MANAGEMENT OF HEALTH PRODUCTS AND TECHNOLOGIES IN KENYA: A MULTI-COUNTY STUDY ON ACCESS TO QUALITY, AFFORDABLE HEALTH PRODUCTS AND TECHNOLOGIES

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THESIS SUBMITTED TO THE DEPARTMENT OF HEALTH SYSTEMS MANAGEMENT IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF THE CONFERMENT OF A DOCTOR OF PHILOSOPHY DEGREE IN HEALTH SYSTEMS MANAGEMENT OF KENYA METHODIST UNIVERSITY

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DECLARATION

Declaration

This Thesis is my original work and has not been presented for a degree or any other award in any other University.

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Recommendation

This Thesis has been submitted with our approval as university supervisors.

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DEDICATION

I dedicate this Thesis to my wife Agnes Karimi and my children Baraka Kimathi Meme, Rehema Gakii Meme and Nehema Makena Meme for their moral support and patience with me during the period of doing this study. I also dedicate this Thesis to my Mother Margaret Chekei Meme for believing in me since I was a small child and the sacrifices she made to see me through education in the formative years of my life.

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ABSTRACT

Health Products and Technologies (HPTs) are a cornerstone of Kenya's health system and essential for achieving universal health coverage by ensuring access to high-quality medical services with minimal financial burden. Effective management of HPTs is critical for maintaining availability, affordability, and quality of healthcare services. Despite ongoing efforts, challenges such as delays in supply, inadequate stocks of essential medicines and laboratory commodities, wastage of health products, long lead times, poor stock monitoring, and irrational use due to inadequate storage and training persist across counties. This multi-county comparative study examined institutional determinants influencing the management of HPTs in Kisumu, Kiambu, Nyeri, Machakos, and Isiolo counties. The study focused on five independent variables, health financing, supply chain practices, inventory optimization, human resource factors, and health information management, with institutional leadership culture included as a moderating variable, while the dependent variable management of HPTs, was assessed through the dimensions of availability, affordability, and quality. Anchored on the Utilization Management Theory and Goldratt's Theory of Constraints, and guided by the pragmatism paradigm, the study adopted a mixed-methods design that combined quantitative data from 106 respondents using census sampling and qualitative insights from ten key informants via interview guides. Research instruments were pre-tested to enhance validity and reliability, while quantitative data were analyzed using descriptive and inferential statistics and qualitative data analyzed thematically, with diagnostic tests ensuring assumptions of normality, homoscedasticity, autocorrelation, multicollinearity, and singularity were not violated. Findings revealed that HPT financing (P=008), inventory optimization (P=0.000), human resource factors (P=0.002), and health management information systems (P=0.022) had statistically significant positive effects on HPT management, whereas supply chain practice (P=0.546) and institutional leadership (P=0.762) culture demonstrated weak or no significant influence Based on these results, the study proposes an efficient management model integrating lean inventory practices and digitalization to enhance the availability, affordability, and quality of HPTs. The findings provide evidence-based recommendations for county health administrations and policymakers and establish a foundation for future academic, scholarly, and research endeavors in the management of health products and technologies in Kenya.

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LIST OF ABBREVIATIONS AND ACRONYMS

ANOVA	:	Analysis of Variance
DW	:	Durbin-Watson
EMR	:	Electronic Medical Records
EPO	:	Electronic Physician Orders
GHTF	:	Global Harmonization Task Force
H0	:	Null Hypothesis
HMIS	:	Health Management Information System
HPTs	:	Health Products and Technologies
I. I. D	:	independently identically distributed
IFRR	:	Internal Facility Request and Resupply form
KDHS	:	Kenya Health Demographic Survey
KEMSA	:	Kenya Medical Supplies Authority
KNBS	:	Kenya National Bureau of Statistics
KNPP	:	Kenya National Pharmaceutical Policy
LMIS	:	Logistics management information systems
MEDS	:	Mission for essential drug supplies
MMR	:	Maternal Mortality Rate
MOH	:	Ministry of Health

OLS	:	Ordinary Least Squares
RRF	:	Report and Requisition Form
SDP	:	Service Delivery Points
SPSS	:	Statistical Package for Social Sciences
UHC	:	Universal Health Coverage
VIF	:	Variance Inflation Factor
WHO	:	World Health Organization

CHAPTER ONE

The chapter introduces the study in the context of its background while covering the underlying assumptions of the study, the problem statement, the study's purpose, its research hypothesis, its justification, its significance, its delimitation, its scope, its assumptions, and its operational definition of terms.

1.1 Background of the study

Health products are defined as medications, vaccines, and devices used in disease prevention, diagnosis, treatment, and rehabilitation, as well as surgical and medical procedures (Brook, 2020). The appropriate management of Health Products and Technologies, (HPTs), including selection and quantification, procurement, warehousing, distribution, quality management, responsible use, waste management, supply chain systems, and monitoring and evaluation is a critical component of a functional health system. The World Health Organization (WHO) recognizes that effective management of HPTs is vital to achieving the Sustainable Development Goals (SDGs), Universal Health Coverage (UHC), and the right to health (The World Health Organization, [WHO] 2019). In developed countries, investments in high-performance technologies are directed at guaranteeing the availability and prudent utilization of efficient, safe, and affordable HPTs (O'Brien, 2020). Conversely, in developing nations, the focus is often on establishing national HPT reserves to ensure continuity of supply during emergencies. Studies highlight that medical devices and equipment must be legally regulated and adequately funded for operations; without such measures, effective HPT management remains elusive (Borca et al., 2021). However, global evidence also indicates that ministries of health in some regions, such as Asia, often deprioritize financial support for HPT management in budgeting processes, focusing instead on the procurement of drugs and equipment (WHO, 2019).

Countries such as Pakistan, Vietnam, the Philippines, and India have addressed these challenges by creating national priority lists of HPTs to guide procurement across all levels of healthcare (Chandran et al., 2021). Similarly, states in the United States, including New York, New Mexico, and Texas, established standardized inventory management tools such as bin cards, stock cards, the Internal Facility Request and Resupply Form (IFRR), and the Report and Requisition Form (RRF), usable across facilities whether managed manually or electronically (WHO, 2019).

Human resources also play a critical role in HPT management. Limitations such as inadequate staffing, absenteeism, poor productivity, and weak supervision are well-documented globally. For example, Canadian studies on staffing and productivity found that outlying health centers suffered from inadequate staff levels and oversight, leading to inefficiencies in service delivery (Verger et al., 2021). Similarly, Snell and Morris (2018) identify human resource factors as key limitations in the management of HPTs. In Kenya, the MOH is responsible for recruiting and developing human resources to ensure effective commodity management and supply chain oversight, yet gaps persist (Ministry of Health, [MOH] 2029).

While global evidence underscores the importance of efficient HPT management for achieving health goals, regional's experience reveals persistent gaps between policy frameworks and implementation. Across Africa, health products and technologies have not made significant advances. Research from Egypt, Tunisia, Nigeria, Ghana, and Morocco shows that African nations remain cautious about investing in initiatives that promote efficient HPT management (Last & Penrose, 2018). Medicines are not easily accessible either in hospitals or in primary care clinics, with countries such as South Africa lagging in the adoption of effective HPT administration due to regulatory bottlenecks, financing limitations, bureaucratic decision-making, and user resistance (Sriyanto et al., 2021). In Zimbabwe, patients lack access to critical drug information management systems, while Namibia has not

prioritized logistics and supply chain policies to support HPT management (Baporikar, 2022). These examples underscore systemic weaknesses across the continent that continue to undermine effective HPT management.

In Kenya, the health sector plays a central role in the nation's economy and development agenda. Provision of essential medical services has become a contentious issue, particularly in the context of the Constitution of Kenya 2010 and the Vision 2030 blueprint, both of which emphasize affordable and quality healthcare. To advance this agenda, the Ministry of Health (MOH) designated HPTs as a key component of UHC and established regulatory policies to ensure their availability in public hospitals). The Kenya National Pharmaceutical Policy (KNPP) further serves as the primary framework for guiding HPT management, with the goal of attaining universal access to high-quality medicines, diagnostics, healthcare technologies, and pharmaceutical services (Thuku, 2022). MOH is also tasked with ensuring sufficient human resources for HPT management, strengthening supply chain systems, enhancing Health Management Information Systems (HMIS), and exercising stewardship over governance (MOH, 2021).

Despite devolution provided counties with opportunities to strengthen procurement, infrastructure, and supply chains, yet challenges related to financing, human resources, inventory optimization, and information systems remain in Kenya. Studies report that ineffective HMIS undermines HPT management (Gikunda et al., 2021), with some evidence showing a strong negative statistical association between HMIS and HPT management (Oluoch et al., 2020). The Kenya Health Policy (2014–2030) emphasizes leadership, through regulation, policy, and support supervision, as critical to improving procurement processes and ensuring availability of essential HPTs. Yet availability remains limited, with life-saving medicines and basic diagnostics available at only 14% and 19%, respectively, in public facilities (Muiruri, 2017). Moreover, the Second National Health Sector Strategic Plan

acknowledges that poor quality of care is largely attributable to the absence of adequate medical supplies in government health facilities. Social health insurance has been successful only where it is well managed at both national and county levels, with effective health information systems providing real-time data for decision-making (MOH, 2020).

The adoption of devolution in 2013 marked a major shift in Kenya's healthcare delivery by decentralizing services and giving counties control over health budgets and procurement. Devolution enabled counties to prioritize healthcare in their budgets, invest in infrastructure, and streamline supply chain systems. According to Barasa et al. (2017), this resulted in increased availability of essential medicines and health products in public facilities. Counties such as Kiambu benefited from greater autonomy in procurement, which reduced bureaucratic delays that had previously slowed the supply of medicines (Okech & Lelegwe, 2016). Public-Private Partnerships (PPPs) have further enhanced access to affordable generic drugs, while government initiatives to support local manufacturing have reduced reliance on imports, thereby lowering costs (Muchiri et al., 2020). Counties have also invested in information systems such as DHIS2 to monitor inventory and consumption patterns, thereby preventing shortages and wastage (Nyikuri et al., 2017).

At the county level, governments have also enacted policies and invested in infrastructure to improve HPT management. The national government, Kisumu, Nyeri, Machakos, and Isiolo were part of the four pilot counties in Kenya's UHC program, while Kiambu county, though not participated in pilot study, has high population density and substantial progress in improving HPT management under devolution. Kisumu County passed the Kisumu County Health Bill (2019), which tasked the County Department of Health with responsibility for acquiring and managing medical supplies in line with constitutional obligations. Machakos County enacted the Machakos County Health Services Bill, mandating the Department of Health to ensure the availability, and affordability of essential medicines

and supplies through efficient procurement and distribution systems. Nyeri County has invested in rural health facilities, while Machakos boasts 309 renovated reporting facilities and Isiolo has 11 facilities. Kisumu County has 34 hospitals (62% public) and 176 basic healthcare facilities (50% public), while Nyeri has 121 rural health facilities, including 25 health centers. To coordinate these efforts, counties have established Health Products and Technologies Units (HPTUs) composed of multidisciplinary staff, including pharmacists, laboratory coordinators, commodity nurses, and nutritionists, who are tasked with ensuring health commodity security.

Despite these initiatives, management of HPTs in counties such as Kisumu, Nyeri, Machakos, Isiolo, and Kiambu remains below expectations. Stockouts of essential medicines and laboratory commodities persist, with order fill rates averaging only 70%. There are frequent delays in supply, inadequate budgets for commodities such as laboratory reagents, oncology and surgical equipment, and intermittent shortages of critical malaria drugs and diagnostic kits. Long lead times from the Kenya Medical Supplies Authority further compromise service delivery. In addition, lack of electronic commodity management systems leads to wastage, while poor storage facilities and irrational use of HPTs exacerbate resource losses. Compounding these challenges, few healthcare workers are trained in commodity management, forecasting, quantification, or supply pipeline monitoring. These weaknesses contribute to higher morbidity and mortality from preventable diseases.

Inventory optimization is another crucial factor influencing HPT management. Effective techniques such as ABC analysis, First-Expiry-First-Out (FEFO), safety stock policies, record-keeping, Economic Order Quantity (EOQ), and Just-in-Time systems help ensure consistent supply, prevent stockouts, and reduce wastage. Poor inventory control, by contrast, results in overstocking, understocking, and resource wastage, with direct implications for patient outcomes (Babar, 2022).

Universal Health Coverage (UHC), is a human rights-based approach which is premised on the principle that access to quality health services is universal, putting an emphasis on the poorest, vulnerable and marginalized groups and on the principle of non-discrimination. This implies that promotion of UHC must be underpinned by a commitment to address inequalities and exclusion. In this way, a human rights-based approach provides not only a framework for accountability, but also for development of inclusive health policies and programmes, and for mobilizing all stakeholders including civil society to achieve the right to health.

Universal Health Coverage consists of three interrelated components according to a regional study by Abousheishaa et al. (2020) about health insurance namely, the full range of healthcare based on need, coverage from direct payment for health services when used; and coverage for the entire population. Abousheishaa et al. (2020) state that a variety of nations, including Thailand, Brazil, France, Brazil, Japan, and Turkey, have accomplished universal population coverage and are demonstrating how UHC programs can enhance citizens' health and welfare while laying the groundwork for economic development and competitiveness based on the values of equity and sustainability. However, in a study on universal health coverage in Eastern Europe, Varastegh et al., (2022) showed that, there are still many challenges to achieving UHC, including entrenched interest groups and technological advancements, which frequently thwart reforms that threaten to undo unfair or ineffective systems. According to the report, health services, particularly industrialized nations, are extremely vulnerable to market failure because it is difficult to measure and account for resource utilization and the influence that resources have on efficiency, safety, and efficacy of the health products and technologies (Varastegh et al., 2022).

Similarly, at least 40% of people worldwide lack access to basic medical care, including basic medications (Sansone et al., 2020). Due to uninsured medical costs, nearly 90 million individuals are

forced into extreme poverty each year (Sansone et al., 2020). This need not be the case, though. We need decision-makers, licensed healthcare workers, and societies with access to top-notch healthcare so that members may look after their own and their families' health to achieve health for all. In a study on the effects of national health insurance in New Jersey, Tama (2018) suggested that a population-focused healthcare system should help in providing care for residents. The study also demonstrated that the communities they serve are the cornerstone of effective health systems. They place strong emphasis on enhancing people's wellbeing and quality of life in addition to preventing and treating disease. The cornerstone of universal health coverage should be efficient primary healthcare that is population focused. Communities that they serve are at the heart of effective health systems.

A study on UHC coverage in West African countries by WHO (2018) demonstrated the importance of investing in Africa's health systems for inclusive and long-term growth. The percentage of people living in poverty has dropped to 43% thanks to recent strong economic growth. Manzoor et al. (2019) conducted a study in North Africa on UHC and showed that the continent still confronts a significant difficulty in laying the groundwork for long-term inclusive growth as its population grows to reach 2.4 billion by 2050. Malnutrition is much too prevalent, many health systems are unable to successfully combat epidemics, and many nations continue struggle with high rates of infant and maternal mortality, as well as the rising burden of chronic diseases like diabetes and heart disease. These issues necessitate fresh commitments and significant progress toward Universal Health Coverage (UHC), because no one should have difficulties accessing medical care due to financial constraints (WHO, 2018).

Most East and Central African countries have included UHC as a target in their national health agendas, according to Sweed (2016), who conducted a study on health coverage in East Africa, including Tanzania and Uganda. However, it has taken a long time for these commitments to be

translated into improved domestic health resources, efficient development support, and finally equitable and high-quality health services and better financial protection. The UHC in Rwanda lends credence to the notion that nations that meet their UHC goals by 2030 will eradicate avoidable maternal and infant deaths, improve their capacity to respond to public health emergencies, lessen the financial burden of disease and intensify the fundamentals for protracted economic growth (Temmerman, 2019). According to Moshiro et al. (2018), there is no one-size-fits-all method to achieving UHC; instead, strategies will rely on local circumstances and national discourse. Despite the tremendous diversity of African nations, many of them have common problems, as evidenced by studies on health coverage in Ethiopia (Hossain et al., 2019). Various frameworks have been created throughout East Africa and the African Region, and they suggest a series of measures for nations and players interested in Universal Health Coverage.

UHC is a crucial cornerstone for transforming the nation's healthcare system for better service delivery, as demonstrated by a study on universal health coverage in the western portion of Kenya by (Barasa et al., 2018). To ensure that its residents remain productive, Kenya is investing in UHC because a healthy population is a driving factor for improved economic development. Additional prerequisites for implementing UHC include the establishment of effective health service delivery systems, sufficient financial and human capital resources, information systems, outstanding governance, and enabling laws (Gitobu et al., 2018). The ideals of equality, people-centeredness, efficiency, social solidarity, and a multi-sectoral approach are all embraced by this strategy. It focuses on four goals and the associated measures that will help the government achieve its health goal (Gitobu et al., 2018). To determine the effects of UHC, Karanja et al. (2018) also conducted a study in Kenya's county hospitals based in the coastal regions. The study showed that county hospitals are vaguely aware of the mandates acquitted to County and national governments to help in management

of health commodities in promoting UHC. The study recommended that emphasis on the need to promote awareness to ensure that the various stakeholders fully understand and support the UHC objectives is required.

1.2 Statement of the Problem

Access to essential health products and technologies (HPTs) remains a persistent challenge in Kenya, particularly since the devolution of health services to county governments. Despite national policies and significant investments, disparities in the availability, affordability, and quality of HPTs continue to undermine healthcare delivery and progress toward Universal Health Coverage (Ministry of Health [MOH], 2012; World Health Organization [WHO], 2018). These disparities are largely attributed to institutional inefficiencies at the county level, including weak health financing mechanisms, fragmented supply chain management, inadequate human resources, and underutilized health information systems (Mbau et al., 2022). For instance, many counties struggle with frequent stock-outs, inconsistent procurement processes, and limited capacity for quality assurance, all of which directly impact patient access to essential medicines and technologies (Barasa et al., 2017).

While some counties have demonstrated improvements in HPT management through targeted interventions, systemic challenges persist due to a lack of harmonized policies, insufficient regulatory oversight, and limited technical capacity (MOH, 2020; Mbau et al., 2022). At a broader level, the inability to effectively manage HPTs not only limits Kenya's ability to achieve Universal Health Coverage but also perpetuates inequities in access to healthcare, widens disparities in health outcomes, and undermines global commitments to Sustainable Development Goal 3 on ensuring healthy lives and promoting well-being for all. Evidence from other low- and middle-income countries indicates that poor HPT management is closely associated with higher morbidity and mortality, inequitable service delivery, and inefficient resource utilization (O'Brien, 2020).

Existing research in Kenya has largely focused on isolated aspects of HPT management or single-county case studies, leaving a gap in comparative evidence on how institutional determinants collectively shape the management of HPTs across counties. Addressing this gap is critical, not only for improving efficiency within counties but also for advancing equity, strengthening health outcomes, and reducing disparities both locally and in line with global health system improvement efforts.

1.3 Purpose of the study

Health Products and Technologies are acknowledged as being an essential component in delivery of healthcare services under the Universal Health Coverage agenda. However, depending on how it is managed, it can lead to unavailability and unaffordability of quality essential medicines, vaccines, and medical supplies and diagnostics which highly increases the morbidities, mortality rate and financial loads.

The research study endeavors to identify the health products and technologies management factors that contribute to the successful management of HPTs in selected counties, Kenya with the aim developing Health Products and Technologies management framework for essential health commodities in order improve access to quality and affordable Health Products and Technologies.

1.3 Broad objective of the Study

To examine the institutional factors influencing the management of Health Products and Technologies and their implications on access to quality and affordable healthcare in Kisumu, Kiambu, Nyeri, Machakos, and Isiolo Counties, Kenya.

1.4 Objectives of the Study

The study was guided by following specific objectives.

i. To determine the influence of financing on management of Health Products and Technologies in selected Counties, Kenya.
ii. To assess the influence of supply chain practices on management of Health Products and Technologies in selected Counties, Kenya.
iii. To establish the influence of human resource factors on management of Health Products and Technologies in selected Counties, Kenya.
iv. To determine the influence of inventory optimization on management of Health Products and Technologies in selected Counties, Kenya.
v. To establish the influence of health information systems on management of Health Products and Technologies in selected Counties, Kenya
vi. To determine the moderating effect of institutional leadership culture on management of Health Products and Technologies in selected Counties, Kenya.

1.5 Research Hypothesis

The study will be guided by the following hypotheses:

$H0_1$: Financing has no significant influence on the management of health products and technologies, Selected Counties, Kenya

H_1: Financing has significant influence on the management of health products and technologies, selected Counties, Kenya

$H0_2$: Supply chain practices have no significant influence on the management of health products and technologies, Selected Counties, Kenya

H_2: Supply chain practices have significant influence on the management of health products and technologies, Selected Counties, Kenya

$H0_3$: Human resource for health factors has no significant influence on the management of health products and technologies, Selected Counties, Kenya

H_3: Human resource for health factors has significant influence on the management of health products and technologies, Selected Counties, Kenya

$H0_4$: Inventory optimization has no significant influence on the management of health products and technologies, Selected Counties, Kenya

H_4: Inventory optimization has significant influence on the management of health products and technologies, Selected Counties, Kenya

$H0_5$: Health information system has no significant influence on management of health products and technologies, Selected Counties, Kenya

H_5: Health information system has significant influence on management of health products and technologies, Selected Counties, Kenya

$H0_6$: Institutional leadership culture has no significant mediating influence on management of health products and technologies, Selected Counties, Kenya

H_6: Institutional leadership culture has significant mediating influence on management of health products and technologies, Selected Counties, Kenya

1.6 Justification of the Study

Kenya acknowledges that development is primarily about the people and therefore adopted a human rights-based approach to development. The Constitution of Kenya, Chapter Four (4) on the Bill of Rights, Part 2 on the Economic and Social Rights, in Article 43 (1) (a) states that every person has the right to the highest attainable standards of health, which includes the right to healthcare services, including reproductive health. The Constitution of Kenya also adopts a devolved system of government where some functions, like health, have now been devolved to the Counties together with their budget. The successful provision of healthcare services by Kenya's healthcare institutions depends on the availability of essential health items and technologies.

The development of UHC depends on HPT management's capacity to guarantee HPT security by providing HPTs at all levels of the healthcare system in an equitable, trustworthy, and economical way. In Kenya, HPTs are acknowledged as being essential to achieving UHC (Mbau et al., 2023). Management of HPTs is even more crucial given the rising demand brought on by the affordable universal health coverage (UHC) project, shifting epidemiological trends, and better health education for Kenyans. However, issues with quality, affordability, and availability of necessary HPTs in Kenya continue to pose a challenge within the health system.

Resources were deployed in strengthening the management of HPTs in the selected pilot counties, and efforts to resuscitate the management of HPTs at the county level have been recognized (MOH, 2017), but these have not had a significant impact on improving accessibility, affordability, and quality of the HPTs. Research is required to ascertain the factors that, above all else, the national government's efforts through law enforcement and procedures, appropriate legislation, governance, measurement, and finance influence the management of HPTs. Poorly managed HPTs can result in higher rates of morbidity and mortality as well as higher treatment costs, which can be prevented by the availability

of necessary supplies that would help with efforts to offer patients higher-quality medical care. This study therefore sought to contribute toward addressing these challenges by generating evidence on the institutional determinants of HPT management, which is critical for improving equity, health outcomes, and the reduction of disparities across counties. By doing so, the findings will not only inform targeted reforms for efficient HPT management but will also support Kenya's broader goal of achieving Universal Health Coverage.

1.7 Limitations of the Study

This study was limited by its cross-sectional design, which restricted the ability to establish causality between institutional factors and the management of Health Products and Technologies. The reliance on self-reported data from healthcare staff introduced the risk of recall bias and social desirability bias, which may have influenced the accuracy of responses despite assurances of confidentiality. The study was further constrained by sample size and coverage, as it focused only on five counties, which may limit the generalizability of findings to all counties in Kenya. Additionally, the use of structured questionnaires restricted respondents' ability to provide more detailed qualitative insights, while reliance on secondary documents introduced dependence on the accuracy and completeness of existing records. Despite these limitations, the study provides valuable insights and forms a basis for future research using longitudinal and mixed methods approaches.

1.8 Delimitation of the Study

The study focused on determining the factors influencing management in Kisumu, Kiambu, Nyeri, Machakos, and Isiolo counties, because they are characterized by high incidences of communicable diseases, non-communicable diseases, road traffic injuries in urban settings, as well as maternal mortality and low health indicators, respectively (MOH, 2020-2022). Most of the selected health facilities were the UHC pilot counties and are also beneficiaries of the massive health system

strengthening support in readiness for the implementation of UHC. Kiambu County was included in the study because it represents both rural and urban county characteristics for comparison with the UHC pilot counties. The Level 4 and 5 hospitals have well-developed structures for the management of the HPTs, including health administration, procurement, health records, pharmacy stores, as well as Authority to Incur Expense (AIE) that is not available in Level 2 and 3 health facilities. The study did not involve the other 42 counties in Kenya, as well as private and faith-based health facilities.

The study was anchored on a mixed-methods research approach, a descriptive cross-sectional research design, and an exploratory design. Survey design allows the research to arrive at conclusive findings employing probabilistic approaches that will be analyzed statistically. Further, the study will arrive at results that can be generalized to other counties in Kenya. However, such generalizations must proceed with a lot of caution due to the peculiarities of each county hospital setting. The study did not, thus, apply other research designs. Further, the study was grounded on Utilization Management Theory and Goldratt's Theory of Constraints.

1.9 Significance of the Study

The study will contribute to the knowledge on the management of Health Products and Technologies and be useful to county administration because it will help them understand how resources like qualified HPTs staff, financing, and warehouses, supply chain management, a health management information system, and governance for health commodities affect the management of HPTs. The County health departments, when developing regulations, policies, and procedures for the efficient management of HPTs, will base their decisions on the findings of the study.

The study will also help stakeholders and health partners better understand how to assist county-level health facilities in managing HPTs to ensure optimum availability and affordability for efficient health service delivery to patients who need HPTs. The recommendations that will be made when the study

is completed will help close the knowledge gap and promote proper management of HPTs in the country. The study will also set the groundwork for future academic, scholarly, and research endeavors.

1.10 Assumptions of the Study

The research proceeded under the presumption that the sample was representative of the population and that the results could be extrapolated to population-wide parameters. Based on their perception, knowledge, and experience of HPT management, it was assumed that the respondents provided a fair and accurate response to the questionnaire. Since this study was conducted in healthcare facilities that employ various HPT management strategies under various county administrations, it was assumed that the responses were not impacted by the various styles of county leadership.

1.11 Operational Definition of Terms

Governance: Refers to the structures, institutions, and processes through which decisions and policies are implemented in a health system, emphasizing accountability, transparency, and rule of law rather than individual charisma (WHO Regional Office for Europe, 2021).

Health Commodity Supply Chain: Encompasses all activities related to procurement, sourcing, storage, and distribution of health products and technologies (HPTs) to ensure timely access and quality (Yadav, 2020).

Health Management Information System (HMIS): An integrated system that collects, processes, and analyzes health data to support decision-making, patient management, and financial reporting (World Health Organization, 2018).

Health Products: Medications, vaccines, equipment, and procedures used in disease prevention, diagnosis, treatment, and rehabilitation (World Health Organization, 2018).

Health System Governance: The capacity of a health system to ensure strategic policy frameworks, effective oversight, coalition building, regulation, accountability, and system design focus (World Health Organization, 2018).

Health Technology: Structured knowledge and skills applied to develop systems, devices, drugs, vaccines, and procedures to address health problems and improve quality of life (O'Rourke et al., 2020).

Healthcare Facilities: County-level hospitals (Level 4 and 5) providing both outpatient and inpatient services (Kenya Ministry of Health, 2020).

Institutional Leadership Culture: The framework and leadership style through which health facilities set standards, build capacity, establish policies, and foster accountability (Beaudoin, 2013).

Inventory Optimization: Inventory management strategies—including forecasting, stock monitoring, and replenishment—designed to minimize shortages, reduce wastage, and ensure uninterrupted availability of HPTs (Natarajan et al., 2022).

Policy: A formal statement derived from legislation and adapted to emerging health system needs, guiding administrative actions, regulations, incentives, and allocation of resources (Buse, Walt, & Barnett, 2021).

Supply Chain Practices: Management of HPTs' flow from suppliers to health facilities, ensuring the right quantity, quality, and timeliness of delivery (Kruk et al., 2021).

Universal Health Coverage (UHC): A system where all individuals can access essential health services—from prevention to rehabilitation, without financial hardship (World Health Organization, 2021).

Warehouse: A facility, often a drug store, designated for the safe storage and handling of HPTs to maintain their quality and facilitate timely access (Staudt et al., 2015).

CHAPTER TWO

LITERATURE REVIEW

To develop ideas with logical foundations, this chapter covers related studies. To highlight shortcomings in earlier efforts, a critical analysis of empirical and theoretical literature evaluations are used.

2.1. Financing and Management of Health Products and Technologies

2.1.1 Amount of Budgetary Allocation

Insufficient financing for health is one major challenge affecting health care services across the globe (Yamey et al., 2019). According to the WHO (2020), sustainable financing is a major factor that affects access to essential medicines, in addition to rational drug selection, reasonable prices, and dependable health and supply chain systems (Kabaniha et al., 2020). However, there is widespread concern about the uneven distribution of health products and technologies across medical care facilities globally (Abousheishaa et al., 2020). One predicament faced by health systems managers and administrators is ensuring the availability of sufficient funds and sustainable budgeting to HPTs. Similarly, management of HPT funds has been proven concentrated in large hospitals that are located mainly in urban centers or large and medium-sized cities across the globe. According to Tama et al. (2022), Health care facilities rely widely on imperative factors such as finances, which all play a role in ensuring availability of HPTs to patients, and Health care workers in the facilities can conduct mandates and duties expected from them. Finances play a universal driving role in the upgrade of health care systems and procure the needed HPTs in the right quantities. Thus, the lack of enough funds has proved to be detrimental to patients' health and the performance of healthcare workers across hospitals. According to Varasteh et al. (2022), the administration of health products and technologies, and more specifically, the delivery of vital medical services, is significantly impacted by HPT finance

in the Iranian province of Isfahan's healthcare facilities. The study conducted in Iran aimed at assessing the availability of health resources such as finances, warehouses to store medical equipment and medicines, and finally, available trained workers in selected health care centers across the country to manage the health finances. Another quantitative research conducted in China by Baek et al. (2018) revealed that, shortage of health financing caused by the increasing huge population across the country leads to a medical crisis when the demand for health care services subsequently exceeds the supply of medical products and technologies supported by the available health finances. Without effective financial protection mechanisms for healthcare costs, the fundamental human right to health cannot be upheld because of the severe economic, emotional, and physical effects caused by the absence of such systems (Fatima et al., 2018). Despite the rise in demand for medical services, Gong et al. (2020) report that major health care systems around the world have financial difficulties. This would jeopardize their ethical frameworks, equality, and fairness across their workplaces. Health finances are required to be readily available for all health care facilities to ensure that low mortality and morbidity rates are achieved.

Management of medical technologies in developing countries, especially across Africa, has been paralyzed by poor allocation of funds and support from local and national governments. Non-Government Organizations and local/ national governments should thereby work towards the achievement of fair quality medical care. To identify various factors that affect the efficient provision of medical care services and their management in various counties throughout the nation, Karanja et al. (2018) conducted a qualitative study across health care facilities in Kenya. The study showed that health facilities in Kenya's marginalized regions, particularly in the North, not only face a shortage of funding but also inadequate administration of the monies that are available. Gitobu et al. (2018) conducted a follow-up investigation in Machakos County to ascertain the effects of limited resources

on the administration of medical supplies and technologies. Health Care services in the county found that although most hospitals had trained nurses, they had trouble finding certified pharmacists who had the necessary skills to manage health commodities and technologies because of a shortage of funding. Furthermore, citing the nation's recent inflation, both the local and national governments have been hesitant to provide sustainable funding to healthcare facilities (Hossain et al., 2019). The country's mortality and morbidity rates have risen as a result.

Temmerman (2019) recommends that hospitals should have an outlined annual budget that encompasses all possible resources required in the health facilities, including equipment and medicines, to ensure effective management of health products and technologies. This is to ensure that workers conduct their mandates effectively and make quality therapeutic decisions needed for proper management of the hospitals and delivery of effective medical care (Moshiro et al., 2018). Underpinned by Tama et al. (2018), other resources such as warehouses or drug stores have been widely ignored by health care management. The argument is of lack of funds to procure such, leading to unprecedented challenges in the storage of the health commodities, and they should thereby ensure that such finances are set up for hospitals to offer effective HPT management.

2.1.2. Frequency of funds disbursement

The management of HPTs is a global priority, and it requires adequate investment to ensure that people can access the essential health services they need. However, management of HPTs depends critically on the frequency of disbursement of funds. For the avoidance, detection, and management of illnesses, access to medical supplies and medicines is crucial. However, these HPTs reach and price present major problems, especially in low- and middle-income nations. As a result, allocating funds has turned into an essential tactic for overcoming these obstacles and advancing universal health coverage (Nicola et al., 2020). To guarantee that the budgeted resources are used effectively and quickly, appropriate

fund disbursement administration is essential. The availability of HPTs for those who require them most, especially fragile groups like women, children, and the elderly, should be ensured by a well-managed funds distribution system. The system should also make sure that the HPTs are of a high caliber and adhere to the required safety requirements.

The connection between funds disbursement and the management of HPTs has been the subject of several studies. Mueller & Knapp (2018) evaluated how funding distribution affected the availability and demand for medical supplies in low- and middle-income nations. The research discovered that guaranteeing the supply of necessary HPTs depended on the efficient and effective distribution of funds (Mueller & Knapp, 2018). Sohani et al. (2018) evaluated the effect of funding distribution on the control of TB in India in a different study. The research found that assuring the supply of top-notch TB medications and tests required proper disbursement of funds (Sohani & Sayyaadi, 2018).

The administration of infant health goods and innovations in low- and middle-income nations was also the focus of research by Akseer et al. (2017). The research discovered that guaranteeing the accessibility and cost of crucial infant health goods and innovations depended on the effective administration of the distribution of funds (Akseer et al., 2017). The regularity of funding distribution is crucial in the administration of healthcare goods and resources for UHC, according to several studies in Africa. In their research, Aregbeshola and Folayan (2022) in Nigeria, a positive correlation between regular budget distribution and increased management of HPTs was established. Another quantitative study in South Africa submitted that deficits and stock-outs of crucial medications and supplies were caused by irregular budget allocations (Ganyaupfu, 2019). Similarly, in Nigeria, by Folarin et al. (2020), it was discovered that the management of HPTs was adversely impacted by irregular budget distribution and payment delays. The research also emphasized the need for greater responsibility and openness in the budget distribution procedure to guarantee that resources are used effectively (Sun et

al., 2020). Manzoor et al. (2019 carried out research in Egypt that indicated facilities in North Africa are affected significantly by financial resource allocation.

Additionally, research conducted in Meru County established that erratic and uncertain budget distribution had a negative impact on the management of HPTs. According to the research, a dependable and regular funding allotment is needed to maintain a constant stock of important medications and supplies (Ongwae, 2019). Under Kenya's devolved governance arrangement, the national government retained policy formulation and regulation roles while the service delivery function was transferred to counties. The study by Kairu et al. (2021) established that the irregular disbursement of funding affects the management of HPTs at the county level. County level 4 and 5 hospitals faced funding flow challenges because centrally held funds meant for their operations often failed to reach these facilities between the years 2017-2018 (Waweru et al., 2016). For instance, a qualitative assessment found that almost a third of allocations approved are not received by these health facilities.

2.1.3. Rate of Budget Absorption

How the allocated health budget is absorbed affects performance and the planned health system goal. Budget absorption pertains to the pace at which the financial resources are assigned to specific initiatives or undertakings employed. Budget absorption in the context of HPTs pertains to the prompt and effective utilization of funds designated for the procurement and distribution of crucial health products and technologies. The concept of budget absorption rate pertains to the velocity at which healthcare products and technologies are procured using the allocated funds. The timely availability and accessibility of essential healthcare products and technologies are crucial in advancing universal health coverage. In this regard, the absorption rate of the budget is a critical factor to consider. Research findings indicate that a sluggish pace of budget utilization may have adverse effects on the

administration. Agustina et al. (2019) conducted a study to evaluate the influence of budget absorption on the accessibility and cost-effectiveness of vital medications in Nigeria. The research revealed that a sluggish pace of budget absorption had the consequence of postponing the acquisition and distribution of essential pharmaceuticals, culminating in the depletion and inadequacy of medical supplies in healthcare establishments. The unavailability of medicines in public healthcare facilities has led patients to resort to purchasing medications from private pharmacies, which are frequently costlier (Agustina et al., 2019). Universal Health Coverage (UHC) is a worldwide health objective that seeks to guarantee that individuals can obtain the necessary health services without experiencing financial difficulties. The attainment of Universal Health Coverage necessitates the presence of a proficient healthcare system that can furnish reasonably priced and superior healthcare services, encompassing indispensable HPTs.

The absorption rate of the budget is a crucial determinant in the management of HPTs for the promotion of Universal Health Coverage (UHC) in Kenya as well. Numerous studies have emphasized the significance of budget absorption in the management of HPTs for the advancement of Universal Health Coverage (UHC). An investigation carried out in Kiambu County revealed that inadequate budget absorption posed a substantial hindrance to the execution of the National Health Act, which sought to enhance the management of crucial healthcare commodities (Onyancha, 2022). The research revealed that insufficient budget absorption led to postponed procurement and distribution of healthcare commodities, thereby adversely affecting the accessibility and caliber of healthcare services (Onyancha, 2022). Similarly, an investigation carried out in Nairobi County revealed that the implementation of the National Essential Medicines List impeded by noteworthy challenges associated with low budget absorption rates (Musiega et al., 2023). The research discovered that inadequate budget absorption caused delays in the procurement and distribution of crucial essential medicines,

ultimately resulting in stock-outs. This, either in turn, led to patients being unable to obtain the required medication or having to purchase it at elevated prices from private pharmacies. Several strategies have been advanced to tackle the issue of inadequate budget absorption in the management of HPTs for the advancement of Universal Health Coverage (UHC). Strategies such as enhancing the planning and budgeting processes, strengthening the management of the supply chain, augmenting the proficiency of procurement and supply chain personnel, and enhancing coordination among stakeholders are proposed to enhance budget absorption rates (Musiega et al., 2023)

2.1.4 Frequency of budgetary allocation

In their comprehensive research, Meaza (2019) shed light on the crucial role of regular budget allocation in optimizing management of HPTs in the United States. The study analyzed a diverse range of organizations and compellingly demonstrated that those with steadfast budget allocation practices for the management of HPTs reaped substantial benefits (Meaza, 2019). These included heightened productivity levels, increased employee satisfaction, and enhanced overall performance across the board.

By providing consistent financial support, organizations fostered an environment of stability and confidence within their HPTs, allowing team members to focus on innovation, collaboration, and delivering exceptional results. Such findings underscore the pivotal significance of resource management in nurturing and sustaining successful high-performance teams in contemporary workplaces (Meaza, 2019).

In addition, a study conducted by Md Hamzah et al. (2021) investigated the effects of irregular budget allocation on the management of HPTs in Canada. It was found that institutions that were exposed to irregular or unpredictable budgeting encountered difficulties in sustaining their levels of performance.

These teams frequently encountered a decline in motivation, a decrease in available resources, and challenges in attaining their desired outcomes, promoting access to quality and affordable HPTs (Md Hamzah et al., 2021).

The study conducted by Kamara and Ibrahim (2017) in Tanzania sheds light on the significance of budget allocation in the management of HPTs across Africa. By analyzing organizations that adhered to consistent budgeting patterns for their teams, the research demonstrated a strong correlation between this financial approach and improved project outcomes, including access to HPTs, work quality, and employee retention rates. The findings underscore the importance of financial planning and allocation as critical components of successful team management in the African context. This research has implications for policymakers, managers, and organizations seeking to enhance their performance and achieve sustainable growth by optimizing budgetary strategies to strengthen management of HPTs. Additionally, the study contributes valuable insights to the existing body of knowledge on organizational behavior and performance in Africa.

The regularity of funding distribution is crucial in the administration of healthcare goods and tools for UHC, according to several studies. In one research, Tashobya et al. (2016) in a study conducted in China discovered a positive correlation between regular budget distribution and increased access to critical medications and supplies in developing nations. The research also demonstrated that deficits and stock-outs of crucial medications and supplies were caused by irregular budget allocations (Tashobya et al., 2016).

In different research conducted in Nigeria by Folarin et al. (2020), it was discovered that the supply of crucial medical supplies and equipment was adversely impacted by irregular budget distribution and payment delays. The research also emphasized the need for greater responsibility and openness in the budget distribution procedure to guarantee that resources are used effectively (Folarin et al., 2020).

Additionally, research conducted in Tanzania by Mubyazi et al. (2015) discovered that erratic and uncertain budget distribution harmed the supply and purchase of important medications and supplies, resulting in stock-outs and higher prices. According to the research, a dependable and regular funding allotment is needed to maintain a constant stock of important medicines and medical supplies (Mubyazi et al., 2015).

2.2 Supply Chain Practices and Management of HPTs

2.2.1 Logistics

Management of health products and technologies is essential for the advancement of resources towards achieving Universal Health Coverage (UHC), with logistics playing a pivotal role in this process. Logistics entails the distribution of medical supplies to hospitals, which in turn ensures that they are directly delivered to the clinics or user departments as soon as they are received. Therefore, logistics guarantees the appropriate provision of products and technologies, meeting the demands of patients and health facilities in terms of timing, quantity, and condition. Supply chain logistics has been proven to be valid due to the increasing demand for health products and technologies across the globe. Studies submit that, government outsources logistics, including health care services and health products, by transferring internal services or activities to external suppliers via long-term contracts, which later widely affect logistics and related aspects (Baek et al., 2018). The health care setting has been widely affected by incompetence among supply chain departments that are mandated with the duties of sourcing as well as ensuring the movement and delivery of affiliated health products and technologies to the health facilities. Poor supply chain logistics aspects in health care facilities have been proven to affect the supply of HPTs in the country (Md Hamzah et al., 2021). Major Hospitals across the globe have embarked on hiring professional supply chain logistics managers and workers who ensure proper sourcing, handling, storage, and movement of HPTs to and from the health organizations (WHO,

2020). This not only reduces the cost of health care and improves efficiency during the delivery of health services, but also ensures that mortality and morbidity rates in health care facilities are significantly reduced. However, in remote areas, the study depicted that logistics is widely affected by poor transport infrastructure, which makes the delivery of health products and technological equipment almost impossible.

