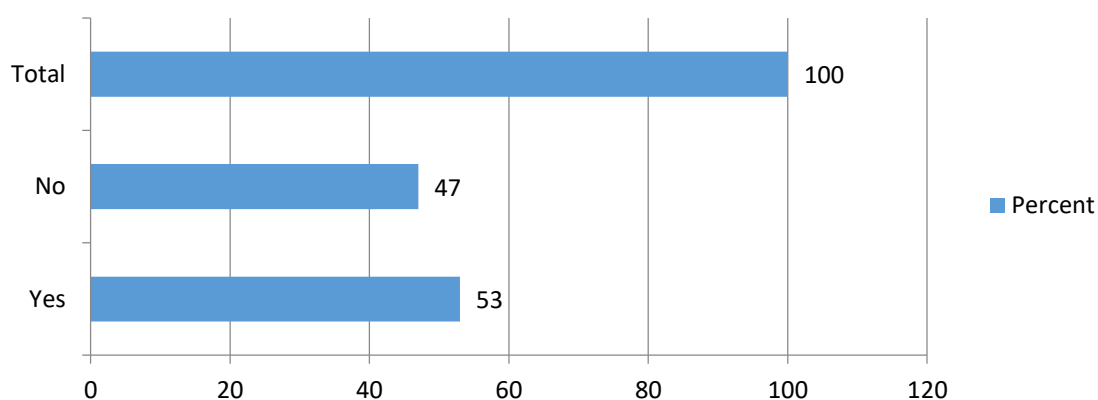
In summary, the data reveals significant challenges in the vaccine distribution practices, particularly with transportation logistics and reverse supply chain mechanisms. There is moderate concern about delays in vaccine supply, and experiences with excess or expired stock vary widely across facilities. These findings highlight the need for targeted interventions to improve logistics and distribution management systems.

4.5.5 Vaccines Availability

The study sought to assess the availability of vaccines across various health facilities in Kisii County. It aimed to identify gaps in accessibility and supply chain efficiency. Findings highlighted disparities in access as shown in Figure 4.9.

Figure 4.9

Vaccines Stock Outs on the Day of the Study



Source: The Researcher (2025)

The data reveals that vaccines stock outs occurred in 53.0% of the cases (62 out of 117), while 47.0% (55 out of 117) reported no stock outs, indicating that vaccines availability is a significant issue in over half of the assessed facilities. The findings concurred with those of Mkamba et al. (2023) that indicated that vaccines stock outs had been experienced in 63% of the facilities on the day of the study. This suggests a concerning level of inconsistency in vaccines supply, which could undermine immunization programs and public health efforts.

Table 4.9

Vaccines Stock Outs on the Day of the Study

Vaccine type	Percent
BCG	10.3
DPT-HepB-Hib	7.7
Inactivated polio	9.4
Measles-rubella	20.5
Oral polio	35.0
Pneumococcal	8.5
Rotavirus	8.5
Total	100.0

Source: The Researcher (2025)

The data on vaccine stock outs indicates that oral polio vaccine experienced the highest frequency of stock outs, accounting for 35.0% of all reported cases, followed by measles-rubella at 20.5%. This suggests significant supply chain or demand management issues with these two vaccines, which are critical for preventing widespread and potentially severe childhood illnesses. BCG, inactivated polio, pneumococcal, and rotavirus vaccines each accounted for 8.5–10.3% of stock outs, while DPT-HepB-Hib had the lowest frequency at 7.7%. Similarly, Iwu et al. (2020) findings indicated that BCG and Oral polio vaccines had the most stocks outs in frequency. These findings imply that while stock outs are distributed across all vaccine types; oral polio and measles-rubella followed by BCG vaccines are disproportionately affected, pointing to a need for targeted intervention in the procurement and distribution of these specific vaccines to ensure uninterrupted immunization services.

Figure 4.10

Vaccines Stock Outs in the Preceding 12 Months



Source: The Researcher (2025)

The data indicates that all 117 surveyed facilities (100%) experienced vaccine stock outs in the preceding 12 months, highlighting a critical and widespread issue in the vaccines supply chain. The findings are in line with Ngcobo and Kamupira (2017)

which showed that 100% of clinics in South Africa had experienced vaccines stock outs in the preceding one year. This uniformity suggests systemic challenges such as inadequate forecasting, poor inventory management, or logistical failures that affect the availability of vaccines. The total absence of facilities reporting no stock outs implies that the problem is pervasive and not isolated to specific regions and can be beyond the county level.. Consequently, these findings underscore the urgent need for intervention at policy, planning and operational levels to improve vaccines availability and ensure consistent immunization coverage.

Table 4.10

Vaccines Stock Outs in the Preceding 12 Months

Statement	N	Min	Max	Mean	Std. Dev
BCG	117	1	5	3.97	.675
DPT-HepB-Hib	117	1	5	2.61	1.326
Inactivated polio	117	1	5	2.61	1.313
Measles-rubella	117	1	5	3.05	1.024
Oral polio	117	1	5	3.53	1.297
Pneumococcal	117	1	5	2.71	1.526
Rotavirus	117	1	5	3.17	1.241
Tetanus	117	1	5	3.78	.882

Source: The Researcher (2025)

Table 4.10 represents descriptive analysis of vaccines stock outs in the preceding 12 months which reveals notable differences in stock out experiences across various vaccines, as indicated by their mean values. A higher mean represents more frequent or prolonged stock outs, while a lower mean suggests better stock availability. Among the vaccines, BCG (mean = 3.97) and Tetanus (mean = 3.78) had the highest average scores, suggesting these vaccines experienced the most severe stock outs during the period. These high means, combined with relatively low standard deviations (BCG = 0.675; Tetanus = 0.882), indicate consistent stock out issues across the facilities surveyed. Oral Polio Vaccine (OPV) and Rotavirus vaccine had moderately high means

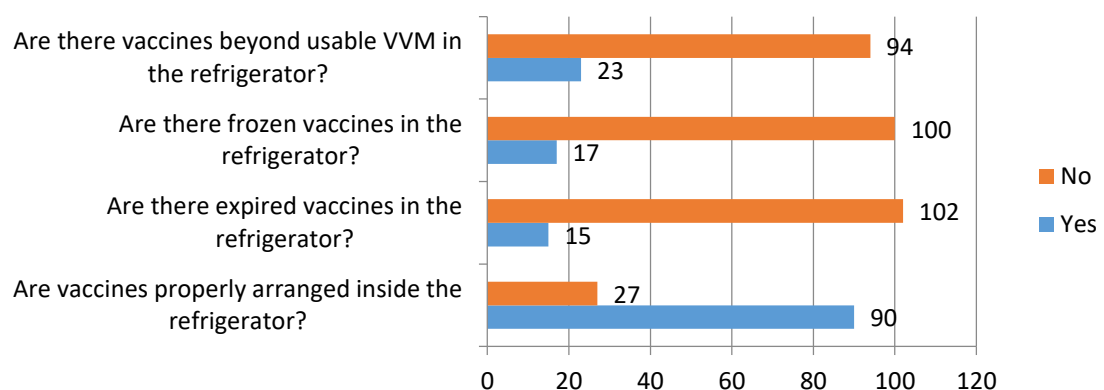
(3.53 and 3.17 respectively), indicating periodic stock outs, while Measles-Rubella (mean = 3.05) and Pneumococcal vaccine (mean = 2.71) showed intermediate levels of stock outs. In contrast, DPT-HepB-Hib and Inactivated Polio Vaccine (IPV) had the lowest means (both = 2.61), indicating relatively better availability and fewer stock outs occurrences. The moderate standard deviations (DPT-HepB-Hib = 1.326; IPV = 1.313) imply some variability in experiences, but generally these vaccines were more consistently available compared to others. Similarly, Kanja et al. (2021) findings indicated vaccines stock outs were majorly for tetanus, measles-rubella, oral polio and BCG vaccines. Overall, the data suggest that BCG and Tetanus vaccines faced the most significant stock out issues over the past year, both in terms of frequency and/or duration, while DPT-HepB-Hib and IPV were better stocked. The variation in means across vaccines underscores the need for targeted interventions to improve supply chain performance, especially for those with consistently high stock out rates.

