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**MODERATING EFFECT OF HEALTHCARE DIGITIZATION ON THE RELATIONSHIP
BETWEEN MEDICAL EQUIPMENT PROCUREMENT PRACTICES AND HEALTHCARE
SERVICE DELIVERY AMONG REFERRAL HOSPITALS IN KENYA**

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ABSTRACT

This study examined the moderating effect of healthcare digitization on the relationship between medical equipment practices and healthcare service delivery in referral hospitals in Kenya. The study was grounded in the systems theory. A positivist research philosophy was adopted, employing an explanatory cross-sectional research design. Primary data was collected through structured questionnaires administered to 156 key informants from all 52 referral hospitals in Kenya. The findings revealed that healthcare digitization demonstrated a synergistic moderating effect. This study contributes theoretically by extending the application of systems theory in healthcare delivery research, and methodologically by applying SEM with moderation analysis in the context of public healthcare systems. Managerially and policy-wise, the findings offer actionable insights for adopting digital health innovations to improve service quality, accessibility, and efficiency in referral hospitals. Limitations of the study included the use of a cross-sectional design, which restricts causal inference, and reliance on self-reported data, which may introduce response bias. Also, the study focused only on public referral hospitals and excluded private hospitals hence limiting the generalizability of the study findings. Future studies should consider longitudinal designs and incorporate patient-level data to validate and extend the current findings. Furthermore, future studies should consider integrating private hospitals to augment the generalizability of the study outcomes.

Key Words: Telemedicine, e-Record management, Diagnostics Digitization, Electronic Supporting Infrastructure

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INTRODUCTION

Medical equipment procurement practices enhance efficiency by adopting healthcare digitization through digital tools and data-driven strategies, such as demand forecasting and inventory management, ensuring that medical equipment is available when and where it is needed, thereby reducing delays and shortages. Yadav (2024) explains that as digital solutions are increasingly integrated into global health product supply chains, procurement practices driving healthcare digitization involve forecasting demand through historical and future event analysis, enabling procurement agencies to place purchase orders fulfilled by manufacturers or their agents from existing or newly produced inventory, processes that align with the source, make, and deliver framework encompassing procurement, manufacturing, and delivery.

Infrastructure procurement can lead to improved healthcare digitization and faster healthcare service delivery to patients. The use of digital technologies, including the internet and data-driven tools, to innovate and improve healthcare service delivery can lead to better health management, lower costs, and improved patient well-being. Freitas (2023) highlights that the Picker Institute's research has identified eight dimensions of patient-centered care, which include: respect for the patient's values, preferences, and expressed needs; information and education; access to care; emotional support to alleviate fear and anxiety; involvement of family and friends; continuity and secure transition between healthcare providers; and placing the patient and their family at the center of all decisions and quality evaluations (Li et al., 2020). Digital transformation in healthcare also affects medical education, bringing new opportunities and training methods for practitioners (Stoumpos et al., 2023).

Healthcare digitization enable online transactions for hospital operations, making them faster and easier for future reference. Digitization is the conversion of analog information into binary digital data, enabling computers to store, process, and transmit it efficiently (Verhoef et al., 2019). Fährndrich (2022) defines digitization as the technical process of converting analog data into a digital format, which allows the content to be programmable, addressable, traceable, and communicable. Digitization is a technical process that converts, enhances, or represents analog, physical objects and real-world phenomena into digital artifacts (Gladillas & Thomas, 2023). Healthcare systems must leverage digital technology to enhance healthcare delivery and address medical challenges, with digital transformation encompassing internet-based innovations, digital technologies, and their integration into new therapies and best practices for improved health management (Stoumpos et al., 2023). This transformation involves adopting internet-based innovations such as telemedicine, electronic health records, and mobile health applications, which help in remote consultations, streamlined data management, and better patient engagement.

Co-creation initiatives can help planners understand how things currently work and what users need so they can create a tool that is easy to use and beneficial, making it easier to combine a digital solution with existing practices and processes. Integration of digital technologies helps healthcare providers optimize workflows, improve diagnostic accuracy, and enable real-time communication between medical professionals and patients. Digital technologies enable seamless communication between hospitals and patients, facilitating bookings and ensuring consistent adherence to appointment dates.