Fatima (2018) conducted a study in North Africa on various factors affecting the management of health products and technologies advancements, and the provision of essential medical care in the region. Supply chain logistics appeared to be one major challenge affecting HPTs in the region. Various health care facilities, therefore, had no transport vehicle delegated to logistics mandates, thereby making the supply of imperative and needed health products and technologies a predicament. Healthcare facilities in the Northern part of Africa have also neglected the imperativeness of procurement by only relying on local and national governments in the delivery of products, leading to frustrations and poor supply chain logistics approaches in the region. With the increasing demand for health care services across the globe, governments and other institutions offering health care services are finding ways to control their budget to minimize costs and increase their profits. Through efficient supply chain logistics, including the procurement of products. Moshiro (2018) asserted that health care facilities can effectively manage their spending. The study that was done in Tanzania by Moshiro (2018) depicted that supply chain optimization in medical facilities for health products and technologies leads to improvement of healthcare services, saving costs of the healthcare facilities, and ensures satisfaction among customers. Medical facilities in rural Tanzania are vaguely aware of the effectiveness of logistics and procurement approaches towards ensuring quality management of the health products and technologies. This can be mitigated, according to Manzoor (2019), by training hospital administrators on the essence of logistics and procurement in their health facilities. Moran (2025)

conducted a study in Malaysia that was aimed at evaluating logistics and procurement strategies in the hospitals based on products found in the Eastern part of the country. Results depicted that health care workers were well aware of the importance of supply chain logistics but were unaware of how to apply logistics and procurement strategies in the management of the HPTs. This has led to poor performance towards achieving quality health care results in the region, and more so, leading to a lack of satisfaction among patients, family members, and healthcare workers.

Hospitals across various counties in Kenya were found to be adamant towards incorporating logistics and procurement in the provision and supply of health products and technologies in their services (Gitobu et al., 2018). Further, Karanja et al. (2018) conducted a study in Kirinyaga West Sub-County, based on the implementation of logistics and procurement in hospitals found in the region. The study argues that despite the essence of well-functioning logistical systems, most hospitals have widely underestimated the aspect, with little prompting to hire professional logistics and procurement personnel for HPTs. Poor logistics and procurement approaches in the county have been attributed to over-dependence on the local and national governments, which have subsequently failed in allocating sufficient funds and support. Lack of transport vehicles and poor logistic approaches have been attributed to crippled logistics aspects in healthcare facilities, not only in Kirinyaga West Sub County but also across most healthcare facilities in Kenya (Karanja et al., 2018). Njuguna et al. (2018) depict that only 30%-40% of the hospitals across Kenya have invested in supply chain logistics activities and thereby leaving a huge proportion of hospitals with concerns on the essence of logistics and procurement in the delivery and supply of quality and affordable HPTs (Maata & Ombui, 2018). Efficient supply chain activities ensure management of HPTs in hospitals during the provision of essential medical care in health care systems by ensuring the needs of the patient and health care workers are met.

Within the framework of Universal Health Coverage (UHC), logistics encompasses a range of activities, including but not limited to strategic planning, acquisition, conveyance, and dissemination of health-related commodities and technologies. Additionally, logistics entails the administration of data and assets that are essential to facilitate these operations. Achieving the goals of Universal Health Coverage (UHC) requires efficient and effective execution of activities with a strong emphasis on quality.

2.2.2 Procurement

The management of health products and technologies for the advancement of Universal Health Coverage (UHC) resources is heavily reliant on the role of procurement. The process pertains to the procurement of necessary goods and services that are essential for providing healthcare services to patients. This encompasses a wide range of items, ranging from pharmaceuticals and healthcare apparatus to physical structures and technological advancements. The impact of procurement on the availability, quality, and affordability of health products and technologies can have a significant effect on the achievement of Universal Health Coverage (UHC) objectives. The significance of procurement in the administration of health products and technologies has been emphasized in an expanding corpus of literature. In a study conducted by the World Health Organization (WHO), it was found that effective procurement practices can help reduce costs, improve access to essential medicines, and ensure the quality and safety of healthcare products and technologies. The World Health Organization (WHO) has underscored the significance of enhancing the procurement process in health supply chains to enhance the management of HPTs in advancing UHC. Numerous academic studies have emphasized the significance of procurement in the management of medical commodities and health technologies to enhance resources for achieving Universal Health Coverage (UHC). According to a study conducted by the World Bank (2015), procurement management has the potential to enhance

accessibility of crucial medications by as much as 70%. The World Health Organization (2017) conducted a study that concluded that enhancing supply chain management has the potential to enhance the accessibility of health products and technologies, minimize occurrences of stock-outs, and mitigate wastage.

Poor procurement approaches were also identified to be predicaments affecting the supply of HPTs in Nigeria (Nsikan et al., 2022). Incompetence across procurement management systems in various hospitals in Zambia leads to late delivery and arrival of medical products and health technologies that are necessary for procedures such as surgeries, thereby leading to inconveniences among health workers and more so, leading to poor management of HPTs (Sipalo, 2021). Hospitals across Zambia rely on effective procurement practices of health products and technologies from affiliated sources including the national and local governments as well as the suppliers (Sipalo, 2021). As such, health care administrators are expected to employ and deploy professional procurement workers who will create reliable strategies that provide an effective means of meeting the demand of customers and suppliers.

In study conducted in Tanzanian public hospitals established there exist positive significant influence of procurement on management of health products (Mbepera, 2022). The aforementioned factors encompass the accessibility of resources, the caliber of procurement procedures, and the regulatory framework. The significance of implementing a procurement process that adheres to global standards and regulations is underscored in a study conducted by the United Nations Development Programme (UNDP, 2014) which determined that the implementation of fair and competitive procurement practices can contribute to the assurance of equitable acquisition of healthcare products and technologies, ultimately resulting in favorable outcomes for patients.

2.2.3 Warehouses/Drug stores

The crucial role of HPTs in attaining universal health coverage lies in their availability and accessibility. The management of HPTs is reliant on the crucial involvement of warehouses and drug stores, which are responsible for ensuring the availability, accessibility, affordability, and quality of these products. The objective of this literature review is to analyze the impact of warehouses and drug stores on the management of HPTs to enhance resources for achieving universal health coverage (UHC). Abuya et al. (2019) conducted a study in Brazil which revealed that the implementation of a national warehouse management system resulted in an improvement in the availability of essential medicines and commodities in health facilities. The research highlighted the significance of guaranteeing that drug stores and warehouses are adequately supplied, supervised, and staffed with trained personnel to enhance the supply chain of HPTs (Abuya et al., 2019).

Mihrete et al. (2018) conducted a study in Ethiopia which demonstrated that the implementation of a computerized drug inventory management system in drug stores resulted in a significant improvement in the availability of essential medicines and a reduction in stock-out rates. The research findings suggest that proper management of drug inventory plays a critical role in ensuring the accessibility of vital medications, thereby facilitating the progress of Universal Health Coverage initiatives (Enyew & Mihrete et al. (2018).

Furthermore, Tashobya et al. (2016) conducted a study in Uganda which identified various factors that influenced the availability of essential medicines. These factors included the ability of warehouse and drug store personnel to manage inventory, the availability of financial resources for procurement and transportation of medicines, and the presence of dependable supply chain systems. The research suggests that enhancing the drug stores and warehouses' capabilities, refining the supply chain mechanism, and guaranteeing sufficient financial resources could facilitate the progress of Universal Health Coverage (UHC) resources (Tashobya et al., 2016).

2.2.4 Standard operating procedures

In a study conducted by Mbepera (2022) in Ethiopia, researchers undertook a comprehensive evaluation of the existing Standard Operating Procedures (SOPs) governing the country's health products supply chain. The assessment aimed to identify areas of inefficiency, bottlenecks, and non-compliance to lay the groundwork for a more robust and reliable supply chain management process, (Mbepera, 2022). By meticulously analyzing each stage of the supply chain, from procurement to distribution, the researchers sought to pinpoint potential improvements that could enhance the system's overall efficiency and effectiveness. This study's findings could serve as a valuable resource for policymakers and stakeholders to optimize the supply chain and ensure the timely delivery of essential health products and technologies to communities in need (Mbepera, 2022).

In China, Lee et al. (2021) delved deeply into the evaluation and improvement of SOPs in the health product supply chain. Understanding the significance of streamlined processes and effective resource allocation, the researchers focused on identifying gaps in the existing procedures. Through a combination of quantitative data analysis and qualitative stakeholder interviews, they sought to gain insights into potential areas of improvement. By ensuring strict adherence to standardized protocols and promoting better collaboration between different stakeholders, including manufacturers, distributors, and healthcare facilities, the study aimed to increase the accessibility and availability of health products and technologies across the vast and diverse country (Lee et al., 2021)

Brazil, as a vast and populous nation, faces unique challenges in the supply chain management of health technologies. In their study, Krajcsik (2022) explored the implementation of SOPs in the context of health technology supply chains. The research aimed to enhance the overall supply chain management process by streamlining procedures and optimizing resource allocation. By fostering better communication channels and aligning the efforts of various stakeholders, including

governmental agencies, manufacturers, and healthcare providers, the study sought to improve the availability and distribution of essential health technologies in the Brazilian healthcare system. The findings from this research could offer valuable insights for other countries with similar healthcare infrastructures and challenges (Krajcsik, 2022). Similarly, In Uganda, Kulaba (2019), conducted an appraisal of the SOPs in the supply chain management of health products and technologies. This study's primary objective was to identify gaps and inefficiencies in the existing system and propose evidence-based solutions for enhancement. Considering the country's unique geographical and logistical challenges, the research emphasized the importance of implementing best practices tailored to the local context. The goal was to create a more efficient and resilient healthcare supply chain capable of ensuring the timely and reliable delivery of health products to those in need, even in the most remote areas (Kulaba, 2019).

A survey conducted by Karanja et al. (2018) in Kenya took a comprehensive look at the compliance and effectiveness of SOPs in the health product supply chain. By engaging with various stakeholders, including manufacturers, distributors, and healthcare providers, the researchers assessed how well the existing procedures were followed and identified potential areas for improvement (Karanja et al., 2018). The study emphasized the importance of promoting a culture of adherence to SOPs and the integration of innovative technologies to optimize the Kenyan healthcare supply chain further. By fostering continuous improvement and collaboration among stakeholders, the research aimed to ensure the availability and accessibility of essential health products and technologies throughout the nation (Karanja et al., 2018).

2.3 Human resource factors and management of HPTs

2.3.1 Staffing

The management of HPTs and the promotion of Universal Health Coverage are heavily reliant on the critical factor of staffing. Sufficient staffing levels are imperative in guaranteeing the availability and accessibility of HPTs, as well as in ensuring their safe and efficacious utilization. The World Health Organization (WHO) has identified access to essential medicines and health technologies as a fundamental component of Universal Health Coverage (UHC). The pillar's attainment is contingent upon staffing, as healthcare providers bear the responsibility of prescribing, dispensing, and administering HPTs to patients. Insufficient staffing levels may lead to deficits in crucial medications and technologies, along with tardiness in their transportation and dispersal. In 2019, the World Health Organization conducted a literature review that identified various factors that can affect the availability and accessibility of home pregnancy test kits, one of which is staffing (Tashobya et al., 2016). The study revealed that insufficient staffing levels may result in scarcities of crucial medications and technologies, in addition to inappropriate utilization of these resources owing to inadequate guidance and oversight. The review emphasized the significance of the training and education of healthcare providers, in addition to their accessibility. Healthcare professionals must possess the requisite expertise and proficiency in utilizing HPTs securely and efficiently.

Additionally, they must be capable of providing guidance and encouragement to patients to foster healthy habits and ensure compliance with prescribed treatments. The review underscored the significance of healthcare provider distribution. In numerous low- and middle-income nations, healthcare practitioners are primarily situated in urban regions, leading to a dearth of healthcare access and health-promoting technologies in rural and isolated areas. The lack of access to healthcare providers who are capable of prescribing, dispensing, and administering HPTs can potentially have a

noteworthy effect on the management of HPTs, particularly in areas where patients are situated (Enyew & Mihrete et al., 2018). Therefore, the HPT's management dilemma is a result of both an uneven worker distribution among nations and a generally low level of staffing in rural and outlying health institutions. Frequently, health personnel are understaffed, hence overloaded in their workplace, which, according to WHO (2020) negatively influences the management of HPTs. Therefore, they are unmotivated. Similarly, low staffing levels have a detrimental effect on service quality in addition to the small number of healthcare professionals providing care, which jeopardizes the management of health commodities. Subpar health outcomes and indicators are the inevitable result of this combination of insufficient healthcare professionals and skill in providing appropriate healthcare services (Chen et al., 2004; Anand et al., 2005). According to a study on the pharmacy workforce around the world, Malta has 25.07 pharmacists per 10,000 people compared to 0.02 in Africa.

This ratio differs significantly between countries and is typically connected with metrics of economic development at the national level. The average number of pharmacists per 10,000 people in Africa is 6%, with the greatest shortage, where that number is only 0.57% on average. A total of 640 pharmacists, 479 pharmacy technicians, and 376 pharmacy assistants were identified in Tanzania's pharmaceutical human resources report for 2009, with a mean pharmacist density of just 0.18 per 10,000 people nationwide. Aside from a critical shortage of all categories of the pharmaceutical workforce, the findings indicated a skills mix imbalance, with many highly qualified staff (pharmacists) compared to a small number of staff with basic training (pharmaceutical technicians and pharmacy assistants). This has had a significant impact on the management of HPTs in the respective countries. Additionally, pharmacists in Uganda typically work at higher levels of the health system and in urban regions. Other cadres with no background in healthcare frequently occupy positions at lower levels and in more remote locations.

2.3.2 Training

The significance of training on the management of health products and technologies for the advancement of universal health coverage cannot be overstated. The adequate education of healthcare practitioners who are responsible for the acquisition, allocation, and administration of health commodities and technologies is imperative to guarantee the secure and efficient utilization of these items. This is a crucial element in the attainment of Universal Health Coverage. Therefore, a health worker's education in fundamental medical principles is crucial to provide high-quality, reasonably priced healthcare. Healthcare professionals must be capable of prioritizing their requests for HPTs from their facilities and possess the necessary expertise to forecast demand. One of the key advantages of training is its ability to enhance the proficiency of healthcare personnel in managing health products and technologies with efficacy. However, still, the biggest obstacle to achieving universal health coverage the global shortage of skilled medical personnel. The training encompasses instructions on the appropriate utilization and upkeep of medical devices and equipment, the safe handling and disposal of hazardous waste, and the effective management of supply chains to guarantee sufficient access to crucial medicines and vaccines (Oyewole et al., 2018). Training programs can enhance the proficiency of healthcare personnel, thereby mitigating errors and enhancing the standard of healthcare. This, in turn, results in superior health outcomes and augmented availability of healthcare services for the populace. Moreover, the provision of training can enhance the efficacy of the procurement and distribution systems of health products and technologies. Health systems can enhance access to essential medicines and technologies by imparting training to procurement officials and supply chain managers on the most effective techniques for managing the supply chain. This can result in a reduction of waste, enhancement of forecasting accuracy, and prevention of stockouts (Tesfaye et al., 2019).

Several studies have demonstrated the positive impact of training on the management of health products and technologies. For instance, in a study done in Ethiopia, Malawi, and Rwanda to determine what influences community health workers (CHWs) access to essential medical supplies like vaccines and medications, it was discovered that while more than 95% of staff in Malawi and Rwanda who manage medical products and technologies had received training on supply chain issues, whilst, only 10% of staff in Ethiopia reported having done so. Even employees who had received supply chain training in all three countries frequently had no idea how to manage health commodities according to SOPs. Standard operating procedures were available to 16% of the workforce in Malawi, compared to 7% of the staff in Ethiopia and Rwanda (Chandani et al., 2012). According to a Tanzanian study on the effect of pharmacy worker deployment and training on essential medication access and health outcomes, a key bottleneck in national efforts to achieve UHC is a lack of staff members who are trained to manage HPTs. They postulate that removing the staff deployment restriction will enhance HPT management, resulting in increased availability of medical care services at public health institutions, community access to necessary medications, and improved health outcomes. Although Namibia, South Africa, and Tanzania have similar UHC systems already in place, there is minimal information available about the costs or effects of HPT management in public health facilities (Lubenga et al., 2014). Therefore, an integral part of a strong health system is effective HPT management with appropriate, well-trained, and motivated human resources.

Similarly, a study conducted in Kenyan public hospitals revealed that providing training on medical device maintenance resulted in a noteworthy reduction in equipment downtime, ultimately enhancing the quality of healthcare (Oyewole et al., 2018). A potential remedy to promote staff competency is in service training. In their review of task-shifting research, Kagwanja et al. (2020) staff training would be a useful and affordable method of management HPTs. training might raise skills while also helping

to mitigate problems involving health workers (Baine et al., 2018). Clinical health professionals like nursing aides and medical assistants handle logistics and supply chain tasks at health centers in the absence of certified staff once getting adequate in-service training. However, taking cadres away from their primary responsibility of overseeing HPTs directly has had a clear downside because no health care personnel receive training in health commodity management during their professional careers.

2.3.3 Staff distribution

According to Karanja et al. (2018), this research sheds light on the vital relevance of health workforce distribution in Trans-Saharan nations. There may be discrepancies in access to important services because of an uneven distribution of healthcare professionals, with underprivileged communities being the ones to suffer the most. According to the findings of the study, metropolitan regions often draw a larger concentration of competent professionals, while rural and distant villages are left with insufficient healthcare resources (Karanja et al., 2018). The unequal distribution of healthcare employees between the public sector and the commercial sector was regarded as one of the most significant concerns. It is often the case that qualified professionals tend to go toward private institutions because of the higher compensation, which in turn makes the shortage of health workers in public facilities even worse. Financial incentives, possibilities for professional growth, and the enhancement of living circumstances in rural communities are some of the tactics that policymakers need to explore to devise methods that would encourage healthcare professionals to work in places that are currently underserved (Karanja et al., 2018).

Kanyepe (2022) did thorough research on the training and distribution of health workers in Zambia. This study was carried out across different nations. The research highlighted how important it is to create comprehensive training programs that are tailored to meet the distinct demands of the healthcare systems of various nations. It has long been acknowledged that the provision of supervision and

mentoring is an essential component in elevating the level of performance and motivation shown by healthcare employees (Kanyepe, 2022). It is common knowledge that in order to successfully meet the needs of future patients in the healthcare industry, it is necessary to engage in workforce planning and forecasting. The grasp of demographic and epidemiological trends may give useful insights that can be used for the purpose of making educated choices on the allocation and deployment of employees. It is necessary to address these fundamental aspects to ensure the delivery of healthcare services in a manner that is both fair and efficient in order to improve healthcare delivery systems (Kanyepe, 2022).

According to the results of an analysis that Karanja et al. (2018) carried out in Kenya to establish how the distribution of healthcare workers influences access to healthcare services. This investigation was carried out to discover how the distribution of healthcare products affects access to healthcare services. The findings of the research shed light on the challenges that are involved in transporting essential medical supplies to remote and rural areas. These challenges consist of logistical constraints, limitations imposed by infrastructure, and transportation issues. To make headway in addressing these issues, the paper suggested doing research into alternative distribution strategies and establishing public-private partnerships as viable avenues for resolving these issues. In addition, there was a focus made on efficient inventory management and data analytics to reduce the danger of stockouts and make the most of the availability of critical medical supplies. This was done to make the most of the availability of vital medical supplies. Consumption of health commodities in an acceptable manner, as well as engagement from the community and education on the subject, are both necessary components to improve the overall health of the population.

2.3.4 Compensation

The study conducted by Kairu et al. (2021) focused on the management of health products and technologies in the sub-Saharan African region. The aim of their study was to evaluate the difficulties

and potential advantages related to acquisition, distribution, and upkeep of medical equipment and vital medications. The objective of this initiative was to identify areas of deficiency within the supply chain systems and incorporate technological advancements to improve the availability of health products (Kairu et al., 2021). This endeavor ultimately aimed to establish the necessary foundation for the realization of Universal Health Coverage (UHC) in the region. In a similar vein, a research study conducted by Kabaniha et al. (2020) investigated the effects of compensation strategies on the motivation and performance of healthcare professionals in India. The primary objective of their study was to identify and analyze incentive mechanisms that have proven to be effective in promoting motivation and engagement among healthcare professionals. To enhance healthcare delivery and enhance overall health outcomes in the nation, the study sought to align the interests of employees with the goals of Universal Health Coverage (UHC) (Kabaniha et al., 2020).

Within a relevant framework, Jacobs (2018) examined remuneration structures about healthcare professionals in affluent regions such as Canada and the United Kingdom. The researchers sought to offer valuable insights into the design of sustainable and inclusive healthcare systems in developed nations by evaluating the effects of various compensation structures on workforce satisfaction, quality of care, and accessibility of health services (Jacobs, 2018). In addition, a study was conducted by Fatima et al. (2018) to examine the correlation between compensation practices and job satisfaction within the healthcare profession in Ethiopia. Given the current global emphasis on attaining UHC in settings with limited resources, it is imperative to comprehend the various factors that impact the retention and motivation of skilled healthcare professionals (Fatima et al., 2018). The researchers posited that equitable and competitive compensation would have a significant impact on the recruitment and retention of skilled personnel, thereby facilitating the effective execution of Universal Health Coverage (UHC).

2.3.5 Attitude

Dye (2020) conducted a study in the United States to investigate how human resource management (HRM) may enhance the distribution and use of medical technologies. The authors stressed the need for continuing education and skill building for anyone working in the healthcare industry. They emphasized the need to study throughout one's whole life to keep up with the rapidly evolving field of HPTs. Next, Tamene (2016) investigated the challenges of implementing UHC in developing countries, especially focusing on the administration of HPTs in a rural region of Uganda. Management of human resources and the strategic positioning of healthcare personnel were identified as two of the most important challenges by the study. They also brought attention to the need for incentives and support to maintain the presence of brilliant people in underdeveloped areas (Tamene, 2016).

Sweed (2016) carried out an in-depth investigation of the global initiatives taken to promote UHC as well as the role that human resource management plays in ensuring the most efficient use of medical supplies and equipment. The study emphasized the need for equitable HPT distribution through policy measures. The research used data from a wide variety of locales. The authors emphasized how important it is to foster a happy environment at work, to provide fair remuneration, and to make it easier for people to communicate across different fields (Sweed, 2016). In addition, Sansone et al., (2019) did a study in South Africa to assess how the various styles of leadership influenced the motivation and performance of healthcare professionals working in the context of UHC and HPT management. This research was carried out to answer the question "How does different leadership affect motivation and performance?" According to the findings of the research, transformational leadership is critical for successfully inspiring healthcare employees to embrace innovation and make use of new technologies. This, in turn, moves the needle closer to the goal of universal health care coverage (Sansone et al., 2019).

2.4 Inventory Optimization and Management of HPTs

One key objective in WHO essential medical care services strategy is to ensure universal health coverage by improving health products and technologies management (WHO, 2020). However, a significant barrier of management of inventories across health facilities across many nations worldwide has been recognized as unreliable inventory management systems. Inventory optimization is a technique for balancing service-level goals over a wide range of stock-keeping units (SKUs) while considering demand and supply unpredictability (Neve & Schmidt, 2022). By compiling and providing all reports for stock replenishment, inventory management ensures that there is enough stock available, identifies supply risks, and requests replenishment to enable a desired overlap between expected stock and present stock (Coslett, 2024). Inventory Optimization's primary objective is to lower healthcare costs without compromising service, often by increasing the effectiveness or productivity of the systems. As a result, hospitals maintain an inventory of their optimal levels primarily for maintenance purposes to repair the system and enable it to resume performing its original role (Saha & Ray, 2019). In joint systems, inventory is examined continually or infrequently, using both methods (Neve & Schmidt, 2022). When a certain need for the safety stock is reached, the inventory levels are regularly reviewed under the continuous review policy. To prevent stock outs, inventory management systems depend on the availability of goods. When maximizing HPTs management and first inventory management should both be considered at the same time because of their close ties. This is because organizations optimize their inventory systems by focusing on costs, downtime, and service levels. Three main components make up the inventory costs. There is a holding expense that must be considered. Because the ordering cost is typically a fixed sum that is associated with each order that is placed, retaining inventory is costly because institutions do not receive interest on the blocked cash, as would be the case if the capital could be invested in other initiatives. Health facilities need inventory

performance indicators because they may use them to gauge how well supply chain departments are handling HPTs.

2.4.1 Stock Categorization (ABC Analysis)

The ABC analysis is one of the inventory optimization attributes and that is a widely used technique that categorizes items according to their significance, with the objective of enhancing inventory levels and minimizing expenses. The utilization of ABC analysis is applicable in the realm of HPTs to effectively prioritize the acquisition and dissemination of crucial medical supplies such as essential medicines, vaccines, medical devices, and diagnostic tests, among other health commodities. The aforementioned can be regarded as a potential means of promoting the progression of UHC, a concept that strives to guarantee that every person and society can avail themselves of necessary healthcare services without incurring financial distress (Mohajan, 2017).

The ABC analysis according to Mueller & Knapp (2018) is a method that entails the categorization of items into three distinct groups, predicated on their relative significance concerning utilization or worth. Items belonging to Category A are of utmost significance and usually constitute a minor fraction of the overall inventory yet possess the highest value or usage. Category B items are characterized by moderate importance and a moderate share of the inventory, whereas category C items are deemed the least important and constitute a significant portion of the inventory yet exhibit the lowest value or usage (Mueller & Knapp, 2018). ABC analysis can be employed within the framework of Health Product Tracing to discern and rank the acquisition and dissemination of crucial pharmaceuticals and other healthcare goods. Category A items encompass essential medical supplies such as life-saving medications, vaccines, and medical devices that are crucial for preventing morbidity and mortality and must always be readily accessible. Category B items comprise of pharmaceuticals and equipment that are significant but not essential for sustaining life, whereas

category C items consist of infrequently used pharmaceuticals or equipment that can be stored in lesser quantities or obtained as per requirement.

ABC analysis in a study conducted in Malaysia has been identified as a potentially beneficial tool for managing high priority tasks as evidenced by multiple studies. A study carried out in Ghana discovered that the implementation of ABC analysis led to the optimization of essential medicine stock levels and a decrease in stock outs (Muhindi & Ngaba, 2018). This resulted in an improvement in the availability of medicines for patients and a reduction in the workload of healthcare personnel. A study carried out in Uganda has demonstrated that the implementation of ABC analysis has facilitated the prioritization of essential medicines procurement and led to a decrease in the expenses incurred from holding surplus inventory. This has resulted in an enhancement of the financial sustainability of the healthcare system (Mohajan, 2017).

Nevertheless, certain difficulties may emerge during the execution of ABC analysis within the framework of High-Performance Teams. The precision of information regarding usage and worth may be restricted, particularly in resource-constrained environments where health information systems may exhibit inadequacies. Furthermore, the classification of items may not always be uncomplicated, as certain items may possess varying degrees of significance contingent on the context or prevalence of the disease (Mwihia, 2020).

2.4.2 First Expiry-First Out (FEFO)

According to the First Expiry First Out (FEFO) concept of inventory management, products that were received or manufactured first should be used or sold first. HPTs can benefit from FEFO by ensuring that consumables are used up before they expire, thus cutting down on wastage and increasing patients' access to lifesaving drugs and equipment. All people, everywhere, should be able to afford the medical

care they need, and this can help move the goalposts toward UHC. Vaccines, blood products, and some medications expire quickly, so it's crucial to handle them using the FEFO principle. These things have a short lifespan and must be used before they go bad, or else they will have to be thrown away. Medical centers can save money by using their older supplies first (hence the name "FEFO") instead of risking expiry or going to trash (Okungu, 2019).

The advantages of using FEFO for HPT administration have been the subject of several recent research. Research in Nigeria, for instance, showed that FEFO for vaccines increased vaccine supply and decreased vaccine waste. In separate research performed in Zambia, FEFO was found to enhance patient results by reducing the danger of stock outs and maintaining a steady supply of antiretroviral treatment (ART) (Rahi, 2017). However, there could be difficulties in applying FEFO to HPTs. Inaccurate inventory records and supply chain data, for instance, can make it tough to monitor stock expiration dates and properly apply FEFO. In addition, healthcare employees who use the FEFO principle may need more extensive instruction and oversight to guarantee its proper implementation (Rowan & Laffey, 2020).

2.4.3 Safety Stock Policy

High-priority medications, also referred to as important medications, are vital for the treatment and avoidance of illnesses that have a major effect on the general public's health. However, providing access to high-priority treatments continues to be very difficult, especially in low-income nations. To advance comprehensive health care and enhance health results, HPTs must be effectively managed (Scala & Lindsay, 2021). The administration of HPTs is significantly impacted by two important variables: the safeguard supply strategy and record-keeping. A product's safety stock policy refers to the quantity of merchandise kept above the level of anticipated demand in order to guarantee that there will be enough products to satisfy unforeseen demand. Since HPTs are frequently life-saving

medicines that cannot run out of supply, the safeguard stock strategy is crucial. Thus, it is crucial to keep enough backup storage to guarantee that there is always enough HPTs accessible. According to research done in Tanzania, a safeguard supply policy works well to decrease HPT stockouts and increase accessibility in basic healthcare institutions (Selemani, 2020). The implementation of a safeguard supply strategy, according to research conducted in Kenya, greatly decreased the amount of HPT stockouts in basic healthcare institutions. Another important aspect that affects the management of HPTs is record-keeping.

The act of recording all inventory operations, including stock purchases, issuances, and changes, is referred to as record-keeping. To make sure there is a sufficient supply of HPTs accessible and to spot any inventory management problems, accurate record-keeping is crucial. Poor record-keeping techniques were found to be a major impediment to the efficient administration of HPTs in research carried out in Kenya. Similarly, Kenyan research on health discovered that inadequate record-keeping procedures posed a major obstacle to guaranteeing HPT accessibility in basic healthcare institutions (Shangala, 2020).

2.4.4 Economic Order Quantity (EOQ)

Economic Order Quantity (EOQ) is an important idea here because it allows healthcare systems to find a happy medium between inventory holding costs and ordering costs, ensuring a steady supply of vital medical goods. Saha et al. (2019) looked at how EOQ concepts may be applied to the management of pharmaceutical and medical device stock in a British hospital context. They discovered that by using EOQ, the hospital saved money, decreased waste, and kept sufficient supplies on hand for patient care. The hospital's excellent handling of HPTs helped forward the cause of universal health care (Saha & Ray, 2019).

Considering this, Rowan & Laffey (2020) researched the viability of EOQ in managing medical supplies for UHC at a low-resource healthcare facility in a rural area in South Sudan. According to the study's findings, the hospital improved inventory management and resource allocation after using EOQ principles. This improved their ability to meet the basic health needs of the local community and represented a major step forward in the achievement of UHC. Rahman & Zailani (2017) conducted a meta-analysis of research conducted in a wide range of healthcare systems throughout the globe, broadening the review's coverage. The evaluation looked at how HPT management may benefit from EOQ and how it might hinder progress toward UHC. It emphasized the potential of EOQ to reduce both stockouts and surplus inventory, making essential tools and medicines more accessible to people who need them.

In addition, Pilgrim & Bohnet-Joschko (2019) investigated how EOQ concepts may be used in a high-volume urban healthcare institution via the use of technology-driven inventory management systems. The facility may improve stock management, cut down on supply chain inefficiencies, and distribute resources more efficiently with the use of data analytics and computerized inventory monitoring. Better inventory management helped them promote UHC initiatives and enhance health outcomes for the city's residents (Pilgrim & Bohnet-Joschko, 2019).

2.4.5 Just-In-Time

A viable strategy for expanding UHC is just-in-time (JIT) inventory optimization and management, which effectively controls the supply of HPTs. This plan intends to lower inventory holding costs, decrease waste, and ensure prompt availability of critical medical supplies, all of which will help achieve the overarching objective of ensuring equitable access to high-quality healthcare.

The authors of ground-breaking research by Park et al. (2020) examined the use of JIT concepts for managing medical supplies and equipment in a hospital environment in Japan. They discovered that the hospital could maintain ideal inventory levels, get rid of surplus goods, and simplify the supply chain by using JIT procedures. This strengthened the hospital's efforts to advance UHC via cost reductions and better resource allocation. Similarly, Chen et al. (2019) research looked at the viability of JIT inventory management for HPTs at a resource-constrained healthcare institution in Tunisia. The researchers emphasized the beneficial effects of JIT in limiting stockouts and lowering inventory costs, resulting in improved access for the local community to necessary health items. This JIT implementation made great strides toward the facility's achievement of UHC goals (Park et al., 2020). Based on these results, Ongwae (2019) conducted a systematic review that examined several research from various healthcare settings to evaluate the efficacy of JIT in HPT management for UHC in Uganda. The analysis found that using JIT concepts might reduce lead times, increase inventory turnover rates, and boost supply chain efficiency. Healthcare facilities were better able to react quickly to patient requirements and improve overall healthcare access and delivery by managing inventories in this way (Ongwae, 2019).

Additionally, research by Onyancha (2022) investigated the implementation of JIT systems that are technology-driven at a large metropolitan hospital in Kenya. The hospital was able to anticipate demand patterns and modify inventory levels because of using real-time data and predictive analytics, guaranteeing a smooth flow of HPTs and reducing waste. This technologically enabled JIT strategy made a substantial contribution to the hospital's efforts to advance UHC and provide top-notch treatment to the urban population (Onyancha, 2022).

2.5 Health Management Information Systems and Management of HPTs

Health Management Information Technology is defined as applying information processing by use of computer systems that entail its hardware and software towards data storage, sharing, retrieval, and use of health-affiliated information and knowledge for therapeutic decision making and communication. Health information systems entail knowledge and technologies that range from simple to more advanced aspects that are integrated within the medical setting (Wu & Luo, 2019). Management of health products and technologies in the advancement of UHC subsequently relies on deployed health information systems implemented for patient safety and to reduce mortality and morbidity rates (Awadh, 2021).

2.5.1 Deployment of Health Management Information

Health Management Information Systems (HMIS) refer to computerized systems that are utilized for the purpose of managing and organizing health-related information. The implementation of HMIS can potentially exert a noteworthy influence on the administration of high-priority medicines and the progression of UHC (Singh & Misra, 2018). The deployment of HMIS can enhance the efficiency of managing high-priority targets through optimizing inventory management, monitoring medication consumption, and guaranteeing prompt medication distribution.

The essence of competent management of health information systems depicts that health care facilities in the past decades have accelerated the adoption and development of health information-related in the management of HPTs, with subsequent varying degrees of how effective health information systems on patient safety (Sachs, et al., 2019). Gong et al. (2020) also conducted a quantitative study that involved healthcare workers working in 20 public hospitals in Shanghai, China, to determine the implementation of good health information systems in healthcare facilities in relation to health products and technologies in the city. Results indicated that the government and non-governmental

organizations have invested in health-related information management systems in the region in areas such as storage of patients' data, whereby most hospitals were equipped with internet connections and computers, especially at reception (Gong et al., 2020). China has been among the leading manufacturers and producers of health technology gadgets and software, and health care facilities in the country have benefited from these advancements. In the United States, research conducted by Alfalah (2018) depicted that health care policymakers and clinicians in hospitals based in New York were able to effectively manage their health products and technologies in the provision of medical care. This was attributed to the implementation of health information systems in most health care facilities and thereby aiding the medical providers in making therapeutic interventions in a timely manner. Effective use and application of health information systems have proven to improve patient safety, and more so, helpful towards the management of health products and technologies during the provision of universal health coverage.

The adoption of a computerized inventory management system resulted in a significant enhancement in the management of crucial medications, such as HPTs, in healthcare facilities in Ghana (Rahi, 2017). A study carried out in Uganda has demonstrated that the implementation of electronic health records (EHR) has resulted in enhanced management of hypertension (HPT), which includes improved monitoring of medication usage and decreased occurrences of stockouts (Okungu, 2019). The deployment of HMIS can aid in the assurance of accurate medication and dosage administration to patients, thereby playing a crucial role in enhancing health outcomes. According to a study carried out in Ethiopia, the implementation of a computerized prescription system resulted in enhanced precision in medication prescription and dispensation, including for HPTs (Mishra et al., 2019). In addition, both local and national governments in Tanzania have improved their efforts in ensuring that health care facilities in the country are equipped with the necessary health information technology. This is

despite various challenges affecting implementation, such as levels of illiteracy among members of the community.

Kanyepe (2022) conducted a study in hospitals in the Mashonaland region of Zimbabwe to determine management aspects associated to health products and technologies during revision of medical care and depicted that health information management systems have played an imperative role in the reduction of mortality and morbidity rates in the country. Hospitals in Malaysia were found to utilize various health information management aspects such as computerized physician orders (PO), smart pumps, electronic medical records (EMR), and automated dispensing cabinets (Bakry, 2018). Kelly (2018) emphasizes the imperativeness of implementing health information management systems to ensure quality delivery of health services through the application of knowledge, technology, systems, and processes to solve problems that are mainly caused by human errors in hospitals, not only in Egypt but across the globe.

Similarly, according to a study recommendation, health care workers in Kenya need to undergo mandatory training on health-related software to ensure that they are well conversant with new advancements in the medical field, and more so, ensuring that using information systems, patients can benefit, and health workers are satisfied (WHO, 2020). This is particularly important in monitoring the utilization of Health Promotion Technologies, identifying any deficiencies in service delivery, and facilitating informed decision-making to enhance health outcomes. According to research conducted in Kenya, the utilization of a web-based system for monitoring drug usage was effective in identifying service delivery gaps and enhancing the management of HPTs (Rahman & Zailani, 2017).

2.5.2 Application of HMIS

The potential impact of HMIS and Information and Communication Technology (ICT) infrastructure on the management of health products and technologies for the advancement of UHC. Universal Health Coverage is a crucial goal pursued by numerous nations in their efforts to guarantee equitable access to fundamental healthcare services, while also preventing individuals from facing financial distress. The achievement of this objective necessitates proficient management of health products and technologies. The utilization of HMIS and Information and Communication Technology (ICT) infrastructure offers a diverse set of tools and capabilities that can facilitate the efficient administration of healthcare products and technologies. The systems encompass electronic health records (EHRs), inventory management systems, supply chain management systems, and decision support tools. Through the utilization of these tools, healthcare professionals and administrators can enhance their capacity to monitor and oversee health-related goods and technologies, optimize the allocation of resources, and guarantee the accessibility of crucial products and technologies to all individuals requiring them.

An increasing number of scholarly works have been published in Ethiopia regarding the influence of HMIS and Information and Communication Technology (ICT) infrastructure on the administration of healthcare goods and services, with the aim of promoting UHC (Schleipman, 2017). Haskew et al. (2020) conducted a systematic review that examined 55 studies assessing the effects of ICT on the quality, accessibility, and availability of healthcare products and services in low- and middle-income nations. The study conducted by the authors revealed that the utilization of Information and Communication Technology (ICT), specifically mobile health (mHealth) applications, was linked to enhanced management of supply chain, augmented accessibility of medicines and other health-related commodities, and better patient outcomes. Schachner et al. (2020) conducted a study in India to assess the effects of an integrated HMIS on the management of medical supplies and equipment in a hospital

located in Uganda. According to the research, the implementation of the HMIS resulted in a noteworthy enhancement in inventory control, as evidenced by a decrease in occurrences of stock outs and expired items. The authors have additionally observed that the system has enhanced the efficacy of the supply chain and facilitated superior surveillance of equipment utilization and upkeep (Scala & Lindsay, 2021).

Ndung'u (2018) conducted a systematic review of healthcare facilities in Mlolongo care centers, Machakos County to determine various factors affecting the management of health commodities during the revision of medical care in Kenya. The results depicted that most hospitals in the county were at least equipped with computer systems and health care workers were well aware of the application of HMIS in the management of HPTs. This was further mirrored by a study finding that depicted that physicians and healthcare workers in hospitals across coastal Kenya used computerized physician order entry stems via the use of computers or smartphones (Shangala, 2020). This is an effective aspect that has helped them save time during recording and retrieval of necessary patient information, and thereby able to use effective therapeutic interventions in time. Orang and Kwamboka (2020) conducted a meta-analysis on management of health commodities and its affecting factors and found out that hospitals in marginalized areas of Kenya are faced with subsequent predicaments during the application of effective health management information systems. This is attributed to a lack of resources such as internet connection, computer hardware and software, trained personnel who can apply technological advancements, and a high level of illiteracy among members of the community in the regions (Shangala, 2020). Lang'at (2019) thereby, calls for intervention by county and national governments in marginalized areas in Kenya and in urban centers to ensure that health care facilities are well equipped with health information management systems and gadgets that ensure effective decision making and subsequently reduce human errors that can be mitigated by technologies such as

storage of data. The health information management system is very critical in ensuring the appropriate management of the HPTs through improved accuracy of the data to inform forecasting and quantification of the needed HPTs, accurate issuing of the health products from the stores to the wards and dispensing pharmacies within the health facility. Health information management system also plays a role in ensuring proper management by ensuring adequate tracking of the HPTs to reduce pilferage and losses though expiries thus improving availability of HPTs and cost saving for the healthcare system.

2.5.3 Data Quality

Efficient Health Management Information Systems (HMIS) play a critical role in the advancement of UHC and the optimization of HPTs management. Data quality and data storage are two crucial elements in this context. They have a significant impact on guaranteeing precise information for decision-making purposes and upholding the integrity of vital health product records. Numerous scholarly investigations have examined the significance of data quality and storage within HMIS for the advancement of UHC.

The impact of data quality on the management of HPTs was investigated by Yarkoni (2020) in a regional health system in the United States. The present study evaluated the precision, comprehensiveness, and punctuality of data within the HMIS and its potential ramifications on supply chain decision-making (Yarkoni, 2020). The researchers discovered that inadequate data quality resulted in less-than-optimal inventory management and inefficiencies in the supply chain, potentially impeding advancements towards achieving UHC. In continuation of the, research conducted by Wu & Luo (2019) within a healthcare setting with limited resources in a developing nation, centered its attention on the difficulties associated with the storage and management of data pertaining to high-performance tests. The researchers investigated the ability of the current HMIS to effectively store and

process substantial quantities of health product data. The authors recognized the necessity of establishing a resilient data storage framework and secure information management systems to guarantee uninterrupted retrieval of vital health product data, particularly in settings with limited resources (Wu & Luo, 2019).

Incorporating a broader perspective, a thorough examination conducted by Westman (2021) amalgamated results from numerous studies conducted in diverse healthcare settings and countries. The review emphasized the importance of implementing data quality assurance mechanisms in HMIS to promote the progress of UHC. The importance of conducting regular data audits, implementing data validation processes, and providing staff training to ensure the accuracy and reliability of health product information was underscored.

Furthermore, Tama et al. (2018) conducted a study that examined the incorporation of cloud-based data storage solutions within a sizable metropolitan healthcare system in Tanzania. Through the utilization of cloud technology, the hospital can effectively store and oversee extensive quantities of health product data, all the while guaranteeing the security and availability of said data. The implementation of cloud-based data storage has bolstered the hospital's capacity to monitor health program targets, improve inventory management, and facilitate decision-making processes aimed at advancing UHC (Tama et al., 2018).

In summary, the management of Health Products and Technologies for advancing Universal Health Coverage relies heavily on the critical components of data quality and data storage within Health Information Management Systems. Numerous investigations conducted across diverse healthcare settings have underscored the importance of precise and effectively managed health product data in maximizing supply chain decision-making, facilitating uninterrupted information access, and improving the overall delivery of healthcare services. By effectively tackling the issues surrounding

data quality and storage, healthcare systems have the potential to promote evidence-based decision-making and enhance the availability and accessibility of crucial health products for individuals across the board.

2.5.4 Suitability of the HMIS system

The significance of HMIS lies in its pivotal role in promoting UHC and enhancing the effective administration of HPTs. The efficiency of healthcare operations, data accessibility, and decision-making processes are influenced by the design, structure, and functionality of the HMIS. Numerous scholarly investigations have been conducted to explore the characteristics of HMIS within the framework of advancing UHC and effectively managing HPTs. Wang et al. (2020) conducted a study within a significant urban healthcare system in South Korea to investigate the characteristics of the HMIS and its influence on health product management. The researchers evaluated the system's interoperability, its capacity to capture real-time data, and the extent of its integration with the supply chain. The research emphasized the significance of a well-integrated and interoperable HMIS in maximizing the efficiency of managing Health Provider Teams and facilitating UHC initiatives.