4.5.6. Quality of Vaccines

The study sought to assess the quality of vaccines in health facilities in Kisii County. It aimed to determine whether vaccines were consistently available, potent, and delivered under appropriate conditions and Figure 4.7 presents the vaccines quality issues.

Figure 4.11

Quality of Vaccines



Source: The Researcher (2025)

The data indicates that vaccine storage practices at the facility are generally well-managed but show some areas for improvement. A majority (76.9%) of vaccines were properly arranged inside the refrigerator, ensuring optimal storage conditions. Additionally, expired vaccines are minimal (12.8%), reflecting effective inventory control. However, frozen vaccines are present in 14.5% of cases, which could compromise potency if unintended freezing occurs. Similarly, vaccines beyond usable Vaccine Vial Monitor (VVM) levels account for 19.7%, suggesting potential lapses in monitoring storage conditions. Feyisa (2021) also noted the same challenges with quality of vaccines in public healthcare facilities in Ethiopia. While overall vaccine quality appears well maintained, efforts should focus on reducing instances of freezing, expiry and vaccines beyond usable vaccine vial monitor to enhance storage efficiency and ensure vaccine efficacy.

4.5.7 Observation Checklist

The study also used an observation checklist and the observations were recorded and analyzed below:

Table 4.11*Observation checklist*

Item description	Yes	No
1. Facility vaccine orders are done by 5 th of every month	89	28
2. Availability and functionality of the cold chain equipment		
a) At least one functional refrigerator	106	11
b) At least one functional freezer	18	99
c) Adequate functional vaccine carriers	74	43
d) Functional cold boxes	34	83
3. Quality of vaccines		
a) Vaccines are properly arranged inside the refrigerator	90	27
b) Are there expired vaccines in the refrigerator?	15	102
c) Are there frozen vaccines in the refrigerator?	17	100
d) Are there vaccines beyond usable VVM in the refrigerator?	23	94
4. Are there any vaccines stock outs on the day of the study?		
BCG	33	84
DPT-HepB-Hib	17	100
Inactivated polio	28	89
Measles-rubella	45	72
Oral polio	58	59
Pneumococcal	21	96
Rotavirus	21	96
5. Have you had any vaccines stock outs in the preceding 12 months?		
BCG	117	0
DPT-HepB-Hib	100	17
Inactivated polio	117	0
Measles-rubella	117	0
Oral polio	117	0
Pneumococcal	90	27
Rotavirus	117	0
Tetanus	117	0

Source: The Researcher (2025)

The observation checklist in Table 4.11 reveals generally good vaccine management practices across most facilities, though notable gaps exist in cold chain functionality. Most facilities (89 out of 117) order vaccines by the 5th of each month, and nearly all (106) have at least one functional refrigerator; however, only 18 have a functional freezer, and less than half possess adequate vaccine carriers (74) or cold boxes (34),

indicating weaknesses in maintaining the cold chain during transport and storage. Vaccine quality appears satisfactory, with the majority properly arranged and minimal issues of expiry (15), freezing (17), or vaccines beyond usable VVM (23). On the day of observation, stock outs were minimal for most vaccines except for oral polio (58 facilities affected) and measles-rubella (45), though all facilities reported stock outs for vaccines in the preceding 12 months. Overall, while vaccine availability and management are strong, the limited functionality of cold chain equipment could compromise vaccine potency and program reliability.

4.6 Regression Analysis

Before analyzing the results of regression analysis examining the impact of supply chain management practices on vaccines availability in public health facilities in Kisii County, the study undertook essential steps to validate the model. This process involved checking key assumptions, including the absence of influential outliers, the normal distribution of residuals, no multicollinearity among predictors, homoscedasticity (equal variance of errors), and the existence of linear relationships between the predictors and the outcome variables, specifically inventory management practices and organizational performance. Addressing these assumptions helped enhance the model's reliability and interpretability, thereby providing more robust insights into the factors influencing vaccines availability through supply chain management practices.

4.6.1 Tests of Normality

The Tests of normality are statistical procedures used to determine whether a dataset follows a normal (Gaussian) distribution. These tests are important because many statistical methods assume normality. They evaluate the data's distribution shape by

comparing it to a theoretical normal distribution, often using measures of skewness and kurtosis. The result was captured in Table 4.12.

Table 4.12

Test of Normality

Variables	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Planning	.160	117	.060	.920	117	.060
Ordering practices	.296	117	.062	.846	117	.062
Storage practices	.164	117	.059	.937	117	.059
Distribution	.125	117	.067	.918	117	.067
Vaccines availability	.168	117	.063	.938	117	.063

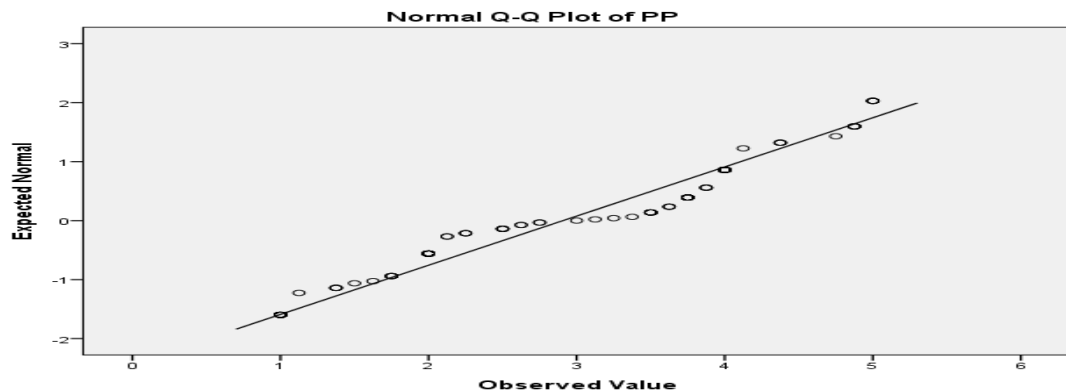
a. Lilliefors Significance Correction

Source: *The Researcher (2025)*

The Kolmogorov-Smirnov and Shapiro-Wilk tests of normality, the results indicate that all the variables planning (PP), ordering practices (OrdP), storage practices (SP), distribution (DP) and vaccines availability (VA) have significance values (Sig.) greater than the common alpha threshold of 0.05 in both tests. This suggests that the null hypothesis of normality cannot be rejected for any of the variables, implying that the data distributions for these variables do not significantly deviate from normality. This is critical for the study, as it validates the use of parametric statistical techniques for further analysis, which assume normal distribution of data. Consequently, the results lend credibility to any inferential statistical methods applied in evaluating the relationships among these variables in relation to the study's objectives.

Figure 4.12

Q-Q Plot Test

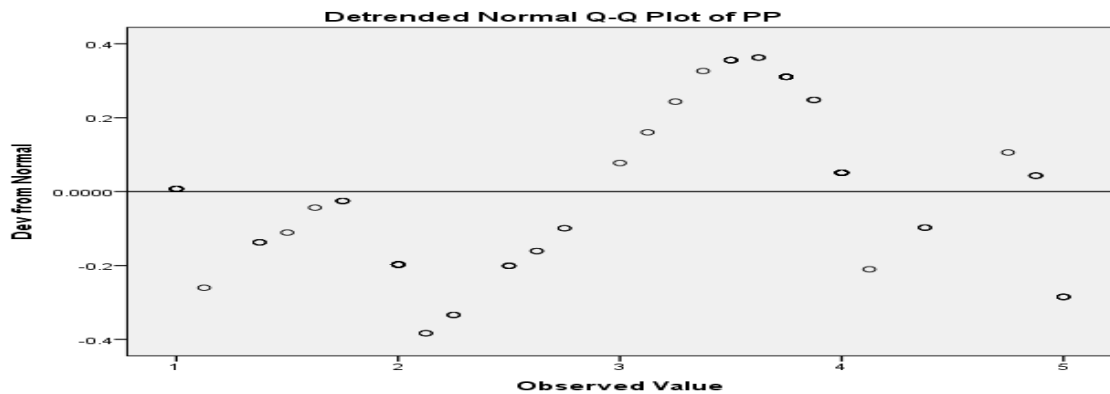


Source: *The Researcher (2025)*

The Normal Q-Q Plot presented assesses whether the dataset follows a normal distribution by comparing the observed values to the expected normal values. The points in the plot represent individual data values, while the diagonal line signifies the ideal normal distribution. If the points align closely with this line, it suggests that the data adheres to normality. In this case, most points closely follow the diagonal trend, indicating a likely normal distribution. However, slight deviations at higher values suggest minor departures from strict normality. This visualization is crucial for determining whether parametric statistical methods that assume normality are appropriate for further analysis.