The International Organization for Standards defines an Electronic Health Record (EHR) as a secure digital repository for patient data, accessible by authorized users, that supports continuous, efficient, and high-quality healthcare by integrating comprehensive medical information, including past, present, and future health data (Bouh et al., 2024). Ndlovu et al. (2021) define eHealth as the use of information and communication technologies (ICT) for health, encompassing areas such as health informatics, telehealth, e-learning, and e-commerce, with mHealth a rapidly growing component leveraging mobile technologies to enhance healthcare accessibility, while eRecord systems, including electronic medical records (EMRs), electronic health records (EHRs), and personal health records (PHRs), facilitate seamless data exchange, even though adoption remains limited in low-income countries, where fewer than 15 percent have national EHRs despite the documented

benefits of reducing duplicate tests and improving care quality.

As the late digital history pioneer Roy Rosenzweig suggested two decades ago, historians may be facing a paradigm shift from a culture of scarcity to a culture of abundance that includes the transformative potential of digital resources and historical data for historical research (Zaagsma, 2022). Digital diagnostics optimize healthcare resources by reducing unnecessary consultations, alleviating staff shortages, and improving referral behaviors, while also enhancing accessibility, sustainability, and equity by providing flexible, technology-driven diagnostic pathways that can operate independently of traditional infrastructure constraints (Villalobos-Quesada et al., 2023). While many digital health innovations focus on patient care, advancements also benefit physicians, such as portable smartphone-connected ultrasound devices for instant imaging (Simon et al., 2024), alongside the digitization of pathology labs through digital case management, digital slide reading, and computer-aided diagnostics, which enhance workflow efficiency, accessibility, and accuracy (Schwen et al., 2023).

The shift to digital resources has fundamentally revolutionized historical research practices and access to digital data, opening new avenues for comparative analysis and historical interpretation. There is growing interest in comprehending the influence of digital technology on innovation management as it becomes increasingly integrated into daily life. Digitization changes processes by removing or reducing material constraints associated with work, such as limitations of time, space, location, or capital requirements (Leonardi & Treem, 2020). The digital economy's rapid evolution has brought an industrial revolution, characterized by breakthrough technologies including big data, internet technologies, blockchain systems, cloud computing services, and artificial intelligence applications. This transformation has changed the operations of governments that have adapted to digitization (Chen et al., 2023).

Digital transformation is essential for economic growth and industrial advancement, a reason for governments to set up policies that guide their operationalization. Digital technologies transform medical education by introducing innovative training methods and offering new opportunities for practitioners, while quality control of large datasets can enhance patient health outcomes and reduce service costs (Stoumpos et al., 2023). Digital technologies, including virtual simulations, e-learning platforms, and telemedicine programs, enhance the training of healthcare professionals that can be applied in referral hospitals in Kenya by offering continuous professional development and enabling practitioners to learn advanced medical procedures, diagnostics, and treatment protocols remotely, especially in underserved areas (Gupta et al., 2020).

The status of medical equipment in referral hospitals reflects significant challenges, particularly the outdated analog equipment that struggles to meet the demands of modern healthcare service delivery. While analog equipment is still in use, the lack of interconnectivity through Information and Communication Technology (ICT) limits diagnostic efficiency, impedes real-time data sharing, and affects overall service provision (Chen et al., 2023).

The transition from analog to digital medical equipment has an impact on healthcare. Digital medical devices, such as MRI scanners, dental equipment, digital X-rays, and automated patient monitors, offer greater accuracy, real-time data analysis, and the ability to integrate with hospital management systems for seamless patient care (Nguru & Ileri, 2022). However, many referral hospitals in Kenya still rely on outdated analog equipment that is prone to frequent breakdowns and inefficient diagnostic outputs. A Ministry of Health report revealed that 35 percent of referral hospitals face frequent equipment shortages, a problem exacerbated by the difficulty in maintaining and sourcing parts for older machines (Njanwe et al., 2021). The use of digital medical equipment and its potential for ICT interconnectivity enhances diagnostic capabilities and facilitates efficient service provision by allowing health professionals to access patient records, diagnostic results, and treatment plans through centralized systems (Chen et al., 2023). Despite the benefits, the high cost of acquiring and maintaining this technology presents significant challenges for Kenyan hospitals, which often operate under budget constraints (Nguru & Ileri, 2022).