In a rural healthcare facility in Bangladesh, Verger et al. (2021) conducted a study to examine the characteristics of the HMIS and its potential impact on the advancement of UHC. The researchers directed their attention towards evaluating the system's ease of use for users, its capacity for generating comprehensive reports, and its measures for ensuring the security of data. The study placed emphasis on the significance of an intuitive and user-friendly HMIS in promoting greater adoption among healthcare professionals. This, in turn, resulted in enhanced data collection and improved management of Health Promotion Technologies, ultimately leading to more favorable health outcomes (Verger et al., 2021).

In a comprehensive analysis conducted by Shangala (2020), the authors examined a range of HMIS implementations in different counties in Kenya. The objective of this review was to identify recurring patterns and themes that contribute to the effectiveness of these systems in managing Health Policy Tools and promoting UHC (Shangala, 2020). The review emphasized the significance of scalability, flexibility, and adaptability in the design of HMIS. These qualities are crucial for accommodating the changing healthcare requirements and facilitating the smooth integration of emerging health technologies (Shangala, 2020).

Additionally, the utilization of mobile-based HMIS in a remote healthcare environment in India was investigated in a study conducted by Sharma et al. (2020). The researchers investigated the characteristics of the mobile system and its function in enabling the collection of data, remote monitoring, and management of the supply chain for high-performance technologies. The researchers discovered that the mobile-based HMIS played a significant role in promoting UHC by effectively addressing geographical disparities and enhancing the availability of crucial healthcare products in underserved regions (Sharma et al., 2020).

2.6 Institutional Leadership, Culture, and Management of HPTs

2.6.1 Communication culture

Leadership plays a crucial role in the management of Health Products and Technologies for advancing UHC because it ensures the establishment and maintenance of the systems for the system's organization, finance, and regulation as well as those for facilitating coordination, participation, and accountability. Effective leadership has to do with how hospital administrators support mentoring and oversight in various departments dealing with the management of HPTs in healthcare facilities, as well as policy and legal modeling on health commodity security in healthcare facilities, to achieve effective management of health products and technologies (Fursman, 2021), ensuring that HPTs are efficiently

managed, and that they are accessible and affordable to everyone, regardless of their socioeconomic status. Studies on the leadership culture at healthcare facilities focusing on medical products, vaccines, and technologies have been carried out in Asian nations. According to a qualitative study on health facilities in Asia, there are several leadership parameters that make it difficult to manage health technologies and medical commodities, amongst them, poor communication skills (Nicola et al., 2020). Communication skills are important for effective leadership in the management of HPTs for UHC. Good communication skills can ensure that there is effective communication between different stakeholders involved in the management of HPTs. Effective communication can facilitate the sharing of information, ideas, and knowledge among different stakeholders, including health professionals, policymakers, and patients. Effective communication can also help to build trust and rapport among stakeholders, which is essential for successful collaboration. According to Sharma (2020) in a study conducted in Indian hospitals, communication skills are critical in creating a shared vision, ensuring that all stakeholders are aligned, and facilitating the exchange of information between teams. In addition, another study in United Nations, effective communication can help to promote transparency, which is essential in managing health products and technologies (Pilgrim & Bohnet-Joschko, 2019).

In agreement, quantitative research conducted in Mozambique on leadership and management of Health products at healthcare facilities provided that planning, directing, controlling, coordinating, and budgeting for health commodities depends largely on the institutional top management's ability to communicate to employees giving directions. Another systematic review in South Africa submitted that, management of HPTs can only be accomplished with strong communication cultures among the managers of healthcare systems and workers by communicating the health facility's vision in order to motivate, inspire, support, and empower hospital staff to work toward achieving this vision. Similarly,

Kohan et al. (2020) contended that through communication, managers are able to support mentorship and supervision in various departments dealing with the management of HPTs in the health facilities.

Several factors, including ineffective communication skills, have been observed all over Kenya connected to the institutional leadership culture in hospitals, and have had a significant impact on Kenya's management of health products and technologies (Kairu et al., 2021). While the core hospital leadership team is made up of senior professionals, including the hospital superintendent, health services administrator, head of procurement, accountant, pharmacist, and director of nursing services, the county government, through the department of health, provides the hospital with external leadership (Kairu et al., 2021). The functional department heads at the hospital, such as those in charge of the lab, pharmacy, maternity, outpatients, general, children's, and maternity wards, are viewed as members of a bigger leadership team outside of this core. Leadership actors have access to various forms of power, including legitimate, referent (based on identification), coercive, reward, and expert authority, which they can employ to affect hospital processes and outcomes (Mwihia, 2020). The extent of their power is, however, influenced by contextual factors in the health sector, such as institutional arrangements, national and sub-national policies, rules, and regulations. Similarly, according to a study by Mamudu and Hammond (2019), research found that effective communication can help to ensure that health products and technologies are managed efficiently, promoting UHC at the county level.

2.6.2 Motivation Culture

Motivation has become one of the essential leadership culture elements that influence the management of HPTs across nations. Research evidence in European nations shows that within a specific range, work efficiency is enhanced with an increase in motivation intensity (Abo-Elenein et al., 2021). Numerous scholars have confirmed the role of achievement motivation in the management of HPTs

(Jia, 2022). Also, a meta-analysis in the field of public administration showed that intrinsic motivation positively affects job satisfaction and management of health commodities. Notably, unlike in other fields, health systems professionals are trained for a prolonged period in the medical field, and they have clear professional goals. They desire to complete their tasks correctly and efficiently in their hospitals. According to the achievement need hypothesis coined by McClelland, people exhibiting high achievement motivation are more devoted to work, and they further achieve higher performance by enjoying an adventurous work environment through positive feedback. Additional research evidence indicates that internal drive and motivation positively influence the management of health products and technologies among Chinese physicians (Jia, 2022). By inference, achievement motivation makes employees work towards achieving the objectives of UHC.

Additionally, employees with high achievement motivation are more connected to the hospitals they work for. A study in Nigeria indicated that achievement motivation and HPTs management are significantly and positively correlated (Ebenso et al., 2020). Moreover, the study submitted that achievement motivation is positively related to how the HPTs are managed (Ebenso et al., 2020). Similarly, effective reward systems can incentivize employees to work hard, be innovative, and find new and creative ways to improve the management of HPTs. Reward systems can also encourage employees to take ownership of their work and to be accountable for their actions. According to Mothibi et al. (2018), rewards can take the form of financial incentives, recognition, and career advancement opportunities. When employees are rewarded for their efforts in managing health products and technologies, they are likely to be more committed and motivated to ensure that UHC is achieved. A study by Odetola et al. (2018) done in Tanzania found that financial incentives were essential in motivating health workers to use health technologies effectively, resulting in improved health outcomes. Therefore, reward systems can be used to promote appropriate management of health

products and technologies, ultimately contributing to the achievement of UHC (Odetola et al., 2018). Although some studies argue that achievement motivation promotes good management of HPTs, the underlying mechanisms of this relationship are controversial. Whether there exists an intermediate variable that plays a crucial role remains unknown.

2.6.3 Planning Culture

Competence in planning has been touted as one of the effective leadership tools in the management of HPTs, through effective decision-making and systematic implementation of goals. Therefore, planning in the context of the present study shall be defined as the systematic alignment of decisions and activities aimed at the management of HPTs. Planning ensures that there is a focus on evidence-based decision-making, which is essential for the management of HPTs. According to Zeng et al. (2018), planning defines organizational direction and therefore determines the objectives and goals of the organization that are as realistic as possible. Therefore, a good plan should be founded on innovative and creative defining the hospital's mission, specifying achievable objectives, and setting policy guidelines. The process of planning is mainly carried out at three levels, which include the facility level, operation level, and functional level. The lower-level managers drive the functional roles, which have short-term horizons and relate to a functional area (Sharma et al., 2020). A survey technique was used with the administration of questionnaires to 100 respondents (of which 80 were retrieved) comprising of both the senior and junior staff of public hospitals in South-West, Nigeria. The data collected were analyzed using the Statistical Package for Social Sciences (SPSS). Also, T - t-test and Chi-square statistical methods were used in testing the hypotheses. The three hypotheses were confirmed. The key findings were that planning has a significant influence on the management of health products in the health facility context.

The importance and significance of planning in healthcare can hardly be overemphasized in Kenya today, when providing proper and adequate service continues to be a key concern of most county hospitals. For growing longevity and ageing population amidst dwindling birth rates, many countries are increasingly hard-pressed for the extra budget and resources to meet the healthcare needs. Many have turned to OR for optimization and cost-control measures. Some of the key healthcare issues considered in OR today include estimation of future demand for services in order to build enough capacity, selection of hospital locations for covering a target population, and design of the emergency facilities for efficient handling of patients.

2.6.4 Institutional policies

To make progress toward UHC, it is vital to have strong policies ingrained in the institutional culture of leadership as well as an effective administration of health commodities and technology. A number of studies have been conducted to investigate how the rules influence individuals' opportunities to get the necessary medical treatment.

Schmutz et al. (2019) conducted research in the United States that looked at how institutional leadership culture affects healthcare policy and practice. The research investigated how the beliefs, goals, and methods of decision-making of organizational leaders influenced the implementation of UHC initiatives. According to their findings, achieving the vision of universal health care requires a culture of collaboration, transparency, and a primary emphasis on the individual patient. In a study on Chinese health products and technologies, Scala and Lindsay (2021) examined the influence of technology management policies on healthcare outcomes. Their research explored innovations such as telemedicine and electronic health records, concluding that technology-driven interventions significantly improve healthcare delivery in underserved areas. These findings underscore the role of policies in integrating technology to advance UHC. Rowan and Laffey (2020) evaluated how public health systems manage medical supplies and technology, analyzing challenges in acquisition, distribution, and maintenance of life-saving drugs and equipment.

They emphasized that clearly defined policies, adequate regulation, and effective implementation are critical for ensuring universal access to health commodities.

Similarly, Pilgrim and Bohnet-Joschko (2019) synthesized evidence from multiple European countries on institutional leadership culture and health technology management. Their study identified both common challenges and effective strategies, recommending cross-country policy coordination and learning from successful models to achieve UHC globally.

In Africa, institutional policies are often undermined by weak enforcement, inadequate resources, and governance challenges, which limit their ability to strengthen the management of health products and technologies (HPTs). Studies show that fragmented procurement policies and poor coordination across government levels contribute to persistent medicine shortages, stockouts, and wastage, even where robust national frameworks exist (Cleary et al., 2020; Asante et al., 2021). Weak regulatory systems have also allowed counterfeit and substandard medicines to infiltrate public facilities, undermining patient safety and eroding public trust (Berhanu et al., 2020). Furthermore, corruption and inefficiencies in procurement processes, as highlighted in Nigeria and Uganda, weaken accountability and exacerbate inequities in access to essential medicines and technologies (Onyemaechi et al, 2021). Despite these challenges, evidence from across Sub-Saharan Africa demonstrates that where institutional accountability is strengthened—through harmonized procurement systems, transparent financing mechanisms, and integration of ICT-based monitoring—substantial improvements in availability, affordability, and quality of HPTs can be achieved. These findings emphasize that robust institutional policies, backed by strong enforcement and leadership commitment, are critical for advancing UHC in Africa.

In Kenya, institutional policies governing the management of health products and technologies (HPTs) are largely anchored on the Kenya Health Policy (2014–2030), the Kenya Essential Medicines List (KEML), and the Kenya Medical Supplies Authority (KEMSA) Act. These frameworks are designed to ensure universal access to quality, safe, and affordable medicines and

technologies. However, the policy environment has faced persistent challenges that weaken implementation and limit efficiency. Recurrent stockouts of essential medicines in public hospitals have been attributed to weak procurement planning, delays in disbursement of funds, and heavy reliance on a single national supplier—KEMSA—whose capacity and governance have often been questioned. Reports of corruption and mismanagement at KEMSA, particularly during the COVID-19 pandemic, further revealed systemic weaknesses in institutional accountability, undermining confidence in the centralized procurement model (Ndung'u al., 2022). In response, the Ministry of Health and county governments have attempted to decentralize procurement and introduce direct facility purchasing, but these reforms have been inconsistently implemented across counties, leading to inequities in HPT access (Onyemaechi et al., 2021).

Despite these limitations, Kenya has made progress in integrating digital innovations to strengthen institutional policies around HPTs. The rollout of the Health Commodities Information System (HCIS) and other ICT-based platforms has improved data visibility, enabling better forecasting, inventory management, and tracking of commodities at county and facility levels (Oyugi et al., 2020). Yet, the effectiveness of such systems has been constrained by inadequate infrastructure, limited staff training, and weak enforcement of reporting standards. In practice, counties with stronger leadership cultures and clear institutional policies such as Nyeri and Machakos—have demonstrated better budget absorption rates, improved record-keeping, and reduced frequency of stockouts compared to counties with weaker governance structures (Kairu et al., 2021). Overall, while Kenya’s policy frameworks are relatively well developed, gaps in enforcement, governance, and institutional leadership continue to impede their effectiveness. This underscores the need for stronger alignment between national policies and county-level implementation to achieve sustainable improvements in HPT management and accelerate progress towards UHC.

2.6.5 Monitoring and Evaluation

Monitoring and evaluation play a crucial role in ensuring the effectiveness and success of policies related to institutional leadership culture and the management of health products and technologies for advancing UHC. Onyancha (2022) carried out research that aimed to explore the adoption of monitoring and evaluation frameworks within healthcare facilities that are in a variety of Trans-Saharan nations. The primary purpose of this research was to investigate the role that various conceptual frameworks had in determining the impact that leadership culture has on aspects such as healthcare quality, patient happiness, and staff performance. The findings stressed the need for continuous assessment and feedback systems to identify areas that demand development and better leadership tactics in the quest for UHC (Onyancha, 2022). The effectiveness of monitoring and evaluation systems in a Southeast Asian nation was investigated by Nicola et al. (2020) as it related to the acquisition, distribution, and consumption of critical medications and medical equipment in the field of health goods and technologies. The research was carried out in the context of health products and technologies. The researchers stressed the necessity of adopting data-driven decision-making to optimize resource allocation and increase the availability of health goods for disadvantaged groups. This would contribute to the accomplishment of the UHC goals that have been set out (Nicola et al., 2020). In addition, Mwihia (2020) researched the practices of monitoring and assessment in a variety of healthcare settings in Kenya. The findings of the research placed a particular emphasis on the role that effective technology management plays in attaining UHC goals. The research put a large amount of emphasis on the need to make use of standardized indicators and performance measures to guarantee comparability and make the process of learning from successful tactics implemented in a variety of nations as easy as possible (Mwihia, 2020). Nsikan et al. (2022) recently performed research to investigate the effectiveness of monitoring and evaluation systems in Nigeria to monitor the

implementation of UHC policies relevant to leadership culture and health technology. Researchers looked at how data analytics, benchmarking, and performance indicators might help drive organizational reforms and bring about fair access to healthcare for all individuals (Mwihia, 2020).

2.7 Theoretical Framework

This research is grounded in a theoretical perspective related to identifying and mitigating issues that are affecting the management of health products and technologies in advancing UHC.

2.7.1 Utilization management theory

Utilization management theory was invented in the 20th Century by Avedis Donabedian (Khan & Khayal, 2022) and has for decades been used across healthcare settings to improve the quality of healthcare services through the provision of health products and technologies across medical facilities. The theory emphasizes the essence of efficiency, medical necessity, and appropriateness during application and the management of health products and technologies in the delivery of medical services (Hays et al., 2020). The theory further uses or implements procedures that are run by purchasers of medical products and technologies, and other affiliates such as supply chain managers, procurement officers, and logistics personnel rather than by doctors, and medical staff (Jacobs, 2018). The utilization management theory is imperative in the evaluation and mitigation of various factors affecting the management of health products and technologies in the delivery of health services. The theory emphasizes the various techniques and procedures that allow health care managers and affiliates, including health insurance companies, to effectively manage the costs of health care benefits. This is achievable through assessing the appropriateness of aspects such as health products and technologies to medical care, for advancing universal health coverage. The theory is therefore important in ensuring that health products and technologies across the healthcare setting are competently managed for quality healthcare service delivery. Critics have argued that cutting costs

management of health products and technologies during delivery of medical services through the implementation of the Utilization Management theory would lead to healthcare rationing (Ali & Watson, 2019). The health care rationing would be experienced due to overzealous denial of health care and as well retrospective delays in health care services, denial during payments, and unexpected financial crises that may arise during management of health products and technologies (Schleipman, 2017).

The strength of the theory towards achieving management of health products and technologies is that medical officers and health care workers can concentrate on imperative matters such as; therapeutic interventions and thereby leaving duties such as management of the HPTs to other qualified personnel who are competent in ensuring delivery and supply of health products and technologies from suppliers to health care facilities across the given region. The utilization management theory has three various types of reviews that include concurrent review, prospective review, and retrospective review whose structures are comparable to the Donabedian model of medical care (Santry et al., 2020). Each kind of review of the theory is imperative towards achieving competent management of health products and technologies across the health care setting (Fatima, 2018; Santry et al., 2020). The utilization management theory has been proved to be imperative across management of health products and technologies due to its effectiveness during experimental treatments. Studies of health products, and harmful treatments using various health products and technologies can be stopped through the implementation of the theory. Costs affiliated with the management of health products and technologies can be compared to the savings made, and thereby evaluating the cost incurred during their management, and finally, the theory supports health insurance companies that also play role in the supply and delivery of health products and technologies across health care facilities (Fatima, 2018). As such, the theory ensures that health care administrators can reduce the costs of supplying and

delivering health products and technologies from suppliers through interim storage facilities to the health care facilities.

However, the utilization management theory has various weaknesses. It has received criticism despite the various strengths affiliated with the management of health products and technologies during the delivery of quality health care services. The theory has thereby been criticized for attributing treating costs as outcome metrics and thereby confusing the outlined objectives across health care facilities (Schmutz et al., 2019). This also reduces the potential healthcare value due to the mixing up of healthcare processes during the management of health products and technologies. The weaknesses of the theory have been supported by examples whereby some authors have depicted that while cost cutting is the main goal of the theory, during delivery of medical care services, this has led to the overzealous denial of health care and denial of payment during delivery and supply of health products and services to patients (Ali & Watson, 2019). As such, implementing the utilization management theory in health products and technologies management during the delivery of health services would lead to delays in medical care services, financial risks among patients and thereby reducing the effectiveness of managing health products and technologies. Implementing the utilization management theory in ensuring the management of health products and technologies during the delivery of medical services is beneficial to all the stakeholders including patients, health workers, and supply chain organizations. Patients can get lower costs of quality medical services, healthcare providers can effectively deliver therapeutic interventions using appropriate health products and technologies that would be readily available, and other players such as insurers would get lower costs claims and better data during the evaluation of management of health products and technologies from the medical facilities.

2.7.2 Goldratt's Theory of Constraints

Eliyahu M. Goldratt developed the Theory of Constraints (TOC) in 2005 (Cox & Boyd, 2020), building on earlier works such as Mewes (1963), who emphasized bottlenecks as the main cause of inefficiency in organizational processes (Aineah Apwoka, 2018). TOC is grounded in the principle that every system, regardless of its complexity, has at least one limiting factor or "constraint" that prevents it from achieving its maximum potential. Improvement, therefore, requires identifying and addressing that constraint, since optimizing non-constraints has minimal impact on overall system performance (Goldratt, 2004). In practice, TOC follows five key steps: (1) identifying the system's constraint, (2) deciding how best to exploit the constraint, (3) subordinating all other processes to support that decision, (4) elevating the performance of the constraint, and (5) revisiting the process continuously to identify new constraints as systems evolve (Cox & Boyd, 2020).

In the context of healthcare and HPT management, TOC is particularly relevant because hospitals and health systems often face systemic bottlenecks that hinder the efficient availability and distribution of essential commodities. For example, stockouts of medicines may result not from a complete lack of funding, but from delays in procurement processes, limited storage capacity, or weak record-keeping systems. By applying TOC, managers can identify which of these factors is the "weakest link" and focus improvement efforts accordingly. Singh and Misra (2018) demonstrated that applying TOC in health supply chains—such as improving lead times, reducing replenishment cycles, and addressing late deliveries—can significantly improve the flow of essential health products. Furthermore, TOC aligns with the need for health systems to prioritize critical interventions, especially in resource-constrained settings, by ensuring that scarce resources are directed toward overcoming the most impactful limitations.

In Kenya's public healthcare system, TOC provides a useful lens for addressing chronic inefficiencies in HPT management. For instance, challenges such as delayed disbursement of funds, reliance on a

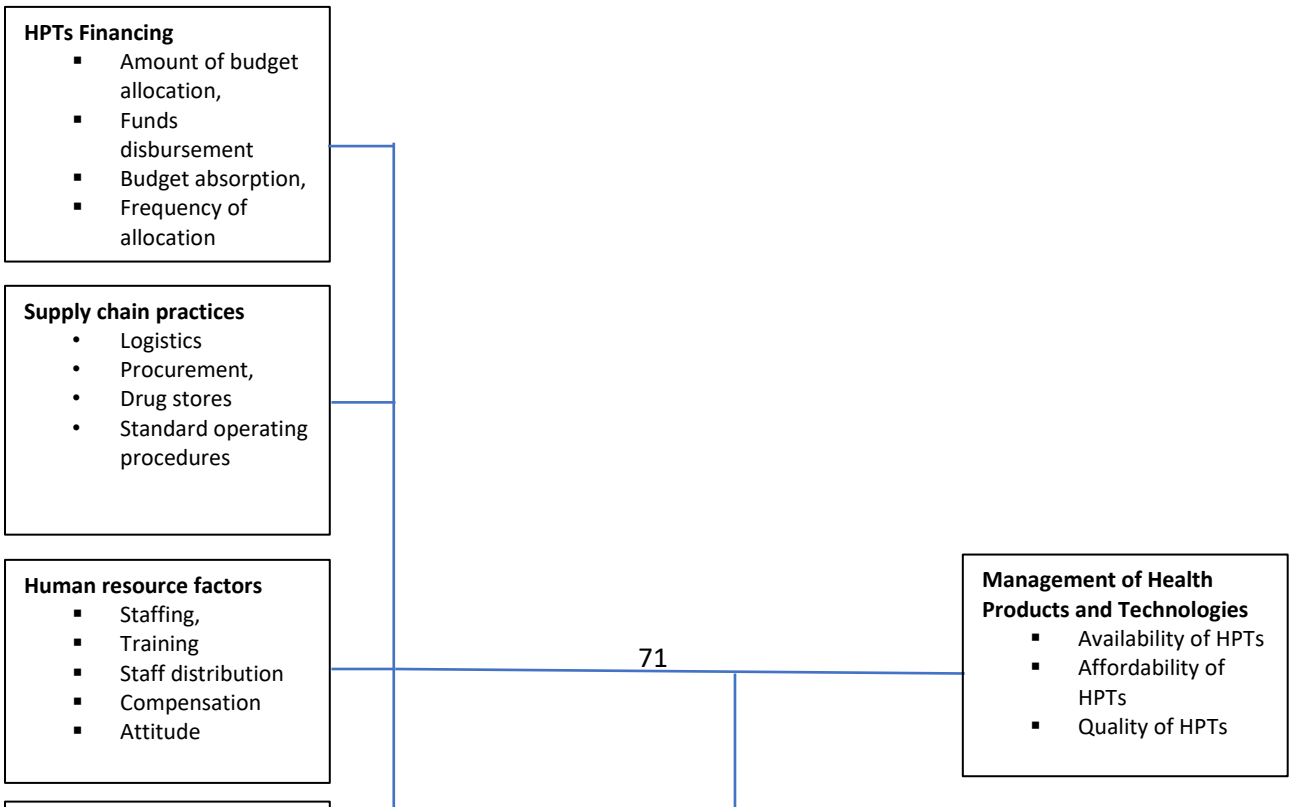
single supplier (KEMSA), and poor last-mile distribution are often more restrictive than the availability of commodities at the national level. Applying TOC would mean focusing on these systemic bottlenecks to unlock improvements across the entire supply chain. Moreover, constraints such as inadequate ICT infrastructure for inventory visibility, weak staff training, and insufficient storage facilities also represent practical limitations that, if resolved, could dramatically improve HPT management outcomes. In this way, TOC goes beyond theoretical abstraction to provide actionable strategies for health system strengthening, enabling better availability, reduced waste, and improved efficiency in the management of essential medical products and technologies.

2.8 Conceptual Framework

The conceptual framework aids the researcher in comprehending the relationships between the theories that explain the phenomenon. By organizing key concepts and variables, it shows the relationships between independent and dependent variables graphically.

Figure 6

The illustration of the proposed model for the management of HPTs



CHAPTER THREE

RESEARCH METHODOLOGY

This chapter explains the research methodologies that were used to carry out the investigation. The study environment, research paradigm, research design, target population, sample size estimation and sampling methods, data gathering tools, data collection methods, data analysis methods, and ethical issues are the eight subheadings that make up this chapter.

3.1 Study Site

The study was conducted in four counties of Isiolo, Kisumu, Machakos and Nyeri due to their involvement in the UHC pilot program and their diverse health system structures, which provide a suitable context for assessing HPT management practices across different county settings. (Nzwili, 2018). Kiambu County, located in central Kenya, is one of the most densely populated counties in the country. According to the 2019 Kenya Population and Housing Census, Kiambu had a population of approximately 2.4 million people, with an annual growth rate of 2.81%. The county has a relatively young population, with a significant proportion being under the age of 30. The county is highly urbanized due to its proximity to Nairobi, Kenya's capital. The county hosts several urban centers such as Thika, Ruiru, Kikuyu, and Limuru. Life expectancy in Kiambu is around 67 years, slightly higher than the national average. The county's maternal mortality rate is lower than the national average, but challenges such as non-communicable diseases (NCDs), infectious diseases, and malnutrition remain significant (Kenya National Bureau of Statistics, 2019).

Health products and technologies in Kiambu include essential medicines, medical supplies, and diagnostic tools. The supply chain for these products is primarily managed by the Kenya Medical Supplies Agency (KEMSA), which delivers essential medicines and medical supplies to public health

facilities. However, challenges such as stock-outs of essential drugs, delays in supply, and inadequate access to specialized medical equipment remain common in the public sector. Rural areas often face more significant shortages than urban centers. The county has also made efforts to improve access to vaccines, antiretroviral drugs, and malaria treatments, but disparities in distribution persist (MOH, 2020).

Public health facilities offer subsidized or free essential medicines and technologies for primary healthcare, but limited resources mean that some products are unavailable or require out-of-pocket payments. The County government covers the cost of certain essential medicines, vaccines, and treatments in public health facilities. However, patients often face additional costs for diagnostic services or when certain medicines are out of stock. As part of Kenya's UHC agenda, Kiambu County has been working to improve access to affordable healthcare, which includes ensuring the availability of essential medicines at public health facilities. The county has started implementing digital health management systems to enhance the tracking of medical supplies and improve efficiency in public health facilities.

Kisumu County is in Nyanza and is home to a population of approximately 1.15 million people (2019 census). The county's population is predominantly rural, though it is also the region's main urban and commercial hub due to Kisumu City. Kisumu has a high poverty rate, with over 47% of the population living below the poverty line. The county's infant mortality rate is higher than the national average, largely due to malnutrition, malaria, and HIV/AIDS. The prevalence of HIV is particularly high, with Kisumu being one of the hardest-hit counties in Kenya (MOH, 2020)

Health products and technologies are distributed through both public and private health facilities. Public health facilities rely on KEMSA for essential medicines and medical supplies. However, frequent stock-outs, especially of antimalarial drugs and antiretroviral therapy (ART) drugs, are common. The quality of health products varies between public and private facilities. Public health

services are often limited by aging infrastructure and equipment, while private facilities in Kisumu City have better resources. However, rural areas are often underserved in terms of both product availability and quality. In public health facilities, essential medicines and treatments, including ART and malaria treatments, are subsidized or offered for free through donor supported by the donors. Private facilities, however, charge market rates, making affordability a significant barrier for many people in the county. Some of the key challenges facing the county includes high burden of infectious diseases like malaria and HIV, frequent stock-outs of essential medicines and Inadequate health infrastructure in rural areas.

Machakos is in eastern Kenya, with a population of about 1.42 million (2019 census). It is an agricultural and industrial hub, characterized by a blend of urban and rural populations. The county has a high literacy rate compared to the national average, contributing to better healthcare awareness. Machakos has relatively low maternal and infant mortality rates compared to many other counties in Kenya, though the region struggles with rising cases of non-communicable diseases (NCDs), such as hypertension and diabetes (MOH,2020).

Machakos has a network of public and private health facilities, with the public sector relying on KEMSA for supplies. While the urban centers are relatively well-served, rural areas still face periodic shortages of essential medicines, such as antibiotics and vaccines.

Public health facilities are generally equipped with essential medicines but lack advanced medical technologies. The quality of health services in remote areas can be substandard due to poor infrastructure, unavailability of essential medical commodities, and insufficient staff.

Public health services offer free or low-cost primary care, including immunizations and maternal healthcare, but some specialized treatments and diagnostics require out-of-pocket payments. Machakos County faces challenges of inadequate health infrastructure in rural areas rising burden of NCDs, particularly hypertension and diabetes.

Isiolo County, located in northern Kenya, has a smaller population of about 268,000 (2019 census). The county is largely arid and sparsely populated, with a nomadic lifestyle characterizing much of the population. Poverty levels are high, with over 60% of residents living below the poverty line. Isiolo has some of the highest maternal and infant mortality rates in the country. The county also faces high rates of malnutrition, waterborne diseases, and occasional outbreaks of diseases like cholera due to poor sanitation (MOH, 2020).

The availability of health products and technologies is a significant challenge in Isiolo. The county depends heavily on the national supply chain through KEMSA, but logistical challenges and poor road infrastructure often lead to stock-outs, especially in remote areas. Essential vaccines and medications, such as antimalarial drugs, are often in short supply. The public healthcare infrastructure is underdeveloped, and many health facilities lack basic equipment and qualified staff. Public health services are heavily subsidized, but even with free or low-cost services, many residents face access challenges due to distance, stock-outs, and informal charges. Out-of-pocket costs can be significant for specialized services, which are often only available in larger towns like Isiolo (County Government of Isiolo, 2018).

Nyeri County is in central Kenya and has a population of approximately 759,000 (2019 census). The county is known for its relatively high-income levels and high literacy rates. It has a predominantly rural population, with agriculture being the main economic activity. Nyeri has relatively low maternal and infant mortality rates, but it has a high prevalence of NCDs, especially cancer and diabetes, compared to the national average (MOH, 2020)

Nyeri County benefits from a relatively efficient supply chain due to its proximity to Nairobi. Public health facilities receive regular supplies from KEMSA, and the region is better served than many other counties in terms of access to essential medicines and vaccines.

Public healthcare services are relatively well-equipped with essential medicines and diagnostic tools.

Main challenges facing the health system in Nyeri county is the high burden of Non-Communicable Diseases such as Cancer and Diabetes and the cost of specialized care, particularly for NCDs, which remains a challenge although public health facilities provide free primary healthcare services, (County Government of Nyeri, 2018).

The management of health products and technologies in Kisumu, Kiambu, Machakos, Nyeri and Isiolo, counties are influenced by the unique demographic, geographic, and economic characteristics of each region. While urbanized counties like Nyeri, Kiambu and Machakos have relatively better healthcare infrastructure and access to quality health products, rural and arid counties like Isiolo face significant challenges in availability, quality, and affordability. Addressing these disparities will require continued efforts in improving supply chain management practices, health information management systems, inventory management, human resource factors and health financing.

The management of health products and technologies in selected counties reflects the broader challenges faced by Kenya's healthcare system. While there are efforts to improve the availability, quality, and affordability of Health products and technologies through government initiatives, disparities between urban and rural areas in the public health system persist. Addressing these challenges requires continued investment in supply chain management, infrastructure, and regulatory enforcement. Nairobi City County Government, despite receiving the lion’s share of the health sector budget, level 4 and 5 hospitals have been faced with chronic shortages and out of stock of essential medications affecting service delivery.

3.2 Research Philosophy

Research Philosophy or paradigm refers to a set of beliefs or philosophical assumptions about how data regarding a phenomenon should be collected and analyzed (Rahi, 2017). Further, Tamene (2016) The research paradigm is a set of generations of knowledge or worldviews that guide the researcher when conducting a study. The research was anchored on the Pragmatism paradigm because it is

basically based on the existing body of knowledge that is fixed, observable and objective as well as multiple, socially constructed by individuals. Pragmatists believe that the nature of knowledge is both quantifiable (objective knowledge) using scientific research as well as gained through in-depth understanding (Park et al., 2020). Pragmatist's beliefs are both single and multiple. Pragmatism is the result of combining the positivism and interpretivism principles. The usage of a mixed method approach was chosen because it provides more detailed information about respondents' perceptions while still ensuring high levels of data dependability. In terms of quantitative methods, a descriptive cross-sectional research design was used because fact-finding investigations were conducted with a focus on describing the situation on the ground and quantifying and predicting outcomes, whereas qualitative methods provided insight and understanding of the phenomena under investigation through an exploratory research design. Additionally, the pragmatism philosophy minimizes the weakness of positivism philosophy which sometimes does not provide in-depth data and the interpretivism paradigm does not provide numerical data for the statistical conclusion (Ryan, 2018). Hence, debated providing data that is not representative enough and information-rich for hypotheses testing (Corry et al., 2019).

3.3 Research design

A descriptive cross-sectional research design and interviews, both anchored by the pragmatism paradigm, were used in the study. The use of survey design aids in gathering information that addresses who, what, when, where, and how of a specific research topic, whereas the use of exploratory design resulted in a deeper understanding of the research problem (Omware et al., 2020). Because HPTs management can be monitored at both hospital and staff capacities, which can readily be described and provide a wealth of information, this research design was primarily deemed to be excellent for the current study. Consequently, since the two approaches are complementary, they were used to strengthen the study's findings.

3.4 Operationalization Framework

Operational framework is an arrangement of variables that the researcher operationalizes to carry out the study objectively (Mugenda & Mugenda, 2003). HPTs financing was measured in terms of budgetary allocation, frequency of budget disbursement, rate of budget absorption, sources of funding and budgeting process. Supply chain practices were operationalized in terms of pipeline monitoring, procurement processes, warehouses/drug stores, and standard operating procedures. Human resource factors were measured by staffing levels, training of staff dedicated to management of HPTs, support supervision, compensation, and staff attitude. Inventory optimization was assessed using ABC analysis, First-Expiry-First-Out (FEFO), economic order quantity, Just-in-Time, and safety stock policy record keeping. Health management information systems were operationalized in relation to deployment of HMIS, application (usage), ICT infrastructure, and data quality. The moderating variable, institutional leadership culture, was measured through communication culture, planning culture, monitoring and evaluation, motivation culture, and institutional policies. The dependent variable, management of HPTs, was measured in terms of availability, quality, and affordability of essential health products and technologies in the health facilities, as shown in Table 1.

Table 3.1

Variables

Variable	Indicators
Independent Variables	
HPTs Financing	Budgetary allocation, Frequency of disbursement, Rate of absorption, Sources of funding, Budgeting process
Supply Chain Practices	Logistics, Procurement, Warehouses/Drug stores, Standard Operating Procedures
Human Resource Factors	Staffing levels, Training, Staff distribution, Compensation, Attitude
Inventory Optimization	ABC Analysis, First-Expiry-First-Out (FEFO), Safety Stock Policy & Record Keeping, Economic Order Quantity, Just-in-Time
Health Management Information System	Deployment of HMIS, Application of HMIS, ICT infrastructure, Data Quality, System Suitability
Moderating Variable	
Institutional Leadership Culture	Communication culture, Planning culture, Monitoring and evaluation, Motivation culture, Institutional policies
Dependent Variable	
Management of HPTs	Availability of HPTs, Affordability of HPTs, Quality of HPTs

3.5 Target population

The target population is typically a collection of individuals or entities possessing certain characteristics relevant to the phenomenon being studied (Elfil & Negida, 2017). The target population comprised staff directly involved in the management of health products and technologies (HPTs) at the service delivery point in level 4 and level 5 public health facilities in Kisumu, Nyeri, Isiolo, Kiambu, and Machakos Counties. The counties were purposely selected based on the Universal Health Coverage (UHC) pilot implementation as well as their epidemiological and demographic profiles. In addition, members of the County Health Management Team (CHMT) were included as key informants. Specifically, these comprised the County Pharmacist, County Medical Supplies Coordinator, County Health Records and Information Officer, and the County Director of Health (or their designated representative). Their inclusion was justified because they are directly responsible for policy interpretation, oversight of HPT management, coordination of supply chains, and ensuring data-driven decision-making in county health systems.

Table 3.2

Target Population

County	Level 4 Hospitals	Level 5 Hospitals	Target Hospital Populace	Key Informants (CHMT)	Total Target Population
Nyeri	8	1	27	2	29
Isiolo	2	1	9	2	11
Machakos	10	1	33	2	35
Kisumu	9	1	30	2	32
Kiambu	13	1	42	2	44

Total	**42**	**5**	**141**	**10**	**151**

Source: MOH (2020)

3.6 Sample size

The study obtained 141 staff for quantitative study and two Key Informants for qualitative study purposely selected from each of the five counties giving a total of ten (10). The selection of two key informants per county was guided by the need to balance adequate representation of county-level perspectives while ensuring feasibility and depth of inquiry. Specifically, one informant was drawn from the pharmaceutical/medical supplies unit, while the other was drawn from the health records or policy/management unit, thus providing complementary insights on both technical and administrative aspects of HPT management. This purposive approach allowed triangulation of information without overextending the scope of the study.

3.7 Sampling techniques

A portion of the population chosen to reflect the greater population is referred to as a "sample" (Levy & Goldfarb, 2021). Since it is not feasible to investigate the entire population, a representative sample is selected to enable generalization of findings (Yarkoni, 2020). The representativeness of the sample is influenced by the sampling strategy, sample size, and response rate (Oribhabor & Anyanwu, 2019). The sample size must be sufficient to allow reliable inferences, and the sampling design should be systematic and well-defined. Sampling design effectiveness is determined by how well it captures the characteristics of the target population (Odhiambo et al., 2018).

The study employed a census method to include all 141 staff respondents, since the population size was relatively small and manageable. Using a census ensured comprehensive coverage and minimized sampling error. The key informants were selected purposively from each county.

Inclusion criteria:

- Staff directly involved in the management of HPTs at level 4 and 5 facilities.

- Staff who had worked in the respective departments for at least one year, ensuring familiarity with HPT management processes.
- CHMT members with direct oversight responsibilities for HPTs, such as pharmacists, medical supplies coordinators, health records officers, and county directors of health.

Exclusion criteria:

I. Newly recruited staff with less than one year of service in HPT-related roles.

II. Staff on long-term leave (e.g., study leave, maternity leave, or medical leave) during the study period.

III. Administrative staff not directly engaged in HPT management.

3.8 Data collection instruments

Data collection is gathering data from the selected subjects of an investigation to test research Hypotheses (Pandey & Pandey, 2021). The quality of information gathered depends on the data collection tools and methods employed (Gatuyu & Kinyua, 2020).

3.8.1 Interview schedules

The study employed survey questionnaires with two main sections: one that gathered data on respondent profiles, which was used to describe the characteristics of the sample, and the other gathered data on study variables, which had six subsections to ensure validity and used to both describe the study's components and test the hypotheses. Structured questionnaires were administered to healthcare managers, procurement officers, supply chain coordinators, and key administrative staff. The questionnaire will be divided into sections measuring: Independent variables (health financing, supply chain practices, inventory optimization, HR factors, and information management), Mediating variable (leadership culture) and Dependent variable (HPT management outcomes

The semi structured questionnaire, which was developed by objectives and study hypotheses, contained both closed-ended and open-ended items. Open-ended questions were used to collect data without probing and provided respondents with the freedom to express their opinions more practically while also offering insightful comprehension of the phenomena being studied. Due to their quick coding and transcription, low response variability, and high response rate, closed-ended questions were utilized to restrict the respondents. Because it is a quick and effective way to acquire information, the survey questionnaire is considered appropriate for this study (Krosnick, 2018).

3.8.2 Key Informant Interview Guide

A Key informant interview guide was used to obtain qualitative data from the County health Management team. The guide was designed based on the study objectives and other thematic areas to acquire information-rich data. The respondents were provided with online interview guides which they filled in the presence of the researcher who provided any clarification that was sought.

3.9 Data collection procedures

The researcher sought and got approval from Kenya Methodist University ethics and review committee and the National Commission for Science, Technology, and Innovations before starting data gathering (NACOSTI). The researcher also sought and got approvals to conduct research from each of the five counties. Prior to data collection, the research assistants who were the interviewers received thorough training on data collecting, study objectives, and principles. Interviewers administered data gathering instruments (Sileyew, 2019).

3.10 Pretest of the instruments

A pretest study is a small-scale test run conducted in advance of a larger investigation (Truong, 2017). Validity and reliability of interview schedules are not determined by pretesting; rather, enhances or improves validity and reliability (Mbugua & Omagwa, 2017). To assure the accuracy of pretesting

study, a 1 to 10 % sample size is acceptable. The study pre-tested the data collection tools on 12 respondents comprising of 10 staff and 2 KII at Kajiado County. The ten respondents were selected from the five level 4 and 5 hospitals namely Kajiado County Referral Hospital, Ngong Sub County Hospital, Ongata Rongai Sub County Hospital, Kitengela Sub County Hospital and Loitoktok Sub County Hospital while the two KII were the County Pharmacist and County Director for Health. Kajiado County has similar characteristics in demographics and relations to HPTs management with Kiambu, Machakos, Nyeri, Isiolo and Kisumu counties such representing both rural and urban settings. There was an active involvement of the first authors; supervisors during enhancement of the data collection tools after pre-testing to guarantee that the actual study captured valid, reliable and error-free data.

3.10.1 Instrument Validity

Validity refers to how well an instrument accomplishes "what it is supposed to measure" or "what it purports to measure," i.e., how well the instrument can be applied to addressing the study's purpose(s) and research hypotheses (Mueller & Knapp, 2018). According to Grégis (2019), the test's validity is how well it measures the things it purports to be measuring, giving assurance that the measure is accomplishing its goals. In this inquiry, both construct validity and content validity were applied. To ensure that each team assessed data for a specific goal and that there were the same close links to the conceptual framework for this study, the questionnaire was separated into numerous sections. Further, the questionnaire was thoroughly examined. The respondents assessed the measuring questions in the questionnaire to determine their relevance and whether they are disagreeable, meaningful, and transparent, all to enhance construct validity (Kothari et al., 2020).

Additionally, the study conducted content validity through SPSS to check whether the tools would collect valid data. Content validity ration of the scale was analyzed using Lawshe expert evaluation method.

Table 1.4

Content Validity Results

Variable	Number of items	Scale- Based Content Validity Ratio (CVR)
HPTs Financing	15	0.56
Supply chain practices	15	0.73
Human resources practices	15	0.53
Inventory optimization	15	0.76
Health Management Information System	15	0.78
Institutional leadership		0.77
Management of Health Products and Technologies		0.70

The study found that the scale would collect valid data. Based on S-CVI, supply chain practices (0.73), Inventory optimization (0.76), Health Management I formation System (0.78), institutional leadership (0.77) and the measure variable of HPTs management (0.70), majority of items were considered relevant by the experts because they provided index equal or greater than 0.7, suggesting that the items adequately captured the construct of interest (Sürücü & Maslakci, 2020). Nonetheless, An S-CVI of 0.56 on financing and 0.53 on human resources practices indicated a moderate level of content validity for the overall scale. The study focused on revising and clarifying the statements with low CVIs. This involved re-wording the items and gathering more experts feedback to ensure they accurately reflect the constructs being measured. The study then conducted another round of expert review analysis after making scale refinement to enhance consensus on the relevance of the statements.