Figure 4.13

Q-Q Plot Test for Normality



Source: *The Researcher (2025)*

The Normal Q-Q Plot provides a graphical representation of whether the data follows a normal distribution. In this plot, the observed values are compared against expected normal values. The diagonal reference line represents perfect normality, meaning that if the data were normally distributed, the points would align closely with this line. In this case, most points follow the trend of the diagonal line, suggesting that the data set is approximately normal.

4.6.2 Planning and Vaccines Availability

The study sought to evaluate the linear relationship between the planning and vaccines availability. It aimed to determine how strategic planning activities, such as forecasting, coordination, and resource allocation, affect the consistent availability of vaccines. By analyzing this relationship, the study highlights the critical role of effective planning in ensuring timely and adequate vaccine supply within healthcare systems.

Table 4.13*ANOVA for Planning and Vaccines Availability*

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	12.699	1	12.699	118.617	.000 ^b
	Residual	12.311	115	.107		
	Total	25.010	116			

a. Dependent Variable: Vaccines Availability

b. Predictors: (Constant), Planning Practice

Source: The Researcher (2025)

Table 4.13 the ANOVA results reveal that the model predicting the dependent variable (VA) based on the predictor (Planning Practice) is statistically significant ($F(1,115) = 118.617$, $p < .001$), indicating a strong relationship between the two variables. The regression sum of squares (12.699) accounts for a substantial portion of the total variation (25.010) in the dependent variable, suggesting that Planning Practice explains approximately 50.8% of the variance in vaccines availability. The relatively low residual mean square (.107) further demonstrates the model's effectiveness in minimizing prediction errors. This analysis supports the conclusion that Planning Practice is a significant predictor of vaccines availability, underscoring its importance in influencing the outcome within the context of the study.

Table 4.14*Model Summary for Planning and Vaccines Availability*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.713 ^a	.508	.503	.32719	2.137

a. Predictors: (Constant), Planning practice

b. Dependent Variable: Vaccines Availability

Source: The Researcher (2025)

The model summary indicates a strong positive relationship between the predictor variable and the dependent variable Vaccines Availability, with an R value of 0.713.

The R Square value of 0.508 suggests that approximately 50.8% of the variance in vaccines availability can be explained by planning practices, indicating that planning is a significant contributor to changes in vaccines availability. The Adjusted R Square value of 0.503, which adjusts for the number of predictors in the model, confirms the model's reliability and generalizability. The standard error of the estimate, 0.32719, reflects the average distance that the observed values fall from the regression line, showing a relatively moderate level of prediction accuracy. Additionally, the Durbin-Watson statistic of 2.137 is close to 2, suggesting that there is no significant autocorrelation in the residuals, thereby affirming the appropriateness of the regression model for the study. Overall, the results suggest that planning practice is a meaningful and statistically significant predictor of vaccines availability within the context of the study.

Table 4.15

Coefficients for Planning and Vaccines Availability

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	2.377	.080		29.855	.000
1 Planning practices	.276	.025	.713	10.891	.000

a. Dependent Variable: Vaccines Availability

Source: The Researcher (2025)

Table 4.15 presents the coefficients for a regression model assessing the effect of the planning practices on vaccines availability. The unstandardized coefficient ($B = 0.276$, $p < .001$) indicates that for every unit increase in the planning practices, vaccines availability increases by 0.276 units, holding other factors constant. The standardized coefficient ($Beta = 0.713$) suggests a strong positive relationship, and the high t-value (10.891) further supports the statistical significance of this predictor. The significance

level ($p = .000$) confirms that the relationship is not due to chance. These findings validate the model's claim that effective planning practices significantly enhance vaccines availability, demonstrating both statistical and practical importance. The findings were in agreement with the study done by Moodley et al. (2021) who highlighted how inadequate planning and misaligned budget allocations directly lead to drug shortages in South African public healthcare facilities, underscoring the need for needs-based and transparent planning processes to enhance pharmaceutical access. Similarly, Akunne et al. (2023) demonstrated that discrepancies between drug policy and prescribing practices, driven by insufficient planning and training, disrupted consistent drug availability, thereby stressing the critical role of coordinated planning aligned with national health policies. Complementing this, Onyango (2024) proposed that innovative planning approaches using technology and data analytics significantly improve forecasting and inventory control, which are crucial for minimizing stock outs and ensuring vaccine availability. From an organizational perspective, Asewe (2022) revealed that structured strategic planning and clearly defined strategic directions significantly boost performance in pharmaceutical settings, factors that directly correlate with the efficient provision of essential drugs. Collectively, these studies triangulate the conclusion that robust planning practices whether strategic, operational, or budgetary are indispensable to ensuring the consistent availability of vaccines and other essential medicines. The findings across several studies strongly support the conclusion that planning practices are a significant predictor of vaccines availability.

4.6.3 Ordering Practices and Vaccines Availability

The study sought to evaluate the linear relationship between the ordering practices and vaccines availability. Specifically, it focused on the ordering process, assessing how effectively structured and timely ordering impacts the consistent availability of

vaccines. Understanding this relationship is essential for improving supply chain performance and ensuring uninterrupted immunization services.

Table 4.16

ANOVA for Ordering Practices and Vaccines Availability

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	11.526	1	11.526	98.308	.000 ^b
	Residual	13.484	115	.117		
	Total	25.010	116			

a. Dependent Variable: Vaccines Availability

b. Predictors: (Constant), Ordering Practices

Source: The Researcher (2025)

The ANOVA results presented in Table 4.16 demonstrate that the regression model examining the influence of ordering practices on vaccines availability is statistically significant, as indicated by a high F-value of 98.308 and a p-value of .000 ($p < .05$). This suggests that there is a significant linear relationship between the ordering practices and vaccines availability. The model explains a substantial portion of the variance in vaccines availability, with the regression sum of squares (11.526) representing a notable proportion of the total variance (25.010). Thus, the findings validate the model and support the inference that improvements or changes in the ordering practices are likely to significantly influence vaccines availability, highlighting the importance of efficient ordering systems in healthcare logistics.

Table 4.17*Model Summary for Ordering Practices and Vaccines Availability*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.679 ^a	.461	.456	.34241	2.126

a. Predictors: (Constant), Ordering Practices

b. Dependent Variable: Vaccines Availability

Source: The Researcher (2025)

The validity of the model presented in Table 4.17 can be considered moderately strong, as indicated by an R value of 0.679 and an R Square of 0.461, suggesting that approximately 46.1% of the variance in vaccines availability (VA) can be explained by the ordering practices. The Adjusted R Square of 0.456 confirms this strength while accounting for the number of predictors, indicating a minimal decrease and thus reinforcing model reliability. The standard error of the estimate (0.34241) is relatively low, pointing to a reasonable level of prediction accuracy. Additionally, the Durbin-Watson statistic (2.126) is within the acceptable range (1.5–2.5), suggesting minimal autocorrelation in residuals, thereby reinforcing the reliability of the model.