Kenya integrated digital equipment into its healthcare system, particularly through initiatives like the Managed Equipment Services (MES) project. This program has improved access to modern diagnostic tools by leasing digital medical equipment to county and referral hospitals (Wachira & Mwai, 2021). However, affordability remains a significant issue, as most advanced digital technologies are imported at high costs, and there is a limited domestic capacity for producing such equipment. Moreover, the inconsistent implementation of technology adoption initiatives and resistance to change slow down progress (Simeoni & Kinoti, 2023). This gap in advanced medical technology has led many Kenyans to seek healthcare services abroad, particularly in countries like India, where medical equipment is more advanced, specialized care is more accessible, and treatments are more affordable.

India's healthcare system is known for its cutting-edge diagnostic and treatment technologies, offering services at a fraction of the cost compared to private healthcare facilities in Kenya, which often cannot provide the same level of care due to outdated equipment and limited ICT integration (Gupta et al., 2020). Medical equipment operates at a higher level when procurement is based on user needs, technical specifications, and lifecycle considerations, and in so doing, improving operational efficiency and patient safety (Simeoni & Kinoti, 2023). Properly managed medical equipment reduces downtime, enhances diagnosis accuracy, and supports timely treatment, ultimately improving patient clinical outcomes (Kabeta et al., 2023; Hinrichs-Krapels et al., 2022).

When medical equipment management practices are at lower levels, the link between medical equipment procurement and healthcare service delivery is weakened, resulting in adverse effects on patient care and operational efficiency. Inadequate equipment management practices such as poor maintenance, improper storage, and lack of user training can lead to frequent equipment breakdowns, extended downtimes, and unreliable diagnostic tools, which delay patient diagnostics and treatment, compromise patient safety, increase operational costs, limit delivery of quality healthcare services, especially in resource-constrained settings like referral hospitals in Kenya (Kabeta et al., 2023; Hinrichs-Krapels et al., 2022; Huang et al., 2024).

Despite the various advantages of digital medical technology, such as superior diagnoses and enhanced service delivery through ICT interconnectivity, its accessibility in Kenya is hindered by financial limitations and sluggish adoption rates. The persistent utilization of analog equipment in numerous referral hospitals impedes the effectiveness of the country's healthcare system, prompting many patients to pursue treatment overseas (Leonardi & Treem, 2020). While projects such as MES represent progress, there is a necessity for measures to surmount the financial and logistical barriers to fully realize the potential of digital healthcare technology and reduce medical tourism (Wachira & Mwai, 2021).

The current situation in referral hospitals is that the procurement process is done manually, and then the outcome or tender awards are posted in the Integrated Financial Management Systems (IFMIS). The records, which include medical records, are done manually in county government referral hospitals, and only the national referral hospitals are automated, with some transactions, such as requests for diagnostic services, done manually and the results uploaded in the system (Afwande et al., 2021). Patient files are maintained manually, and sometimes retrievability becomes a challenge. It is for this reason that sometimes the referral hospitals open up temporarily or replace the files completely. The historical data, which should form part of the reference in areas of healthcare, are not available when the referral hospitals need to use them; as a result, the doctor depends on the explanation provided by the patient or the patient's next of kin, which may not be reliable (Adjagba et al., 2024). A lasting solution needs to be found to improve healthcare services to the patients and better records management.

This study used e-Procurement, e-Records management, adoption of digitization diagnostics and electronic supporting infrastructure as a metric to measure healthcare digitization, the justification being to identify penetration of digital technology, frequency of use of digitization, quality of records, and availability of digital tools for effective healthcare service delivery in referral hospitals in Kenya.