The instrument was appropriately modified before the actual data collection activity based on the evaluation. The participant comments were examined to make sure that the validity of the information is increased.

3.10.2 Instrument Reliability

Reliability is the consistency of results that the same person would obtain if they took the test repeatedly, in different contexts, on other forms, for different items, or with different rates (Mueller & Knapp, 2019). Reliability promotes openness, lessens the possibility of prejudice, and has additional advantages to give neutrality and credibility (Mohajan, 2017).

Internal consistency assesses correlations between items on the same test (or the same subscale on a bigger exam) and establishes whether scores from many questions that assess the same fundamental construct are similar (Kothari et al., 2020). The internal consistency of the questionnaire constructs was checked using Cronbach's alpha, and the reliability coefficient of the measures was assessed. The scale value of the Cronbach's coefficient alpha (r) lies between -1 and +1. The research relied on the following generalizations: $r>0.6$ = Doubtful, $r>0.7$ = Acceptable, $r>0.8$ = Good; and $r>0.9$ = Excellent (Adeniran, 2019).

3.11 Diagnostic Tests

Williams and Albers (2019) advocate the utilization of diagnostics to help in assessing the validity and reliability of an official outcome to address various types of prejudice which may occur in research. Before doing an inferential statistical analysis, diagnostic tests make sure that no assumptions have been broken. According to Arru (2020), most inferential statistical techniques, including bivariate correlational analysis, multiple regression analysis, and Chi-square tests for independence are impervious to assumptions that are broken.

3.11.1 Testing of Normality

To determine whether the score distribution of the dependent variable is regularly distributed or not, normality tests are utilized (Mishra et al., 2019). The results of a normality test offer support or a framework for choosing between parametric and non-parametric methods for statistical analysis. To determine if the scores on the dependent variable are regularly distributed, the researcher used the Kolmogorov-Smirnov statistic. If the significance value [Sig-Value] is more than or equal to 0.05, the results were judged non-significant. This result implies that the dependent variable's scores are regularly distributed, whereas a significance value of 0.05 or less implied that the dependent variable's distribution does not adhere to the assumption of normality.

3.11.2 Homoscedasticity

The mistakes that are independently identically distributed is one of the basic tenets of a linear model (i.i.d.). Particularly, the errors are homoscedastic when they are i.i.d. The mistakes are said to as heteroscedastic if they are not i.i.d. and are expected to have distributions with various variances (Lee, 2020). If heteroscedasticity mistakes are not effectively managed, they can result in incorrect statistical results (Chown & Müller, 2018). When heteroscedasticity is tested, the ability of the regression model to accurately predict the dependent variable throughout the range of values for all explanatory factors is evaluated (Westman, 2021). Homoscedasticity analysis will be used through a visual inspection of both the standardized residuals to determine whether the connection under consideration is the same throughout the whole spectrum of the dependent variable. Whenever a frequency distribution of the normalized predicted dependent parameter is regressed against the regression line in a scatter plot, a randomized pattern across the whole range of the dependent variable should appear (Daryanto, 2020). The homoscedasticity test was performed using a scatter plot.

3.11.3 Autocorrelation Testing

Because regression analysis depends on the assumption of autocorrelation, it is deemed unreliable and cannot be used to estimate population parameters if this assumption is violated (Knief & Forstmeier, 2021). There is no correlation between the succeeding disturbances because, in accordance with the assumptions provided by the linear regression model, the random error components are equal and independently distributed. The Durbin-Watson (DW) statistic was used to examine the autocorrelation based on residuals. Values for the test statistic fall between 0 and 4. When the statistic value is 4, negative autocorrelation is assumed to exist, while 0 and 2 indicate no autocorrelation (Islam & Erum, 2019; Desviona & Yanuar, 2020; Turner, 2020). However, the model can be altered when autocorrelation occurs to create a new, serially independent model that includes the error term.

3.11.4 Multicollinearity and Singularity

Multicollinearity is the term used to describe the connections between independent variables. Multicollinearity occurs when the correlation coefficient between the independent variables is r=.9 or greater. When a single independent variable includes a sizable number of other independent variables, this is known as the singularity. To determine if independent variables are multicollinear, the researcher applied the Tolerance and Variance Inflation Factor (VIF). The amount of the specified independent variable's variability that cannot be explained by the other independent variables in the model is referred to as tolerance. It was calculated using formula 1-R squared for each variable. The numerous correlations with other variables are significant if this value is low (below.10), which suggests that multicollinearity is likely. On the other hand, the Variance Inflation Factor (VIF) is simply the Tolerance Value's inverse (1 divided by Tolerance). If the VIF readings are larger than 10, which suggests multicollinearity, there would be an issue.

3.12 Data Analysis Techniques

Data processing refers to summarizing data in questionnaires or interview guides in a manageable and consumable manner through data handling, data manipulation, data processing, and interpretation

(Sharma et al., 2021). The study's objectives, the measurement scale and the type of data collected, guide the data analysis process which can be quantitatively or qualitatively (Meaza, 2019).

3.12.1 Quantitative Data Management

Statistical program for social sciences (SPSS) window version 25 was used to construct a data file from the numerical information gathered from the field via interview schedules. The researcher then checked the data for flaws, cleaned it up, and performed a preliminary analysis to see if the statistical techniques' underlying assumptions were violated. Descriptive and inferential statistics were employed in the analysis to meet the goals of the study. By using one number to represent a group of numbers, descriptive statistics like frequency, percentages, mean, and standard deviation were utilized to describe and summarize the data. Descriptive statistics analysis answered some research questions while inferential statistics draws conclusions and predictions about a population based on the sample data. Inferential statistics allowed the researcher to test hypotheses helping in generalization. The study findings were presented using frequency tables and charts. The inferential statistical techniques: correctional analysis and hierarchical multiple regression analysis were applied. The independent variables were introduced into the equation in the hierarchy determined by the researcher based on theoretical considerations in hierarchical multiple regression. Steps (blocks) of variables are entered, and once the previous variables have been considered, each independent variable is evaluated in terms of the contribution it makes to the prediction of the dependent variable. the proportionate contribution follows. The R-squared value for the block 1 model was examined. Each independent variable's individual contribution to the overall variations expected was made. Analyzing and interpreting the results of the Analysis of Variance (ANOVA) determined whether the model is statistically significant.

$$Y = \beta 0 + \beta\ 1X1 + \beta\ 2X2 + \beta\ 3X3 + \beta\ 4X4 + \beta\ 5X5 + \beta\ 6X6 + e \ldots$$

Where:

Y = Management of HPTs

{β i; i=1,2,3,4, 5,6 The} = The coefficients for the independent variable components

Xi for:

X1 = HPT s financing (predictor variable)

X2 = Supply chain practices (predictor variable)

X3 = Human resource factors (predictor variable)

X4 = Inventory optimization (predictor variable)

X5 = Health Information Management System (predictor variable)

X6 = Institutional leadership culture (Moderating variable)

e is the error term which is assumed to be normally distributed with mean zero and constant variance.

3.12.2 Hypothesis Testing

A hypothesis is a plausible assertion that a link exists between two variables or that there are differences between them (Pandey & Pandey, 2021). To effectively organize the study effort, a good hypothesis must meet specific criteria (Loannidou & Erduran, 2021).

Therefore, a hypothesis is put out for acceptance or rejection in quantitative research. A null hypothesis (H0) and an alternative hypothesis (Ha), which can be directional or non-directional, make up a hypothesis test (Wu, 2017). Depending on whether the p-value is below the significance level (), we either reject or fail to reject the null hypothesis. The likelihood of rejecting the null hypothesis if it is accurate is known as a Type I error rate. It is on par with the level of significance. The likelihood of failing to reject the null hypothesis as being incorrect is known as the Type II error rate. Power, which is equal to 1 less the likelihood of a Type II error, is the probability of correctly rejecting the null hypothesis when the alternative hypothesis is true.

Table 3.5

Hypotheses testing summary table

Null Hypothesis (H0)	Alternative Hypothesis (Ha)	Test	Decision Rule
H01: HPTs financing has no statistically significant influence on management of HPTs	$\beta 1 \neq 0$	F-test / ANOVA to assess model significance	Reject H0 if p-value ≤ 0.05; otherwise, fail to reject H0
H02: Supply chain practices have no statistically significant influence on management of HPTs	$\beta 2 \neq 0$	F-test / ANOVA to assess model significance	Reject H0 if p-value ≤ 0.05; otherwise, fail to reject H0
H03: Human resource factors have no statistically significant influence on management of HPTs	$\beta 3 \neq 0$	F-test / ANOVA to assess model significance	Reject H0 if p-value ≤ 0.05; otherwise, fail to reject H0
H04: Inventory optimization has no statistically significant influence on management of HPTs	$\beta 4 \neq 0$	F-test / ANOVA to assess model significance	Reject H0 if p-value ≤ 0.05; otherwise, fail to reject H0
H05: Health Information Management System has no statistically significant influence on management of HPTs	$\beta 5 \neq 0$	F-test / ANOVA to assess model significance	Reject H0 if p-value ≤ 0.05; otherwise, fail to reject H0
H06: Institutional leadership culture has no statistically significant moderating effect on management of HPTs	$\beta 6 \neq 0$	F-test / ANOVA to assess model significance	Reject H0 if p-value ≤ 0.05; otherwise, fail to reject H0

3.12.3 Qualitative Data Management

The information from the key informant interview guides was thematically examined. The study objectives served as the basis for developing the themes. Based on the goals of the study, the findings were given to triangulate the quantitative data.

3.13 Ethical issues and considerations

Ethics are a set of conduct or principles that the researcher should obey when conducting the research (Mugenda & Mugenda, 2012). Regarding beneficence, the study will benefit county government, the national government, and future scope; hence the studies are about doing well and not for self-gain. The study ensured no harm to any respondent; emotionally, socially, or physiologically or expose them to unnecessary risk(s). The researcher treated anyone participating in the study fairly and equally with veracity. Although respondents were given data collection participation consent, they still had freedom and right not to respond to certain questions; hence participants' privacy was protected. Additionally, the researcher obtained data collection letter from Kenya Methodist University and research permit from National Commission for Science Technology and Innovation and authorization letter from each county before actual data collection exercise.

CHAPTER FOUR

RESULTS AND DISCUSSION

The chapter presents the study findings in line with the research objectives, including data analysis, interpretation, and discussion. It connects the results to previous research discussed in chapter two. The chapter covers the response rate and the reliability of data collection instruments, followed by descriptive statistics; frequencies, percentages, means, and standard deviations. Before delving into inferential statistics, diagnostic tests such as normality, autocorrelation, and multicollinearity were conducted to assess the violation of assumptions. The inferential statistics involved, Pearson Chi-square for independence, Kruskal-Willis H tests, one-way ANOVA, Pearson-product moment correlation and multiple hierarchical regression analysis, with results presented in frequency tables as well as the discussion of the findings.

4.1 Response Rate

A total of 141 structured questionnaires were distributed to the respondents using the google forms. Out of which 106 were completed, resulting to 75.2% response rate. This rate was considered adequate because the population was large (n>30). Moreover, Mongan et al. (2020) submitted that quantitative studies typically require a minimum sample size of 30 subjects. Therefore, with 106 participants responding to the study tools, the sample size exceeded this criterion, thus it was adequate for statistical data analysis. The adequacy of response rate could be attributed to the data collection procedures, in which the researcher pre-tested the tool. Further, the study used online self-administration of questionnaires which allowed adequate time with respondents to participate. Informed consent and other ethical considerations were adhered to. Nonetheless, the 25% of non-response could have been due to respondents not finding the topic relevant or lack of personal benefit in completing the survey. All the key informants participated into the study.

4.2 Reliability Test

Reliability test was undertaken by use of Cronbach's Alpha coefficient to measure the internal consistency of the constructs making up the scale.

Table 4.1

Reliability results

Variable	Cronbach's Alpha	Number of constructs	Comment
HPTs Financing	0.700	14	Reliable
Supply chain practices	0.841	16	Reliable
Human resources factors	0.775	16	Reliable
Inventory optimization	0.806	13	Reliable
Health management information system	0.915	17	Reliable
Leadership	0.828	12	Reliable
HPTs management	0.885	12	Reliable
The data collection instrument (all the constructs making up the scale)	0.941	116	Reliable and dependable

The individual variables and the overall data collection instrument demonstrated good to excellent reliability, indicating that the instrument used in the study was both reliable and dependable for capturing the intended data (r=0.935 on 100 items). This strong internal consistency across variables

supported the validity of the study's findings. The results implied that the respondents answered the questions in a similar way. The reliability results for each variable; (financing=0.700; supply=0.841; human resource factors=.775; inventory optimization=.806; health management information system=.915; leadership culture= .828; management of HPTs=0.885). According to Ingle and Mahesh (2020), a Cronbach Alpha coefficient of 0.7 and above is considered reliable and dependable.

4.3 Descriptive Statistics: Background data

Descriptive statistics: frequencies and percentages were conducted to describe the characteristics and composition of the study population.

Table 4.2

Descriptive Statistics: Background data

Variable	**Category**	**Percent (%)**
County	Kiambu	12.3
	Isiolo	13.2
	Machakos	34.9
	Kisumu	21.7
	Nyeri	17.9
Facility Level	Level 4 Subcounty Hospital	68.9
	Level 5 County Referral Hospital	31.1
Age Group	18–25	15.0
	26–35	22.7
	36–45	30.2
	46–55	21.1
	56+	11.0
Sex	Male	58.5
	Female	41.5
Education Level	Undergraduate/Diploma	73.5
	Postgraduate	25.5
Employment role	Leadership/Management	20.8
	Supply Chain/Inventory	56.0
	Human Resource/Finance	11.3

Variable	Category	Percent (%)
	Health Information	12.3
Year of employment in the section/department	<1 year	8.5
	1–5 years	46.2
	>5 years	45.2

The study observed that Machakos county had the highest representation among respondents, making up about a third of the total sample 37(34.9%), while Kiambu county 13(12.3%) and Isiolo county 14(13.2%) had the lowest representation. Most respondents work at Level 4 Subcounty Hospitals 73(68.9%), indicating that most of the data were derived from middle-level healthcare facilities. Additionally, the sample was predominantly composed of senior individuals 66(62.3%), suggesting that the insights gathered would primarily reflect the perspectives of more experienced professionals. Among respondents, majority were males 62(58.5%) compared to female respondents, 44(41.5%). Most respondents had an undergraduate degree 40(37.7%) and a diploma 38 (35.8%), with a smaller percentage having a master's degree 22(20.8%), postgraduate diploma 5(4.7%). Only one respondent holds a certificate 1(0.9%). The results indicated a high level of education among participants. Inventory Management for HPTs 30(28.3%) and Supply Chain Management 29(27.4%) roles were the most common among respondents. Leadership and Management also had a significant representation 22(20.8%), while Financing of HPTs 5(4.7%) and Human Resource Management 7(6.6%) were less represented. Nearly half of the respondents 49(46.2%) have between 1 to 5 years of work experience, suggesting a relatively young workforce. A combined 24 (45.2%) have more than 5 years of experience, indicating a balanced mix of experience levels within the sample.

The findings of the study align with previous research by Barnes (2020), which also observed that senior professionals tend to dominate in healthcare settings, contributing significantly to data collected from these environments (Barnes, 2020). While the conclusion that the workforce is relatively young

could be contested (Inastrilla, 2022). Similarly, the study's observation of high educational levels among respondents mirrors the findings of Inastrilla (2022), who noted that healthcare professionals often possess advanced qualifications. For instance, in a study by Soroya et al. (2021), it was argued that a more balanced mix of experience levels, rather than a predominance of younger professionals, is often present in healthcare settings, suggesting that the findings may not fully represent the true composition of the workforce (Soroya et al., 2021).

4.4 Descriptive Statistics Results: Study Variables

Descriptive statistic results for the study variables are provided in this section. The specific descriptive statistics analysed included frequencies, percentages, mean and standard deviation. Mean value less than three (M<3) indicated disagreement (Samejima, 2016). The mean value of three (M=3) indicated moderate agreement while, mean value greater than three (M>3) indicated positive agreement (Samejima, 2016). Further, Standard Deviation (SD) less than one confirmed less variability in the scores.

4.5 HPTs Financing and the Management of HPT in Public Hospitals in Kenya

4.5.1 Financing factors influencing the management of HPT.

The study sought the main financial factors influencing the management of HPTs in public hospitals.

Table 4.3

Financing factors influencing the management of HPT

County	Budgetary Allocation (%)	Frequency of Allocation (%)	Frequency of Disbursement (%)	Rate of Budget Absorption (%)	Total N
Kiambu	76.9	7.7	15.4	0.0	13
Isiolo	92.9	0.0	7.1	0.0	14

County	Budgetary Allocation (%)	Frequency of Allocation (%)	Frequency of Disbursement (%)	Rate of Budget Absorption (%)	Total N
Machakos	73.0	2.7	18.9	5.4	37
Kisumu	82.6	4.3	13.0	0.0	23
Nyeri	94.7	0.0	5.3	0.0	19
Total	82.1	2.8	13.2	1.9	106

Chi-Square (χ^2) = 9.183; p = 0.687

Note: Percentages represent the proportion of respondents who perceived each financing factor as critical to the management of HPTs. Key informant interviews provided qualitative insights supporting these findings.

The results indicated that across the counties, the amount of budgetary allocation was overwhelmingly perceived as the most critical factor affecting the management of HPTs, 87(82.1%). Nyeri County had the highest proportion of respondents (94.7%) citing budgetary allocation as a critical factor. Frequency of Funds Allocation was considered by only 3(2.8%) of respondents; Kiambu, Machakos, and Kisumu percentages (7.7%, 2.7%, and 4.3%, respectively). Frequency of Funds Disbursement was viewed as an important factor by 14(13.2%) of respondents, with Machakos County reporting the highest proportion (18.9%) while Nyeri County the lowest views (5.3%). Rate of Budget Absorption was considered by only 1.9% (2 out of 106) of respondents as a factor affecting HPT management. Only respondents from Machakos County identified this factor, indicating that it was not seen as a major concern in other counties. The Chi-Square test results suggested that there was no significant variation in these perceptions across the different counties, implying that these views were relatively uniform regardless of the county (χ^2= 9.183, p-value = 0.687).

During the key interviews on how financing is structured for health products and technologies, the respondents recorded that funding for HPTs comes from own source revenue, the Health Budget, as well as government disbursements. One of the officers in the interview (KI1) pointed out that:

"*… The county uses the facility improvement fund to finance health products, with funds generated at hospitals ring-fenced for use at source. Health products are financed from health budgets, own source revenue (FIFs), and county allocations. HPTs are financed through county allocations, MOH allocation for program items, and donations. HPTs are mainly for essential medicines and medical supplies, while HPTs for malaria, HIV, TB, and family planning programs are held centrally at the national government. Funding for HPTs comes from the FIF and the Health Budget, as well as own revenue and government disbursements…" (KII, Female, 001, 4th May, 2024).*

Further, interviews were conducted to assess the health financing factors influencing HPTs. Key respondent number two suggested that:

"… Factors affecting HPTs include insufficient allocated funds, pharmacy staff shortages, limited real-time visibility, difficult terrain, delays in fund disbursements, poor record-keeping practices, lack of ICT support, nomadic lifestyle, and infrastructural challenges. Expired supplies disposal and redistribution are not funded. Insufficient funding for HPTs and management systems can result in stock outs due to budget constraints…" (KII, Male, 002, 4th May, 2024).

The study established that health financing is a critical factor affecting the availability of quality and affordable health products and technologies. The results concurred with those of Shangala (2020) that, insufficient budgetary allocations significantly hindered the effective management of health projects in Nairobi City County. Similarly, in Uganda, Kiwanuka et al. (2021) observed that budgetary constraints were the primary challenge in managing health service delivery, further reinforcing the importance of adequate financial resources. However, a study by Mboera et al. (2021) in Tanzania disagreed, suggesting that while budgetary allocation is important, the frequency of funds

disbursement plays a more critical role in ensuring the timely execution of health programs, indicating that factors other than budget allocation may be more influential in some contexts (Mboera et al., 2021).

4.5.2 Frequency of Budgetary Allocation to Health Facilities

The study established how the facilities received budget allocation.

Table 4.4

Frequency of Budgetary Allocation to Health Facilities

County	Quarterly	Yearly	Half Yearly		Pearson Chi-Square	P Value
Kiambu	12(92.3%)	1(7.7%)	0(0.0%)	13		
Isiolo	6(42.9%)	7(50.0%)	1(7.1%)	14		
Machakos	30(81.1%)	5(13.5%)	2(5.4%)	37		
Kisumu	21(91.3%)	2(8.7%)	0(0.0%)	23		
Nyeri	19(100.0%)	0(0.0%)	0(0.0%)	19		
Total	88(83.0%)	15(14.2%)	3(2.8%)	106	23.346	0.003

The study found that the majority of health facilities, 88(83.0%), received their budgetary allocation on a quarterly basis, while 14.2% received it yearly, and only 2.8% received it half-yearly. The Pearson Chi-Square statistic indicated a statistically significant difference in the distribution of budgetary allocation frequencies across the counties (χ^2= 23.346; p-value = 0.003). This implied that the frequency with which health facilities received their budgetary allocation significantly varies by county. This variability suggested that some counties might have more consistent budgetary processes than others, which could impact on the management and operations of health facilities in those regions including timely procurement of HPTs.

The findings agreed to those of Nagaraj and Deepalakshmi (2020) in Nigeria that health facilities receiving quarterly allocations had better operational efficiency compared to those receiving funds less frequently. Similarly, in Ghana, Nsiah et al. (2022) observed that irregular budget disbursement led to disruptions in healthcare service delivery, aligning with the study's findings of variability in budget allocation frequencies affecting facility management (Nsiah et al., 2022). However, a study by Chilunjika et al. (2024) in Zimbabwe disagreed, arguing that while budget frequency is important, the total amount of funding received plays a more crucial role in determining the effectiveness of health facility operations, suggesting that budget consistency alone may not be sufficient to ensure optimal management (Chilunjika et al., 2024).

4.5.3 Accuracy of budget estimates for health products and technologies

Table 4.5

Confidence in the accuracy of budget estimates

County	Not Confident	Slightly Confident	Moderately Confident	Very Confident	Extremely Confident	**N**	Chi-Square	P Value
Kiambu	2(15.4%)	2(15.4%)	3(23.1%)	5(38.5%)	1(7.7%)	13		
Isiolo	3(21.4%)	4(28.6%)	5(35.7%)	1(7.1%)	1(7.1%)	14		
Machakos	6(16.2%)	9(24.3%)	19(51.4%)	3(8.1%)	0(0.0%)	37		
Kisumu	3(13.0%)	5(21.7%)	6(21.7%)	9(39.1%)	0(0.0%)	23		
Nyeri	2(10.5%)	3(15.8%)	9(47.4%)	5(26.3%)	0(0.0%)	19		
	16(15.1%)	23(21.7%)	42(39.6%)	23(21.7%)	2(1.9%)	106	20.756	0.188

The results showed how respondents from different counties rated their confidence in the accuracy of budget estimates for HPTs. The Pearson Chi-Square test assessed whether there was a statistically significant difference in confidence levels across the counties. The study revealed that majority of respondents 42(39.6%) across all counties are "Moderately Confident" in the accuracy of budget estimates for HPTs, followed by those who are "Slightly Confident" and "Very Confident." Overall, most respondents in Kiambu were either "Moderately Confident" or "Very Confident" about the accuracy of budget estimates, with fewer respondents at the extremes of confidence. In Isiolo, confidence is more evenly distributed across the lower and middle levels, with the majority being either "Moderately Confident" or "Slightly Confident." Additionally, most respondents in Machakos county were moderately confident 51.4% (19 respondents) with fewer respondents expressing either very low or very high confidence. Like Kiambu, Kisumu has a higher proportion of respondents who are "Very Confident," 39.1% (9 respondents) with no respondents feeling "Extremely Confident." In Nyeri, most respondents are "Moderately Confident," with some also being "Very Confident," 47.4% (9 respondents) and none reporting extreme confidence. Therefore, among the five counties, Kiambu and Kisumu counties have ensured accuracy of budget estimates compared to Machakos, Nyeri and Isiolo counties. The statistical analysis indicated that these variations in confidence levels across the counties were not statistically significant, suggesting that the confidence in budget estimate accuracy is consistent across regions (χ^2=20.756; P=0.188).

Most of the staff involved in the management of health products and technologies lack confidence in the accuracy of the budgetary allocation for health products and technologies. Musabi et al. (2020) found similar confidence levels in budget estimate accuracy for health products in Nakuru County, with most respondents being moderately confident. Similarly, Otieno et al, (2020) reported comparable results in Mombasa County, noting a consistent distribution of confidence across different

levels (Otieno et al., 2020). However, Kosgei (2020) presents contrasting evidence from Uasin Gishu County, where a significantly higher proportion of respondents expressed extreme confidence in budget estimate accuracy, diverging from the patterns observed in this study (Kosgei, 2020).

Table 4.6

Kruskal-Wallis H Test Results

Description	**Mean Rank Range (Counties)**	**Kruskal-Wallis H**	**P Value**
Timely disbursement of funds affects HPT management	47.78 – 72.62	9.182	0.057
Stakeholders' involvement	44.59 – 68.48	10.673	0.030
Confidence in budget estimates	45.61 – 63.46	5.883	0.208
Fairness of budget allocations	43.18 – 57.23	2.538	0.638
Budget alignment	37.86 – 61.21	6.478	0.166
Efficiency of budget absorption	43.79 – 66.08	8.425	0.077
Disbursement process vs planned timelines	27.78 – 53.18	9.148	0.057
Satisfaction with fund communication	29.82 – 63.89	15.534	0.004
Belief in health financing improvements	27.78 – 73.81	28.745	0.000

The table summarizes the results of a Kruskal-Wallis H test, a non-parametric statistical test used to compare the mean ranks between groups. The test determined if there were statistically significant mean differences between the groups by the counties. The study revealed that Kiambu county had the highest mean value in the timely disbursement of funds affecting management of health (72.62), followed by Isiolo (61.71), Machakos (48.68), Kisumu (47.78), and Nyeri (50.68). However, there

was no statistically significant difference in the perception of how timely disbursement of funds affects the management of health across the counties (Kruskal-Wallis H: 9.182, P-Value: .057).

In terms of effectiveness of stakeholders' involvement in the planning and budgeting the health, Kisumu County depicted the highest mean rank compared to other counties; Kisumu (68.48), Kiambu (60.08), Nyeri (52.42), Isiolo (47.79), Machakos (44.59). This implied that Kisumu County involve stakeholders in the planning and budgeting for health products and technologies than Kiambu county, Nyeri county, Isiolo and Machakos county. The mean rank was statistically significant difference in stakeholder involvement in the budgeting process across the counties, suggesting that the perception of stakeholder involvement varied meaningfully between the regions (Kruskal-Wallis H= 10.673, P-Value: .030).

The study observed that Kiambu county observe budget estimates accuracy (mean=63.46), followed by Kisumu (59.37), Nyeri (58.45), Machakos (46.80), while Isiolo county (45.61) had the lowest means in observing the accuracy in budget estimates. Nevertheless, the mean differences in the confidence in the accuracy of budget estimates among the counties were not significant with a p-value greater than 0.05 (Kruskal-Wallis H= 5.883, P-Value: .208).

Machakos county (57.23) had the highest means in fairness and appropriateness of budget allocations, Kiambu (57.04), Kisumu (52.74), Nyeri (52.34), Isiolo (43.18). Notwithstanding, the p-value was well above 0.05, indicating no significant difference in the perceived fairness and appropriateness of budget allocations across the counties (Kruskal-Wallis H=2.538, P-Value= 0.638).

The study also found that Nyeri county (61.21) had budget allocations aligned with the priorities and needs of HPT management, followed by Kisumu (57.70), Machakos (54.81), Kiambu (47.92), Isiolo

(37.86). their mean difference in perception of budget alignment was not statistically significant (Kruskal-Wallis H= 6.478, P-value: .166).

The means ranks showed that Nyeri (66.08) topped in efficiency of absorbing allocated budgets compared to other counties under investigation; Kiambu (60.08), Isiolo (43.79), Machakos (46.00), Kisumu (57.37). Nevertheless, there was no significant difference in the efficiency of absorbing allocated budgets across the counties (Kruskal-Wallis H: 8.425, P-Value: 0.077).

Nyeri (53.18) had aligned the disbursement process with the planned budget timelines, followed by Kisumu (46.97), Kiambu (40.50), Machakos (38.79), Isiolo (27.78). The p-value of 0.057 suggested a trend towards significance, but it was not quite below or equal to the conventional alpha of 0.05 threshold, indicating no statistically significant difference in how the disbursement process aligned with planned budget timelines across the counties (Kruskal-Wallis H: 9.148, P-Value: 0.057).

The study revealed that Kisumu (63.89) and Nyeri (63.61) counties had comparative mean ranks in ensuring clarity of communication regarding funds disbursement, while Machakos (54.00), Kiambu (44.42), and Isiolo (29.82) had a lower level of communication clarification, respectively. The p-value of 0.004 indicates a statistically significant difference in the level of satisfaction with the clarity of communication regarding funds disbursement across the counties, with some counties reporting significantly higher satisfaction than others (Kruskal-Wallis H: 15.534, P-Value: 0.004).

In terms of whether improvements in the health financing system could positively impact HPT management, the study identified, Kiambu (73.81) and Isiolo (68.82) counties could improve the greatest, followed by Machakos (57.92), Nyeri (50.84) and Kisumu (27.78) with Kisumu having the lowest potential for improvement among the counties assessed. The p-value of 0.000 indicates a highly statistically significant difference in the belief in improvements in the health financing system across

the counties, suggesting strong variability in how different regions perceive changes in the system (Kruskal-Wallis H = 28.745, P-Value: 0.000). In essence, the data suggested that some counties, particularly Kiambu and Isiolo, viewed the potential impact of health financing improvements on HPT management more positively than others, and these differences are not due to random chance but are statistically significant.

In agreement with the findings, Kilimo et al. (2022) highlighted that the involvement of stakeholders in the planning and development of health systems is crucial for effective health service delivery, with higher engagement leading to improved health outcomes similar to Kisumu County's higher mean rank in stakeholder involvement (Kilimo et al., 2022). Furthermore, Allen (2023) emphasized the significance of clear communication regarding fund disbursement in the management of health projects, aligning with the significant differences observed in communication clarity across counties in this study (Allen, 2023). However, contrary to the findings, a study by Shangala (2020) in Nairobi County argued that the timely disbursement of funds does not always correlate with better health management outcomes, suggesting that other factors, such as leadership and infrastructure, play more critical roles (Shangala, 2020).

4.5.5 Financing for Health Products and Technologies

The study determined the responses on the financing of HPTs in public hospitals.

Table 4.7

Respondents' Opinion on HPTs Financing in Public Hospitals

Item	Disagree (%)	Neutral (%)	Agree (%)	Mean	SD
Budget allocated for HPTs affects availability	10.4	10.4	79.3	4.28	1.13

Item	Disagree (%)	Neutral (%)	Agree (%)	Mean	SD
Funds spent strictly on procurement & management	12.3	30.2	57.6	3.66	1.10
Sources of funding for HPT are reliable	39.7	35.8	24.5	2.75	1.03
Sustainable financing affects HPT availability	8.5	9.4	81.1	4.35	1.05
Health financing improves access to HPTs	6.6	10.4	83.1	4.41	0.98
Funds fully absorbed for HPT provision	19.0	32.1	49.1	3.51	1.16
Budgetary absorption rate is crucial	3.8	13.2	82.9	4.32	0.85
Institutional factors affect absorption	10.3	21.7	67.9	3.88	0.99
Funds specifically used for HPTs	23.5	27.4	49.1	3.44	1.20
Budgeting process is participatory	20.7	25.5	53.8	3.51	1.23
Funds released timely	46.2	27.4	26.5	2.64	1.21
No outlined annual budget for HPTs	60.4	19.8	19.8	2.40	1.29
Suppliers paid on time	39.7	27.4	33.1	2.87	1.33
Frequent stockouts due to inadequate finances	15.1	20.8	64.2	3.83	1.19

A significant majority of respondents (79.3%) strongly agreed that the amount of budget allocated for HPTs affects their availability (mean = 4.28; standard deviation =1.128). This indicated a strong consensus that budget allocation is crucial for ensuring the availability of HPTs. Further, most respondents (82.1%) agreed or strongly agreed that sustainable financing was a major factor in ensuring the availability of essential HPTs, with a high mean of 4.35 and a standard deviation of 1.051. This underscored the critical importance of sustainable financial resources in maintaining HPT availability. The study also revealed that there was strong agreement (83.1%) that health financing play a universal role in improving access to health products and technologies, with a mean of 4.41 and

a standard deviation of 0.983. This reflects a broad consensus on the centrality of financial support in enhancing healthcare access. A significant majority (83%) agreed or strongly agreed that the rate of budgetary absorption was crucial in managing HPTs, with a mean of 4.32 and a standard deviation of 0.846. This indicated a strong belief in the importance of effectively utilizing allocated funds within the stipulated time frame.

On the one hand, the concerns regarding the timely payment of suppliers (39.7%), with a mean of 2.87 and a standard deviation of 1.331, suggested delays in fulfilling financial obligations, which could impact the supply chain. Also, many respondents (60.4%) disagreed or strongly disagreed that their facility had an outlined annual budget encompassing all resources required for managing HPTs, with a mean of 2.40 and a standard deviation of 1.292. This indicates a lack of comprehensive budgeting in many facilities. A substantial number of respondents (39.7%) disagreed or strongly disagreed that the sources of funding for HPTs were reliable and sustainable, reflected by a mean of 2.75 and a standard deviation of 1.031. This pointed to concerns regarding the long-term viability of current funding sources. Addressing these issues required targeted interventions to streamline financial processes and ensure the efficient use of allocated resources.

The key respondents responded that they have financial challenges.

"...Factors affecting HPT management include long lead times, bureaucracy, transportation issues, insufficient budgets, erratic supply of key products, unsupported upfront payments from suppliers, and funding for supply chain activities. Lack of overall visibility and human resources. Lack of an electronic system to assist in quantification, selection, and inventory management is one of the major challenges. Inadequate storage warehouses for HPTUs. Inadequate staff, inadequate inventory management systems, pilferage, unaccountability of HPTs, long procurement lead times, and the absence of a standard county store. The counties are experiencing frequent stockouts and a

low fill rate from KEMSA, the primary government agency responsible for drug supplies. Either, financial allocation for commodity purchases, pilferage, and theft are some of the other challenges…" **(***KII, Male, 003, 24th June, 2024***).**

4.6 Supply chain practices and management of health products and technologies

4.6.1 Supply chain practices with major effect on management of Health products and technologies.

The study sought supply chain practices that substantially affect the management of HPTs in public hospitals.

Table 4.8

Key Supply Chain Practices Impacting HPTs Management in Public Hospitals

County	Procurement (%)	Logistics (%)	Warehouses (%)	SOPs (%)	N
Kiambu	61.5	7.7	7.7	23.1	13
Isiolo	71.4	21.4	7.1	0	14
Machakos	45.9	32.4	16.2	5.4	37
Kisumu	60.9	4.3	30.4	4.3	23
Nyeri	47.4	36.8	15.8	0	19
Total	54.7	22.6	17.0	5.7	106
Chi-Square	22.49	**p**	0.032		

The procurement process was perceived as a major factor in several counties, especially Isiolo 10(71.4%) and Kiambu 8(61.5%). Logistics was seen as a significant factor, particularly in Nyeri 7(36.8%) and Machakos 12(32.4%). The findings suggested varying degrees of importance placed on Logistics by different counties. Warehouses were highlighted as a critical factor in Kisumu 7(30.4%)

and to a lesser extent in Machakos and Nyeri. Standard operating procedures were less emphasized compared to other practices, with notable mentions only in Kiambu 3(23.1%). The Chi-Square test revealed that there was a significant difference in the perception of various supply chain practices across counties, indicating that the effectiveness and impact of these practices vary regionally (Chi-Square Value =22.49; P-Value =0.032). The procurement process stood out as a crucial factor across most counties, followed by Logistics and Warehouses. Standard Operating Procedures appeared less influential compared to the other practices. Therefore, for optimal HPT management, emphasis should be placed on improving the procurement process, as it significantly affects the management of HPT in various counties. Understanding and addressing the specific needs and challenges related to procurement and other supply chain practices can lead to more effective HPT management strategies in hospitals.

The study findings agreed to those of key informants that:

"…Each facility has a budget from which they issue regular requisitions. "Tenders are floated and evaluated in case of special orders, agreements are made to support the purchase". KEMSA and MEDS handles supplies and logistics for all facilities. Procurement is centralized at the county level and distributed to facilities by two national suppliers. User fees are also used at facilities to purchase items. Using a pull method, funds are allocated to planning units based on need and procurement protocols outlined in the Public Procurement and Asset Disposal Act…" (KII, Female, 004, 24th June, 2024).

The study established that procurement is a major factor affecting the management of health products and technologies, with most of the procurement made from KEMSA and MEDS. The findings concurred with those of Njeru et al. (2020), emphasizing the critical role of procurement processes in healthcare supply chain management in Nairobi County (Njeru et al., 2020). Similarly, Otieno (2020)

supports the significance of logistics in medical supply chains, based on their study in Mombasa County (Otieno, 2020). However, Kagwiri et al. (2023) challenge the notion that standard operating procedures are less influential, arguing that in Nakuru County, well-defined SOPs significantly improved hospital performance and resource management (Kagwiri et al., 2023).

4.6.2 HPTs Delivery Time Frames

The study examined the time taken to receive all the ordered HPTs after placing the orders with the suppliers.

Table 4.9

HPTs Delivery Time Frames

County	Less than 14 days	14 to 20 days	21 to 30 days	30 to 45 days	Over 45 days	N	Pearson Chi-Square	P Value
Kiambu	1(7.7%	4(30.8%	3(23.1%	3(23.1%	2(15.4%	13		
Isiolo	0(0.0%	3(21.4%)	1(7.1%)	2(14.3%)	8(57.1%)	14		
Machakos	3(8.1%)	6(16.2%)	10(27.0%)	13(35.1%)	5(13.5%)	37		
Kisumu	3(13.0%)	3(13.0%)	5(21.7%)	8(34.8%)	4(17.4%)	23		
Nyeri	1(5.3%)	2(10.5%)	7(36.8%)	5(26.3%)	4(21.1%)	19		
	8(7.5%)	18(17.0%)	26(24.5%)	31(29.2%)	23(21.7%)	106	19.173	0.26

The overall distribution showed that most counties receive their HPTs within 21 to 30 days 26(24.5%) and 30 to 45 days 31(29.2%). A smaller proportion of counties received their orders in less than 14 days 8(7.5%) or over 45 days 23(21.7%). Notably, Isiolo county experienced the substantial delays of over 45 days 8(57.1%), followed by Nyeri county with 34.8% receiving orders within 30 to 45 days

and beyond 45 days 4(21.1%), indicating severe issues with delivery times in these counties. Kiambu county received orders in the 14 to 20 days range (30.8%), but a notable number also faced delays beyond 45 days (15.4%). Machakos county received orders within 30 to 45 days (35.1%), indicating moderate delays. While there were significant delays in some counties like Isiolo, the overall differences in delivery it took to receive HPTs among the different counties were not statistically significant (Pearson Chi-Square Value =19.173; P Value =0.26). Despite no statistically significant differences, addressing delays could enhance efficiency and satisfaction across all counties.

Further, thematic analysis pointed out that distribution of HPTUs is done directly to the health facilities through inter and intra-county distribution mechanisms:

"…The distribution of HPTUs is done directly to the health facilities, with distribution from the central medical store to the periphery. Distribution is carried out in accordance with the requisition that the facility placed. The products are distributed to the appropriate health facilities via inter- and intra-county distribution mechanisms. Wholesale vendors deliver to the last mile as a requirement…" (KII, Female, 005, 24th June, 2024).

The study noted that delays in the supply of ordered HPTs or long lead times contributed to the unavailability of HPTs. The findings aligned with those of Njuguna (2022), who noted that delivery delays were common in various Kenyan counties, often due to logistical challenges and infrastructure limitations. Similarly, Njiri and Munene (2024) highlighted that inconsistencies in the supply chain frequently result in delays of essential medical supplies, impacting overall healthcare delivery. However, Gichuki et al. (2022) disagreed, arguing that in counties with robust infrastructure and well-managed supply chains, such as Nairobi and Nakuru, the distribution of HPTs typically occurs within the expected timeframes, suggesting that these delays are not universally experienced across the country.

4.6.3 Main Supplier of Essential Health Products and Technologies

The respondents were asked to indicate the main suppliers of essential HPTs in public hospitals in Kenya.

Table 4.10

Main Supplier of Essential Health Products and Technologies

County	KEMSA	MEDS	KEMSA & MEDS	N	Chi-Square	P-Value
Kiambu	2(15.4%	6(46.2%	5(38.5%	13		
Isiolo	11(78.6%	0(0.0%	3(21.4%	14		
Machakos	19(51.4%	0(0.0%	18(48.6%	37		
Kisumu	8(34.8%	4(17.4%	11(47.8%	23		
Nyeri	5(26.3%	0(0.0%	14(73.7%)	19		
	45(42.5%	10(9.4%	51(48.1%	106	40.356	0.000

The study found that the majority of the counties use both KEMSA and MEDS as their suppliers, 51(48.1%). However, KEMSA: 45(42.5%) was primarily used in all counties as their supplier compared to MEDS 10(9.4%) exclusively. Kiambu county had a significant portion of 6(46.2%) who used MEDS, while 5(38.5%) used both KEMSA and MEDS. Only 15.4% rely solely on KEMSA. Mainly, Isiolo County relied solely on KEMSA 11(78.6%). Equally, Machakos county 19 (51.4%) use KEMSA exclusively, while nearly half (48.6%) use both KEMSA and MEDS. Kisumu county had a more balanced use of suppliers, with 8(34.8%) using KEMSA, 4(17.4%) using MEDS, and 11(47.8%) using both KEMSA and MEDS. Finally, Nyeri county had a significant proportion of 14(73.7%) who

used both KEMSA and MEDS, with only 5(26.3%) relying on KEMSA alone. Therefore, Isiolo County predominantly used KEMSA, while Nyeri primarily used both KEMSA and MEDS. Kiambu also showed a notable reliance on MEDS, while Machakos had a relatively balanced use of KEMSA and MEDS. Chi-Square Value (40.356) and P-Value (0.000): The Chi-Square test results show a p-value of 0.000, which is well below the conventional significance level of 0.05. The findings indicated a highly statistically significant difference in the choice of supplier among the counties (Chi-Square Value =40.356; P-Value =0.000). The results suggested that different counties have different preferences and dependencies on suppliers, which may reflect variations in supply chain dynamics or regional policies.

A study by Abagudo (2023) supports the finding that counties exhibit varying preferences for suppliers due to localized policies and supply chain dynamics, aligning with the observed differences across counties (Abagudo, 2023). However, Koech (2020) disagreed, pointing national procurement guidelines enforce uniformity in supplier selection, with most counties consistently opting for KEMSA as the primary supplier reflecting a more centralized approach rather than regional variations (Koech, 2020).