Table 4.18*Coefficients for Ordering Practices and Vaccines Availability*

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.446	.080		30.457	.000
	Ordering	.280	.028	.679	9.915	.000

a. Dependent Variable: Vaccines Availability

Source: The Researcher (2025)

The validity of the model presented in Table 4.18 which examines the relationship between the ordering practices and vaccines availability, appears strong based on the statistical outputs. The unstandardized coefficient ($B = 0.280$) for the ordering practices is positive and significant ($p < 0.001$), indicating that improvements in the ordering practices are reliably associated with increased vaccines availability. The high t-value (9.915) further supports the strength of this relationship. Additionally, the standardized coefficient (Beta = 0.679) suggests a substantial effect size, meaning the ordering practice is a major predictor of vaccines availability in this model. The constant term is also significant, indicating the baseline level of vaccines availability when the ordering process is zero. Overall, these findings validate the model's predictive power and suggest that enhancing ordering practices can significantly improve vaccines availability. The finding was in agreement with the study done by Ouma et al. (2023) who revealed that poor forecasting, delays in ordering, and lack of training are central causes of stock outs in Tana River County, clearly linking weak ordering practices to vaccine shortages. Similarly, Wanyonyi et al. (2024) found that despite standardized requisition forms being used, limited knowledge among healthcare workers regarding proper vaccine handling impaired the effectiveness of these ordering tools, suggesting that procedural compliance alone is insufficient without adequate training. The findings by Gavi (2022) point to the fact that infrastructure upgrades alone do not resolve stock outs, implying that systemic flaws in ordering and distribution remain unaddressed. Furthermore, Mkamba et al. (2023) also emphasize that experienced healthcare workers are more adopted at managing vaccine orders and inventories, suggesting that human capacity plays a crucial role in effective ordering practices. Lastly, Chandani et al. (2016) provide a broader perspective, indicating that governance and data management reforms, key components of structured ordering systems are essential to resolving

bottlenecks and ensuring consistent vaccine supply. Together, these studies consistently highlight that strengthening ordering practices through accurate forecasting, adequate training, experience, and systemic improvements is essential to improving vaccines availability across various Kenyan counties. The triangulated findings from the various studies strongly support the conclusion that ordering practices are a significant predictor of vaccines availability.

4.6.4 Storage Practices and Vaccines Availability

The study sought to evaluate the linear relationship between storage practices and vaccines availability. As part of this assessment, the storage process was examined as a critical component influencing the timely and efficient availability of vaccines. Proper storage ensures vaccine potency and minimizes wastage, thereby supporting sustained availability. Vaccine availability, in turn, reflects the health system's capacity to meet immunization demands, which is essential for disease prevention and public health outcomes.

Table 4.19

ANOVA for Storage Practices and Vaccines Availability

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	13.465	1	13.465	134.129	.000 ^b
	Residual	11.545	115	.100		
	Total	25.010	116			

a. Dependent Variable: Vaccines Availability

b. Predictors: (Constant), Storage Practices

Source: The Researcher (2025)

The ANOVA results in Table 4.19 confirm the statistical significance of the regression model evaluating the impact of storage practices on vaccine availability. The F-statistic (134.129) is notably high, indicating a strong explanatory power of storage practices in predicting vaccine availability. The p-value (.000) further validates this significance at

conventional thresholds ($p < 0.05$), confirming that storage practices play a crucial role in determining vaccines availability. The regression sum of squares (13.465) accounts for a substantial proportion of the total variance, demonstrating the importance of effective storage strategies, while the residual sum of squares (11.545) represents unexplained variance. These findings emphasize the necessity of optimizing vaccine storage systems to enhance reliability and distribution efficiency.

Table 4.20

Model Summary for Storage Practices and Vaccines Availability

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.734 ^a	.538	.534	.31684	2.148

a. Predictors: (Constant), Storage Practices

b. Dependent Variable: Vaccines Availability

Source: The Researcher (2025)

The model summary in Table 4.20 demonstrates a strong positive correlation ($R = 0.734$) between storage practices and vaccines availability, indicating that enhanced storage management significantly contributes to vaccines availability. The R Square value (0.538) shows that 53.8% of the variation in vaccines availability is explained by storage practices, while the Adjusted R Square (0.534) refines this estimate, accounting for model complexity. The standard error of the estimate (0.31684) suggests relatively low variability in predicted values, indicating a well-fitted model. Additionally, the Durbin-Watson statistic (2.148) falls within the acceptable range (1.5–2.5), confirming minimal autocorrelation in residuals and reinforcing the reliability of the model’s conclusions. These results highlight the crucial role of effective storage strategies in ensuring the consistent and stable availability of vaccines.

Table 4.21*Coefficients for Storage Practices and Vaccines Availability*

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.261	.084		26.764	.000
	Storage practices	.311	.027	.734	11.581	.000

a. Dependent Variable: Vaccines Availability

Source: The Researcher (2025)

The regression coefficients in Table 4.21 highlight the significant influence of storage practices on vaccines availability. The unstandardized coefficient ($B = 0.311$) suggests that for every unit increase in storage practices, vaccines availability improves by 0.311 units, assuming other variables remain constant. The standardized coefficient ($Beta = 0.734$) indicates a strong positive effect, emphasizing that storage practices play a crucial role compared to other predictors. The t-value (11.581) is considerably high, demonstrating the robustness of this relationship, while the p-value (.000) confirms its statistical significance ($p < 0.05$). These findings underscore the critical role of proper storage management in ensuring consistent vaccines availability, highlighting the need for optimized storage systems to enhance healthcare supply chain efficiency.

The findings were in agreement with the study done by Wanyonyi et al. (2024) who revealed a gap in healthcare workers' understanding of vaccine sensitivities in Vihiga County, despite most knowing how to condition ice packs highlighting the need for comprehensive training in cold chain management to ensure proper vaccine storage. Similarly, Sinnei et al. (2023) found that healthcare workers with more experience in vaccine storage were more likely to maintain consistent vaccine availability, with experienced staff in Tana River County being 6.25 times more effective in this regard. Kanja et al. (2021) reinforced the importance of storage monitoring, showing that

although cold chain infrastructure existed in Nairobi City County, only 62% of facilities consistently monitored temperatures, and many lacked contingency plans—factors that compromised storage reliability. These findings align with the broader concern expressed by Ayako et al. (2023) and Wanyonyi et al. (2024) that logistical challenges and poor stock management practices also exacerbate availability issues. Collectively, these studies underscore that robust storage practices, encompassing both infrastructure and staff competence, are critical for ensuring consistent vaccines availability across diverse regions. The triangulated findings from multiple studies strongly indicate that storage practices are a significant predictor of vaccines availability in Kenyan healthcare facilities.

4.6.5 Distribution and Vaccines Availability

The study sought to examine the impact of distribution on vaccines availability, focusing on how logistical efficiency, supply chain management, and distribution protocols influenced timely and equitable access to vaccines. It aimed to identify gaps and best practices in current distribution systems to enhance vaccines delivery, particularly in health facilities in Kisii County.

Table 4.22

ANOVA for Distribution and Vaccines Availability

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.545	1	10.545	83.841	.000 ^b
	Residual	14.465	115	.126		
	Total	25.010	116			
a. Dependent Variable: Vaccines Availability						
b. Predictors: (Constant), Distribution						

Source: The Researcher (2025)

The ANOVA results in Table 4.22 confirm the statistical significance of the regression model examining the relationship between distribution and vaccines availability. The F-

statistic (83.841) is notably high, indicating that distribution significantly impact vaccines availability. The p-value (.000) further validates the model’s statistical significance, confirming that the predictor variable meaningfully explains variations in vaccines availability at conventional thresholds ($p < 0.05$). The regression sum of squares (10.545) accounts for a substantial portion of the total variance, demonstrating the explanatory power of distribution practices, while the residual sum of squares (14.465) reflects the variance not captured by the model. These findings emphasize the critical role of efficient distribution strategies in optimizing vaccines availability, reinforcing the need for strategic improvements in supply chain management.

Table 4.23

Model Summary for Distribution and Vaccines Availability

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.649 ^a	.422	.417	.35465	2.116
a. Predictors: (Constant), Distribution					
b. Dependent Variable: Vaccines Availability					

Source: The Researcher (2025)

The model summary in Table 4.23 indicates a moderate positive correlation ($R = 0.649$) between distribution and vaccines availability, suggesting that improvements in distribution contribute meaningfully to vaccine availability. The R Square value (0.422) shows that 42.2% of the variance in vaccines availability is explained by this predictor, while the Adjusted R Square (0.417) accounts for model complexity, providing a refined estimate. The standard error of the estimate (0.35465) reflects the variability in predicted values, with lower values indicating a better fit. The Durbin-Watson statistic (2.116) falls within the acceptable range (1.5–2.5), suggesting minimal autocorrelation in residuals, thereby reinforcing the reliability of the model. These findings highlight

the critical role of effective distribution strategies in ensuring consistent vaccines availability.