The rapid growth and diffusion of digital health technologies have significantly increased the availability of electronic tools enabling patient-provider communication, enhancing citizens' health awareness, and offering potential improvements in the quality, efficiency, equity, effectiveness, and safety of healthcare systems (Carini et al., 2021). Reliable data and information systems contribute highly to monitoring health outcomes, tracking disease patterns, and making evidence-based decisions (Afwande et al., 2021). This information also shows the disease patterns, treatment, and statistical success rates stored in the repository for future reference and policy guidance. WHO asserts that quality healthcare services are measured through the desired health outcomes for individuals and populations, grounded in evidence-based professional knowledge and essential for achieving universal health coverage.

The referral hospitals in Kenya currently face numerous challenges of self-referrals by patients who have lost trust and confidence in the levels 5 and 4 hospitals because of the unavailability of medical equipment. Improving health system efficiency involves maximizing outputs and outcomes through cost-effective production and optimal resource combination efficiency, which is seen as a way to expand fiscal space, and budgetary capacity to allocate resources without compromising financial sustainability, especially given that 20 to 40 percent of global health resources are lost to inefficiencies (Nyawira et al., 2023). This kind of situation is in Kenya, where medical equipment is available, but the staff lacks the relevant training to use it in the treatment of patients. Some of the equipment procured under the managed equipment services (MES) program requires civil works, which were not considered at the time of procurement because they did not involve the stakeholders. Conducting real-time formative evaluation alongside implementation and optimization can improve co-design even post-deployment, whereas delayed evaluation often occurs after substantial resource investment when changes are no longer feasible, risking poor implementation, adoption, and user engagement (Cresswell & Williams, 2024).

Statement of the Problem

Healthcare service delivery in Kenya's referral hospitals faces several challenges, which include financial constraints that lead to non-procurement of essential medical equipment, services affected by staff shortages, brain drain as a result of staff going for greener pastures outside the country, overburdened and overcrowded hospitals, high cost of medical care, and poor infrastructure. According to the Resource-Based View (RBV), organizational performance depends on how effectively institutions acquire, develop, and utilize valuable, rare, inimitable, and non-substitutable (VRIN) resources. Okoroafor et al. (2022) report that a Health Labor Market Analysis by the Ministry of Health revealed that, in 2020, Kenya had 189,932 health workers in the public sector with a ratio of 30.14 per 10,000 population that is 68 percent of the sustainable development goals (SDG) target of 44 per 10,000. Kenya faces a critical shortage and high attrition of healthcare workers due to poor working conditions, low pay, lack of professional growth opportunities, and international migration (Brownie & Oywer, 2016).

Despite human resources for health consuming substantial resources, Kenya's chronically underfunded health system spends only 2.3 percent of GDP, below the recommended 5 percent needed for universal coverage (Nyawira et al., 2022). The delays in procurement have led to shortages of medical equipment and caused repairs and maintenance to be delayed, which contributes to patients seeking healthcare services outside the country. Despite established policies, recurring issues impede the efficacy of Kenya's medical procurement process, which is essential to attaining universal healthcare and linked to the pillars of the health system (Chikophe et al., 2024).

Medical equipment procurement practices, equipment management practices, and healthcare digitization would involve a streamlined, transparent procurement process, state-of-the-art management systems, and fully integrated digital health solutions (Mwihia, 2020). Ideally, procurement would be timely and efficient, ensuring that hospitals are equipped with the latest medical technologies without delays (World Health Organization, 2021). Equipment management practices would be robust, featuring regular maintenance and

upgrades to ensure all devices are functional and up-to-date (Ministry of Health Kenya, 2020). Healthcare digitization would facilitate the seamless integration of equipment management with patient records and operational processes, enabling real-time data access, predictive maintenance, and efficient resource allocation, thereby significantly improving healthcare service delivery and patient outcomes (Ohando et al., 2024).