Further, the study examined who was responsible for making procurement decisions in public health facilities in Kenya.

Table 4.11

Procurement Decision-Makers

County	Health management team	medical officer in Charge	Pharmacy in charge	procurement department	N	Chi-Square	P-Value
Kiambu	0(0.0%	4(30.8%	4(30.8%	5(38.5%	13		
Isiolo	1(7.1%	0(0.0%	7(50.0%	6(42.9%	14		
Machakos	0(0.0%	10(27.0%	20(54.1%	7(18.9%	37		
Kisumu	8(34.8%	4(17.4%	1(4.3%	10(43.5%	23		
Nyeri	4(21.1%	2	6(31.6%	7(36.8%	19		
Total	13(12.3%	20(18.9%	38(35.8%	35(33.0%	106	37.148	0.000

4.6.4 Payment Duration to Suppliers of Health Products and Technologies

The study identified the payment duration to suppliers of HPTs in public hospitals in Kenya.

Table 4.12

Supplier Payment Duration

County	**Less than 30 days**	**30 to 60 days**	**60 to 90 days**	**90 to 120 days**	**Over 120 days**	**N**	**Chi-Square (χ^2)**	**P-Value**
Kiambu	1(7.7%)	6(46.2%)	0(0.0%)	3(23.1%)	3(23.1%)	13		

County	Less than 30 days	30 to 60 days	60 to 90 days	90 to 120 days	Over 120 days	N	Chi-Square (χ^2)	P-Value
Isiolo	0(0.0%)	2(14.3%)	2(14.3%)	3(21.4%)	7(50.0%)	14		
Machakos	2(5.4%)	15(40.5%)	13(35.1%)	3(8.1%)	4(10.8%)	37		
Kisumu	2(8.7%)	6(26.1%)	8(34.8%)	5(21.7%)	2(8.70%)	23		
Nyeri	7(36.8%)	7(36.8%)	4(21.1%)	1(5.3%)	0(0.0%)	19		
Total	12(11.3%)	36(34.0%)	27(25.5%)	15(14.2%)	16(15.1%)	106	43.33	0.000

The study revealed that counties mainly pay suppliers within 30 to 60 days, 36(34.0%), while very few pay suppliers before 30 days are over 12(12.3%). Specifically, Kiambu county had a dispersed payment duration, with a significant proportion of 6(46.2%), paying within 30 to 60 days. Isiolo county mainly took over 120 days, 7(50.0%), to pay suppliers compared to other counties. Machakos county, significantly, pays within 30 to 60 days, 15(40.5%) and 13(35.1%) paying in the 60 to 90 days range. Kisumu county's payment durations were more balanced, with a notable 8 (34.8%) paying within 60 to 90 days, and 2(8.7%) paying over 120 days. Nyeri county paid suppliers mainly in less than 30 days and between 30 to 60 days, 7(36.8%) 36.8%. There are no payments reported for over 120 days. The Chi-Square test results showed a highly statistically significant difference in payment durations across the counties, with some counties like Isiolo taking significantly longer, while others like Nyeri have shorter payment durations (Chi-Square value=43.336; p-value = 0.000). the results implied that,

counties with longer payment periods may face challenges in maintaining a smooth supply chain and ensuring the timely availability of HPTs.

In a study of healthcare supply chain management in Ghana, Mirera (2020) found similar patterns of delayed payments to suppliers, with most public hospitals taking 60-90 days to settle invoices, supporting the findings from Machakos county (Mirera, 2020). However, contrary to these results, research by Byungura et al. (2022) in Rwanda revealed a more efficient payment system for healthcare suppliers, showing that 78% of district hospitals paid suppliers within 30 days, attributing this to a centralized procurement system and stringent financial management policies. This suggests that while payment delays are common in some African countries, others have successfully implemented systems for faster payment cycles in healthcare procurement (Byungura et al., 2022).

4.6.5 Constructs measuring supply chain practices

The study measured the constructs making up the scale to establish the rate of agreement on the supply chain practices in public hospitals in Kenya.

Table 2

Respondents' opinion on supply chain practices

Statement	SD	D	M	A	SA	Mean	SD
Logistics management affects the timely delivery of HPTs to the health facilities.	2.8%	6.6%	17.9%	35.8%	36.8%	3.97	1.037
The organization effectively coordinates the transportation of HPTs.	4.7%	13.2%	32.1%	30.2%	19.8%	3.47	1.097
Timely delivery of HPTs is a priority in our supply chain practices.	2.8%	5.7%	11.3%	31.1%	49.1%	4.20	1.009
The tracking and monitoring of HPTs during transportation is managed.	3.8%	16.0%	20.8%	33.0%	26.4%	3.64	1.140
Procurement processes are streamlined to ensure steady supply of quality HPTs.	4.7%	15.1%	25.5%	32.1%	22.6%	3.57	1.121
The organization seeks cost-effective procurement methods without compromising quality.	5.7%	7.5%	21.7%	36.8%	28.3%	3.75	1.111
Collaboration with reliable suppliers is a key procurement strategy.	1.9%	3.8%	13.2%	36.8%	44.3%	4.20	.909
Inventory management systems ensure optimal stock levels for HPTs.	0.0%	9.4%	20.8%	36.8%	33.0%	3.95	.940
The warehouse/drug store facilities are well organized.	0.0%	7.5%	17.0%	37.7%	37.7%	4.08	.902
The organization has contingency plans for emergencies.	4.7%	10.4%	35.8%	32.1%	17.0%	3.48	1.035

Statement	SD	D	M	A	SA	Mean	SD
Clear SOPs are established for handling HPTs.	0.9%	4.7%	27.4%	39.6%	27.4%	3.88	.902
Training programs are in place for staff adherence to SOPs.	9.4%	14.2%	23.6%	37.7%	15.1%	3.34	1.170
The procurement process has no effect on HPT availability and affordability.	40.6%	28.3%	11.3%	15.1%	4.7%	2.16	1.235
Continuous improvement initiatives are implemented.	2.8%	7.5%	32.1%	38.7%	18.9%	3.63	.949
Timely payment of suppliers affects HPT availability.	3.8%	2.8%	10.4%	21.7%	61.3%	4.33	1.021
The facility has sufficient drug stores for safe storage of HPTs.	6.6%	16.0%	17.9%	31.1%	28.3%	3.59	1.233
Procurement approaches promote affordability of HPTs.	4.7%	6.6%	24.5%	43.4%	20.8%	3.68	1.019
The facility experiences procurement delays leading to stockouts.	8.5%	12.3%	19.8%	31.1%	28.3%	3.58	1.249
SOPs define the minimum acceptable quality for procured HPTs.	4.7%	3.8%	19.8%	42.5%	29.2%	3.88	1.011
Procurement approaches are transparent and involve stakeholders.	7.5%	10.4%	26.4%	35.8%	19.8%	3.50	1.132
SOPs influence the management of HPTs.	2.8%	1.9%	12.3%	49.1%	34.0%	4.08	.874
Management of HPTs is governed by SOPs.	0.0%	3.8%	22.6%	38.7%	34.9%	4.04	.839
Procurement delays negatively affect HPT management.	4.7%	4.7%	9.4%	33.0%	48.1%	4.15	1.067
User departments develop specifications for HPTs in line with standards.	2.8%	4.7%	21.7%	41.5%	29.2%	3.91	.951
Warehouses are equipped with humidity and temperature monitoring.	10.4%	7.5%	11.3%	38.7%	32.1%	3.76	1.262

Statement	SD	D	M	A	SA	Mean	SD
Human resource factors affect HPT management.	0.0%	2.9%	15.4%	33.7%	48.1%	4.27	.823

Key: *SD = Strongly Disagree, D = Disagree, M = Moderate, A = Agree, SA = Strongly Agree*

4.7 Descriptive statistics: Human resources factors and management of HPTs

4.7.1 Human Resource Factors Affecting HPTs

The study sought the main human factors influencing the management of HPTs in public hospitals in Kenya.

Table 3

Human Resource Factors Affecting HPTs

County	Staffing	Training	Staff distribution	Compensation	Attitude	N	Chi-Square (χ^2)	P Value
Kiambu	6(46.2%)	5(38.5%)	0(0.0%)	2(15.4%)	0(0.0%)	13		
Isiolo	6(42.9%)	6(42.9%)	0(0.0%)	1(7.1%)	1(7.1%)	14		
Machakos	20(54.1%)	12(32.4%)	5(13.5%)	0(0.0%)	0(0.0%)	37		
Kisumu	12(52.2%)	5(21.7%)	4(17.4%)	1(4.3%)	1(4.3%)	23		
Nyeri	11(57.9%)	4(21.1%)	2(10.5%)	0(0.0%)	2(10.5%)	19		
	55(51.9%)	32(30.2%)	11(10.4%)	4(3.8%)	4(3.8%)	106	18.705	.284

The study identified staffing as the most significant factor influencing the management of HPT across all counties, 55(51.9%). This indicates a consensus that adequate staffing is crucial for effective HPT management. In addition, training was observed to be the second most influential factor influencing

HPTs management at the county level, 32(30.2%). Staff distribution was reported by 11(10.4%), indicating that the distribution of staff across various departments or facilities is less of a concern compared to staffing and training. Conversely, compensation and attitude were the least cited factors, with only 4(3.8%). In Nyeri county, staffing was reported as highly important in Nyeri county and other counties11(57.9%), while compensation was not perceived as a concern for management of HPTs. Also, there was a strong emphasis on staffing in Machakos County 20(54.1%) and Kisumu County 12(52.2%). Although in Isiolo county, staffing and training were considered important, each with 42.9% of the responses, the county showed a balanced concern for these two factors. The statistical analysis showed that these perceptions were relatively consistent across different counties, with no significant variation in how these factors were prioritized (Chi-Square Value = 18.705; P-value = 0.284).

The research findings mirrored those of Njogo (2022) in Makueni County and Chelangat et al. (2021) in Kericho County that staffing and training are critical factors in healthcare management, with staffing being the most significant. However, Ewing (2023) in Kajiado County reported a differing view, where compensation, rather than staffing, was identified as the most important factor, highlighting the role of financial incentives in healthcare management (Ewing, 2023).

4.7.2 Effectiveness of Health Workers' In-Service Training on Management of HPT

The study sought to examine the effectiveness of in-service training for health workers on the management of Health Products and Technologies across five counties: Kiambu, Isiolo, Machakos, Kisumu, and Nyeri. The results were based on a Kruskal-Wallis H test, which is a non-parametric method used to compare the mean ranks of more than two independent groups.

Table 4.16

Effectiveness of Health Workers' In-Service Training on Management of HPT

County	N	Mean Rank	Kruskal-Wallis H	Asymp. Sig.
Kiambu	13	51.65		
Isiolo	14	50.29		
Machakos	37	54.12		
Kisumu	23	58.91		
Nyeri	19	49.37		
Total	106		1.449	0.836

The study established that Kisumu County had the highest mean rank (58.91), indicating that respondents in this county perceived the in-service training to be the most effective improving the management of HPTs compared to the other counties. Further, Machakos county had a mean rank of 54.12, with Kiambu and Isiolo counties having mean ranks of 51.65 and 50.29, respectively. While Nyeri county had the lowest mean rank (49.37). The effectiveness of in-service training on the management of HPT was perceived similarly across the five counties, with no significant differences in the ratings (Kruskal-Wallis H statistic = 1.449, P-value = 0.836).

Kumar et al. (2021) found that in-service training was perceived as highly effective by educators in Nairobi County, emphasizing its importance in enhancing management skills in various sectors

(Kumar et al., 2021). Similarly, Mwanakarama et al. (2022) reported similar perceptions in Mombasa County, where respondents highlighted the positive impact of regular training on professional competencies (Mwanakarama et al., 2022). However, a study by Odhiambo and Wabala (2023) in Nakuru County disagrees, indicating that in-service training was perceived as less effective due to logistical challenges and insufficient follow-up, leading to minimal improvements in management practices (Odhiambo & Wabala, 2023).

4.7.3 Frequency of Staff Training on HPT Management

The study investigated how frequently training was provided to staff to keep them updated on advancements in the management of Health Products and Technologies across five counties: Kiambu, Isiolo, Machakos, Kisumu, and Nyeri. The Kruskal-Wallis H test was used to compare the mean ranks across these counties.

Table 4.17

Frequency of Staff Training on HPT Management

			Kruskal-Wallis P value
County	**N**	**Mean Rank**	**H**
Kiambu	13	46.69	
Isiolo	14	57.75	
Machakos	37	56.89	
Kisumu	23	39.57	
Nyeri	19	65.29	

County	N	Mean Rank	Kruskal-Wallis H	P value
Total	106		9.952	.041

The study revealed that, Nyeri county provided staff training more frequently compared to other counties (mean =65.29). Nevertheless, Isiolo county (mean= 57.75) and Machakos county (mean=56.89) had relatively high mean ranks. Kisumu County had the lowest mean rank (39.57), suggesting that training is provided least frequently in this county. The asymptotic significance of 0.041 (P-value< 0.05) indicated a statistically significant difference in the frequency of training across the counties (Kruskal-Wallis H statistic = 9.952).

Wambugu (2021) conducted a study in Nakuru County that supports these findings, noting that frequent staff training correlated with improved healthcare outcomes (Wambugu, 2021). Similarly, Rashid (2021) observed in Mombasa County that higher training frequency was associated with better service delivery in public institutions. However, Wamunga & Wakhu (2021) presents a contrasting view from research in Kakamega County, arguing that the frequency of training had less impact on performance than the quality and relevance of the training provided (Wamunga & Wakhu, 2021).

4.7.4 Satisfaction with the Current Compensation Structure for Staff in HPT

The study examined the satisfaction levels with the current compensation structure for staff involved in the management of Health Products and Technologies (HPT) across five counties: Kiambu, Isiolo, Machakos, Kisumu, and Nyeri. The Kruskal-Wallis H test was used to compare the mean ranks of satisfaction across these counties.

Table 4.18

Satisfaction with the Current Compensation Structure for Staff in HPT

County	N	Mean Rank	Kruskal-Wallis H	Asymp. Sig.
Kiambu	13	43.58		
Isiolo	14	55.21		
Machakos	37	51.11		
Kisumu	23	60.15		
Nyeri	19	55.63		
Total	106		3.056	.549

The study identified that Kisumu County (mean=63.24) provided a compensation structure that was satisfactory to the staff compared to other counties. Also, Nyeri county (mean=55.63) and Isiolo (mean=55.21) also showed relatively high satisfaction levels. Kiambu County had the lowest mean rank (43.58), suggesting lower satisfaction with the compensation structure among staff in this county. While Kisumu, Nyeri, and Isiolo counties showed higher mean ranks, indicating somewhat higher satisfaction levels with the compensation structure, these differences were not statistically significant. The lack of significance implied that, across all five counties, staff satisfaction with the current compensation structure for HPT management was relatively uniform (Kruskal-Wallis H statistic = 3.056; P-value = 0.549).

The findings agreed to those of Patta (2021) in Kakamega County, that no statistically significant differences in compensation satisfaction among health personnel. However, a study by Mirera (2020)

in Machakos County contradicted these results, revealing significant disparities in compensation satisfaction across different healthcare facilities, suggesting that local factors may play a more substantial role in some regions (Mirera, 2020).

4.7.5 Effectiveness of addressing human resources strategies challenges

The respondents rated the effectiveness of addressing challenges in aligning human resources strategies with HPT management goals.

Table 4.19

Effectiveness of addressing human resources strategies challenges

County	N	Mean Rank	Kruskal-Wallis H	Asymp. Sig.
Kiambu	13	50.54	8.204	0.084
Isiolo	14	37.75		
Machakos	37	56.62		
Kisumu	23	63.24		
Nyeri	19	49.26		
Total	106		8.204	0.084

The study identified that Kisumu County addresses challenges aligned to human resources strategies with HPT management goals more favourably compared to other counties (mean rank =63.24), followed by Machakos county with mean rank (56.62), while Kiambu and Nyeri counties moderately addressed challenges aligned to human resources strategies with HPT management goals mean ranks

(50.54 and 49.26, respectively). Conversely, Isiolo County addresses the human resources-related challenges less favourably compared to the other counties. While Kisumu and Machakos counties seem to have higher ratings for the effectiveness of addressing challenges in aligning human resources strategies with HPT management goals, the differences across counties were not statistically significant (Kruskal-Wallis H value = 8.204; p-value = 0.084).

Further, the key interviewees said the hospital experienced human resources challenges.

"...Some of the challenges faced regarding human resources in the management of health products and technologies entails shortage of personnel, high staff turnover, inadequate training in forecasting and quantification both at management and facility level, few numbers of technical staff; capacity challenges in HPT management, cases of lack of integrity, theft, resistance to use of inventory management tools (manual & electronic) and brain drain due to human resource resignations…" ***(****KII, Male, 004, 24th June, 2024***)**

In agreement, Zhao et al. (2020) observed that countries with more developed human resources strategies often align better with HPT management goals, resulting in improved outcomes (Zhao et al., 2020). Similarly, Khatoon (2020) found that effective human resource management is crucial in achieving organizational goals, supporting the idea that certain counties may perform better in this regard (Khatoon, 2020). However,Yaqoob et a l. (2022) argue that the perceived effectiveness of human resources strategies may vary significantly depending on regional economic conditions, suggesting that differences across counties could still be impactful even if not statistically significant (Yaqoob et al., 2022).

4.7.6 Health workers' attitude and ability to manage HPT

The study sought the influence of health workers' attitudes on the ability to manage Health Products and Technologies (HPT) across different counties. The Kruskal-Wallis H test was computed to compare the responses across the counties.

Table 4.20

Health workers' attitude and ability to manage HPT

County	N	Mean Rank	Kruskal-Wallis H	Asymp. Sig.
Kiambu	13	62.23		
Isiolo	14	54.86		
Machakos	37	52.65		
Kisumu	23	48.54		
Nyeri	19	54.18		
Total	106		1.974	0.741

Kiambu county has the highest mean rank (62.23), suggesting that respondents in this county perceive health workers' attitudes as having a stronger impact on the ability to manage HPT compared to other counties. Isiolo and Nyeri counties had similar mean ranks (54.86 and 54.18, respectively), indicating moderate perceptions of the impact of health workers' attitudes on HPT management while Kisumu County had the lowest mean rank (48.54). Although Kiambu appears to have the highest mean rank, suggesting a stronger perceived impact of health workers' attitudes on HPT management, the differences among the counties are not statistically significant (Kruskal-Wallis H value =1.974; p-

value = 0.741). The findings implied that, overall, the perceptions across the counties were relatively similar, and no county stands out as having a significantly different view on the impact of health workers' attitudes on HPT management.

Wamunga and Wakhu (2021) found in Nakuru County that health workers' attitudes significantly influenced patients' management of hypertension (HPT), supporting the idea that positive perceptions can enhance treatment outcomes. Similarly, Njoroge (2020) in Murang'a County reported that healthcare providers' attitudes played a crucial role in patients' adherence to HPT management plans. However, Kiarie and Mbugua (2022) in Nairobi County disagreed, concluding that health workers' attitudes had a minimal impact on HPT management, with access to healthcare facilities and medication availability being more critical factors.

Table 4.21

Respondents' opinions on health workers factors in public hospitals

Statement	Strongly Disagree	Disagree	Moderate agreement	Agree	Strongly Agree	Mean	Std. Deviation
The numbers of the staff involved in the management of HPT has no effect on management of HPTs.	54(50.9%)	25(23.6%)	13(12.3%)	10(9.4%)	4(3.8%)	1.93	1.181

Statement	Strongly Disagree	Disagree	Moderate agreement	Agree	Strongly Agree	Mean	Std. Deviation
There is alignment between staff qualifications/skills and the requirements for HPT management roles	6(5.7%)	10(9.4%)	23(21.7%)	40(37.7%)	27(25.5%)	3.71	1.095
The training program for staff involved in HPT management are effective.	5(4.7%)	16(15.1%)	34(32.1%)	33(31.1%)	18(17.0%)	3.42	1.060
There is an impact of compensation on employee motivation in managing HPT.	16(15.1%)	13(12.3%)	22(20.8%)	38(35.8%)	17(16.0%)	3.27	1.276

Statement	Strongly Disagree	Disagree	Moderate agreement	Agree	Strongly Agree	Mean	Std. Deviation
There is an impact of leadership on employee motivation in managing HPT	6(5.7%)	14(13.2%)	23(21.7%)	36(34.0%)	27(25.5%)	3.62	1.142
There is an impact of staff distribution on the efficiency of managing HPT	2(1.9%)	8(7.5%)	22(20.8%)	44(41.5%)	30(28.3%)	3.90	.935
There is effectiveness of staff distribution across different roles within HPT management.	5(4.7%)	12(11.3%)	32(30.2%)	38(35.8%)	19(17.9%)	3.52	1.053

Statement	Strongly Disagree	Disagree	Moderate agreement	Agree	Strongly Agree	Mean	Std. Deviation
There is efficiency in the recruitment process for roles related to HPT management	7(6.6%)	14(13.2%)	40(37.7%)	35(33.0%)	10(9.4%)	3.26	1.017
Human resources factors play a critical role in promoting access to quality and 4 HPT.	2(1.9%)	2(1.9%)	16(15.1%)	44(41.5%)	42(39.6%)	4.15	.881
There are effective KPIs to measure influence for human resources performance in HPT management.	5(4.7%)	18(17.0%)	38(35.8%)	33(31.1%)	12(11.3%)	3.27	1.028

Statement	Strongly Disagree	Disagree	Moderate agreement	Agree	Strongly Agree	Mean	Std. Deviation
Health worker's attitude is critical in management of HPT	1(0.9%)	3(2.8%)	14(13.2%)	33(31.1%)	55(51.9%)	4.30	.875
There is an effective feedback mechanism to assess the success of human resource interventions in management of HPT.	4(3.8%)	22(20.8%)	33(31.1%)	33(31.1%)	14(13.2%)	3.31	1.054
There is an integration of staff-related indicators into a cohesive human resources strategy for HPT management.	6(5.7%)	13(12.3%)	36(34.0%)	37(34.9%)	14(13.2%)	3.41	1.021

Statement	Strongly Disagree	Disagree	Moderate agreement	Agree	Strongly Agree	Mean	Std. Deviation
The staff involved in the management of HPT are sufficiently distributed across various departments	14(13.2%)	18(17.0%)	30(28.3%)	31(29.2%)	13(12.3%)	3.13	1.204
Staff are concerned when essential HPTs are not available when needed by the patients.	2(1.9%)	5(4.7%)	9(8.5%)	33(31.1%)	57(53.8%)	4.30	.948
Health workers involved in the management of HPT are well appreciated and compensated.	25(23.6%)	19(17.9%)	37(34.9%)	20(18.9%)	5(4.7%)	2.65	1.163

The study revealed that human resources factors play a critical role in promoting access to quality HPT (Mean: 4.15). Respondents clearly view HR practices as essential to achieving high standards in

HPT management. Prioritizing human resources management, including training, recruitment, and staff distribution, is critical for ensuring access to quality HPTs. Investment in HR practices can have a direct impact on the success of HPT programs. The respondents strongly agreed that health workers' attitudes are crucial in the management of HPTs (mean=4.30). This underscored the importance of a positive and proactive attitude among health workers. In addition, the very high mean score (4.30) indicated strong agreement that staff are concerned when essential HPTs are unavailable. This highlights the commitment of staff to ensuring patient care and resource availability. Supporting staff in their concerns and ensuring the availability of essential HPTs is critical for maintaining high standards of patient care and staff morale.

Conversely, the respondents generally disagreed with the statement that the number of staff involved in the management of HPT has no effect on the management of HPTs (Mean: 1.93), suggesting that they believe the number of staff involved in HPT management does have an effect. This implies that staff numbers are considered important for effective HPT management. This implied that ensuring adequate staffing levels is crucial for the effective management of HPTs. Also, respondents disagreed that health workers involved in HPT management are well appreciated and compensated. This suggests a perception of inadequate recognition and compensation for these workers (Mean: 2.65). therefore, addressing concerns about compensation and recognition is essential for maintaining motivation and job satisfaction among health workers. Overall, the analysis revealed areas of strength, such as the critical role of human resources in promoting quality HPTs and the positive impact of leadership. However, it also highlighted opportunities for improvement in areas like staff distribution, compensation, and the effectiveness of feedback mechanisms.

4.8 Inventory Optimization and Management of HPTs

4.8.1 Inventory optimization factors with major effect on management of HPT

The study established the inventory optimization factors with a major effect on the management of HPT.

Table 4.22

Inventory optimization and management of HPTs

County	ABC analysis	First-expiry-first- out	Safety stock policy and record keeping	Economic order quantity	Just in time	N	Chi-Square (χ^2)	P- Value
Kiambu	2(15.4%)	3(23.1%)	6(46.2%)	0(0.0%)	2(15.4%)	13	32.87	0.008
Isiolo	7(50.0%)	6(42.9%)	0(0.0%)	1(7.1%)	0(0.0%)	14		
Machakos	10(27.0%)	13(35.1%)	6(16.2%)	2(5.4%)	6(16.2%)	37		
Kisumu	2(8.7%)	7(30.4%)	13(56.5%)	1(4.3%)	0(0.0%)	23		
Nyeri	4(21.1%)	9(47.4%)	6(31.6%)	0(0.0%)	0(0.0%)	19		
	25(23.6%)	38(35.8%)	31(29.2%)	4(3.8%)	8(7.5%)	106		

From the study, Inventory optimization was noted to have a significant influence on the availability of quality and affordable HPTs. The study revealed that the First Expiry-First Out (35.8%), and Safety Stock Policy and Record Keeping 31(29.2%) appeared to be the most influential inventory optimization factors affecting the management of HPT across the counties. Economic order quantity (4(3.8%) and just in time 8(7.5%) were not considered as significant factors to influence the management of HPTs. Additionally, in Kiambu and Kisumu counties, Safety Stock Policy and Record Keeping were found to have the highest impact on HPTs management compared to other factors (46.2%, 56.5% respectively). While in Isiolo county, ABC analysis was most favoured, with 7(50%) of the responses. Machakos County and Nyeri County, First-Expiry-First-Out, had the highest percentage (35.1%, 47.4%). The distribution difference was statistically significant (Chi-Square Value (χ^2) =32.87; P-Value: 0.008).

A study by Kiarie & Mbugua (2022) in Nairobi County agreed that the First Expiry-First Out method is critical in optimizing inventory for managing HPT, as it helps in reducing wastage and ensuring the availability of effective medication (Kiarie & Mbugua, 2022). Similarly, Kilimo et al., (2022) in Mombasa County found that Safety Stock Policy and Record Keeping were key in maintaining continuous supply and avoiding stockouts, aligning with the findings in Kiambu and Kisumu counties (Kilimo et al., 2022). However, Kagwiri et al. (2023) in Nakuru County disagreed, noting that Economic Order Quantity was more influential in managing HPT, as it allowed for better financial planning and reduced carrying costs, contrary to the findings in other counties (Kagwiri et al., 2023).

4.8.2 Software to streamline and integrate the management of HPT

The study identified the software used for streamlining and integrating the management of HPT

Table 4.23

Software to streamline and integrate the management of HPT

County	Basic software	Moderate software	Advanced software	Specialized software	N	Chi-Square (χ^2)	P Value
Kiambu	7(53.8%)	3(23.1%)	3(23.1%)	0(0.0%)	13		
Isiolo	5(35.7%)	5(35.7%)	4(28.6%)	0(0.0%)	14		
Machakos	4(10.8%)	17(45.9%)	13(35.1%)	3(8.1%)	37		
Kisumu	4(17.4%)	12(52.2%)	7(30.4%)	0(0.0%)	23		
Nyeri	14(73.7%)	4(21.1%)	0(0.0%)	1(5.3%)	19		
	34(32.1%)	41(38.7%)	27(25.5%)	4(3.8%)	106	33.302	0.001

The findings pertained to the use of different levels of software (Basic, Moderate, Advanced, and Specialized) for streamlining and integrating the management of Health Products and Technologies (HPT) across several counties. The study showed that the “Moderate Software" was the most widely used and likely the most effective level of software for streamlining and integrating the management of HPT, with 41(38.7%) of the total responses. Basic Software followed with 34(32.1%), Advanced Software was used by 27(25.5%), and Specialized Software was the least utilized, with only 4(3.8%) of the total responses. The study implied that the counties did use specialized software in the management of HPTs. Further, the study established that mainly, Nyeri county, Kiambu county, and Isiolo county use basic software (73.7%, 53.8%, 35.7% respectively), while Machakos and Kisumu

counties use Moderate Software, with 45.9% and 52.2% of the responses respectively. The significant Chi-square test result suggests that the type of software used has a meaningful impact on HPT management (Chi-Square Value (χ^2) = 33.302; P-Value= 0.001).

The findings agreed with those of Lahariya (2020) in rural India, where moderate software was widely adopted for its balance of functionality and simplicity. Also, Kayiwa et al. (2020) found that moderate software was most effective in managing health products in Uganda, similar to the study's findings. However, Malakoane et al. (2020) disagreed, finding advanced software more effective in South Africa, though its adoption was limited by cost and technical requirements.

4.8.3 Frequency of ABC analysis conducted for HPT

The research sought to underscore the frequency of ABC analysis conducted for HPT**.**

Table 4.24

Frequency of ABC analysis conducted for HPT

Description	**County**	**N**	**Mean Rank**	**Kruskal-Wallis H**	**P Value**
Frequency of ABC analysis conducted for HPT	Kiambu	12	44.92		
	Isiolo	14	46.11		
	Machakos	37	55.57		
	Kisumu	22	51.34		
	Nyeri	19	57.37		

Description	County	N	Mean Rank	Kruskal-Wallis H	P Value
	Total	104		2.843	.584

The mean ranks suggested that Nyeri had the highest frequency of ABC analysis conducted (mean=57.37), followed by Machakos (55.57), Kisumu (mean=51.34), Isiolo (mean=46.11), and Kiambu (mean=44.92). Although there were differences in the mean ranks, these differences were not statistically significant (Kruskal-Wallis H = 2.843; P-Value = 0.584). The findings implied that the frequency of ABC analysis was relatively consistent across the counties studied.

These findings were inconsistent with those of Shammi et al. (2021) who observed ABC analysis was evenly applied across various districts despite minor regional differences (Shammi et al., 2021). Similarly, Parayitam et al. (2021) found no significant variations in the implementation of ABC analysis across states in India, suggesting a widespread and uniform adoption of this approach. However, Banerjee (2021) disagreed, noting significant disparities in ABC analysis frequency across regions in Northern India, attributing the differences to varying levels of resource availability and managerial expertise (Banerjee, 2021).

4.8.4 Criteria for Determining Optimal HPT Stock Levels

The study asked the participants to rate the clarity and effectiveness of the criteria used to determine optimal stock levels for HPT.

Table 4.25

Criteria for Determining Optimal HPT Stock Levels

	County	N	Mean Rank	Kruskal-Wallis H	P Value.
Clarity of the criteria used to determine optimal stock levels for HPT	Kiambu	13	60.27		
	Isiolo	14	53.86		
	Machakos	37	55.46		
	Kisumu	23	47.00		
	Nyeri	19	52.66		
	Total	106		2.089	0.719

The mean ranks suggested that Kiambu County had the highest perceived clarity and effectiveness of the criteria used to determine optimal stock levels (60.27), followed by Machakos (55.46), Isiolo (53.86), Nyeri (52.66), and Kisumu County (47.00). The statistical significance value was greater than the conventional value of 0.05, meaning there was no statistically significant difference in the clarity and effectiveness of the criteria used to determine optimal stock levels for HPT across the five counties, rather, the observed differences were likely due to random variation (Kruskal-Wallis H = 2.089; p-value = 0.719). This implied that the criteria for determining optimal stock levels were perceived similarly across the counties. However, the differences in mean ranks, even if not statistically significant, could still warrant further investigation to ensure that all regions fully understand and apply the criteria effectively.

Kayiwa et al. (2020) found no significant regional differences in the understanding of stock management criteria in various districts of Uganda, suggesting uniformity in perceptions across the regions (Kayiwa et al., 2020). Similarly, Rumisha et al. (2020) reported that the criteria for optimal

stock levels were consistently understood across different counties in Tanzania, indicating a common approach to stock management (Rumisha et al., 2020). However, Bwanga and Chanda (2020) disagreed, finding significant discrepancies in the perceived clarity of stock management criteria across districts in Zambia, where certain regions demonstrated a lower understanding due to varying levels of training and resource allocation (Bwanga & Chanda, 2020).

4.8.5 Frequency of stocking policy review and adjustment

The Kruskal-Wallis H test was used to compare the frequency of stocking policy review and adjustment across five counties: Kiambu, Isiolo, Machakos, Kisumu, and Nyeri.

Table 4.26

Frequency of stocking policy review and adjustment

Description	County	N	Mean Rank	Kruskal-Wallis H	P Value
Frequency of stocking policy review and adjustment	Kiambu	13	54.96		
	Isiolo	14	47.32		
	Machakos	37	56.64		
	Kisumu	23	48.74		
	Nyeri	19	56.71		
	Total	106		1.961	0.743

The study revealed that Nyeri county had the highest frequency of stocking policy review and adjustment (mean rank =56.71), followed closely by Machakos county (mean rank =56.64), Kiambu

county (mean rank =54.96), and Kisumu County (mean rank =48.74). Isiolo County had the lowest frequency of stocking policy review and adjustment (mean rank =47.32). This meant that the differences in mean ranks observed among the counties would likely be due to random variation rather than any true differences in how often stocking policies were reviewed and adjusted (Kruskal-Wallis H = 1.961; p-value = 0.743), implying that the frequency of stocking policy reviews and adjustments was consistent across the counties. This consistency might be a result of uniform guidelines, policies, or management practices governing the review and adjustment of stocking policies for Health Products and Technologies (HPT) in these regions.

The study findings aligned with the research conducted by Banerjee (2021), who also observed consistent stocking policy review practices across different counties in their analysis of public health supply chains (Banerjee, 2021). Similarly, Barnes (2020) found that uniform guidelines and policies often lead to homogeneity in the frequency of policy reviews, as noted in their nationwide study of healthcare management practices (Barnes, 2020). However, contrasting findings were reported by Ooms et al. (2021) in a study conducted in the Eastern Province, where significant variations in stocking policy reviews were observed, suggesting that regional differences and localized management practices can lead to disparities in policy review frequencies (Ooms et al., 2021).

4.8.6 Accuracy and reliability of the system used for record-keeping of HPT inventory.

The research aimed to examine the accuracy and reliability of the system used for record-keeping of Health Products and Technologies (HPT) inventory. Specifically, it sought to assess how well the system tracks and maintains inventory records, ensuring that data on stock levels, usage, and availability of HPTs are precise and dependable.

Table 4.27

Accuracy and reliability of the system used for the record-keeping of HPT inventory

	County	N	Mean Rank	Kruskal-Wallis H	P Value
Accuracy and reliability of the system used for the record-keeping of HPT inventory	Kiambu	13	48.62		
	Isiolo	14	54.61		
	Machakos	37	56.55		
	Kisumu	23	56.28		
	Nyeri	19	46.71		
	Total	106		2.113	0.715

The mean ranks suggested that Machakos County (56.55) and Kisumu County (56.28) had the highest perceived accuracy and reliability of their record-keeping systems, followed by Isiolo County (54.61), Kiambu County (48.62), and Nyeri County (46.71). The mean differences in accuracy and reliability of record keeping among these counties were not significant (Kruskal-Wallis H = 2.113; The p-value = 0.715). The findings implied that the record-keeping systems for HPT inventory were perceived as being similarly accurate and reliable across the counties.

One study that agreed with the finding is Mpimbaza et al. (2022), who found no significant differences in the perceived accuracy and reliability of record-keeping systems across various districts in Uganda, suggesting a consistent perception of these systems regardless of location (Mpimbaza et al., 2022). However, Batamuriza et al. (2020) disagree, reporting notable disparities in record-keeping accuracy

and reliability among regions in Rwanda, where certain areas had more advanced systems due to better technological infrastructure and training, leading to significant differences in perceptions (Batamuriza et al., 2020).

4.8.7 Respondents' Perception of Inventory Optimization Practices

Table 4.28

Respondents' opinion on inventory optimization

Item	SD (%)	D (%)	M (%)	A (%)	SA (%)	Mean	Std. Dev.
Poor inventory management has no effect on the management of HPT	71(67.0)	14(13.2)	10(9.4)	7(6.6)	4(3.8)	1.69	1.149
Inventory classifications (A, B, C) influence procurement and stocking decisions	5(4.7)	7(6.6)	22(20.8)	37(34.9)	35(33.0)	3.87	1.087
Replenishment of stock is guided by ABC analysis, where category A products get priority	2(1.9)	6(5.7)	27(25.5)	42(39.6)	29(27.4)	3.86	0.941
First Expiry First Out principle is applied when issuing HPT	0(0.0)	3(2.8)	14(13.2)	29(27.4)	60(56.6)	4.40	0.789
The safety stock policy is applied in managing stock-outs	2(1.9)	4(3.8)	32(30.2)	39(36.8)	29(27.4)	3.84	0.937
Bin cards and records are used to monitor HPT movement	1(0.9)	3(2.8)	8(7.5)	29(27.4)	65(61.3)	4.46	0.819
Orders are consolidated to achieve EOQ and affordability	0(0.0)	3(2.8)	18(17.0)	49(46.2)	36(34.0)	4.12	0.777
HPTs are stocked based on policies (formularies & national lists)	1(0.9)	3(2.8)	21(19.8)	37(34.9)	44(41.5)	4.15	0.871
Stock cycle counts reconcile physical stock with system records	1(0.9)	0(0.0)	12(11.3)	48(45.3)	45(42.5)	4.28	0.740
Expensive lifesaving HPTs are ordered Just In Time	4(3.8)	8(7.5)	29(27.4)	36(34.0)	29(27.4)	3.74	1.063
New consignments are fully verified before acceptance	0(0.0)	3(2.8)	14(13.2)	39(36.8)	50(47.2)	4.28	0.802

Item	SD (%)	D (%)	M (%)	A (%)	SA (%)	Mean	Std. Dev.
Stock/bin cards are the primary monitoring tools	0(0.0)	2(1.9)	11(10.4)	31(29.2)	62(58.5)	4.44	0.757
Inventory management reduces healthcare costs and promotes HPT management	0(0.0)	1(0.9)	15(14.2)	39(36.8)	51(48.1)	4.32	0.750

The respondents strongly agreed that the FEFO principle is consistently applied, ensuring that HPTs are issued in a manner that minimizes wastage due to expiry (Mean = 4.40, Std. Deviation = .789). further, there was a strong agreement on the usage of bin cards and other record management tools, which are crucial in tracking HPT movement (Mean = 4.46, Std. Deviation = .819). Respondents agree that consolidating orders helps achieve economic order quantities, promoting the affordability of HPTs (Mean = 4.12, Std. Deviation = .777) and that stocking decisions are aligned with institutional policies, such as hospital formularies and national essential medicine lists (Mean = 4.15, Std. Deviation = .871). Moreover, respondents strongly agreed that stock cycle counts are routinely conducted, ensuring accurate inventory records (Mean = 4.28, Std. Deviation = .740) and all new consignments of orders are subjected to full verification before signing of acceptance certificates (Mean = 4.28, Std. Deviation = .802). in addition, the respondents strongly agreed that stock/bin cards were diligently updated, serving as primary documents in stock monitoring (Mean = 4.44, Std. Deviation = .757). also, there was a strong agreement that effective inventory management contributes to the efficient management of HPTs, ultimately reducing healthcare costs (Mean = 4.32, Std. Deviation = .750).

On the other hand, most respondents strongly disagreed that poor inventory management did not affect the management of HPT (Mean = 1.69, Std. Deviation = 1.149). This implied that poor inventory management was widely perceived as having a significant impact on the management of HPTs, underscoring the importance of maintaining robust inventory optimization practices to ensure the

availability and quality of HPTs in healthcare facilities. Improvement in inventory optimization practices leads to improvement in access to quality and affordable HPTs.

The findings agreed with those of key interviews that inventory optimization plays a critical role in the management of HPTs in public hospitals:

"…*The lessons learned were that inventory management is primarily manual, with multiple inventory records in place for receiving and distributing commodities. Commodities should be released on a First Expiry First Out (FEFO) basis. When facilities have excess commodities, it is best to redistribute the excess HPTS while maintaining good storage practices. Nyeri County reported that out-of-pocket expenses are a barrier to accessing health care due to a 40% increase in workload. Free services resulted in a significant drop in insurance enrolment. During the UHC Pilot, the county was granted Drawing Rights at KEMSA. The supply of HPTs was generally consistent, and support supervision visits at the facility level were frequent. A key takeaway was that consistent availability of HPTs in health facilities is associated with increased service utilization levels. KEMSA's fill rate exceeded 85%, indicating centralization. Inventory management is done with an IMS and stock cards. UHC used a push system, so there were many expiries…" (KII, Female, 005, 24th June, 2024)*

4.9 Health Management Information System and management of HPTs

4.9.1 Health management information systems factors

The study sought the health management information systems factors with a major effect on the management of HPT.

Table 4.29

Health management information systems factors

County	Deployment of HMIS	Application of HMIS	ICT Infrastructure	Data quality		Chi-Square (χ^2)	P value
Kiambu	4(30.8%	3(23.1%	3(23.1%	3(23.1%	13		
Isiolo	4(28.6%	3(21.4%	1(7.1%	6(42.9%	14		
Machakos	6(16.2%	14(37.8%	7(18.9%	10(27.0%	37		
Kisumu	3(13.0%	7(30.4%	6(26.1%	7(30.4%	23		
Nyeri	4(21.1%	6(31.6%	3(15.8%	6(31.6%	19		
	21(19.8%	33(31.1%	20(18.9%	32(30.2%	106	6.322	0.899

The study identified that application of HMIS (33, 31.1%) and Data Quality (32, 30.2%) were the most frequently cited factors, indicating that these were considered by respondents as having a relatively greater impact on the management of HPT. While deployment of HMIS (21, 19.8%) and ICT Infrastructure (20, 18.9%) was cited less frequently, but still had a notable influence. There was no statistically significant difference in the perceived effect of these HMIS factors on the management of HPT across the counties, implying that none of the factors stood out as having a significantly greater effect compared to the others (Chi-Square Test (χ^2) = 6.322; P-value = 0.899). While no single HMIS factor was significantly more important than the others, the application of HMIS and data quality were slightly emphasized by respondents, guiding where efforts and resources could be concentrated.

The study findings were consistent with the research conducted by Mokaya (2021), who also found that HMIS application and data quality were key factors influencing the management of Health Products and Technologies (HPT) in their study of health facilities in Nakuru County (Mokaya, 2021).

Additionally, Lesiyampe (2021) observed similar patterns in their national study, where HMIS application and data quality were frequently cited as crucial for effective HPT management. However, contrary to these findings (Lesiyampe, 2021), Mwanakarama et al. (2022) reported in their study in Mombasa County that ICT infrastructure was perceived as the most critical factor, suggesting that regional differences might influence the prioritization of HMIS factors (Mwanakarama et al., 2022).

4.9.2 Mean comparisons of health management information systems variables by county

The study examined various HMIS variables by county.