Table 4.24

Coefficients for Distribution and Vaccines Availability

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.516	.079		31.678	.000
	Distribution	.260	.028	.649	9.156	.000
a. Dependent Variable: Vaccines Availability						

Source: The Researcher (2025)

The regression coefficients in Table 4.24 illustrate the significant impact of distribution on vaccines availability. The unstandardized coefficient (B = 0.260) suggests that for every unit increase in distribution practice, vaccines availability improves by 0.260 units, holding other factors constant. The standardized coefficient (Beta = 0.649) further emphasizes the strength of this predictor, indicating a substantial positive influence relative to other independent variables. The t-value (9.156) is high, demonstrating the robustness of this relationship, while the p-value (.000) confirms statistical significance at conventional thresholds ($p < 0.05$). This finding highlights the critical role of efficient distribution strategies in ensuring vaccines availability. The findings were in agreement with the study done by Gavi (2025) who emphasized the direct impact of unreliable transportation systems on vaccine supply, particularly in Nairobi City County, where 91% of public health facilities relied on public or informal transport means. This mode of transport compromised cold chain integrity and timely delivery, thereby limiting vaccines availability. Similarly, Kanja et al. (2021) reinforced the critical role of transport logistics, revealing that only 1% of facilities had access to reliable government vehicles, leading to frequent stock outs. Finally, Gavi's (2025)

ongoing efforts to mitigate these issues through a transport support hub in partnership with DHL demonstrate a proactive response aimed at streamlining distribution processes and enhancing supply chain transparency. These collective insights affirm that strengthening distribution practices is essential for ensuring sustained vaccines availability across diverse regions. The triangulated findings across the four studies strongly affirm that distribution practices are a significant predictor of vaccines availability.

4.6.6 Multiple Linear Regression and Vaccines Availability

The study sought to evaluate the linear relationship between supply chain management practices and vaccines availability in public health facilities in Kisii County. Multiple Linear Regression was employed as a statistical method to assess how various independent factors that is, planning, ordering practices, storage practices and distribution influence the dependent variable, vaccines availability. Multiple Linear Regression enables the analysis of the collective and individual impact of these supply chain components on ensuring consistent vaccine stocks in health facilities.

Table 4.25

ANOVA for Multiple Linear Regression

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	13.945	4	3.486	35.286	.000 ^b
	Residual	11.065	112	.099		
	Total	25.010	116			

a. Dependent Variable: Vaccines availability

b. Predictors: (Constant), Planning , Ordering practices, Storage practices and Distribution practices

Source: The Researcher (2025)

The ANOVA results in Table 4.25 confirm the statistical significance of the multiple linear regression model examining the relationship between supply chain practices,

planning, ordering, storage, and distribution, and vaccines availability. The F-statistic (35.286) is notably high, indicating a strong model fit, while the p-value (.000) confirms that the regression equation is statistically significant at conventional levels ($p < 0.05$). The sum of squares for regression (13.945) suggests that the independent variables explain a substantial portion of the variance in vaccines availability, whereas the residual sum of squares (11.065) accounts for unexplained variance. Given the model's statistical significance, these predictors play a crucial role in determining vaccines availability.

Table 4.26

Model Summary for Multiple Linear Regression

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.747 ^a	.558	.542	.31432	2.170

a. Predictors: (Constant), Planning , Ordering practices, Storage practices and Distribution

b. Dependent Variable: Vaccines Availability

Source: The Researcher (2025)

The multiple linear regression model presented in Table 4.26 indicates a strong positive correlation ($R = 0.747$) between the independent variables, planning, ordering, storage, and distribution practices, and vaccines availability. The R Square value (0.558) suggests that 55.8% of the variation in vaccines availability can be explained by these predictors, while the Adjusted R Square (0.542) accounts for model complexity, refining this estimate. The standard error of the estimate (0.31432) provides insight into the accuracy of predictions, with lower values suggesting better fit. Notably, the Durbin-Watson statistic (2.170) falls within the acceptable range (typically between 1.5 and 2.5), indicating that autocorrelation in residuals is minimal, thereby enhancing the reliability of the model's conclusions. These results underscore the critical role of effective supply chain practices in optimizing vaccines availability.

Table 4.27*Coefficients for Multiple Linear Regression*

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.182	.098		22.215	.000
	Planning	.065	.157	.168	.415	.001
	Ordering practices	.022	.088	.054	.254	.000
	Storage practices	.524	.203	1.237	2.585	.001
	Distribution	.165	.087	.412	1.899	.000
a. Dependent Variable: Vaccines Availability						

Source: *The Researcher (2025)*

Table 4.27 the coefficients for the multiple linear regression models reveal the individual effects of planning, ordering, storage, and distribution on vaccines availability. The constant value of 2.182 ($p = .000$) is statistically significant, indicating that when all independent variables are held constant, the baseline level of vaccines availability is positive. Planning have a positive but statistically insignificant effect ($B = 0.065$, $p = .679$), suggesting that while improved planning might relate to better vaccines availability, the evidence is weak. Ordering practices also show a very small positive impact ($B = 0.022$, $p = .800$), which is statistically insignificant, implying limited influence on vaccines availability. Storage practices demonstrate a strong and statistically significant positive relationship ($B = 0.524$, $p = .011$), indicating that effective storage substantially enhances vaccines availability and is the most influential predictor in this model. In contrast, distribution have a positive unstandardized coefficient ($B = 0.165$) but a negative standardized Beta ($-.412$), with a marginal significance ($p = .060$), suggesting a complex or potentially inverse relationship that might warrant further investigation. Overall, storage practices emerge as the most

significant and impactful factor in determining vaccine availability among the variables studied.

All four independent variables, Planning, ordering practices, storage practices, and distribution practices, positively influence vaccines availability, with statistically significant p-values (Sig.) below 0.05. Storage practices exhibit the strongest standardized coefficient (Beta = 1.237), suggesting they have the greatest impact on vaccines availability, followed by distribution (Beta = 0.412). Although planning and ordering practices show relatively lower Beta values (0.168 and 0.054 respectively), their statistical significance ($p = .001$ and $.000$) confirms that they still contribute meaningfully to the model. The constant value of 2.182 implies a baseline level of vaccines availability even in the absence of these practices. Overall, these findings suggest that improving storage and distribution practices, in particular, could substantially enhance vaccines availability.

4.7 Correlational Analysis

The study sought to examine the relationships among key supply chain management activities through a correlational analysis. Specifically, it investigated the extent to which Planning, Ordering practices, Storage practices, and Distribution are interrelated.

Table 4.28*Correlational Analysis*

		PP	OrdP	SP	DP	VA
PP	Pearson Correlation	1	.897**	.984**	.937**	.713**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	117	117	117	117	117
OrdP	Pearson Correlation	.897**	1	.935**	.926**	.679**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	117	117	117	117	117
SP	Pearson Correlation	.984**	.935**	1	.944**	.734**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	117	117	117	117	117
DP	Pearson Correlation	.937**	.926**	.944**	1	.649**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	117	117	117	117	117
VA	Pearson Correlation	.713**	.679**	.734**	.649**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	117	117	117	117	117

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

PP=Planning, OrdP=Ordering practices, SP=Storage practices and DP =Distribution practices

Source: The Researcher (2025)

The correlation analysis in Table 4.28 reveals strong, statistically significant positive relationships among all variables related to supply chain management practices. Planning (PP) show the highest correlation with Storage Practices (SP) at $r = .984$, indicating that effective planning is closely aligned with how inventory is stored. Similarly, strong correlations exist between PP and Distribution (DP) ($r = .937$), as well as Ordering Practices (OrdP) ($r = .897$), suggesting that well-structured planning underpins efficient ordering and distribution. All variables also significantly correlate with Vaccines availability (VA), though to a relatively lesser extent (e.g., PP and VA: $r = .713$), implying that while planning practices enhance value, their direct impact on VA is somewhat weaker compared to inter-practice relationships. The findings collectively suggest a tightly integrated supply chain management system where

improvements in one domain are likely to reinforce others, ultimately contributing positively, though moderately, to value addition.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This section presents the summary of the study findings, conclusions, and recommendation of the study and areas for further research.

5.2 Summary of the Findings

This study examined various critical aspects affecting the availability of vaccines within the healthcare supply chain. The findings were organized around five key themes: planning, ordering practices, storage practices, distribution and overall availability of vaccines. Each theme highlighted specific challenges and strengths encountered in ensuring vaccines are effectively planned for, ordered, stored, and distributed to meet public health needs. The insights gained provide a comprehensive understanding of how these interconnected practices influence vaccines availability at different levels of the healthcare system.

5.2.1 Planning and Vaccines Availability

The study reveals that health facilities experience inconsistent engagement in key aspects of immunization program planning and implementation, particularly in budgeting, funding, supervision, and forecasting. While there were isolated instances of moderate involvement such as in monthly supervision and vaccine forecasting, the overall sentiment across facilities leaned toward neutrality or dissatisfaction. Limited funding, especially for vaccine collection and cold chain maintenance, appeared to be a systemic concern, and irregular supervisory support further undermined program consistency. These findings suggest that significant disparities exist among facilities, pointing to the need for targeted reforms in policy, operational support, and resource allocation to ensure a more coordinated and effective immunization planning process.

The findings suggest that effective planning practices play a crucial role in improving vaccines availability. The strong and statistically significant relationship indicates that enhancements in planning practices are closely associated with better vaccines access, supporting the inference that targeted improvements in planning mechanisms could lead to more a reliable vaccine supply chain. This underscores the importance of strategic planning in public health logistics, implying that investments in planning practices are likely to yield practical benefits in vaccines distribution and availability.

5.2.2 Ordering Practices and Vaccines Availability

The findings indicate systemic inefficiencies in the vaccine ordering and supply process across health facilities, with respondents generally expressing disagreement or neutrality toward statements suggesting proper vaccine management practices. The data reveal irregular ordering patterns, delayed responses to emergencies, occurrences of stock outs despite vaccines availability at higher levels, and inconsistencies in fulfilling vaccine orders as requested. These patterns suggest underlying logistical, administrative or procedural challenges that hinder the timely and adequate supply of vaccines, ultimately posing risks to effective immunization service delivery and public health outcomes.

The study demonstrates a strong and meaningful relationship between ordering practices and vaccines availability, suggesting that as ordering practices improve, vaccines availability also increases notably. The statistical evidence supports the model's validity, highlighting ordering practices as a key factor in predicting vaccines availability. These findings imply that targeted improvements in how vaccines are ordered could lead to more reliable and consistent access, reinforcing the importance of streamlining logistical operations within healthcare supply chains.

5.2.3 Storage Practices and Vaccines Availability

The study reveals significant disparities in cold chain management practices across facilities, with a general perception that storage capacity is inadequate and that trained personnel for equipment maintenance are lacking. Although monthly physical counts of vaccines are relatively well-practiced, inconsistencies in stock records and the absence of routine maintenance plans highlight weaknesses in inventory and equipment management. The moderate satisfaction with the accuracy of vaccine ledger books suggests partial compliance with documentation standards, but the variation in responses indicates inconsistent implementation. Overall, the findings infer that while some essential processes are in place, systemic gaps in infrastructure, personnel, and planning undermine the reliability and effectiveness of vaccine cold chain systems, necessitating targeted improvements in policy and operational frameworks.

The study reveals that storage practices have a strong and statistically significant impact on vaccines availability, indicating that better storage management leads to more consistent vaccines supply. This relationship is not only robust but also more influential than other predictors, suggesting that improvements in storage systems can greatly enhance the efficiency of the healthcare supply chain. The findings infer that prioritizing proper storage protocols is essential for ensuring reliable vaccine access, which is critical for effective healthcare delivery.

5.2.4 Distribution and Vaccines Availability

The study reveals that vaccines distribution faces notable challenges, especially in transportation from sub-county stores and in the inefficiency of reverse logistics for excess or expired vaccines. Respondents generally disagreed with statements suggesting smooth supply and logistics, indicating that delays and transportation issues are common. While experiences with surplus or expired commodities vary across

facilities, the overall sentiment reflects inconsistency and a lack of effective systems to manage such occurrences. The findings suggest that existing logistical and inventory mechanisms are inadequate and highlight a pressing need for strategic improvements to enhance vaccine supply chain efficiency and reliability.

The study highlights a strong and statistically significant relationship between distribution and vaccines availability, indicating that improvements in distribution strategies lead to better vaccines access. The strength of this relationship, as shown by the high regression coefficients and significance levels, suggests that among various factors, distribution play a particularly influential role. This implies that policymakers and healthcare administrators should prioritize and enhance distribution systems to effectively increase vaccines availability and improve public health outcomes.

5.2.6 Vaccines Availability

The study highlights a troubling inconsistency in vaccines availability, as more than half of the assessed cases experienced stock outs. This finding suggests that gaps in supply chain efficiency, forecasting accuracy, or resource distribution may be undermining immunization efforts. The close balance between facilities with and without stock outs points to systemic issues that require urgent attention to ensure vaccines are consistently available. Addressing these challenges is critical for maintaining effective immunization programs and protecting public health.

The analysis of vaccine stock outs over the past year reveals significant disparities in availability across different vaccines, with BCG and Tetanus experiencing the most frequent and prolonged shortages, consistently affecting multiple facilities. Conversely, DPT-HepB-Hib and IPV showed relatively better stock levels, reflecting more stable supply chains. Other vaccines like OPV, Rotavirus, Measles-Rubella, and Pneumococcal had intermediate stock-out levels, indicating periodic but less severe

disruptions. These findings highlight critical gaps in vaccines distribution and underscore the need for targeted supply chain improvements, particularly for vaccines with persistent and widespread stock-out problems.

The study's findings indicate that all four practices namely; planning, ordering, storage, and distribution positively contribute to vaccines availability, though their individual impacts vary. Storage practices stand out as the most influential factor, showing both a strong statistical significance and the highest effect, implying that better storage methods substantially improve vaccines availability. While distribution also plays a significant role, their mixed coefficients suggest a more complex relationship that may need deeper examination. Planning and ordering practices, though having weaker effects, still show meaningful contributions according to their statistical significance. The consistently positive constant value suggests a foundational level of vaccines availability regardless of these practices, but enhancements, especially in storage and distribution, are likely to produce the most substantial improvements. These results imply that strategic focus on strengthening storage infrastructure and clarifying the role of distribution could yield the greatest benefits in ensuring reliable vaccines availability.

5.3 Conclusion

The study concludes that while all four practices, that is, planning, ordering, storage and distribution positively influence vaccines availability, storage practices have the most significant and impactful role in improving vaccines availability. Distribution also contributes meaningfully to availability of vaccines. Planning and ordering, although less influential, provide important support to vaccines availability. Overall, the findings highlight that strengthening storage infrastructure and better understanding distribution

dynamics are key strategic priorities to maximize reliable vaccine supply, building on a baseline level of availability maintained by these combined efforts.

5.4 Recommendations of the Study

Based on the study findings, the study recommends that the county government, the hospital management teams and health facilities in Kisii County should:

5.4.1 Planning and Vaccines Availability

The County government should formalize a specific budget allocation for immunization programs, including vaccine collection, cold chain maintenance, and operational costs. This policy will ensure sustained and predictable funding; addressing systemic funding gaps that compromise vaccines availability and cold chain functionality.

Develop and enforce county-wide policies mandating regular, scheduled supervisory visits and performance monitoring for all health facilities. This framework should include clear guidelines on frequency, responsibilities, and accountability mechanisms to improve consistency and quality in immunization program oversight.

Hospital management teams should prioritize capacity building for facility managers and relevant staff on immunization program planning, budgeting, and vaccine forecasting. This can be done through regular training, supportive supervision, and the introduction of standardized planning tools to enhance engagement and accuracy in forecasting vaccine needs.