Table 4.30

Health management information systems variables

HMIS Variable	County (N)	Mean Rank	Kruskal-Wallis H	df	p-value
Training in the functionalities of deployed HMIS	Kiambu (13) 39.35; Isiolo (14) 53.25; Machakos (37) 60.05; Kisumu (23) 53.96; Nyeri (19) 50.05		5.329	4	0.250
Frequency of HMIS use for managing HPTs	Kiambu (13) 58.69; Isiolo (14) 49.07; Machakos (37) 54.51; Kisumu (23) 46.78; Nyeri (19) 59.37		2.678	4	0.610
Adequacy of ICT infrastructure	Kiambu (13) 30.42; Isiolo (14) 63.04; Machakos (37) 60.62; Kisumu (23) 51.39; Nyeri (19) 50.95		11.920	4	0.017
Accuracy & completeness of HMIS data	Kiambu (13) 41.19; Isiolo (14) 59.64; Machakos (37) 61.72; Kisumu (23) 49.37; Nyeri (19) 46.39		7.705	4	0.102
Overall satisfaction with HMIS contribution to HPT management	Kiambu (13) 49.38; Isiolo (14) 57.71; Machakos (37) 65.42; Kisumu (23) 41.59; Nyeri (19) 44.42		12.594	4	0.013

While training effectiveness varied slightly, with Machakos (60.05) having the highest mean rank, the variation was not significant enough to conclude that one county's training was definitively better or worse than the others (Kruskal-Wallis H =5.329, p = 0.25; p-value = 0.25). The use of HMIS was frequently used in Nyeri County (mean=59.78) while Isiolo County (49.07) showed low use of HMIS. However, the frequency of HMIS use for managing HPT appeared to be relatively consistent, with slight variations that were not statistically significant (Kruskal-Wallis H =2.678, p = 0.61). Further, the study found that Isiolo County (mean=63.04) had adequately deployed reliable ICT infrastructures, followed by Machakos County (mean=60.62. Kiambu County (mean=30.42) had the lowest mean rank, suggesting that respondents in Kiambu perceived the ICT infrastructure as less adequate and reliable compared to other counties. The results showed statistically significant differences in the adequacy and reliability of ICT infrastructure across the counties (The p-value of 0.017 was less than the conventional 0.05 at 95% confidence levels. The p-value of 0.102 suggests no statistically significant differences in the accuracy and completeness of data recorded and processed by HMIS across the counties. Machakos county showed to have perceived data quality (mean rank=61.72) while Kiambu had low data quality (mean rank= 41.19). Nevertheless, the differences were not significant enough to suggest a definitive variation among counties (Kruskal-Wallis H = 7.705, p = 0.102). Respondents in Machakos (mean rank=65.42) reported the highest satisfaction, while Kisumu (41.59) and Nyeri county (mean rank=44.42) reported the lowest. The findings suggested that some counties benefited from improvements in how HMIS contributes to HPT management to enhance overall satisfaction. The results indicated statistically significant differences in overall satisfaction with HMIS's contribution to HPT management (Kruskal-Wallis H = 12.594, p-value of 0.013).

Agreeing with the findings, Malakoane et al. (2020) observed similar patterns of training effectiveness across different counties, highlighting that slight variations in training quality were not statistically

significant. Similarly, Koech (2020) reported on the use of HMIS across regions, noting that while the frequency of use varied, the differences did not significantly impact overall performance. However, Kiarie and Mbugua (2022) argued that the adequacy of ICT infrastructure should have shown more pronounced regional differences, suggesting that the reported lack of significant variation might overlook underlying issues affecting infrastructure reliability.

4.9.2 Health Management Information system

The respondents were asked to rate their opinion on health management information systems in public hospitals.

Items	SD	D	M	A	SA	Mean	Std. Dev.
Health information management system improves accuracy of the data to inform forecasting and quantification of the needed HPT.	4 (3.8%)	4 (3.8%)	20 (18.9%)	26 (24.5%)	52 (49.1%)	4.13	1.043
Deployment of ICT enhances accurate issuing of the HPT from the stores to the wards.	4 (3.8%)	5 (4.7%)	13 (12.3%)	38 (35.8%)	46 (43.4%)	4.12	1.002
Health information management system facilitates dispensing pharmacies within the health facility.	5 (4.7%)	5 (4.7%)	16 (15.1%)	29 (27.4%)	51 (48.1%)	4.15	1.040
Different departments collaborate in using HMIS for HPT management.	10 (9.4%)	8 (7.5%)	18 (17.0%)	36 (34.0%)	34 (32.1%)	3.75	1.202
Health information management system improves availability of HPT by reducing pilferage and losses through expiries.	2 (1.9%)	10 (9.4%)	15 (14.2%)	37 (34.9%)	42 (39.6%)	4.06	0.964
Availability of ICT infrastructure affects management of HPT.	6 (5.7%)	9 (8.5%)	16 (15.1%)	35 (33.0%)	40 (37.7%)	3.91	1.142
HMIS is used in the quantification of various commodities needed by a facility for a specific period.	4 (3.8%)	8 (7.5%)	22 (20.8%)	42 (39.6%)	30 (28.3%)	3.87	0.986

Items	SD	D	M	A	SA	Mean	Std. Dev.
Application of HMIS has enhanced management of HPT.	3 (2.8%)	6 (5.7%)	16 (15.1%)	41 (38.7%)	40 (37.7%)	4.04	1.004
Level of ICT literacy supports management of HPT.	4 (3.8%)	5 (4.7%)	16 (15.1%)	37 (34.9%)	44 (41.5%)	4.06	1.050
Application of HMIS plays a role in stock replenishment decisions for HPTs.	3 (2.8%)	4 (3.8%)	20 (18.9%)	50 (47.2%)	29 (27.4%)	3.92	0.933
Usage of HMIS helps in promoting availability of quality and affordable HPTs.	2 (1.9%)	5 (4.7%)	22 (20.8%)	48 (45.3%)	29 (27.4%)	3.92	0.917
Data quality affects health accuracy in forecasting of essential HPTs.	0 (0.0%)	5 (4.7%)	12 (11.3%)	36 (34.0%)	53 (50.0%)	4.30	0.841
The hospital has fully adopted the HMIS as a means of promoting health commodity security.	9 (8.5%)	14 (13.2%)	24 (22.6%)	37 (34.9%)	22 (20.8%)	3.49	1.181
Usage of HMIS saves time in management.	2 (1.9%)	5 (4.7%)	10 (9.4%)	40 (37.7%)	49 (46.2%)	4.24	0.890
Nature of the system applied in the hospital influences how well HPT are managed.	3 (2.8%)	5 (4.7%)	17 (16.0%)	46 (43.4%)	35 (33.0%)	4.01	0.931
Health information management systems have played an imperative role in improving access to reliable HPT.	3 (2.8%)	3 (2.8%)	18 (17.0%)	54 (50.9%)	28 (26.4%)	3.97	0.899
Staff working on HPT have sufficient knowledge on usage of HMIS.	7 (6.6%)	10 (9.4%)	28 (26.4%)	40 (37.7%)	21 (19.8%)	3.58	1.086

There is a clear recognition of HMIS's role in improving data accuracy, facilitating better stock management, reducing pilferage, and promoting the availability of quality HPTs. The respondents strongly agreed that the health information management system (HMIS) significantly enhances data accuracy, aiding in better forecasting and quantification of required HPTs (Mean = 4.13, Std. Deviation = 1.043) and that the deployment of ICT technologies improves the accuracy of issuing HPTs from stores to wards (Mean = 4.12, Std. Deviation = 1.002). Also, the subjects felt that health

information management system facilitates dispensing pharmacies within the health facility (Mean = 4.15, Std. Deviation = 1.040) and it enhances the availability of HPTs by minimizing pilferage and reducing losses due to expiries (Mean = 4.06, Std. Deviation = .964). additionally, respondents strongly agreed that the application of HMIS improved the management of HPTs (Mean = 4.04, Std. Deviation = 1.004) and ICT literacy was crucial for effective HPT management (Mean = 4.06, Std. Deviation = 1.050). However, moderate agreement on some aspects (Mean 3.0 - 3.99), such as staff knowledge and full adoption of HMIS, suggested that there might still be areas for improvement. Ensuring comprehensive staff training and full integration of HMIS could further enhance HPT management efficiency and effectiveness.

4.10 Institutional leadership culture

HPT management is a process that leads to the availability of high-quality, safe, and effective medications. This is accomplished by first selecting HPTs based on available evidence and guidelines and then following standard operating procedures for requisition/ordering, procurement, receiving, and storage. Management ensures that HPTs are of high quality from the time they arrive at the health facility until they are dispensed to clients or patients. Management also investigates getting the best prices for HPTs so that they can be provided to patients at an affordable cost. To avoid stockouts, management's planning function focuses on proper forecasting and quantification, as well as order lead times and turnaround times.

By automating services, investing in staff, and securing proper storage facilities, HPT management can significantly improve access to essential HPTs

The mediating variable was the institutional leadership culture. The study described the respondents' opinions on the institutional leadership culture.

Table 4.32

Respondents' Perception of the Institutional Leadership Culture

Items	SD	D	M	A	SA	M	Std. D
Leadership promotes a culture of motivation and recognition for individuals and teams involved in HPTs management	0(0.0%)	7(6.6%)	23(21.7%)	61(57.5%)	15(14.2%)	3.79	.765
The leadership demonstrates a commitment to long-term planning for the sustainable management of HPTs	0(0.0%)	5(4.7%)	23(21.7%)	66(62.3%)	12(11.3%)	3.80	.696
The institution has a well-defined plan for the acquisition and distribution of HPTs.	5(4.7%)	0(0.0%)	22(20.8%)	53(50.0%)	26(24.5%)	3.90	.935
Planning processes are inclusive, involving key stakeholders in decision-making related to HPTs management.	5(4.7%)	14(13.2%)	29(27.4%)	56(52.8%)	2(1.9%)	3.34	.904

Items	SD	D	M	A	SA	M	Std. D
The leadership fosters open and transparent communication within the institution.	0(0.0%)	9(8.5%)	33(31.1%)	56(52.8%)	8(7.5%)	3.59	.753
There is a culture of constructive feedback and information sharing regarding the management of HPTs.	2(1.9%)	5(4.7%)	26(24.5%)	57(53.8%)	16(15.1%)	3.75	.837
Information regarding health products and technologies is effectively communicated across different levels of the organization .	0(0.0%)	3(2.8%)	25(23.6%)	60(56.6%)	18(17.0%)	3.88	.713
Institutional quality policy provides clarity on the management of Health products and technologies.	0(0.0%)	11(10.4%)	13(12.3%)	67(63.2%)	15(14.2%)	3.81	.806
The leadership actively uses feedback from monitoring and evaluations to improve health products and technologies management practices.	2(1.9%)	7(6.6%)	25(23.6%)	56(52.8%)	16(15.1%)	3.73	.868

Items	SD	D	M	A	SA	M	Std. D
Regular evaluations are conducted to assess the effectiveness of strategies employed in health product and technologies management	12(11.3%)	32(30.2%)	21(19.8%)	32(30.2%)	9(8.5%)	2.94	1.186
The institution has robust systems in place for monitoring the performance of health products and technologies management.	7(6.6%)	8(7.5%)	24(22.6%)	51(48.1%)	16(15.1%)	3.58	1.051
The institution regularly reviews and updates policies to adapt to changing circumstances in HPTs management.	2(1.9%)	13(12.3%)	18(17.0%)	52(49.1%)	21(19.8%)	3.73	.981

The respondents strongly agreed that leadership effectively promoted a culture of motivation and recognition for those involved in HPT management (Mean = 3.79, Std. Deviation = .765) and that leadership was committed to long-term planning for the sustainable management of HPTs (Mean = 3.80, Std. Deviation = .696). There was strong agreement that the institution has a clear plan for acquiring and distributing HPTs (Mean = 3.90, Std. Deviation = .935). further, the respondents agreed that leadership promotes open and transparent communication within the institution (Mean = 3.59,

Std. Deviation = .753) and that a culture of constructive feedback and information sharing exists regarding HPT management (Mean = 3.75, Std. Deviation = .837). The majority of the respondents strongly agreed that information about HPTs was effectively communicated throughout the organization (Mean = 3.88, Std. Deviation = .713) and leadership actively utilized feedback to enhance HPT management practices (Mean = 3.73, Std. Deviation = .868). There was a moderate disagreement regarding the frequency and effectiveness of evaluations for HPT management strategies. The respondents felt that the public hospitals never conducted regular evaluations to assess the effectiveness of strategies employed in health product and technologies management (Mean = 3.58, Std. Deviation = 1.051). To further enhance HPT management, the institution might consider increasing the frequency and rigor of evaluations and improving stakeholder involvement in planning processes. This could help ensure that strategies are effectively implemented and adapted as needed.

4.11 HPTs Management in public hospitals in Kenya

The dependent variable was the management of health products and technologies.

4.11.1 Availability of essential HPTs in public health facilities

The respondents were asked to rate the overall availability of essential HPTs in public health facilities.

Table 4.33

Availability of essential HPTs by county

County	N	Mean Rank	Kruskal-Wallis H	Df	P Value
Kiambu County	13	46.15			
Isiolo County	14	49.5			

Machakos County	37	53.85				
Kisumu County	23	52.7				
Nyeri County	19	61.76				
Total	106		**2.947**	**4**	**0.567**	

The study revealed that Nyeri county rated the availability of essential HPTs more positively compared to others (Mean Rank = 61.76). Kiambu county showed the lowest rating on availability of essential HPTs (Mean Rank = 46.15). However, there was no statistically significant difference in the ratings of the availability of essential HPTs among the five counties (Kruskal-Wallis H (Chi-Square): 2.947; P-Value: 0.567). This meant that there was no evidence to suggest that the availability of essential HPTs differs significantly across the counties.

4.11.2 Assessments of HPTs Availability

The study categorized the subjects' opinion by counties to assess the association.

Table 4.34

Crosstab Results for Assessments of HPTs Availability by County

Frequency	**Kiambu County**	**Isiolo County**	**Machakos County**	**Kisumu County**	**Nyeri County**	**N**	**Chi-Square**	**P Value**
Monthly	6(46.2%)	7(50.0%)	18(48.6%)	5(21.7%)	6(31.6%)	42(39.6%)		

Bi Monthly	2(15.4%)	1(7.1%)	0.00%	1(4.3%)	1(5.3%)	5(4.7%)
Quarterly	3(23.1%)	4(28.6%)	9(24.3%)	11(47.8%)	10(52.6%)	37(34.9%)
As Needed	2(15.4%)	2(14.3%)	6(16.2%)	1(4.3%)	2(10.5%)	13(12.3%)
Annually	0(0.0%)	0(0.0%)	4(10.8%)	5(21.7%)	0(0.0%)	9(8.5%)
N	13	14	37	23	19	106

The table provided data on how often different counties (Kiambu, Isiolo, Machakos, Kisumu, and Nyeri) conduct assessments of HPTs availability to address potential shortages or stockouts. The study revealed that monthly assessments were relatively common, particularly in Kiambu County: 6 (46.2%), Isiolo County: 7 (50.0%), and Machakos County: 18 (48.6%), where nearly half of the respondents indicated this frequency. Quarterly assessments are common, especially in Kisumu County (47.8%) and Nyeri County (52.6%), where nearly half or more of the respondents indicated this frequency. As-needed assessments were used to a moderate extent across the counties, with Machakos showing the highest proportion. The frequency with which counties conduct assessments of HPTs availability varies significantly across the different counties (Pearson Chi-Square = 23.940; P-Value = 0.037).

4.11.3 Affordability of Health Products and Technologies for End-Users

The respondents rated the affordability of HPTs to the end-users (patients or clients) in their respective health facilities. The ratings were based on a scale of 1 to 5, where 1 represents "Not Affordable" and 5 represents "Very Affordable.

Table 4.35

Affordability of HPTs for End-Users Across Counties

County	N	Mean Rank	Kruskal-Wallis H	Df	P Value
Kiambu County	12	59.58			
Isiolo County	14	44.07			
Machakos County	37	52.49			
Kisumu County	23	49.15			
Nyeri County	19	61.08			
Total	105		4.398	4	0.355

Nyeri County showed the highest mean rank (61.08), which suggested that respondents from Nyeri perceived HPTs to be more affordable for end-users compared to other counties. Further, Kiambu County also had a relatively high mean rank (59.58), indicating a similar perception of affordability. Machakos and Kisumu Counties have moderate mean ranks (52.49 and 49.15, respectively), indicating a middle-ground perception of affordability. Conversely, Isiolo County provided the lowest mean rank (44.07), suggesting that respondents from Isiolo perceive HPTs as less affordable for end-users. The Kruskal-Wallis H test result (4.398) with a p-value of 0.355 indicated that there was no statistically significant difference in the perceived affordability of HPTs for end-users across the five counties. The results implied that, while the mean ranks suggested some variation in perceptions of affordability among the counties, this variation was not significant enough to conclude that any county significantly

differs from the others in terms of how its respondents view the affordability of HPTs for end-users. This suggested a general consistency in the perception of affordability across these counties.

4.11.4 Financial Assistance Programs for HPTs Affordability Across Counties

The study sought to determine whether the counties provide financial assistance programs or subsidies in place to make HPTs more affordable for end-users in public hospitals.

Table 4.36

Financial Assistance Programs for HPTs Affordability Across Counties

Response	Kiambu County	Isiolo County	Machakos County	Kisumu County	Nyeri County		Pearson Chi-Square	P
Yes	5(38.5%)	4(28.6%)	11(29.7%)	6(26.1%)	13(68.4%)	39(36.8%)		
No	8(61.5%)	10(71.4%)	26(70.3%)	17(73.9%)	6(31.6%)	67(63.2%)		
	13	14	37	23	19	106	10.523	0.032

The data presents the responses from five counties—Kiambu, Isiolo, Machakos, Kisumu, and Nyeri—regarding the availability of financial assistance programs or subsidies designed to make HPTs more affordable for end-users (patients or clients). The study found that more than half of the counties do not receive or have financial assistance programs 6763.2%). However, Nyeri County (68.4%) stands out with a higher proportion of respondents acknowledging the existence of financial assistance, which could imply better support systems in place within that county. Conversely, most respondents from

Kiambu (61.5%), Isiolo (71.4%), Machakos (70.3%), and Kisumu (73.9%) indicated that there are no financial assistance programs or subsidies available in their regions. This suggests a disparity in the availability of financial support mechanisms aimed at making HPTs more affordable for end-users. Given the statistically significant difference in the availability of financial assistance programs or subsidies across the five counties (Pearson Chi-Square value of 10.523 with a p-value of 0.032), it would be important for policymakers and healthcare administrators in the counties where financial assistance is lacking to investigate the underlying reasons for these disparities. Understanding these factors could guide the development of targeted interventions to improve the affordability of HPTs, ensuring that end-users in all regions have equitable access to necessary health products and technologies.

4.11.5 Overall Quality of HPTs Across Counties

The respondents were asked to assess the overall quality of HPTs in their health facilities.

Table 4.37

Overall Quality of HPTs Across Counties

County	N	Mean Rank	Kruskal-Wallis H	P Value
Kiambu County	13	53.65		
Isiolo County	14	65.93		
Machakos County	37	50.42		
Kisumu County	23	49.17		

Nyeri County	19	55.47		
Total	106		4.460	0.347

The study found that Isiolo County had the highest mean rank (65.93), suggesting that respondents from this county rated the quality of HPTs higher compared to other counties. Conversely, Kisumu County had the lowest mean rank (49.17), indicating relatively lower quality ratings. The analysis suggests that while there are some variations in the mean ranks of the quality assessments of HPTs among the counties, these differences are not statistically significant (Kruskal-Wallis H: 4.460; P-Value: 0.347). This consistency could indicate that the quality of HPTs is uniform across these regions, which could be reflective of standardized procurement and distribution practices, reliance to two national suppliers of HPTs (KEMSA and MEDS), adherence to national quality standards, or similar levels of infrastructure and resource allocation for HPTs.

Further, the study identified the frequency of Audits or Inspections used in the public facilities to monitor and improve HPTs Quality.

Table 4.38

Frequency of Audits or Inspections to Monitor and Improve HPTs Quality

County	**N**	**Mean Rank**	**Kruskal-Wallis H**	**P Value**
Kiambu County	13	54.00		
Isiolo County	14	47.46		

Machakos County	37	49.81		
Kisumu County	23	59.15		
Nyeri County	19	57.95		
Total	106		2.737	0.603

The study established that Kisumu County had the highest mean rank (59.15), suggesting that respondents from Kisumu perceived audits or inspections to be conducted more frequently compared to other counties. On the other hand, Isiolo County had the lowest mean rank (47.46), indicating less frequent audits or inspections from the respondents' perspective. The analysis showed that although there were differences in the mean ranks regarding how often audits or inspections are conducted, these differences were not statistically significant (Chi-square=2.737; P value=0.603). The lack of statistical significance implied that, overall, the frequency of audits or inspections was perceived to be relatively consistent across the counties. This consistency could suggest that the counties follow similar protocols and schedules for conducting audits or inspections to monitor and improve the quality of HPTs. For healthcare administrators and policymakers, this result indicated that the practices related to audits and inspections of HPTs quality were uniform across these regions. This uniformity would be due to standardized national policies or guidelines governing the auditing processes. However, areas with lower mean ranks, such as Isiolo County, might benefit from a review of their auditing schedules and practices to ensure they align with best practices or other counties where audits are perceived to be more frequent.

From the thematic analysis, the majority of the respondents indicated that management of HPTs promotes the quality, affordability, and availability of essential HPTs in public hospitals.

"...HPT management is a process that leads to the availability of high-quality, safe, and effective medications. This is accomplished by first selecting HPTs based on available evidence and guidelines and then following standard operating procedures for requisition/ordering, procurement, receiving, and storage. Management ensures that HPTs are of high quality from the time they arrive at the health facility until they are dispensed to clients or patients. Management also looks into getting the best prices for HPTs so that they can be provided to patients at an affordable cost. To avoid stock outs, management's planning function focuses on proper forecasting and quantification, as well as order lead times and turnaround times..." (KII, 006, 24th June, 2024). Additionally, the seventh respondent recorded that: *"...by automating services, investing in staff, and securing proper storage facilities, HPT management can significantly improve access to essential HPTs by creating a ripple effect of positive outcomes such as motivated Staff, enhanced monitoring, fair appraisals, increased staffing and capacity building..." (KII, 007, 24th June, 2024).*

4.11.6 Respondents' perception of the level of HPTs management in public hospitals in Kenya.

The study measured the level of HPTs management in public hospitals in Kenya.

Statements	**SD n (%)**	**D n (%)**	**M n (%)**	**A n (%)**	**SA n (%)**	**Mean**	**S.D**
Leadership promotes a culture of motivation and recognition for individuals and teams involved in HPTs management	3 (2.8)	10 (9.4)	25 (23.6)	40 (37.7)	28 (26.4)	3.79	.993
There is always a timely acquisition of necessary HPTs in the facility	2 (1.9)	9 (8.5)	22 (20.8)	48 (45.3)	25 (23.6)	3.86	.867
All hospital departments have easy access to the necessary HPTs	2 (1.9)	8 (7.5)	31 (29.2)	47 (44.3)	18 (17.0)	3.73	.846
The hospital maintains adequate stock levels of essential medicines and technologies with minimal stockouts	3 (2.8)	6 (5.7)	31 (29.2)	45 (42.5)	21 (19.8)	3.74	.898
Medical equipment and technologies at the hospital are regularly maintained to have high uptime rates	2 (1.9)	3 (2.8)	30 (28.3)	51 (48.1)	20 (18.9)	3.86	.786

Statements	SD n (%)	D n (%)	M n (%)	A n (%)	SA n (%)	Mean	S.D
The right products are consistently available at the right time in the facility	1 (0.9)	9 (8.5)	33 (31.1)	44 (41.5)	19 (17.9)	3.73	.846
The facility implements government regulations to control the pricing of essential medicines and technologies	0 (0.0)	8 (7.5)	25 (23.6)	50 (47.2)	23 (21.7)	3.90	.804
Patients obtain health products at the lowest possible cost	2 (1.9)	5 (4.7)	33 (31.1)	46 (43.4)	20 (18.9)	3.76	.834
There is always reduced out-of-pocket expenses for health products	4 (3.8)	8 (7.5)	34 (32.1)	43 (40.6)	17 (16.0)	3.64	.886
The facility procures health products and technologies that meet quality standards	3 (2.8)	9 (8.5)	39 (36.8)	39 (36.8)	16 (15.1)	3.58	.904
The facility addresses any quality issues raised on the HPTs quickly	7 (6.6)	16 (15.1)	36 (34.0)	40 (37.7)	7 (6.6)	3.27	.981
HPTs are stored under recommended conditions	3 (2.8)	8 (7.5)	42 (39.6)	42 (39.6)	11 (10.4)	3.50	.854

The majority of respondents agreed that HPTs were not effectively managed. Specifically, the average response suggested that participants generally agree that leadership effectively fosters a motivational and recognition culture within HPT management (Mean: 3.79). The relatively high mean score indicated a positive perception of leadership's role in enhancing team motivation and recognition. Respondents mostly agree that there is timely acquisition of necessary HPTs (Mean: 3.86). therefore, ensuring the timely procurement of HPTs remains a strength. The respondents indicated a general agreement that hospital departments have good access to the necessary HPTs, though there might be room for improvement in some areas (Mean: 3.73). Addressing any barriers to access could further enhance operational efficiency and ensure that all departments consistently receive the required HPTs. Always, the hospital maintains adequate stock levels of essential medicines and technologies, with minimal instances of stockouts (Mean: 3.74), reflecting effective inventory management practices.

Conversely, the lower mean score indicates that respondents were less positive about the facility's responsiveness to quality issues with HPTs (mean=3.27). This suggested that quality concerns may not be addressed as promptly as desired. Thus, improving the speed and effectiveness of addressing quality issues can enhance the overall management of HPTs and increase stakeholder confidence in the facility's quality control measures. Overall, the analysis reveals strengths in several areas of HPTs management, such as timely acquisition and cost control, while also highlighting opportunities for improvement, particularly in addressing quality issues and ensuring consistent availability and access to HPTs.

The key interviewee submitted that the county encourages cross-functional collaboration to address challenges in managing HPTs.

"... the county encourages timely and accurate communication, leadership to give the facility direction on all aspects. Also, the facility structure allows autonomy and teamwork, through the County HPTU, which is multidisciplinary and incorporates some members from service delivery units..." (KII, 008, 24th June, 2024).

4.12 Diagnostic Test Results

Diagnostic tests were conducted to ensure that appropriate statistical tests were applied in the analysis to ensure precision in estimations. They ensured that the assumptions required for statistical techniques, correlations and hierarchical multiple regressions, and Analysis of Variance (ANOVA), were met. The tests included a normality test, a multicollinearity test, and an autocorrelation test.

4.12.1 Normality Test

A normality test is used to determine whether data comes from a population that follows a normal distribution. The normality test was primarily conducted on the residuals of the dependent variable because correlation and linear regression rely on the assumption that these residuals are normally

distributed. This assumption ensures the validity of hypothesis tests and confidence intervals derived from the analysis. This enhanced robustness of results through the calculation of p-values and confidence intervals, which are central to statistical inference. The normality test was not typically conducted on independent variables of their flexibility nature; Independent variables can take on any distribution, whether normal or not because their main role is to explain or predict the variance in the dependent variable, not to satisfy the normality assumption because their role was to explain variance in the dependent variable, not to meet the model's assumptions directly.

There are two statistical tests for normality: the Shapiro-Wilk Test and the Kolmogorov-Smirnov Test. Primarily, the Shapiro-Wilk Test was reported because it tests the null hypothesis that the data is normally distributed. conversely, the Kolmogorov-Smirnov test compares the data distribution with a reference distribution, such as a normal distribution, to suggest deviations from normality. Additionally, the Shapiro-Wilk Test is appropriate for cases above 50 (n=106). The study conducted the normality test for all variables. For each normal test, the results were visualized with a histogram and normal Q-Q plots. The histograms were expected to be close to each other because a bar standing alone indicates deviation from the data, outliers, or extremes.

Table 4.40

Shapiro-Wilk Test of dependent variable

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Dependent variable	Statistic	df	Sig.	Statistic	df	Sig.

HPTs Management	.074	106	.181	.979	106	.090

a. Lilliefors Significance Correction

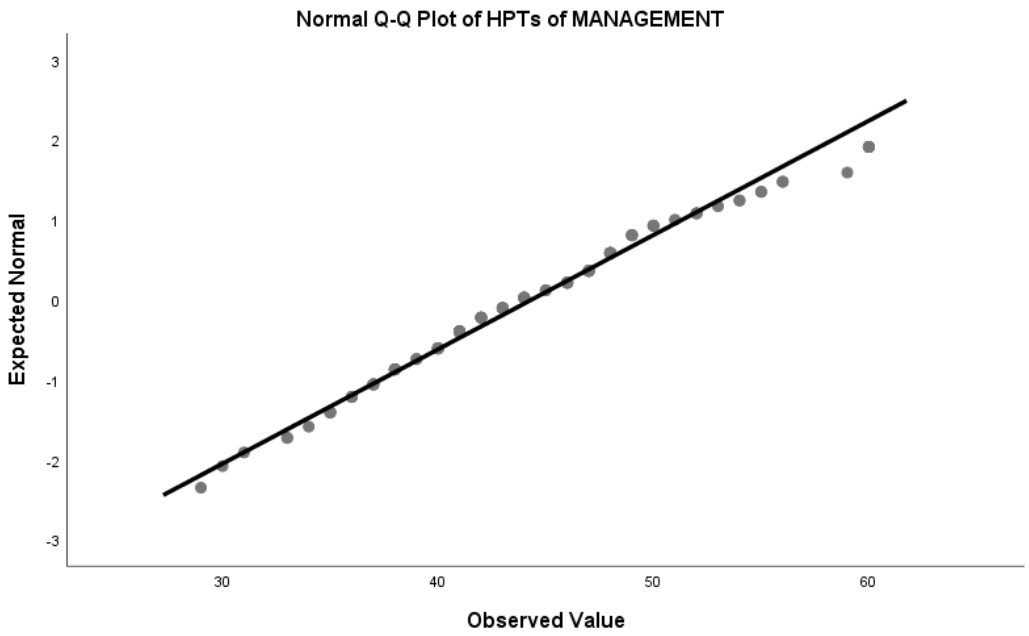
The results depicted a Shapiro-Wilk test statistic of .979. The closer this value is to 1, the more likely the data is normally distributed. The p-value > 0.05 indicated non-significant values, suggesting that there is no significant deviation from normality. The degree of freedom is provided by the number of observations in the data sets. Therefore, the scores on the dependent variable were normally distributed, which guided the researcher to apply parametric techniques.

Khatoon (2020) affirms that a Shapiro-Wilk test statistic close to 1 and a non-significant p-value reliably indicate that the data is normally distributed, supporting the use of parametric techniques for analysis. Conversely, caution that relying only on the Shapiro-Wilk test can be problematic, as it may not fully capture deviations from normality, particularly in large samples, and recommend combining it with other tests and visual assessments to ensure accuracy (Bwanga & Chanda, 2020).

Graphically, histograms and normal Q-Q plots provided a visual representation of data distribution.

Figure 2

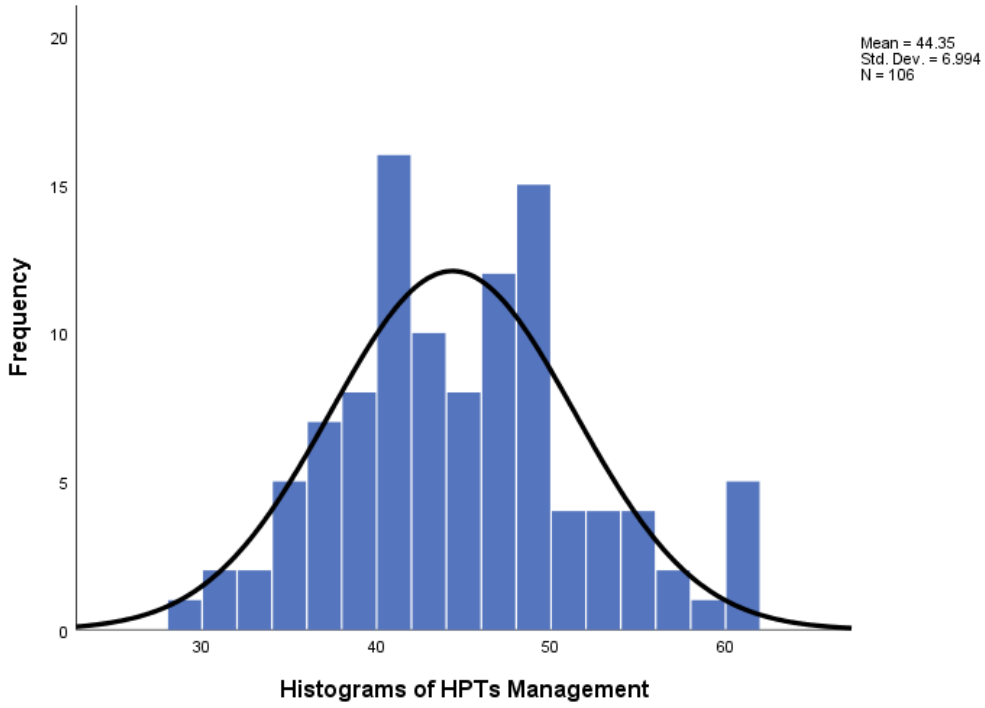
The Normal Q-Q Plots of Dependent Variable



An inspection of the normal probability plots (Normal P-P plots), the distribution of scores on the dependent variable were normally distributed. From the normal fit line in the normal Q-Q Plots, the scores appeared to be reasonably above and over the normal line.

Figure 3

Histograms of HPTs Management



The histogram with a "superimposed" normal curve suggested that the data is perfectly normally distributed.

4.12.2 Multicollinearity test

A multicollinearity test was conducted to determine the level of interrelationship among the independent variables. Multicollinearity, which occurs when two or more independent variables in a regression model are highly correlated, was examined. Highly correlated predictors would cause issues in estimating the coefficients of the model, leading to less reliable and unstable estimates. This would further make it difficult for the study to determine the individual effect of each predictor. The degree of multicollinearity in the model was quantified through tolerance and Variance Inflation Factor (VIF) tests.

Table 4.41

Multicollinearity test

	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
Model	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
(Constant)	-6.025	5.198		-1.159	.249		
Financing	.231	.086	.206	2.688	.008	.794	1.259
Supply Chain	-.031	.051	-.050	-.601	.549	.662	1.511
Human Resources factors	.225	.069	.252	3.249	.002	.773	1.294
Inventory optimization	.392	.102	.356	3.841	.000	.540	1.850
Health Management Information System	.136	.058	.207	2.335	.022	.591	1.693

a. Dependent Variable: Management of HPTs

Source: Field data (2024)

From the analysis, all the tolerance values for all independent variables were less than 1.0 and greater than 0.1, while all Variance Inflation Factor values were greater than 1.0 and less than 10, implying that there was no violation of the assumption of multicollinearity among the independent variables.

4.12.3 Auto-correlation Test

The test of autocorrelation was done using the Durbin-Watson test to detect the presence of first-order autocorrelation in the residuals from a regression analysis. Autocorrelation would occur when residuals from a regression model are not independent but instead follow a pattern. The Durbin Watson test reports a test statistic that ranges from 1.5 and 2.5. If the Durbin Watson test value falls in this range, then, no violation of the assumption of first-order autocorrelation. Values outside this range could be cause for concern (Park et al., 2020).

Table 4.42

Durbin-Watson test of Autocorrelation

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.732[a]	.535	.512	4.886	1.870

a. Predictors: (Constant), financing, supply chain, huma resource factors, inventory optimization, health management information systems

b. Dependent Variable: management of HPTs

Source: Field data (2024)

The results depict a Durbin-Watson value of 1.870, which ranges between 1.5-2.5. The null hypothesis of no autocorrelation was accepted in favour of the alternative hypothesis because the residuals were not autocorrelated.

4.13 Correlation analysis

Bivariate Pearson product-moment correlation analysis was used to measure the strength and direction of the relationship between the independent variables and the dependent variable. Further, the analysis assessed whether the associations reached statistical significance or not.

Table 4.43

Correlations between Independent Variables and Dependent Variable

		Y	X1	X2	X3	X4	X5
Y	Pearson Correlation	1					
	Sig. (2-tailed)						
	N	106					
X1	Pearson Correlation	.423**	1				
	Sig. (2-tailed)	.000					
	N	106	106				
X2	Pearson Correlation	.383**	.411**	1			
	Sig. (2-tailed)	.000	.000				
	N	106	106	106			
X3	Pearson Correlation	.509**	.254**	.372**	1		
	Sig. (2-tailed)	.000	.009	.000			
	N	106	106	106	106		
X4	Pearson Correlation	.636**	.350**	.463**	.416**	1	
	Sig. (2-tailed)	.000	.000	.000	.000		
	N	106	106	106	106	106	
X5	Pearson Correlation	.544**	.241*	.436**	.364**	.609**	1
	Sig. (2-tailed)	.000	.013	.000	.000	.000	
	N	106	106	106	106	106	106

Y=HPTs management; X1=HPTs financing; X2=supply chain management; X3=human resources factors; X4=inventory management; X5=Health management information system

Source: Field data (2024)

The study revealed that all the predictor variables had a positive and significant association with the criterion variable. In particular, the HPTs financing positive, moderate, and significant association with the management of HPTs (r=.423**, n=106, P=0.000). The results implied that higher levels of financing are associated with better management of HPTs, and the relationship would be unlikely to be due to random variation in the sample.

Further, the study observed that supply chain practices had a positive, weak but significant association with the dependent measure (r=.383**, n=106, P=0.000). This suggests that improvements or better practices in the supply chain are associated with better management of HPTs. However, the impact of supply chain practices on the management of HPTs was modest. The p-value was significantly below the conventional alpha level of 0.05 at 95% confidence, indicating that the association is statistically significant. Thus, the observed relationship provided strong evidence of a real association between supply chain practices and the management of HPTs.

The research revealed that the correlation between human resource factors and management of health products and technologies was 0.509 (r=.509**, n=106, P=0.000). The moderate to strong positive correlation (r = 0.509) between human resource factors and the management of health products and technologies suggested that better human resource practices are associated with more effective management of these technologies. The correlation was statistically significant, as evidenced by the p-value of 0.000, indicating that the relationship was both reliable and not due to chance. This finding highlighted the importance of human resource factors in improving the management of health products and technologies.

Additionally, the study found a positive, strong, and statistically significant correlation (r = 0.636, n=106, P=0.000) between inventory optimization and the management of health products and technologies. This indicated that better inventory management practices are significantly associated

with more effective management of health products and technologies. The strong relationship was not due to random chance, as evidenced by the p-value of less than the empirical value of 0.05 at 95% confidence level. Optimizing inventory management can substantially enhance the management of health technologies.

Also, the study assessed whether the association between the health management information systems and the management of HPTs existed. Effective information systems can streamline processes, improve data accuracy for forecasting and quantification to enhance decision-making, potentially leading to better management outcomes for HPTs. The study revealed that health management information systems had a positive, strong, and statistically significant association with the management of HPTs ($r=544^{**}$, n=106, P=0.000). The study identified a strong positive correlation (r = 0.544), which implied that effective HMIS is strongly associated with better management of HPTs. The association is statistically significant (p = 0.000), providing strong evidence that the relationship is real and not due to random chance. The results underscored the importance of investing in and optimizing HMIS to improve the management of HPTs in hospitals.

Uzochukwu et al. (2020) in Nigeria found that improved human resource management practices were significantly associated with better management of health technologies, aligning with the study's finding of a strong positive correlation between human resource factors and HPT management (Uzochukwu et al., 2020). However, Ranganathan (2020) in India found no significant impact of supply chain practices on health technology management, which contrasts with your study's observation of a positive but weak association, suggesting that the influence of supply chain practices on HPT management may differ by context (Ranganathan, 2020).

4.14 Multiple Regression Analysis Results

Multiple regression was conducted to explore the predictive ability of the predictor variables on the management of HPTs. The multiple regression evaluated how well the model explained the total variance of the dependent variable. Further, multiple regression provided the moderating influence of institutional leadership culture as well as the relative contribution of each of the predictor variables that made up the model and determined whether the model was statistically significant or not. Preliminary analyses were conducted to ensure no violation of the assumptions of normality, autocorrelation, and multicollinearity.

4.14.1 Model summary

The study evaluated the fit and performance of regression models. Model summary was crucial for understanding how well the models explained the variability in the dependent variable based on the independent variables.

Table 4.44

Model Summary

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.732[a]	.535	.512	4.886	.535	23.029	5	100	.000
2	.732[b]	.536	.507	4.908	.000	.092	1	99	.762

a. Predictors: (Constant), Financing, supply chain practices, human resources factors, inventory optimization, health management information system

b. Predictors: (Constant), Financing, supply chain practices, human resources factors, inventory optimization, health management information system, Leadership

c. Dependent Variable: Management of HPTs

From the model summary analysis, there are two models. **Model 1** is the baseline model with a set of baseline predictor variables (Financing, supply chain practices, human resources factors, inventory optimization, health management information system). Model 2 is the expanded model that includes the mediating predictor (Financing, supply chain practices, human resources factors, inventory optimization, health management information system, and leadership culture).

The R Square value of 0.535 indicated that 53.5% of the variance in the management of HPTs was explained by the five predictors in Model 1. This meant that the model had a moderate to strong explanatory power, but there was still a significant portion of variance (46.5%) that was not accounted for by these predictors. This was a very high proportion, indicating that the model was very effective at predicting the dependent variable and that the chosen independent variables were appropriate and sufficient for explaining the dependent variable. Therefore, the researcher was confident in the robustness of the model based on the independent variables included in the study.

To check whether the model occurred by chance or rather potential overestimation of the R Square in the presence of multiple predictors, the Adjusted R Square was analysed. The study estimated an Adjusted R Square value of 0.512 accounts for the number of predictors in the model and adjusts for an Adjusted R Square of 0.512, indicating that 51.2% of the variance in the management of HPTs is explained by the model, slightly less than the R Square but still a strong effect. However, adjusted R Square is reported with relatively small sample sizes ($n<30$).

Model 2 was constructed to examine if institutional leadership culture, when entered into the original set of predictors in Model 1, would significantly enhance the ability to predict the management of HPTs. The goal was to see if this additional variable would explain more of the variation in the management of HPTs. The addition of leadership culture in Model 2 did not significantly affect the results of the other predictors, as their significance levels remained nearly the same. The non-significant p-value for leadership culture (P=0.762) in Model 2 indicates that including leadership culture as a predictor does not add meaningful explanatory power to the model. Further, the F-change statistics were not significant, and the R Square change was 0%, indicating that institutional leadership culture had no effect on the model's ability to predict the management of HPTs (R Square change =.000, F Change = .092, df1=1, df2= 99, Sig F. Change= 0.762). Therefore, adding this variable did not improve the model, and its influence on the outcome is negligible. This could suggest that leadership culture is not a key factor in predicting the management of HPTs in public hospitals in Kenya.

Agreeing with the findings of this study, Parayitam et al. (2021) concluded that adding predictors like leadership culture often does not significantly enhance a model's explanatory power when the initial variables already account for substantial variance (Parayitam et al., 2021). Similarly, Njogo (2022) found that leadership's impact might not be statistically significant in every context, aligning with the results here (Njogo, 2022). However, Mirera (2020) argued that leadership could have an indirect effect on outcomes, suggesting that its role may still be crucial through mediating variables not included in the analysis (Mirera et al., 2020).