5.4.2 Ordering Practices and Vaccines Availability

The County government should mandate and enforce a standardized vaccine ordering protocol that specifies timeliness, quantities, and communication channels to ensure uniformity in ordering processes. This policy should include regular training for health

workers on these protocols to minimize irregular ordering and improve responsiveness to vaccine demand.

Health facilities should establish or improve vaccine ordering protocols to ensure timely, accurate requests and follow-up. This may include digitalizing ordering systems where feasible, assigning dedicated personnel for vaccine logistics, and fostering stronger communication channels between facilities and supply points to reduce stock outs and ordering delays.

5.4.3 Storage Practices and Vaccines Availability

The County government should develop and implement a policy prioritizing the upgrading and expansion of cold chain storage facilities across all health facilities. This includes budgeting for modern refrigeration units with sufficient capacity and introducing mandatory routine maintenance schedules to ensure equipment functionality.

Formulate policies mandating regular, standardized training and certification for all personnel involved in cold chain management, especially focusing on vaccine storage, stock management and equipment maintenance.

5.4.4 Distribution and Vaccines Availability

Develop and enforce a comprehensive policy framework that standardizes vaccine distribution protocols across all sub-county stores and health facilities. This policy should include clear guidelines for transportation schedules, reverse logistics (handling excess or expired vaccines) and accountability mechanisms to minimize delays and stock outs.

Hospital management teams should establish or enhance dedicated logistics teams responsible for coordinating timely transport of vaccines from sub-county stores to

health facilities. This team should be trained in best practices for cold chain management and equipped with reliable transport means to ensure vaccines are delivered efficiently and safely.

Create an institutional mechanism within the County health system focused on the retrieval, documentation, and proper disposal or reallocation of expired or excess vaccines. This unit should coordinate with all facilities to streamline reverse logistics, reducing wastage and maintaining accountability in vaccine handling.

5.5 Areas of Further Study

The current study looked into supply chain management practices on vaccines availability in public health facilities in Kisii County. There lacks a comparative analysis of supply chain management practices between Kisii County and neighboring counties or regions with similar demographic and health profiles a gap that this study suggest to be further researched. Most studies focus on a single county or region but do not compare how supply chain management practices differ or align with adjacent counties. There is also need for a similar study to be carried out at the National and Regional levels.

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APPENDICES

APPENDIX 1: INFORMED CONSENT FORM

Title: Influence of supply chain management practices on vaccines (KEPI) availability in public health facilities in Kisii County.

Principal Investigator: Emily Moraa Kegesa.

Kenya Methodist University,

P.O. BOX 267-60200,

Meru, Kenya

Introduction

This Consent Form contains information about the research named above. In order to be sure that you are informed about being in this research, we are asking you to read (or have read to you) this Consent Form. You will also be asked to sign it (or make your mark in front of a witness). We will give you a copy of this form. This consent form might contain some words that are unfamiliar to you. Please ask us to explain anything you may not understand.

Reason for the Research

You are being asked to take part in this research to help establish the influence of supply chain management practices on vaccines (KEPI) availability in public health facilities in Kisii County, Kenya. This study is for academic purposes.

General Information about Research

The research will be conducted in public health facilities in Kisii County offering immunization services. Research questionnaires will be used to collect data.

Your Part in the Research

If you agree to be in the research, you will be required to answer questions which will be asked in a research questionnaire. You will be required to fill your responses in the spaces provided or interviewed by the researcher. Your part in the research will last about 40 minutes. About 98 respondents will take part in this research, one respondent per facility.

Possible Risks

There will be no risks involved if you agree to participate in this study. However, the study may interfere with your routine work, I will appreciate if you choose to participate.

Possible Benefits

If you participate in this study you will help strengthen the health systems in Kenya and other low-income countries through the recommendations from the study. This study will also promote better understanding of the influence of supply chain management practices on vaccines availability in public health facilities in Kisii County which will improve service delivery.

If You Decide Not to Be in the Research

You are free to decide if you want to be in this research. Your decision will not affect the health care you would normally receive.

Confidentiality

We will protect information about you and your participation in this research to the best of our ability. You will not be named in any reports. However, the staff of Kisii County Health Management team, Kisii County Research Committee and Kenya Methodist

University may sometimes look at your research records. Someone from the IRB might want to ask you questions about being in the research, but you do not have to answer them. A court of law could order medical records shown to other people, but that is unlikely.

Compensation

You will not be paid, since you do not have to take part in this research.

Leaving the Research

You may leave the research at any time. If you choose to take part, you can change your mind at any time and withdraw.

Your rights as a Participant

This research has been reviewed and approved by the institutional review board of Kenya Methodist University. Institutional review board is a committee that reviews research studies in order to help protect participants. If you have any questions about your rights as a research participant you may contact my supervisors as follows:

Dr Jonathan Monda
Kenya Methodist University
Department of health systems management
Mobile number: 0722 616 324

Ms Susan Mule
Kenya Methodist University
Department of health systems management
Mobile number: 0722 905 666

VOLUNTEER AGREEMENT

The above document describing the benefits, risks and procedures for the research titled (Influence of supply chain management practices on vaccines (KEPI) availability in public health facilities in Kisii County) has been read and explained to me. I have been given an opportunity to have any questions about the research answered to my satisfaction. I agree to participate as a volunteer.

Date

Signature or mark of volunteer

If volunteers cannot read the form themselves, a witness must sign here:

I was present while the benefits, risks and procedures were read to the volunteer. All questions were answered and the volunteer has agreed to take part in the research.

Date

Signature of Witness

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual.

Date

Signature of Person Who Obtained Consent

APPENDIX II: RESEARCH QUESTIONNAIRE

INSTRUCTIONS TO THE RESPONDENTS

This questionnaire seeks to establish influence of supply chain management practices on vaccines (KEPI) availability in public health facilities in Kisii County, Kenya. This is an academic study and all information collected from respondents will be treated with confidentiality. Please respond to all the questions by ticking in the brackets or filling in the required information on the spaces provided.

SECTION A: SOCIO-DEMOGRAPHIC INFORMATION

1. What is your gender?

- a) Female ()
- b) Male ()

2. What is your age bracket?

- a) Less than 25 years ()
- b) 26-35 years ()
- c) 36-45 years ()
- d) Above 45 years ()

3. Highest level of education

- a) Certificate level ()
- b) Diploma level ()
- c) Graduate/ Degree ()
- d) Postgraduate ()

4. Years of experience in the vaccine service

- a) Less than 2 years ()
- b) 2-5 years ()
- c) 6-10 years ()
- d) Above 10 years ()

5. Level of the health facility

Statements	1	2	3	4	5
Facility is actively involved in vaccine budgeting process					
Facility is adequately funded to collect vaccines from the sub county store					
Facility is adequately funded for cold chain equipment routine maintenance					
Facility is supervised by county/sub county teams quarterly					
Facility is supervised by county/sub county teams monthly					
Immunization programme specific supervision is done regularly.					
Facility is involved in forecast planning for their vaccine needs					
Facility is satisfied with their current target population for vaccination					

a) Dispensary ()

b) Health centre ()

c) Hospital ()

d) Referral hospital ()

SECTION B: PLANNING

6. Kindly indicate your level of agreement with the following statements on planning.

Using a scale of 1-5 where 1-Strongly Disagree, 2-Disagree, 3-Neutral,

4-Agree and 5-Strongly Agree.

SECTION C: ORDERING PROCESS

7. Kindly indicate your level of agreement with the following statements on ordering process. Using a scale of 1-5 where 1-Strongly Disagree, 2-Disagree, 3-Neutral,

4-Agree and 5-Strongly Agree.