4.14.2 Analysis of Variance

Analysis of Variance (ANOVA) was constructed to test the overall significance of a regression model.

Table 4.45

Analysis of Variance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2748.818	5	549.764	23.029	.000[b]
	Residual	2387.267	100	23.873		
	Total	5136.085	105			
2	Regression	2751.031	6	458.505	19.032	.000[c]
	Residual	2385.054	99	24.091		
	Total	5136.085	105			

a. Dependent Variable: HPT Management

b. Predictors: (Constant), Financing, supply chain practices, human resources factors, inventory optimization, health management information system

c. Predictors: (Constant), Financing, supply chain practices, human resources factors, inventory optimization, health management information system, leadership

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The results represented an ANOVA test for two regression models predicting the management of HPTs. The F-statistic was lower for Model 2 (19.032) compared to Model 1 (23.029). This reduction suggested that adding the leadership culture variable does not improve the model as much as the original set of predictors did. However, despite the slight decrease in the F-statistic, the model

remained statistically significant, with a p-value of 0.000, indicating good fitting for the data in explaining the variation in the dependent variable.

Agreeing with the results, Inastrilla (2022) argued that while adding variables such as leadership to regression models could potentially enhance predictive power, it does not always lead to substantial improvements, especially if the original predictors already strongly explain the variance in the dependent variable (Inastrilla, 2022). Similarly, Lahariya (2020) found that introducing additional variables in a model sometimes results in a lower F-statistic without significantly enhancing the model's overall explanatory power, as observed in their study on technology management (Lahariya, 2020). On the other hand, contrary to these findings, Khatoon (2020) suggested that the inclusion of leadership as a predictor often enhances model performance in predicting management outcomes, indicating that the effectiveness of additional variables may depend on the specific context of the research (Khatoon, 2020).

4.14.3 Regression Weights: Standardized coefficients

The study estimated the standardized weights before introducing the moderating effect of the new predictor to test the individual unique contribution towards the total variance in the dependent measure. This would enable the study to understand whether the individual predictive ability of the variables is moderated by entering the leadership variable in the model.

Table 4.46

Coefficients

Model	Unstandardized Coefficients	Standardized Coefficients	t	Sig.

		B	Std. Error	Beta		
1	(Constant)	-6.025	5.198		-1.159	.249
	X1	.231	.086	.206	2.688	.008
	X2	-.031	.051	.050	-.601	.549
	X3	.225	.069	.252	3.249	.002
	X4	.392	.102	.356	3.841	.000
	X5	.136	.058	.207	2.335	.022

a. Dependent Variable: HPT Management

The results indicated that all the predictor variables were statistically significant, explaining the individual model apart from supply chain practices (X2) with P=.549 which was greater than the conventional significance of 0.05 at 95% confidence level. Further, supply chain practices provided a negative (inverse) t-statistic with small magnitude (-0.601), implying the coefficient is likely not significantly different from zero in terms of standard errors. This revealed that, as supply chain practices increase, the management of HPTs decreases. The findings were subject to further interrogation after introducing moderation by institutional leadership culture.

Di Matteo (2021) in South Korea both found that the introduction of new supply chain practices did not significantly enhance management efficiency in healthcare, aligning with the inverse relationship observed in the current study. They noted that rigid institutional frameworks and inadequate contextual adaptation could lead to inefficiencies (Lee et al., 2021). However, Pérez-Escoda et al. (2020) in Spain disagreed, finding that tailored supply chain practices, when supported by effective leadership, significantly improved healthcare management, challenging the negative correlation reported.

Among the predictor variable that reached significance, inventory optimization, X4 provided the highest unique contribution towards the total variance (Beta=0.356; t=3.841; P=0.000), followed by human resources factors (Beta=0.252; t=3.249; P=0.002), health management information system

(Beta=0.207; t=2.335; P=0.022) and HPTs financing provided the lowest significant contribution of 0.206) (Beta=0.206; t=2.688; P=0.008).

4.14.4 The regression weights after entering the mediating variable in the model

The study estimated the individual predictors' significant contribution to the total variance on the dependent measure after introducing the institutional leadership culture as a mediating variable.

Table 4.47

The regression weights after entering the mediating variable in the model

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	**Std. Error**	**Beta**	**t**	**Sig.**
1	(Constant)	-6.025	5.198		-1.159	.249
	Financing	.231	.086	.206	2.688	.008
	Supply chain practices	-.031	.051	-.050	-.601	.549
	Human resources factors	.225	.069	.252	3.249	.002
	Inventory optimization	.392	.102	.356	3.841	.000
	Health management information system	.136	.058	.207	2.335	.022
2	(Constant)	-7.021	6.171		-1.138	.258
	Financing	.231	.086	.206	2.683	.009

Supply chain practices	-.032	.051	-.052	-.616	.539
Human resources factors	.224	.070	.251	3.213	.002
Inventory optimization	.392	.103	.356	3.823	.000
Health management information system	.137	.058	.209	2.342	.021
Leadership Culture	.023	.077	.021	.303	.762

a. Dependent Variable: Management of HPTs

Management of HPTs = -7.021+.231 financing -.032 supply chain practices +.224 human resources factors +.392 inventory optimization + .137 health management information system +.023 leadership.

The study applied model 2 coefficients to equate the regression model because Model 2 coefficients account for the influence of all relevant variables, including all predictors from Model 1, plus the additional predictor (leadership culture). Further, the coefficients in Model 2 are adjusted for the effects of both the baseline and additional predictors, providing a more comprehensive view of their relationships with the dependent variable.

From the conventional regression model, $Y = \beta0 + \beta1X1 + \beta2X2 + \beta3X3 + \beta4X4 + \beta5X5 + \varepsilon$, where Y is the management of HPTs, β_0 (beta-zero) is the intercept of the regression equation. The intercept is the value of the dependent variable (Y) when all the independent variables (X_1, X_2, ... X_n) are equal to zero. The β_1 is the coefficient of the independent variable (X_i), representing the change in the dependent variable (Y) for a one-unit change in X_i. ε: The error term, accounting for the variability in Y that cannot be explained by the model. The resulting regression model was constructed from the unstandardized weights.

Management of HPTs = -7.021+.231 financing -.032 supply chain practices +.224 human resources factors +.392 inventory optimization + .137 health management information system +.023 leadership.

The intercept value of -7.021 was the expected value of the Management of HPTs when all independent variables are equal to zero. the constant primarily served as a baseline for the model. Notwithstanding, the negative intercept might not have a practical interpretation because it was unlikely that all predictors would be zero simultaneously. The HPTs financing had a coefficient of 0.231, implying that, for every one-unit increase in financing, the management of HPTs is expected to increase by 0.231 units, assuming all other factors remain constant. This positive coefficient suggests that better financing is associated with improved management of HPTs.

For every one-unit increase in supply chain practices, the management of HPTs is expected to decrease by 0.032 units, holding other factors constant. This negative coefficient implies that, in this model, better supply chain practices are slightly associated with a decrease in the management of HPTs, which might be counterintuitive or indicate complexities in the relationship that need further exploration to understand its implications fully.

Further, the study revealed that, for every one-unit increase in human resources factors, the management of HPTs is expected to increase by 0.224 units, assuming other variables are constant. This positive relationship indicated that better human resource management was associated with improved management of HPTs.

For every one-unit increase in inventory optimization, the management of HPTs is expected to increase by 0.392 units, holding other variables constant. This was the strongest positive coefficient in the model, suggesting that efficient inventory optimization was a significant driver of better HPT management.

Finally, for every one-unit increase in the health management information system, the management of HPTs is expected to increase by 0.137 units, assuming other variables are constant. This indicated a positive relationship where better health information systems contribute to better management of HPTs.

The findings mirrored those of Weymann et al. (2022) in Canada and Webster and Wyatt (2020) in Australia that increased financing and better human resource management positively impact healthcare management, aligning with the study's findings (Webster & Wyatt, 2020). However, Vieira-da-Silva (2021) in Brazil disagrees with the negative coefficient for supply chain practices, as their research found that improved supply chain practices enhanced healthcare management, indicating a potential context-dependent relationship (Vieira-da-Silva, 2021).

4.14.5 Exploring individual predictive ability on the dependent variable after moderating the effect with institutional leadership culture

The study revealed that, even after introducing leadership culture into the model, all the predictor variables provided significant contributions to the dependent variables apart from supply chain practices (P=.616). Still among the predictors, inventory optimization provided the highest contribution towards the total variance (Beta=0.356; t=3.823; P=0.000), followed by human resources factors (Beta=0.251; t=3. 3.213; P=0.002); health management information system (Beta=0.209; t=2.342; P=0.021) and HPTs financing provided the lowest significant contribution of 0.206 (Beta=0.206; t=2.683; P=0.009).

Inventory optimization made the most substantial unique contribution to explaining the variance in the management of HPTs and stood out as the most impactful predictor of the management of HPTs, followed by human resources factors and the health management information system. Although HPTs

financing had the lowest significant contribution, it still played a meaningful role in predicting the management of HPTs. All these predictors contribute positively and significantly, underscoring their importance in the effective management of health products and technologies.

In Tharaka Nithi County, Kameti rt al. (2023) found that inventory optimization played a crucial role in improving the management of health commodities, particularly in minimizing stockouts and ensuring continuous supply (Kameti et al., 2021) emphasized the significance of human resources factors in managing HPTs effectively, noting that well-trained personnel are essential for the proper handling and utilization of health resources (Mbatia, 2021). However, a study by Kosgei (2020) in Laikipia County disagreed with the impact of the health management information system (HMIS) on HPTs management, arguing that despite its intended benefits, HMIS had limited influence due to persistent issues with data reliability and system usage in the county (Kosgei, 2020).

4.15 DISCUSSION

HPT management is a process that leads to the availability of high-quality, safe, and effective medications. This is accomplished by first selecting HPTs based on available evidence and guidelines and then following standard operating procedures for requisition/ordering, procurement, receiving, and storage. Management ensures that HPTs are of high quality from the time they arrive at the health facility until they are dispensed to clients or patients. Management of HPTs also aims to get the best prices for HPTs so that they can be provided to patients at an affordable cost. To avoid stockouts, management's planning function focuses on proper forecasting and quantification, as well as order lead times and turnaround times. By automating services, investing in staff, and securing proper storage facilities, HPT management can significantly improve access to essential HPTs.

4.15.2 Pillars of Health Products and Technologies Management

The management of the health products and technologies in the study counties is poor and inefficient. To ensure consistent availability of quality and affordable essential medicines and medical supplies, management of health products and technologies is built on four pillars of health financing, where adequate and timely disbursement of funds promotes timely acquisition and payment of suppliers for the HPTs. The funds allocated for HPTs need to be managed in a transparent manner, involving all the stakeholders in decision-making. The human resources for health pillar plays a major role in ensuring proper management of HPTs by promoting good ordering practices, rational use of medicines and medical products and making timely decisions on procurement and payment of suppliers. Human resources for health need to be properly trained in health commodity management, adequately and well distributed across all functions involved in the management of HPTs. Inventory management is a key pillar of HPT management by promoting adequate and safe storage of health products and technologies. Supply chain practices are also a critical pillar in supporting management of health products and technologies through timely procurement, efficient logistics for the distribution of essential health products and technologies, and identification and pre-qualification of suppliers. These pillars are supported by leadership culture as the base and covered by the health management information system as the roof. A strong institutional leadership culture is critical in promoting efficient management of health products and technologies through proper planning, coordination, and motivation culture. Health management information systems are the nerves that connect all functions involved in the management of health products and technologies. Integration and adoption of HMIS in the management of health products and technologies promote accuracy in data used to make decisions and stock visibility within the system. This mitigates against overstocking or understocking. Deployment of HMIS requires adequate and elaborate ICT infrastructure, including hardware and software. The diagram below shows the pillars of health products and technologies management.

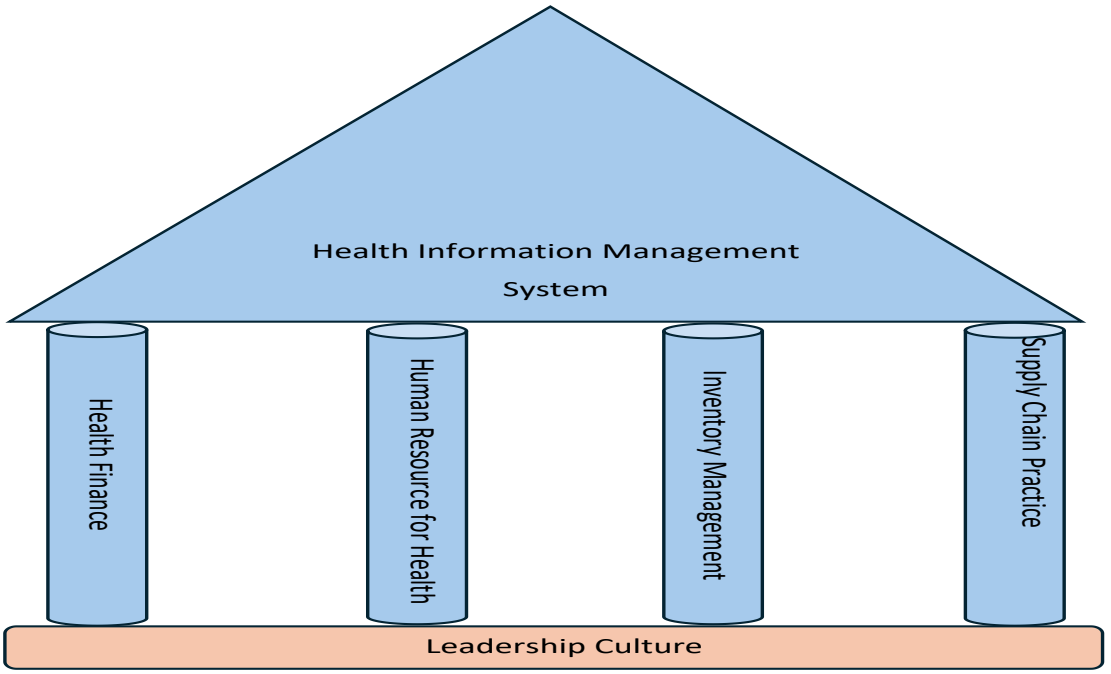


Figure 4. Diagram showing pillars of Health products and technologies management.

4.15.2 Current situation in the management of Health Products and Technologies.

Current management of HPTs is inefficient and takes a long time to complete the health commodity management cycle as established by the study. This inefficient process exposes the patient to a dual tragedy of inadequate or lack of access to quality and affordable health products and technologies. This agrees with the admission by the cabinet secretary for health and investigations by the Daily Nation stating that patients stare at a double headache of inadequate supply of medicines and accumulation of expired medicines.

The current model used in the management of health products and technologies in public health facilities starts with needs identification and raising the requisition. Depending on the level of the health facility and the complexity of the services offered, it takes approximately one month to analyze, collate the needs for various departments, and raise requisitions, as well as have the requisitions fully

approved for the acquisition of required essential health commodities to commence. In the current model procurement process is quite inefficient sometimes a month or so to complete the process. This process involves floating of bids to eligible, evaluation of the bids, preparation of local purchase orders (LPOs), allocation of the vote heads and final approval of the LPOs. Logistics management, which includes the distribution of the procured commodities from the suppliers to the health facilities, also takes sometimes more than a month to receive all the commodities orders from some of the suppliers such as KEMSA. The current inventory management approach is premised on old practices of holding stock procured in bulk this increasing the risk of pilferage, cost of warehousing, increasing stock holding cost, expiries and obsolescence. The current inventory management in public health facilities advocates stocking holding for at least three months buffer and one month working stock which is not only costly but inefficient. The payment of suppliers also takes a lot of time extending well over three months with likely impact of increasing prices and withholding supplies leading to out of stock.

The illustration below shows the current model in management of HPTs

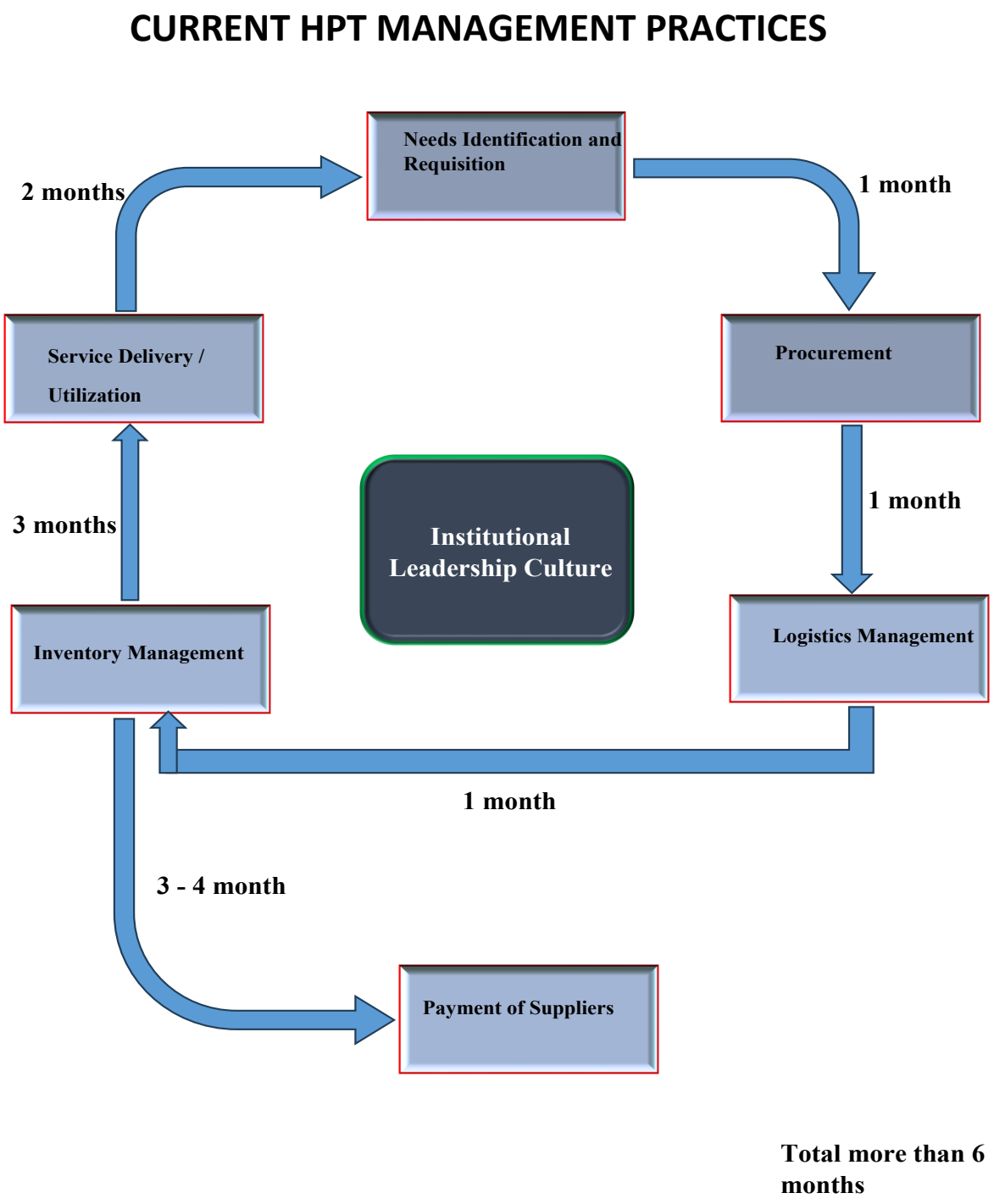


Figure 5: Diagram showing the current model for management of HPTs

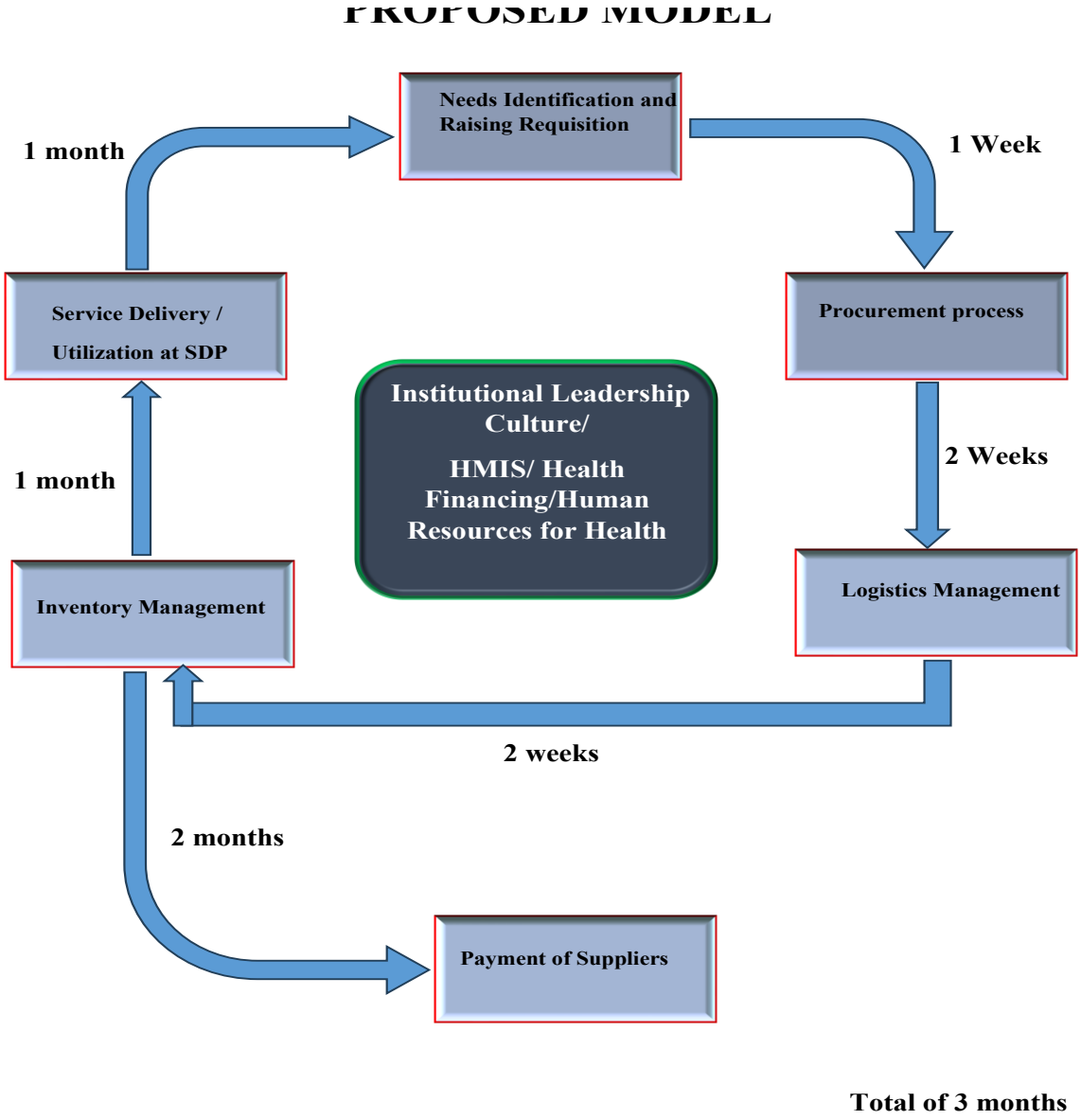
4.15.2 Proposed model for Management of Health Products and Technologies

The study established that there is a relation between the study variables and the management of Health Products and Technologies. All the variables except the moderating variables and supply chain practices had strong correlations with the access to quality and affordable health products and technologies.

Therefore, an efficient model for management of health products and technologies is proposed. The proposed model advocates rapid identification, analysis and validation of the needs as well as raising requisition within a period of one week. This can be achieved through automation and adoption of data driven decision making processes. The proposed model also advocates for shorter periods to conclude the procurement process of approximately one week. This can be achieved by prior pre-qualification and identification of suppliers, use of framework agreements with prequalified suppliers and prior development of specifications involving all the stakeholders as well as establishment of a multi-disciplinary health products and technologies unit in the health facility to promote quick decision making. The model also proposes an efficient logistics management system where it takes only two weeks to receive all the commodities orders from the suppliers. The suppliers sign agreements with performance indicators for On Time In Full (OTIF) delivery. The suppliers issue credit notes for the items they are not able to supply to allow for sourcing from alternative suppliers. The proposed model also proposes lean inventory management with one month buffer stock and one month working stock to reduce the risk of pilferage, mitigate against expiries and reduce the stock holding cost. For some highly specialized health commodities, the model proposed adoption of Just In Time (JIT). The model also advocates for timely payment to suppliers within two months. This ensures the suppliers are well stocked, reduces the cost of HPTs due to arising from lower cost of credit. The success of the proposed model is anchored on adequate financing and timely disbursement of finances, availability of well-

trained human resources for health and a robust health information management system. Below is an illustration of proposed model for health products and technologies management.

PROPOSED HPT MANAGEMENT MODEL



CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

The chapter presents the summary of the study, conclusions drawn from the study key findings, recommendations, implication for policy and practice and further scope of research. The study explored the impact of financing, supply chain practices, human workers' factors, inventory optimization and health management information systems on the management of HPTs in public hospitals across selected counties in Kenya. The research tested the null hypotheses: that financing, supply chain practices, human workers' factors, inventory optimization and health management information systems do not significantly influence HPT management in these hospitals. Additionally, it hypothesized that institutional leadership practices have no statistically significant mediating effect on HPT management. More so, the study applied both statistical analysis and thematical analysis from qualitative data. For quantitative data, descriptive statistics (percentiles, mean and standard deviation) and inferential statistics; chi-square test, Kruskal-Wallis H test, ANOVA, Pearson correlation analysis and multiple hierarchical regression) were analysed. The study attained a 71.0% return response. Prior to inferential statistic estimations, diagnostic tests; normality test, autocorrelation and multicollinearity were conducted to assess the violation of assumptions.

5.1 Summary of the Study

The reliability analysis determined that the research tools were dependable. The study observed that Machakos County had the highest representation among respondents, with the majority working at Level 4 Subcounty Hospitals. Most of these respondents were senior staff, predominantly male, and

held undergraduate or diploma qualifications. Nearly half had between one to five years of work experience.

5.1.1 Model Summary

The study found that financing, supply chain practices, human resources factors, inventory optimization, and the health management information system together explained a significant proportion of the variance in the management of HPTs. However, when institutional leadership practices were introduced into the model, they did not improve its explanatory power. This suggests that leadership culture is not a key predictor of HPT management in public hospitals.

Although the statistical models remained significant, the addition of leadership factors slightly reduced their explanatory strength. The regression model indicated that financing, human resources, inventory optimization, and health management information systems were the main contributors to effective HPT management. Leadership, however, had little measurable impact.

5.1.2 HPTs Financing and Management of Health Products and Technologies

The study revealed that budgetary allocation was overwhelmingly perceived as the most critical factor affecting the management of HPTs, with Nyeri County demonstrating particularly strong performance in both allocation and budget absorption. Financing was widely regarded as central to the effective management of HPTs, with higher funding linked to better outcomes. Adequate and efficiently managed budgetary allocation emerged as the most important driver of success.

5.1.3 Supply Chain Practices and Management of Health Products and Technologies

Procurement processes were identified as the major supply chain factor influencing HPT management in public hospitals. Counties relied heavily on KEMSA and MEDS as suppliers, with delivery timelines ranging from three to six weeks. Payment to suppliers was generally completed within one

to two months. The findings suggested that delays and inefficiencies in procurement and delivery had a direct effect on HPT management. Improvements in procurement systems were therefore associated with better outcomes.

5.1.4 Human Resources Factors and Management of Health Products and Technologies

Staffing was identified as the most significant human resource factor affecting the management of HPTs across all counties. Training frequency varied across counties, with Nyeri providing more regular training, while Kisumu's training was less frequent but considered highly effective by respondents. Compensation structures also varied, with Kisumu's considered the most satisfactory. Attitudes of health workers, especially in Kiambu, were seen as influential in the management of HPTs. Human resource capacity emerged as one of the strongest predictors of effective management, underlining the importance of staffing, training, compensation, and staff attitudes.

5.1.5 Inventory Optimization and Management of Health Products and Technologies

The study revealed that inventory practices such as First-Expiry-First-Out (FEFO), safety stock policies, and record-keeping were the most influential factors affecting HPT management. Most counties relied on moderate-level software systems for managing inventories. Nyeri reported the highest frequency of stock reviews, while Kisumu and Machakos demonstrated strong record-keeping practices. Although there were differences across counties, these were not statistically significant. Overall, inventory optimization was found to be the most impactful predictor of effective HPT management, emphasizing the importance of reliable stock control systems and policies.

5.1.6 Health Management Information System and Management of Health Products and Technologies

The application of HMIS and data quality were identified as the most impactful elements influencing HPT management. While training effectiveness varied slightly across counties, the differences were not significant. Nyeri County demonstrated frequent HMIS usage, while Isiolo lagged behind, though overall usage was relatively consistent. Isiolo exhibited strong ICT infrastructure deployment, while Machakos was considered to have high data quality. Kiambu, however, was perceived to have weaker data quality.

Health management information systems were shown to be strong predictors of effective HPT management. The findings underscored the importance of investing in and optimizing HMIS to strengthen forecasting, accountability, and overall efficiency in the management of health commodities

5.2 Conclusions

Conclusions were drawn from the study findings in relation to each study objective.

5.2.1 HPTs financing and management of health products and technologies

The study tested the hypothesis:

H01: Financing has no significant influence on the management of health products and technologies in selected counties, Kenya.

Ha1: Financing has a significant influence on the management of health products and technologies in selected counties, Kenya.

Decision: The study rejected the null hypothesis (H01) and concluded that financing significantly influences the management of HPTs in public hospitals in Kenya.

5.2.2 Supply chain practices and management of health products and technologies

The study tested the hypothesis:

H02: Supply chain practices have no significant influence on the management of health products and technologies in selected counties, Kenya.

Ha2: Supply chain practices have a significant influence on the management of health products and technologies in selected counties, Kenya.

Decision: The study failed to reject the null hypothesis (H02) and concluded that supply chain practices do not significantly influence the management of HPTs in public hospitals in Kenya.

5.2.3 Human resources factors and management of health products and technologies

The study tested the hypothesis:

H03: Human resource for health factors has no significant influence on the management of health products and technologies in selected counties, Kenya.

Ha3: Human resource for health factors has a significant influence on the management of health products and technologies in selected counties, Kenya.

Decision: The study rejected the null hypothesis (H03) and concluded that human resource factors significantly influence the management of HPTs in public hospitals in Kenya.

5.2.4 Inventory optimization and management of health products and technologies

The study tested the hypothesis:

H04: Inventory optimization has no significant influence on the management of health products and technologies in selected counties, Kenya.

Ha4: Inventory optimization has a significant influence on the management of health products and technologies in selected counties, Kenya.

Decision: The study rejected the null hypothesis (H04) and concluded that inventory optimization significantly influences the management of HPTs in public hospitals in Kenya.

5.2.5 Health management information system and management of health products and technologies

The study tested the hypothesis:

H05: Health management information systems have no significant influence on the management of health products and technologies in selected counties, Kenya.

Ha5: Health management information systems have a significant influence on the management of health products and technologies in selected counties, Kenya.

Decision: The study rejected the null hypothesis (H05) and concluded that health management information systems significantly influence the management of HPTs in public hospitals in Kenya.

5.2.6 Institutional leadership culture and management of health products and technologies

The study tested the hypothesis:

H06: Institutional leadership culture has no significant mediating influence on the management of health products and technologies in selected counties, Kenya.

Ha6: Institutional leadership culture has a significant mediating influence on the management of health products and technologies in selected counties, Kenya.

Decision: The study failed to reject the null hypothesis (H06) and concluded that institutional leadership culture does not significantly mediate the management of HPTs in public hospitals in Kenya

5.3 Recommendations

5.3.1 Financing and management of health products and technologies

County governments should prioritize increasing fiscal discipline by ensuring that monies allocated for the purchase of HPTs are used strictly for that purpose. The counties should also adopt transparent budgeting and involve all the key stakeholders in financial allocation to increase accountability. The counties should also rationalize and increase the budget allocated for HPTs to ensure that public hospitals have sufficient financial resources to manage HPTs effectively. Further, it is recommended that the process of funds disbursement be streamlined to ensure that allocated budgets reach the hospitals on time. This would enable better planning and utilization of funds, reducing the risk of shortages or delays in HPTs management. Counties should invest in capacity-building initiatives to enhance the financial management skills of healthcare administrators. This would improve the efficiency with which allocated budgets are absorbed and utilized, ensuring that funds are directed towards critical needs without wastage. The study advises the county government to implement a system for regular monitoring and evaluation of how funds are utilized in the management of HPTs. This would help identify inefficiencies and areas for improvement, ensuring that financial resources are used optimally. Further, counties should consider increasing the frequency of budget allocation to align more closely with the operational needs of public hospitals. More frequent disbursements could help address the dynamic needs of HPT management, ensuring continuous availability of essential health products and technologies.

5.3.2 Supply chain management and management of health products and technologies

Although the study found no significant influence of current supply chain practices on the management of HPTs, it is essential to explore potential inefficiencies within logistics, procurement, drug stores, and standard operating procedures. Counties should consider expanding the pool of prequalified national suppliers with the capacity to assure quality and affordability of the HPTs and distribute them to facility doorsteps. County health facilities should also adopt strategic purchasing by entering into

framework agreements with national suppliers such as KEMSA and MEDS to diversify and avoid over-reliance on one supplier. Despite the findings, it is also recommended that public hospitals continue to monitor supply chain practices to ensure that they do not become a bottleneck in the future and diversify suppliers instead of over-reliance on one. Periodic evaluations of suppliers should be conducted to track performance, such as on-time in full (OTIF) deliveries and any emerging issues or trends in the health supply chain. The study also recommends the establishment of a multidisciplinary team known as Health Products and Technologies (HPTUs) at the facility level. HPTU is composed of different users such as pharmacy staff, laboratory personnel, commodity nurses, radiology staff, and procurement staff to guide in the synchronized procurement of HPTs. The study opens avenues for further research, particularly to explore why supply chain practices did not have a significant influence. Future studies could investigate the effectiveness of supply chain interventions in different regions or under different healthcare conditions to provide more comprehensive insights.

5.3.3 Human resources to health factors and management of health products and technologies

The county governments in Kenya should ensure adequate staffing levels in public hospitals to improve the management of HPTs. To deal with shortages of staff, the study recommends task shifting where staff are trained to handle basic duties that are not in their core training and mandates such as ordering of HPTs by the nurses and other personnel in the absence of pharmacy staff. The study also recommends regular training of staff on health commodity management to increase competencies in managing HPTs. They should also develop and implement continuous training programs to update healthcare staff on the latest practices in HPT management. To address any existing shortages by recruiting additional qualified personnel and ensuring an equitable distribution of staff across all healthcare facilities. As well, the counties should analyse and optimize the distribution of healthcare workers to ensure that all regions, including underserved areas, have access to the necessary expertise

for effective HPT management. Consider deploying specialized personnel in regions where they are most needed. They are also advised to reevaluate compensation structures to motivate staff and reduce turnover. Competitive compensation, along with benefits and recognition, can enhance job satisfaction and lead to better management of health products and technologies.

In addition, the study recommends that public hospitals foster positive attitudes and professionalism by creating initiatives that promote a positive work culture, encouraging healthcare workers to maintain a professional and proactive attitude towards HPT management. They should also establish mechanisms to regularly monitor and evaluate the impact of human resource initiatives on HPT management. This would help in making data-driven adjustments to policies and practices, ensuring continuous improvement.

5.3.4 Inventory optimization and management of health products and technologies.

Firstly, County health facilities should adopt lean inventory management to improve the management of HPTs. There should be a systematic implementation of ABC Analysis across all public hospitals to ensure that at no given time, class A commodities are unavailable. This tool is vital for categorizing inventory items according to their importance, ensuring that high-priority items receive the most attention. Hospitals should invest in training programs to ensure that all relevant personnel understand and can effectively apply ABC Analysis in their inventory management processes. Secondly, the adoption and strict enforcement of the First Expiry, First-Out (FEFO) method is crucial. FEFO helps in minimizing waste by ensuring that the oldest stock, particularly items with impending expiration dates, is utilized first. Regular audits and training sessions can be instituted to ensure adherence to FEFO practices and to keep staff informed of its importance in reducing product waste and maintaining a steady supply of essential items.

Thirdly, the establishment of a robust safety stock policy is recommended to prevent the stockouts of critical health products. Such a policy should be tailored to the unique needs of each hospital, considering factors like demand variability, lead times, and critical stock levels. A well-formulated safety stock policy would help ensure that public hospitals can respond effectively to unexpected demand surges or supply chain disruptions. To avoid overstocking, public health facilities should adopt a one-month buffer stock and a one-month working stock supported by monthly ordering from reliable suppliers.

In addition, enhancing record-keeping systems is paramount. Accurate, real-time data on inventory levels is essential for making informed decisions about stock management. Therefore, public hospitals should invest in modern digital record-keeping systems that allow for seamless tracking of inventory, thereby improving accountability and operational efficiency. Moreover, the application of the Economic Order Quantity (EOQ) model should be optimized to balance the costs of ordering and holding inventory. Regularly revisiting and adjusting EOQ parameters will ensure that hospitals can maintain the most cost-effective inventory levels, minimize unnecessary expenditure while ensuring the availability of essential products. Furthermore, implementing Just-in-Time (JIT) inventory management practices, where feasible, can reduce inventory holding costs and ensure that health products are available precisely when needed. This approach requires robust coordination with suppliers and a streamlined procurement process to avoid delays that could disrupt hospital operations.

To ensure the continuous effectiveness of these inventory optimization practices, regular inventory audits should be conducted. These audits will help identify areas for improvement and ensure that best practices are consistently applied across all public hospitals. Finally, integrating these inventory optimization practices into broader healthcare supply chain management policies is essential. Policymakers should recognize the critical role that inventory optimization plays in the management

of HPTs and provide the necessary resources and support to ensure these practices are standardized and effectively implemented across all public hospitals.

5.3.5 Health management Information System and management of health products and technologies.

Public hospitals should have a strategic focus on the deployment and widespread adoption of HMIS across all public hospitals. Ensuring that these systems are fully integrated into the hospital's daily operations would enhance the efficiency and accuracy of managing health products and technologies. Healthcare facilities must prioritize the rollout of HMIS, especially in regions where the system is not yet fully implemented. Further, the application of HMIS should be maximized by providing comprehensive training programs for healthcare workers. These programs should be designed to improve the proficiency of hospital staff in using HMIS tools effectively. Continuous professional development opportunities should be made available to keep staff updated on the latest features and best practices related to HMIS.

In addition, strengthening the ICT infrastructure is critical for the successful operation of HMIS. Public hospitals should invest in upgrading their technological resources, including hardware, software, and internet connectivity, to support the efficient functioning of HMIS. This infrastructure investment is necessary to ensure that the systems can handle the demands of data management and facilitate seamless communication within and between healthcare facilities.

Moreover, enhancing data quality within the HMIS is paramount. Accurate and timely data is crucial for making informed decisions regarding the management of HPTs. Hospitals should implement rigorous data validation and verification processes to ensure that the information entered into the

system is reliable. Regular data audits and quality checks should be conducted to maintain the integrity of the system.

Furthermore, the suitability of the HMIS should be regularly evaluated to ensure it meets the specific needs of each hospital. This involves customizing the system to align with the unique operational requirements of different healthcare settings. Feedback from end-users should be actively sought and incorporated into system updates to improve its functionality and user experience.

To support these efforts, it is also recommended that policymakers integrate HMIS development into national healthcare strategies. By doing so, they can ensure that the necessary resources, including funding and technical expertise, are allocated to support the continuous improvement of HMIS in public hospitals. This strategic alignment will help standardize HMIS practices across the country, fostering a more cohesive and efficient healthcare system.

Lastly, it is vital to establish a monitoring and evaluation framework that tracks the impact of HMIS on the management of HPTs. This framework should be designed to measure key performance indicators related to system usage, data quality, and overall management outcomes. Regular assessments will provide valuable insights into the effectiveness of HMIS and guide further improvements.

5.3.6 Institutional leadership, Culture, and management of health products and technologies

While institutional leadership culture did not show a direct mediating influence, the study recommends that the public hospitals and the county government at large continue fostering a strong leadership culture within hospitals. Leadership plays a crucial role in setting the tone for organizational effectiveness and should not be overlooked. Efforts to enhance communication, planning, and

motivation cultures can contribute to overall organizational health and improve other aspects of hospital management, even if they do not directly mediate HPT management.

Secondly, hospitals should ensure that institutional policies are effectively implemented and aligned with the operational needs of managing HPTs. Clear and practical policies are essential for guiding the day-to-day management of health products and technologies. Regular reviews and updates of these policies can help ensure they remain relevant and supportive of efficient HPT management. Moreover, it is advisable to strengthen monitoring and evaluation processes to ensure that management practices and policies are being effectively executed. Although leadership culture did not show a significant mediating effect, robust monitoring and evaluation can provide valuable insights into areas where improvements are needed, helping to refine strategies and enhance overall performance.

Additionally, focus on integrating leadership development into broader organizational strategies. While the current study did not find a significant mediating effect, investing in leadership training and development can have other positive impacts on organizational effectiveness, including improved staff morale and better alignment with organizational goals. Furthermore, consider exploring other potential factors that might mediate the management of HPTs. It may be beneficial to investigate additional variables or different dimensions of leadership that could influence HPT management. Future research could focus on identifying these factors to gain a more comprehensive understanding of what drives effective HPT management in public hospitals. Finally, it is crucial to maintain a supportive environment that encourages open communication, strategic planning, and motivation among staff. These elements contribute to a positive organizational climate, which, while not mediating HPT management directly, can influence overall performance and effectiveness in indirect ways.

5.4. Implications of the Findings on Theories, Practices and Policies

The study's findings offered valuable insights into the management of Health Products and Technologies in public hospitals in Kenya, with significant implications for theories, practices, and policies in healthcare management.

Implications for Theories

The study reinforces and extends existing theories on the management of health products and technologies. The significant influence of financing, human resources, inventory optimization, and health management information systems aligns with established theories emphasizing the importance of these factors in effective health system management. These findings support theories that advocate for a comprehensive approach to healthcare management, integrating financial resources, human capital, efficient inventory practices, and robust information systems to achieve optimal outcomes.

However, the lack of significant influence from supply chain practices and institutional leadership challenges some theoretical assumptions. Traditional supply chain theories that emphasize logistics, procurement, and standard operating procedures as critical factors may need re-evaluation in the context of healthcare settings. Similarly, theories positing that institutional leadership culture directly affects organizational performance may require refinement or further investigation to understand the nuanced role leadership plays in HPT management.

Implications for Practices

From a practical perspective, the findings highlighted the need for hospitals to focus on strengthening specific areas that significantly impact HPT management. Practitioners should prioritize the following:

i. Promote strict fiscal discipline where financial resources allocated for the procurement of HPTs are used for that purpose.

ii. Diversification of health financing, including engagement with donors and generation of own revenue through the establishment of a revolving fund drug unit for sustainability.

iii. Strategic purchasing. To ensure an efficient procurement process with regular monthly orders and regular payment to the strategic pre-qualified suppliers

iv. Lean inventory management to reduce stock holding costs and minimize on wastage through pilferage and expiries.

v. Establishment of facility-based Health Products and Technologies Unit to management, budgeting, and procurement of HPTs.

vi. Strategic partnership with the private sector, national government, donor organizations, community-based organizations, and Non-Governmental Organizations for sustainable financing of health products and technologies is crucial. Hospitals should explore diverse funding mechanisms and streamline financial processes to support sustainable HPT management.

vii. Human resources management and task shifting; Investment in human resources, including recruitment, training, and compensation, is essential. Hospitals should develop targeted strategies to enhance staff capabilities for role enhancement to ensure effective management of HPTs.

viii. Implementing advanced inventory management practices, such as ABC Analysis, FEFO, and Just-in-Time, can significantly improve efficiency and reduce waste. Practitioners should adopt these practices to optimize inventory levels and ensure the availability of critical health products.

ix. Digitization and adoption of Artificial Intelligence (AI); Leveraging robust AI can enhance data management, decision-making, and overall HPT management. Hospitals

should invest in upgrading their ICT infrastructure and training staff to fully utilize AI and digital innovations.

Conversely, while supply chain practices and institutional leadership are important, their direct influence on HPT management may be less pronounced. Practitioners should reassess the role of these factors in their specific contexts and focus on integrating other proven practices.

Implications for Policies

The findings have significant policy implications for healthcare management in Kenya:

i. Review of public health facilities health products and technologies management framework. Policy makers should consider reviewing the current policies that advocates for quarterly orders and adopt the monthly orders for level four and five hospitals with one month working stock and one month buffer stock.

ii. Policy support for Financing: Policymakers should ensure that financial policies support effective management of HPTs by ring-fencing finances allocated for HPTs.

iii. Policy support for revenue diversification in public health facilities for sustainability such as establishment of drug revolving funds pharmacies. This will also mitigate against out of stock and maximise returns for social health insurance which is re-imbursed monthly.

iv. Adopting multidisciplinary approach in budgeting and procurement of HPTs through Health Products and Technologies Units s in the facilities for quicker decision making.

v. Adoption of best practices in inventory optimization. This includes creation guidelines for efficient inventory management practices and providing support for implementing advanced systems.

vi. Prioritize the adoption and implementation of HMIS across public hospitals. This includes investing in ICT infrastructure, ensuring data quality, and providing training to maximize the benefits of HMIS.

Given the limited impact of supply chain practices and institutional leadership, policies should be adjusted to focus more on the areas with demonstrated significance. This does not mean that supply chain and leadership are unimportant, but rather that their role may need to be contextualized within a broader framework of HPT management strategies.

5.5 Recommendations for Further Studies

The study made the following recommendations for further studies.

i. Detailed Analysis of Supply Chain Factors. A study should be conducted to investigate why traditional supply chain practices (logistics, procurement, and drug store management) did not show a significant influence. This could involve a more granular analysis of specific supply chain components and their contextual relevance in healthcare settings.

ii. Investigating the Impact of Institutional Leadership by exploring different dimensions of institutional leadership, such as transformational leadership or participative leadership, to determine if these aspects have any impact on HPT management.

iii. Additional studies are suggested for contextual and regional differences. Exploring how regional differences within Kenya might affect the management of HPTs. This could involve comparing urban vs. rural hospitals or analysing variations across different counties. Identifying context-specific challenges and opportunities in different healthcare settings to tailor management practices more effectively. Conducting comparative studies with other countries to understand how different healthcare systems address similar

challenges in HPT management. This could offer insights into best practices and areas for improvement.

iv. The R Square value of 0.535 indicated that 53.5% of the variance in the management of HPTs was explained by the five predictors in Model 1. This implied that a substantial 46.5% of the variance was unexplained. Consequently, further research is warranted to explore additional variables that may account for this remaining variance and provide a more comprehensive understanding of HPT management.

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APPENDICES

APPENDIX I: INFORMED CONSENT FORM

RESEARCH TOPIC: INSTITUTIONAL FACTORS AND MANAGEMENT OF HEALTH PRODUCTS AND TECHNOLOGIES IN SELECTED COUNTIES

Researcher (Ph.D. Candidate): **Shadrack Meme**

Institution: **Kenya Methodist University, P.O. Box 267-60200, MERU**

1. Introduction

This Consent Form offers information regarding the aforementioned research. Read this informed consent form to ensure that you are fully informed about your participation in this research. You will also be asked to sign it, however, even if you sign a consent form, consent will be re-established at the time of the interview. We will provide you with a copy of this form. Some words on this consent form may be new to you. Please let the researcher know if there is anything you do not understand.

1. I…… voluntarily agree to participate in this research study.
2. I understand that participation involves determining institutional factors influencing the management of Health Products and Technologies (HPT) in advancing universal health coverage.
3. I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.
4. I have had the purpose and nature of the study explained to me in writing and I have had the opportunity to ask questions about the study.
5. I understand that participating in this research will not provide me with any financial or material benefits.
6. I have been assured of no risks associated with participation in this study.

7. I understand that all the information I provide for this study will be treated confidentially.
8. I understand my decision to participate or failing to participate will not affect my job.
9. I understand I will not be paid, since participation is wholly voluntary.
10. I understand that I am free to contact any of the people involved in the research to seek further clarification and information or to ask any other question related to the study during your participation.

_____ _____

Signature for the respondent Date

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

_____ _____

Researcher's signature *Date*

APPENDIX II: INTERVIEW SCHEDULE

PART A: BACKGROUND INFORMATION

1. Name of the county (Tick one)
    A. Machakos
    B. Myeri
    C. Isiolo
    D. Kisumu
    E. Kiambu
2. Name of the facility ……
3. Level of the health facility
    A. Level 4 (Sub-County Hospital)
    B. Level 5 (County Referral Hospital
4. What is your age in specific years? _____
5. What is gender
        i. Male ( )
        ii. Female ( )
        iii. Other ( )
6. What is your level of education completed?
        i. Diploma ( )
        ii. Undergraduate ( )
        iii. Postgraduate diploma ( )
        iv. Master degree ( )
        v. Ph. D ( )

7. What role do you play in relation to management of health products and technologies?
    A. Financing of HPTs
    B. Supply chain management for HPTs
    C. Inventory management for HPTS
    D. Health information management
    E. Human resources management
    F. Leadership and management
8. How long have you worked in the management of Health Products and Technologies? *(Indicate specific number of years)* _____
    i. Less than 1 year ( )
    ii. 1-5 years ( )
    iii. 6-10 years ( )
    iv. 11 years and above ( )

PART B: STUDY VARIABLES

SECTION 1: Health products, technologies financing, and management of Health Products and Technologies

1. Which factor (s) affect management of HPT in regard to their financing? *(You can tick more than one option)*
    a. Amount of budgetary allocation ( )
    b. Frequency of funds disbursement ( )
    c. Frequency of funds allocation ( )
    d. Rate of Budget absorption ( )
2. How often the health facilities receive their budgetary allocation?

a. Yearly ( )

b. Half yearly ( )

c. Quarterly ( )

d. Monthly ( )

e. Never ( )

3. On average, how long does it take to process payment after the receipt of the health products and technologies :

a. Less than 30 days

b. 30- 45 days

c. 45-60 days

d. 60-90 days

e. More than 90 days

4. To what extent do you think timely disbursement of funds affect management of Health products and technologies in your facility?

a. Not at all ( )

b. Small Extent ( )

c. Moderate extent ( )

d. Large Extent ( )

e. Very Large extent ( )

5. Rate the transparency and inclusiveness of the health budgeting process in your organization

a. Very Poor ( )

b. Poor ( )

c. Neutral ( )

d. Good ( )

e. Very Good ( )

6. How effectively are stakeholders involved in the planning and development of the health budget?
   a. Not Effectively ( )
   b. Slightly Effectively ( )
   c. Moderately Effectively ( )
   d. Very Effectively ( )
   e. Extremely Effectively ( )
7. Indicate your confidence in the accuracy of budget estimates for health products and technologies.
   a. Not Confident ( )
   b. Slightly Confident ( )
   c. Moderately Confident ( )
   d. Very Confident ( )
   e. Extremely Confident ( )
8. Rate the fairness and appropriateness of budget allocations for health products and technologies.
   a. Very Unfair ( )
   b. Unfair ( )
   c. Neutral ( )
   d. Fair ( )
   e. Very Fair ( )
9. How well do budget allocations align with the priorities and needs of HPT management?
   a. Poorly Aligned ( )

b. Slightly Aligned ( )

c. Moderately Aligned ( )

d. Well Aligned ( )

e. Very Well Aligned ( )

10. Indicate your satisfaction with the level of flexibility in reallocating funds HPT management.

a. Very Dissatisfied ( )

b. Dissatisfied ( )

c. Neutral ( )

d. Satisfied ( )

e. Very Satisfied ( )

11. Rate the efficiency of absorbing allocated budgets for health products and technologies.

a. Very Inefficient ( )

b. Inefficient ( )

c. Neutral ( )

d. Efficient ( )

e. Very Efficient ( )

12. How would you describe the organization's ability to utilize the allocated budget fully?

a. Very Poor ( )

b. Poor ( )

c. Neutral ( )

d. Good ( )

e. Very Good ( )

13. Indicate the factors that may hinder the effective absorption of the budget for health products and technologies.

a. Erratic budget allocation ( )

b. Inefficient Processes ( )

c. Lack of Training ( )

d. Other (Specify) ( )

14. Rate the timeliness and reliability of funds disbursement for health product management.

a. Very Untimely ( )

b. Untimely ( )

c. Neutral ( )

d. Timely ( )

e. Very Timely ( )

15. How well does the disbursement process align with the planned budget timelines?

a. Poor Alignment ( )

b. Slightly Aligned ( )

c. Moderately Aligned ( )

d. Well Aligned ( )

e. Very Well Aligned ( )

16. Indicate your level of satisfaction with the clarity of communication regarding funds disbursement.

a. Very Dissatisfied ( )

b. Dissatisfied ( )

c. Neutral ( )

d. Satisfied ( )

e. Very Satisfied ( )

17. Overall, how satisfied are you with the financial management processes HPT?

a. Very Dissatisfied ( )

b. Dissatisfied ( )

c. Neutral ( )

d. Satisfied ( )

e. Very Satisfied ( )

18. To what extent do you believe improvements in the health financing system could positively impact HPT management?

a. Not at All ( )

b. Small extent ( )

c. Moderate extent ( )

d. Large extent ( )

e. Very large extent ( )

19. Rate your agreement to the statements relating to financing and management of Health products and technologies in your facility. *(Use the 5-point Likert scale to tick one response appropriately)*

(1 -Strongly disagree (SD) 2- Disagree (D) 3- Medium (N) 4-Agree (A) 5-Strongly Agree (SA))

Statements	1	2	3	4	5
The amount of budget allocated for HPTs affects the amount of budget allocated for HPTs					
Funds allocated for HPT are spent strictly on procurement and management of HPT					
Sources of funding for HPT is reliable and sustainable.					

Sustainable financing is a major factor that affects the availability to essential HPT.					
Health Financing play universal driving role in improving access to and affordable HPT.					
Funds allocated for HPTs are completely absorbed for provision of HPTs for each allocation.					
The rate of budgetary absorption for funds allocated for HPTs is crucial aspect in the management of HPTs					
There are institutional factors that affect the absorption of budget allocated for HPTs.					
Budgeting process for HPTs is participatory and involves stakeholders dealing with the management of HPTs.					
Funds allocated for HPTs are released in a timely manner without delays.					
The health facility has an outlined annual budget that encompasses all possible resources required in management of HPT					
Suppliers for HPT are paid within the agreed terms outlined in the LPO/supply agreement.					
The facility experiences frequent stock out of HPTs due to inadequate allocation of finances.					
The frequency of budget allocation for HPT is regular and predictable.					

SECTION 2: Supply chain practices and management of health products and technologies

1. Rate how much you agree that supply chain practices affect management of health products and technologies in your facility?
    a. Strongly disagree ( )
    b. Disagree ( )
    c. Medium ( )
    d. Agree ( )
    e. Strongly Agree ( )
2. To what extent do you think supply chain practices affect availability, affordability and quality of HPTs in your facility?
    a. Not at all ( )
    b. Small Extent ( )
    c. Moderate extent ( )
    d. Large Extent ( )
    e. Very large extent
3. Which of the following supply chain practices has the **major effect** on management of Health products and technologies? *(You can tick more than one option)*
    a. Logistics ( )
    b. Procurement processes ( )
    c. Availability of drug stores/warehouses ( )
    d. Standard Operating Procedures ( )
4. On average, how long does it take to receive all the ordered HPTs after placing the orders with the suppliers

a. Less than 14 days ( )

b. 14-21 days ( )

c. 21- 30 days ( )

d. 30-45 days ( )

e. Over 45 days ( )

5. Who your main supplier of essential health products and technologies in your health facility

a. KEMSA ( )

b. MEDS ( )

c. Others (Specify) ----------

6. Who makes procurement decisions in your health facility?

a. Pharmacy in charge ( )

b. Medical officer in charge ( )

c. Health administration officer ( )

d. Procurement officer/Manager ( )

e. Any other (Specify) ----------

7. How long on average does it take to pay suppliers of HPT in your health facility?

a. Less than 30 days ( )

b. 30- 60 days ( )

c. 60- 90 days ( )

d. 90- 120 days ( )

e. Over 120 ( )

8. Rate your agreement to the statements relating to supply chain practices and management of Health products and technologies in your facility. *(Use the 5-point Likert scale to tick one response appropriately)*

(1 -Strongly disagree (SD) 2- Disagree (D) 3- Medium (N) 4-Agree (A) 5-Strongly Agree (SA))

Statement	**1**	**2**	**3**	**4**	**5**
Logistics management affects timely delivery of HPTs to the health facilities.					
The organization effectively coordinates the transportation of HPT					
Timely delivery of HPT is a priority in our supply chain practices.					
The tracking and monitoring of HPT during transportation is efficiently managed.					
Procurement processes are streamlined to ensure a steady supply of quality HPT					
The organization actively seeks cost-effective procurement methods without compromising quality.					
Collaboration with reliable suppliers is a key aspect of our procurement strategy for HPT.					
Inventory management systems in place ensure optimal stock levels					
The warehouse or drug store facilities are well-organized to facilitate efficient storage and retrieval.					
The organization has contingency plans for emergencies affecting warehouse or drug store operations.					
Clear and comprehensive SOPs are established for handling HPT					
Training programs are in place to ensure staff adherence to established SOPs.					

Procurement process for has no effects on the availability and affordability of HPTs.					
Continuous improvement initiatives are implemented based on feedback and lessons learned					
Timely payment of suppliers affects availability of essential HPTs in the health facility.					
The facility has sufficient drug stores (warehouses) for safe storage of HPTs					
The Procurement approaches promote the affordability of HPTs used in the facility.					
The facility experiences delays in procurement of essential HPTs leading to stock outs.					
Standard operating procedures define the minimum acceptable quality for the HPTs procured by the hospital.					
Procurement approaches for HPTs are transparent and encourages the involvement of all stakeholders including the users					
Standard operating procedures influence the management of HPT					
Procurement of HPT is done from prequalified suppliers only.					
Management of HPTs is governed by documented standard operating procedures.					
Delays in procurement of HPT negatively affect management of HPT					
The user departments develop specifications for the HPTs that meet defined quality threshold in line national standards.					

There are adequate storage facilities for the HPT to hold safety stocks.					

SECTION 3: Human resource factors and management of Health Products and Technologies

1. How much do you agree that human resource factors affect management of HPT in your health facility?
    a. Strongly disagree ( )
    b. Disagree ( )
    c. Agree ( )
    d. Moderately Agree ( )
    e. Strongly Agree ( )
2. Which of the following human resource factors has the **major effect** on management of HPT? *(You can tick more than one option)*
    a. Staffing ( )
    b. Training ( )
    c. Staff distribution ( )
    d. Compensation ( )
    e. Attitude ( )
3. To what extent would you rate the effectiveness of health workers in-service training on management of HPT in your health facility?
    a. Not at all ( )
    b. Small Extent ( )
    c. Moderate extent ( )
    d. Large Extent ( )

e. Very large extent ( )

4. Indicate the frequency of training provided to keep staff updated on advancements in management of HPT.
   a. Rarely ( )
   b. Occasionally ( )
   c. Regularly ( )
   d. Frequently ( )
   e. Always ( )
5. Rate the overall attitude of staff toward efficient management of HPT.
   a. Very Negative ( )
   b. Negative ( )
   c. Neutral ( )
   d. Positive ( )
   e. Very Positive ( )
6. Rate the effectiveness of initiatives to foster a positive and proactive attitude among staff.
   a. Strongly Disagree ( )
   b. Disagree ( )
   c. Neutral ( )
   d. Agree ( )
   e. Strongly Agree ( )
7. Rate the satisfaction with the current compensation structure for staff in HPT.
   a. Very Dissatisfied ( )
   b. Dissatisfied ( )
   c. Neutral ( )

d. Satisfied ( )

e. Very Satisfied ( )

8. Rate the responsiveness in addressing and adjusting deviations from expected outcomes.

a. Very Ineffective ( )

b. Ineffective ( )

c. Neutral ( )

d. Effective ( )

e. Very Effective ( )

9. Rate the effectiveness of addressing challenges in aligning human resources strategies with HPT management goals.

a. Very Ineffective ( )

b. Ineffective ( )

c. Neutral ( )

d. Effective ( )

e. Very Effective ( )

10. Rate the effectiveness of ongoing initiatives or plans for continuous improvement in human resources practices.

a. Very Ineffective ( )

b. Ineffective ( )

c. Neutral ( )

d. Effective ( )

e. Very Effective ( )

11. Rate the effectiveness of communication between the human resources department and those directly involved in HPT management.

a. Very Ineffective ( )

b. Ineffective ( )

c. Neutral ( )

d. Effective ( )

e. Very Effective ( )

12. To what extent is collaboration encouraged for better alignment between staff and HPT management objectives?

a. Not Encouraged ( )

b. Slightly Encouraged ( )

c. Neutral ( )

d. Encouraged ( )

e. Strongly Encouraged ( )

13. To what extent do you think health workers' attitude affects ability to manage HPT?

a. Very Small Extent ( )

b. Small Extent ( )

c. Moderate Extent ( )

d. Large Extent ( )

e. Very Large Extent ( )

14. Rate your agreement to the statements relating to inventory optimization and management of Health products and technologies in your facility**.** *(Use the 5-point Likert scale to tick one response appropriately)*

(1 -Strongly disagree (SD) 2- Disagree (D) 3- Medium (N) 4-Agree (A) 5-Strongly Agree (SA))

Statement	1	2	3	4	5
The numbers of the staff involved in the management of HPT has no effect on management of HPTs.					
There is alignment between staff qualifications/skills and the requirements for HPT management roles.					
The training program for staff involved in HPT management are effective.					
There is an impact of compensation on employee motivation in managing HPT.					
There is an impact of staff distribution on the efficiency of managing HPT					
There is effectiveness of staff distribution across different roles within HPT management.					
There is efficiency in the recruitment process for roles related to HPT management					
Human resources factors play a critical role in promoting access to quality and affordable HPT.					
There are effective KPIs to measure influence for human resources performance in HPT management.					
Health worker's attitude is critical in management of HPT					
There is an effective feedback mechanism to assess the success of human resource interventions in management of HPT.					
There is an integration of staff-related indicators into a cohesive human resources strategy for HPT management.					

The staff involved in the management of HPT are sufficiently distributed across various departments					
Attitude of staff involved in the management of the HPT affects the management of HPTs					
Staff are concerned when essential HPTs are not available when needed by the patients.					
Health workers involved in the management of HPT are well appreciated and compensated.					

SECTION 4: Inventory optimization and management of Health Products and Technologies

1. How much do you agree that inventory optimization affects management of HPT in your health facility?

   a. Strongly disagree ( )
   b. Disagree ( )
   c. Medium ( )
   d. Agree ( )
   e. Strongly Agree ( )

2. Which of the following inventory optimization factors has the major effect on management of HPT*? (You can tick more than one option)*

   a. ABC analysis ( )
   b. First-Expiry-First- Out ( )
   c. Safety stock policy and record keeping ( )
   d. Economic order quantity ( )

e. Just in Time ( )

3. To what extent do you think inventory optimization affects the management of HPT?

   a. Not at all ( )

   b. Small Extent ( )

   c. Moderate extent ( )

   d. Large Extent ( )

   e. Very large extent ( )

4. Please rate the frequency of ABC analysis conducted for HPT in your facility.

   a. Never ( )

   b. Rarely ( )

   c. Occasionally ( )

   d. Frequently ( )

   e. Always ( )

5. Indicate the perceived correlation between ABC analysis and overall inventory efficiency.

   a. Very Weak ( )

   b. Weak ( )

   c. Moderate ( )

   d. Strong ( )

   e. Very Strong ( )

6. How does adherence to FEFO impact the shelf life and wastage of HPT?

   a. Negatively ( )

   b. Slightly Negatively ( )

   c. Neutral ( )

   d. Positively ( )

e. Very Positively ( )

7. Rate the clarity and effectiveness of the criteria used to determine optimal stock levels for HPT.

    a. Very Unclear ( )

    b. Unclear ( )

    c. Neutral ( )

    d. Clear ( )

    e. Very Clear ( )

8. How frequently is the stocking policy reviewed and adjusted in your facility?

    a. Rarely ( )

    b. Occasionally ( )

    c. Regularly ( )

    d. Frequently ( )

    e. Always ( )

9. Rate the impact of the stocking policy on product availability and costs in your facility.

    a. Negative ( )

    b. Slightly Negative ( )

    c. Neutral ( )

    d. Positive( )

    e. Very Positive ( )

10. Please rate the accuracy and reliability of the system used for record-keeping of HPT Inventory.

    a. Very Inaccurate ( )

    b. Inaccurate ( )

    c. Neutral ( )

    d. Accurate ( )

e. Very Accurate ( )

11. How frequently are historical data and trends utilized in inventory decision-making?

a. Rarely ( )

b. Occasionally ( )

c. Regularly ( )

d. Frequently ( )

e. Always ( )

12. Indicate the observed impact of accurate records on inventory control and financial outcomes.

a. No Impact ( )

b. Slight Impact ( )

c. Neutral ( )

d. Significant Impact ( )

e. Very Significant Impact ( )

13. Rate the integration of ABC analysis, FEFO principle, stocking policy, and record-keeping into a comprehensive inventory management strategy.

a. Very Poorly Integrated ( )

b. Poorly Integrated ( )

c. Neutral ( )

d. Well Integrated ( )

e. Very Well Integrated ( )

14. Indicate the use of specific software or systems to streamline and integrate the management of HPT

a. No Software ( )

b. Basic Software ( )

c. Moderate Software ( )

d. Advanced Software ( )

e. Specialized Software ( )

15. Rate your agreement to the statements relating to inventory optimization and management of Health Products and Technologies in your facility. *(Use the 5-point Likert scale to tick one response appropriately)*

(1 -Strongly disagree (SD) 2- Disagree (D) 3- Medium (N) 4-Agree (A) 5-Strongly Agree (SA))

Statement	1	2	3	4	5
Poor inventory management has no effect on the management of HPT					
Inventory classifications (A, B, C) influence procurement and stocking decisions.					
Replenishment of stock is guided by ABC analysis where category A products are given priority.					
First Expiry First Out principle is applied when issuing HPT to the user departments.					
The safety stock policy is applied in managing complete stock out of essential HPTs.					
Bin cards and other record management tools are used to monitor movement of HPT.					
Orders for HPTs are consolidated to achieve desired economic order quantities to promote affordability.					

All HPT available in the health facility are stocked based on the institutional policies such as hospital formularies and national essential medicine, medical supplies and diagnostics list.					
Stock cycle counts are done to reconcile the physical stock with the data available in the system.					
Essential but expensive lifesaving HPTs are ordered and delivered using Just In Time principle as a strategy of inventory holding management.					
All new consignments of orders are subjected to full verification before signing of acceptance certificate to ensure the products received meet the defined quality specifications					
Stock/bin cards are updated regularly as the primary documents used in monitoring stock of HPTs.					
Good Inventory Management in the facility promotes effective management of HPTs thus reducing healthcare costs					

SECTION 5: Health management information system and management of Health Products and Technologies

1. To what extent do you think health management information system affect HPT management in your facility?

a. Not at all ( )

b. Small Extent ( )

c. Moderate extent ( )

d. Large Extent ( )

e. Very large Extent ( )

2. Which of the following health management information systems factors has the major effect on management of HPT*? (You can tick more than one option)*

a. Deployment of HMIS ( )

b. Application/Usage of HMIS ( )

c. ICT infrastructure ( )

d. Data Quality ( )

3. Rate the effectiveness of the deployment process for HMIS in your health facility.

   a. Very Ineffective ( )

   b. Ineffective ( )

   c. Neutral ( )

   d. Effective ( )

   e. Very Effective ( )

4. How well are users trained on the functionalities of the deployed HMIS?

   a. Poor Training ( )

   b. Slightly Effective ( )

   c. Moderately Effective ( )

   d. Very Effective ( )

   e. Extremely Effective ( )

5. Indicate the level of user satisfaction with the accessibility and usability of the deployed HMIS.

   a. Very Dissatisfied ( )

   b. Dissatisfied ( )

   c. Neutral ( )

   d. Satisfied ( )

e. Very Satisfied ( )

6. Rate the frequency of use of HMIS for managing HPT.
   a. Rarely ( )
   b. Occasionally ( )
   c. Regularly ( )
   d. Frequently ( )
   e. Always ( )
7. How would you rate the overall efficiency of HMIS in supporting decision-making for HPT management?
   a. Very Inefficient ( )
   b. Inefficient ( )
   c. Neutral ( )
   d. Efficient ( )
   e. Very Efficient ( )
8. Rate the adequacy and reliability of the ICT infrastructure supporting HMIS in your facility.
   a. Very Inadequate ( )
   b. Inadequate ( )
   c. Neutral ( )
   d. Adequate ( )
   e. Very Adequate ( )
9. How well does the ICT infrastructure support the integration of HPT HMIS with other health systems?
   a. Poorly ( )
   b. Slightly ( )

c. Moderately ( )

d. Well ( )

e. Very Well ( )

10. Indicate the extent to which technical issues in the ICT infrastructure impact the usage of HMIS in your facility.

a. Significantly ( )

b. Moderately ( )

c. Slightly ( )

d. Rarely ( )

e. Not at All ( )

11. Rate the accuracy and completeness of data recorded and processed by HMIS in this facility.

a. Very Poor ( )

b. Poor ( )

c. Neutral ( )

d. Good ( )

e. Very Good ( )

12. How often are data quality assessments conducted for HPT within HMIS in this facility?

a. Rarely ( )

b. Occasionally ( )

c. Regularly ( )

d. Frequently ( )

e. Always ( )

13. Indicate the perceived impact of high-quality data on the effectiveness of HPT management.

a. No Impact ( )

b. Slight Impact ( )

c. Neutral ( )

d. Significant Impact ( )

e. Very Significant Impact ( )

14. Overall, how satisfied are you with the contribution of HMIS to HPT management in this facility?

a. Very Dissatisfied ( )

b. Dissatisfied ( )

c. Neutral ( )

d. Satisfied ( )

e. Very Satisfied ( )

15. To what extent do you believe improvements in HMIS can enhance the overall management of health products and technologies?

a. Not at All ( )

b. Slightly ( )

c. Moderately ( )

d. Significantly ( )

e. Extremely ( )

16. To what extent do you think HMIS affect the management of HPT?

a. Not at all ( )

b. Small Extent ( )

c. Moderate extent ( )

d. Large Extent ( )

e. Very large extent ( )

17. Rate your agreement to the statements relating to health management information system and management of Health products and technologies in your facility. *(Use the 5-point Likert scale to tick one response appropriately)*

(1 -Strongly disagree (SD) 2- Disagree D) 3- Medium (N) 4-Agree (A) 5-Strongly Agree (SA))

Statement	**1**	**2**	**3**	**4**	**5**
Health information management system improves accuracy of the data to inform forecasting and quantification of the needed HPT.					
Deployment of ICT enhances accurate issuing of the HPT from the stores to the wards.					
Health information management system facilitates dispensing pharmacies within the health facility.					
Different departments collaborate in using HMIS for HPT management					
Health information management system improves availability of HPT by reducing pilferage and losses though expiries.					
Availability of ICT infrastructure affects management of HPT.					
HMIS is used in the quantification of various commodities that will be needed by a facility for a specific period.					
Application of HMIS has enhanced management of HPT					
Level of ICT literacy support management of HPT					
Application of Health information management system plays a role in stock replenishment decision for HPTs.					
Usage of HMIS helps in promoting availability of quality and affordable HPTs.					

Data quality affects health accuracy in forecasting of essential HPTs					
The hospital has fully adopted the HMIS as a means of promoting health commodity security					
Usage of Health information management system saves time in the management					
Nature of the system applied in the hospital influences how well HPT is managed.					
Health information management systems have played an imperative role in improving access to reliable HPT.					
Staff working on HPT have sufficient knowledge on usage of HMIS in the management of HPTs.					

SECTION 6: Institutional Leadership culture and management of Health Products and Technologies

1. To what extent do you think Institutional leadership culture affects the management of Health products and technologies?
   a. Not at all ( )
   b. Small Extent ( )
   c. Moderate Extent ( )
   d. Large Extent ( )
   e. Very large extent ( )
2. Which of the following Institutional leadership factors has the major effect on management of Health products and technologies*? (You can tick more than one option)*

a. Communication culture ( )

b. Planning culture ( )

c. Motivation culture ( )

d. Institutional policies ( )

e. Monitoring and Evaluation ( )

3. To what extent do you think institutional leadership culture promotes availability of quality and affordable health products and technologies.?

a. Not at all ( )

b. Small Extent ( )

c. Moderate extent ( )

d. Large Extent ( )

e. Very Large extent ( )

4. Rate your agreement to these statements relating to your institutional leadership culture**.** ***(use the 5-point Likert scale to circle one response appropriately)***

1 -Strongly disagree (SA) 2- Disagree (D) 3- Medium (N) 4-Agree (A) 5-Strongly Agree (SD)

Statement	**1**	**2**	**3**	**4**	**5**
Leadership promotes a culture of motivation and recognition for individuals and teams involved in HPT management					
The leadership demonstrates a commitment to long-term planning for the sustainable management of HPTs					
The institution has a well-defined plan for the acquisition and distribution of HPTs.					

Planning processes are inclusive, involving key stakeholders in decision-making related to HPT management.					
Leadership fosters open and transparent communication within the institution					
There is a culture of constructive feedback and information sharing regarding the management of HPT					
Information regarding HPT is effectively communicated across different levels of the organization					
Institutional quality policy provides clarity on management of HPT					
The leadership actively uses feedback from monitoring and evaluations to improve HPT management practices					
Regular evaluations are conducted to assess the effectiveness of strategies employed in HPT management					
The institution has robust systems in place for monitoring the performance of HPT management.					
The institution regularly reviews and updates policies to adapt to changing circumstances in HPT management.					
Policies regarding HPT management align with industry best practices and regulatory standards					
The institution invests in the professional development of staff involved in HPT management					
There are clear incentives in place to encourage effective performance in the management of HPT.					

The institution has well-defined policies governing the procurement and utilization of HPT.					
There is clear communication channels among the different stakeholders involved in the management of HPT.					
Communication culture influences the management of HPT.					
Monitoring and evaluation is critical aspect in establishing effectiveness in the management of HPT.					
Planning culture affects availability of quality and affordable HPTs					

Section 7. Management of Health Products and Technologies (HPTs) Questionnaire

Availability of Health Products and Technologies (HPTs)

1. Please provide a list of essential Health Products and Technologies (HPTs) commonly used and available in your organization/health facility.
2. How would you rate the overall availability of essential HPTs in your organization/health facility? (Scale: 1-5, where 1 = Poor, 5 = Excellent) 1 2 3 4 5

3. What challenges, if any, do you face in maintaining an adequate supply of HPTs? (Open-ended response)

4. How often do you conduct assessments of HPTs availability to identify and address potential shortages or stock outs? (Select one)

a) Monthly b) Quarterly c) Annually d) As needed

Affordability of Health Products and Technologies (HPTs)

5. How would you rate the affordability of HPTs for end-users (patients or clients) in your organization/health facility? (Scale: 1-5, where 1 = Not Affordable, 5 = Very Affordable)

1 2 3 4

6. Are there any financial assistance programs or subsidies in place to make HPTs more affordable for end-users? (Yes/No)

a) If yes, please provide details:

3.3 What strategies are implemented to manage and control the cost of HPTs within your organization/health facility? (Open-ended response)

Section 4: Quality of Health Products and Technologies (HPTs)

4.1 How would you assess the overall quality of HPTs in your organization/health facility? (Scale: 1-5, where 1 = Poor Quality, 5 = Excellent Quality)

1 2 3 4 5

4.2 What quality assurance and control measures are in place to ensure the safety and efficacy of HPTs? (Open-ended response)

4.3 How often are audits or inspections conducted to monitor and improve the quality of HPTs? (Select one)

a) Regularly b) Occasionally c) Rarely d) Never

Section 5: Additional Comments

5.1 Please share any additional comments, suggestions, or concerns related to the management of Health Products and Technologies in your organization/health facility.

APPENDIX III: INTERVIEW GUIDE FOR THE KEY INFORMANTS

Instructions: I would like to ask you some questions on HPT management in your facility. The interview may take 1 hour. Kindly be honest and objective in answering the questions Let us start:

1. key informant interview guide on the relationship between institutional factors and the management of health products and technologies with the following indicators; financing of health products and technologies, supply chain practices, human resource factors, inventory optimization, health management information system, quality of health products and technologies, affordability and availability of HPTs

KEY INFORMANT INTERVIEW GUIDE

Section 1: General Information

A. County Name:

B. Date of Survey:

C. Respondent's Name (Optional):

D. Designation/Role:

Section 2: Financing Health Products and Technologies

1. How is the financing structured for health products and technologies in your county?

a. What sources of funding are available for HPTs?

b. Are there budget allocation mechanisms in place for this sector?

2. What are the financial challenges or constraints in managing health products and technologies in your county?

Section 3: Supply Chain Practices

3. Describe the supply chain practices within your institution.

a. How are products and technologies procured?

b. How are products and technologies distributed within the county?

c. Are there any collaboration efforts with external partners in the supply chain?

4. What are the key challenges or bottlenecks in your health product and technology supply chain?

Section 4: Human Resource Factors

5. How does your institution address the human resource needs for managing health products and technologies?

a. What is the composition of the workforce involved in this area?

b. Are there specific training programs for staff?

c. How do you ensure staff retention and motivation in this sector?

6. What challenges do you face regarding human resources in the management of health products and technologies?

Section 2: Inventory Optimization

7. How does your institution manage inventory for health products and technologies?

a. What inventory management systems are in place?

b. How frequently is inventory reviewed and updated?

c. Are there tools or software used for inventory optimization?

8. What challenges do you face in optimizing health product and technology inventory?

Section 6: Health Management Information Systems

9. Explain the health management information systems (HMIS) used in your institution.

a. What data is collected and how is it used for decision-making?

b. Is there integration with broader health information systems?

10. What challenges or limitations do you encounter in implementing and using HMIS for health product and technology management?

Section 7: Institutional Leadership Culture

11. Describe the leadership culture within your institution.

a. How does leadership influence decision-making in health products and technology management?

b. Are there specific strategies or policies that promote a culture of innovation and excellence in this area?

12. What challenges or opportunities are associated with the institutional leadership culture in managing health products and technologies?

Section 8: Additional Comments

13. Briefly describe how management of HPTs can be improved in your Health facilities/ County.

14. Is there any additional information or comments you would like to provide related to the management of health products and technologies in your county?

Thank you for your participation in this study. Your input is valuable in understanding the institutional factors that impact health product and technology management in Kenyan counties.

APPENDIX III

REPUBLIC OF KENYA
COUNTY GOVERNMENT OF MACHAKOS
DEPARTMENT OF HEALTH
Office of the County Director of Medical Services

Telephone: +254 720 754 471
Fax: 254-44-20655
Email: dms.machakos@outlook.com

Machakos Highway
P.O. Box 2574-90100
Machakos, Kenya

Ref No. MKS/DMS/RESEARCH APPROVALS/2024/8 **3rd April 2024**

Mr. Shadrack M. Meme
Kenya Methodist University

RE: LETTER OF AUTHORIZATION FOR CONDUCTING PROPOSED RESEARCH

The Department of Health Services, Machakos County, is keen to collaborate in your study titled, **"Institutional Factors and Management of Health Products and Technologies in Selected Counties, Kenya."**

The Ethical clearance from the Kenya Methodist University Institutional Scientific Ethics and Review Committee, **REF: KEMU/ISERC/HSM/26/2023**, dated 9th November 2023, for the approval period **9th November 2023 to 9th November 2024**; as well as the Research License from the National Commission for Science, Technology & Innovation number **NACOSTI/P/24/31850** for the period ending **12th December 2024**, is acknowledged.

You are authorized to proceed with your research in Machakos County and are urged to share the findings with the Department of Health; Machakos County, through the Email: research.dhes@gmail.com

Sincerely,

DIRECTOR
09 APR 2024

Dr. Jonathan Nthusi
County Director -Medical Services.
MACHAKOS COUNTY

Copy to:
County Executive Committee Member – Health
Chief Officer – Medical Services
All Directors

APPENDIX IV

COUNTY GOVERNMENT OF KIAMBU
DEPARTMENT OF HEALTH SERVICES
P.O Box 2344 - 00900 Kiambu, Kenya
Tel: +254 709 877 000 **Email**: info@Kiambu.go.ke **Website**: www.Kiambu.go.ke **Twitter**: @KiambuCountyGov

REFERENCE KIAMBU/HRDU/AUTHO/MEME S.

Date: 7th FEB 2024

TO WHOM IT MAY CONCERN,

RE: CLEARANCE TO CONDUCT RESEARCH IN KIAMBU COUNTY

Kindly note that we have received a request by **Shadrack Meme** of **Kenya Methodist University** to carry out research in Kiambu County, the research topic being on ***"Institutional factors and management of Health Products and Technologies in selected counties, Kenya"***.

We have duly inspected his documents and found that he has been cleared by **Kenya Methodist University ISERC** until **9th Nov 2024.** He thus does not need any further clearance with another regulatory body in order to conduct research within the county of Kiambu.

However, it is incumbent upon the facility in which the research is being carried out to ensure that they are conversant with the remit of the study and operate in line with their institutional norms on conducting research. This note also accords him the duty to provide feedback on his research to the county at the conclusion of his research.

DR. JUNE MUTHIORA
COUNTY HEALTH RESEARCH OFFICER
KIAMBU COUNTY

APPENDIX V

COUNTY GOVERNMENT OF ISIOLO
OFFICE OF COUNTY DIRECTOR
HEALTH SERVICES

County Director for Health
P.O. BOX 673 – 60300
ISIOLO

When replying Please quote

ISO/CONT/CDH/ADM/43/2024

26th March, 2024.

Shadrack Mururu Meme
P O Box 3005 – 60200
Meru

Dear Sir,

RE: PERMISSION TO CONDUCT A STUDY FOR PHD THESIS IN ISIOLO COUNTY

I am in receipt of your application to do a study on "institutional factors and management of health products and technologies in selected counties, Kenya" with study approval licence No. NACOSTI/P/23/31850.

There is no objection to your study to proceed. Requesting staff to accord you necessary help during the study by a copy of this letter.

Kindly share with us the copy of your findings of your study for record purposes upon completion.

Thank you.

COUNTY GOVERNMENT OF ISIOLO
DIRECTOR OF HEALTH
26 MAR 2024
P.O. Box 36 - 60300, ISIOLO

Dr. Stephen Kiluva
Ag. County Director of Health Services
Isiolo County

APPENDIX VI

REPUBLIC OF KENYA

COUNTY GOVERNMENT OF NYERI
DEPARTMENT OF HEALTH SERVICES
OFFICE OF THE DIRECTOR

Email: nyericountyhealth@yahoo.com
0758563121

COUNTY COMMISSIONER'S HQ
BLOCK 'A'
P.O. Box 110 – 10100
NYERI

REF: CGN/HEALTH/HRM/5/VOL.III **Date: 26th March 2024**

TO WHOM IT MAY CONCERN

RE: RESEARCH AUTHORIZATION

The bearer of this letter, **Shadarack Mururu Meme** is a student at Kenya Methodist University pursuing a PhD in Health Systems Management.

He has written to this office seeking authority to conduct research at your facility.

Consent has been given and he is hence introduced to carry out a research on "**Institutional factors and management of health Products and Technologies in selected counties in Kenya ".**

Kindly accord him the necessary assistance.

The student **must** deposit a copy of the final report with the department following completion of the study.

Dr. Oscar Agoro
For: County Director of Health
NYERI

APPENDIX VI

REPUBLIC OF KENYA
COUNTY GOVERNMENT OF KISUMU

Telegrams: "PRO (MED)"
Tel: 254-057-2020105
Fax: 254-057-2023176
E-mail: kisumucdh@gmail.com

Director of Public Health & Sanitation
P.O. Box 721 – 40100,
Kisumu.

DEPARTMENT OF MEDICAL SERVICES, PUBLIC HEALTH & SANITATION

Our Ref: GN 133 VOL.XVI /69) **Date:** 26th March, 2024

To:

CEO – JOOTRH
ALL Medical Superintendents
KISUMU

RE: APPROVAL TO CONDUCT RESEARCH IN KISUMU COUNTY

The department has reviewed and approved this research titled '**Institutional Factors and Management of Health Products and Technologies in Kisumu County, Kenya'.**

The principal investigator for this research activity is **Dr. Shadrack Meme** and the County Co PI is **Mr. Fredrick Oluoch.**

Kindly accord him all the necessary support.

COUNTY DIRECTOR OF HEALTH KISUMU

Fredrick O. Oluoch, MPH, MBA, HSC, OGW
County Director Public Health & Sanitation
Kisumu County

CC. Principal investigator – Dr. Shadrack Meme

From the office of Director Public Health & Sanitation

APPENDIX VII

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **864872**

Date of Issue: **12/December/2023**

RESEARCH LICENSE

This is to Certify that Dr.. Shadrack Mururu Meme 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 Meru on the topic: INSTITUTIONAL FACTORS AND MANAGEMENT OF HEALTH PRODUCTS AND TECHNOLOGIES IN SELECTED COUNTIES, KENYA for the period ending : 12/December/2024.

License No: **NACOSTI/P/23/31850**

864872

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 VIII

KENYA METHODIST UNIVERSITY
P. O. Box 267 Meru - 60200, Kenya
Tel: 254-064-30301/31229/30367/31171
Fax: 254-64-30162
Email: deanrd@kemu.ac.ke

DIRECTORATE OF POSTGRADUATE STUDIES

November 9, 2023

Commission Secretary,
National Commission for Science, Technology and Innovations,
P.O. Box 30623-00100
NAIROBI

Dear Sir/Madam,

RE: SHADRACK MEME – (REG. NO. HSM-4-0152-1/2020)

This is to confirm that the above named person is a bona fide student of Kenya Methodist University, in the School of Medicine and Health Sciences, Department of Health System Management undertaking a Doctoral Degree in Health System Management. He is conducting research on; **"Institutional Factors and Management of Health Products and Technologies in Selected Counties, Kenya".**

We confirm that his research proposal has been presented and approved by the University.

In this regard, we are requesting your office to issue a research license to enable him collect data.

Any assistance accorded to him will be appreciated.

Yours sincerely.

09 NOV 2023

Dr. John M. Mucniri (PhD)
Dean, Postgraduate Studies
Cc: Dean SMHS
CoD, HSM
Program Coordinator -HSM
Student Supervisors