Statements	1	2	3	4	5
Vaccine orders are usually placed monthly					

Emergency orders are placed immediately any vaccine reaches the minimum level					
At no given time the facility has stock outs of vaccines which are available at the sub county store					
Vaccine orders are usually supplied as per the order requested					

8. Are facility vaccine orders done by 5th of every month?

a) Yes ()

b) No ()

9. What was the order fill rate for the last vaccine order done by the facility?

10. 0-19 % ()

11. 20-39% ()

12. 40-59% ()

13. 60-79% ()

14. 80-99% ()

15. 100% ()

SECTION D: STORAGE PRACTICES

16. What is the availability and functionality of the cold chain equipment?

a) At least one functional refrigerator Y () N ()

b) At least one functional freezer Y () N ()

c) Adequate functional vaccine carriers Y () N ()

d) Functional cold boxes Y () N ()

17. Kindly indicate your level of agreement with the following statements on storage practices. Using a scale of 1-5 where 1-Strongly Disagree, 2-Disagree, 3-Neutral,

4-Agree and 5-Strongly Agree.

Statements	1	2	3	4	5
Cold chain equipment has adequate storage capacity of vaccines					

Availability of correctly and completely filled vaccine ledger books					
Monthly vaccine physical count is conducted					
Vaccines usually tally with what is documented in the ledger book at all times					
Availability of a routine maintenance plan for cold chain equipment at the facility					
Availability of a trained person responsible for cold chain equipment routine maintenance					

SECTION E: DISTRIBUTION

18. Kindly indicate your level of agreement with the following statements on distribution. Using a scale of 1-5 where 1-Strongly Disagree, 2-Disagree, 3-Neutral, 4-Agree and 5-Strongly Agree.

Statements	1	2	3	4	5
There no delays experienced for supply of vaccines once orders are placed					
Facility does not experience any transportation challenges of vaccines from the sub county store					
Sometimes the facility has excess or expired commodities					
Reverse logistics mechanism for distribution of excess and expired vaccines to higher levels is working effectively					

19. What is the average time period between placing and receiving an order (lead time)?

- a) 1 day ()
- b) 2-3 days ()
- c) >3 days-1 week ()
- d) > 1 week ()

20. What mode of transport is used to deliver vaccines to the health facility?

- a) Government utility vehicle ()
- b) Motor cycles ()
- c) Personal cars ()

d) Vans/taxis ()

SECTION F: VACCINES AVAILABILITY

21. Do you have any vaccines stock outs on the day of the study?

Yes ()

No ()

22. If yes above, which vaccines are stocked out?

a) BCG ()

b) DPT-HepB-Hib ()

c) Inactivated polio ()

d) Measles-rubella ()

e) Oral polio ()

f) Pneumococcal ()

g) Rotavirus ()

h) Tetanus ()

23. Have you had any vaccines stock outs in the preceding 12 months?

Yes ()

No ()

24. If Yes above, which vaccines have been stocked out and what is the duration of the stock outs in the preceding 12 months?

Vaccines	< 7 days	>1-2 weeks	>2-4 weeks	>4-8 weeks	> 8 weeks
BCG					
DPT-HepB-Hib					
Inactivated polio					
Measles-rubella					

Oral polio					
Pneumococcal					
Rotavirus					
Tetanus					

25. Are vaccines properly arranged inside the refrigerator?

Yes ()

No ()

26. Are there expired vaccines in the refrigerator?

Yes ()

No ()

27. Are there frozen vaccines in the refrigerator?

Yes ()

No ()

28. Are there vaccines beyond usable VVM in the refrigerator?

Yes ()

No ()

APPENDIX III: OBSERVATION CHECKLIST TOOL

Item description	Yes (Y)	No (N)
1. Facility vaccine orders are done by 5 th of every month		
2. Availability and functionality of the cold chain equipment a) At least one functional refrigerator b) At least one functional freezer c) Adequate functional vaccine carriers d) Functional cold boxes		
3. Quality of vaccines a) Vaccines are properly arranged inside the refrigerator b) Are there expired vaccines in the refrigerator? c) Are there frozen vaccines in the refrigerator? d) Are there vaccines beyond usable VVM in the refrigerator?		
4. Are there any vaccines stock outs on the day of the study? a) BCG b) DPT-HepB-Hib c) Inactivated polio d) Measles-rubella e) Oral polio f) Pneumococcal g) Rotavirus h) Tetanus		
5. Have you had any vaccines stock outs in the preceding 12 months? a) BCG b) DPT-HepB-Hib c) Inactivated polio d) Measles-rubella e) Oral polio f) Pneumococcal g) Rotavirus h) Tetanus		

APPENDIX IV: UNIVERSITY APPROVAL LETTER



KENYA METHODIST UNIVERSITY

P. O. BOX 267 MERU - 60200, KENYA
TEL: 254-064-30301/31229/30367/31171

FAX: 254-64-30162
EMAIL: info@kemu.ac.ke

Our Ref: KEMU/ISERC/HSM/06/2025

March 21, 2025

EMILY MORAA KEGESA
HSM-3-8010-1/2016

Dear Emily,

SUBJECT: INFLUENCE OF SUPPLY CHAIN MANAGEMENT PRACTICES ON VACCINES (KEPI) AVAILABILITY IN PUBLIC HEALTH FACILITIES IN KISII COUNTY, KENYA

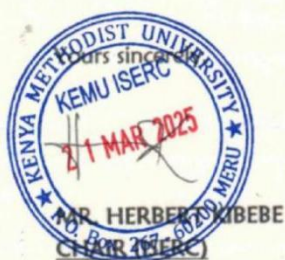
This is to inform you that Kenya Methodist University Institutional Scientific Ethics and Review Committee has reviewed and approved your research proposal. Your application approval number is KeMU/ISERC/HSM/06/2025. The approval period is 21st March, 2025 – 21st March, 2026.

This approval is subject to compliance with the following requirements:-

- I. Only approved documents including (informed consents, study instruments, MTA) will be used.
- II. All changes including (amendments, deviations, and violations) are submitted for review and approval by Kenya Methodist University Institutional Scientific Ethics and Review Committee.
- III. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to KeMU ISERC within 72 hours of notification.
- IV. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to KeMU ISERC within 72 hours.
- V. Clearance for export of biological specimens must be obtained from relevant institutions.

- VI. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
- VII. Submission of an executive summary report within 90 days upon completion of the study to KeMU ISERC.

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



APPENDIX V : NACOSTI LETTER

 REPUBLIC OF KENYA	 NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION
RefNo: 454720	Date of Issue: 15/April/2025
RESEARCH LICENSE	
	
This is to Certify that Dr. EMILY MORAA KEGESA of Kenya Methodist University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Kisii on the topic: INFLUENCE OF SUPPLY CHAIN MANAGEMENT PRACTICES ON VACCINES (KEPI) AVAILABILITY IN PUBLIC HEALTH FACILITIES IN KISII COUNTY, KENYA for the period ending : 15/April/2026.	
License No: NACOSTI/P/25/417990	
454720	
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	

APPENDIX VI: AUTHORIZION LETTER



**KISII COUNTY GOVERNMENT
DEPARTMENT OF HEALTH
OFFICE OF THE COUNTY DIRECTOR OF HEALTH**

Telegramme "Medical"

Kisii County

Telephone: 0111-425-996

P.O Box 92 – 40200 E-Mail: cdh.medical@kisii.go.ke

KISII When replying quote:

Ref: KS/C/HS.42 VOL.III/ (60)

Date: 16th

April, 2025

Ms. Emily Moraa Kegesa

Principal Investigator

KISII

Re: Permission to Conduct a Research in Kisii County Public Health Facilities

Reference is made to your request for permission to carry out a research on the topic ***"Influence of supply Chain Management Practices on Vaccines (KEPI) availability in Public Health Facilities in Kisii County, Kenya"*** for your Masters of Science Degree in Health Systems Management at Methodist University.

This follows the review and approval by the NACOSTI vide Ref. No. 454720 for the period between 21st March 2025 and 21st March, 2026. You are therefore required to adhere to the guidelines of the KTRH ISERC/NACOSTI, observe the confidentiality of the study subjects, work with the Sub county Medical Officers of Health of while carrying out the research, and ensure a copy of the final data is submitted to the County Health Research Unit for retention and use. By copy of this letter, the Sub county Medical Officers of Health are requested to accord the researcher all the necessary assistance.

Thank you.

**Dr. Matiko Giabe
County Director of Medical Services
KISII COUNTY**

Copy to:-

☐ All SMOHs

KISII COUNTY