There is a notable gap in understanding how medical procurement delays, inconsistent management practices, and digitization challenges interact to affect healthcare service delivery in Kenya's referral hospitals. While various studies, such as Mwihia (2020) and Ohando et al. (2024), have examined these elements in isolation, there remains limited empirical understanding of how these practices interact to influence service delivery, particularly within Kenya's referral hospital system. Despite these contextual and policy insights, there is little theoretical work applying resource-based or systems theories to explain how hospitals' internal capabilities influence medical equipment procurement practices, equipment management practices, healthcare digitization and healthcare service delivery in referral hospitals in Kenya. This gap investigated the moderating effect of healthcare digitization on the relationship between medical equipment procurement practices and healthcare service delivery in referral hospitals in Kenya.

Objective of the Study

This study examined the moderating effect of healthcare digitization on the relationship between medical equipment procurement practices and healthcare service delivery in referral hospitals in Kenya. The research was guided by the following hypotheses;

H₀: Healthcare digitization does not significant moderate medical equipment procurement practices and healthcare service delivery in referral hospitals in Kenya.

LITERATURE REVIEW

Theoretical Review

Systems Theory

Systems Theory, introduced by Ludwig von Bertalanffy in the 1950s, provides a holistic framework for analyzing organizations and complex entities as interdependent systems rather than as isolated parts (Mele et al., 2010). Its key postulates are holism, interdependence, and feedback loops. Holism implies that the performance of a system, considers the collective interactions of its parts rather than focusing on individual components. Interdependence highlights that subsystems rely on each other, and changes in one domain affect outcomes in others. Feedback loops emphasize the importance of information exchange within and across systems for corrective action, adaptation, and learning. These principles have been widely applied in organizational, social, and healthcare contexts to explain how subsystems function within a broader whole (Cerchione et al., 2023).

This study anchored on Systems Theory to examine how medical equipment procurement practices, equipment management practices, and healthcare digitization interact as interdependent subsystems that collectively determine the quality of healthcare service delivery in Kenya's referral hospitals. Procurement is the entry point of critical resources, equipment management as the process that ensures functionality and continuity, and digitization as the enabling infrastructure that connects and optimizes these subsystems. In applying Systems Theory, the study conceptualized referral hospitals not as isolated units but as open systems whose internal efficiency depends on smooth coordination among subsystems and their interaction with external suppliers and regulatory environments.

Systems Theory amplifies the understanding of how inefficiencies in one area of hospital operations create ripple effects that compromise overall performance. For instance, delays in procurement directly reduce

equipment availability, which disrupts patient diagnosis and treatment. This inefficiency then places pressure on equipment management practices, leading to frequent breakdowns, repair delays, and downtime that further strain service delivery (Guyow, 2021; Ministry of Health Kenya, 2020). Similarly, weak digitization reduces visibility into procurement timelines, maintenance schedules, and supply chain performance, thereby weakening feedback loops that are critical for efficiency.

The theory also underscores the role of digitization in creating real-time connectivity across subsystems. For example, integrating digital health tools such as electronic equipment tracking, computerized maintenance management systems, and digital supply chain dashboards creates seamless feedback loops that enable predictive maintenance, timely procurement, and improved coordination between biomedical engineers and procurement officers (Mackey & Cuomo, 2020; Adebayo et al., 2024). This amplification clarifies how hospitals can minimize inefficiencies not by focusing on isolated interventions but by strengthening the integration of procurement, management, and digitization practices.

The relevance of Systems Theory to this study's conceptual framework lies in its ability to explain the interconnected relationships among the study variables. The independent variable, medical equipment procurement practices, represents a subsystem responsible for sourcing and availing resources. The mediating variable, equipment management practices, ensures these resources remain functional and effectively utilized. The moderating variable, healthcare digitization, enhances feedback loops by linking procurement data with maintenance records and patient care needs. The dependent variable, healthcare service delivery, reflects the overall system performance that emerges from the integration of these subsystems.

Thus, Systems Theory justifies the hypothesized causal pathways in the conceptual model: procurement influences service delivery directly, equipment management partially mediates this relationship, and digitization moderates it by strengthening interconnections and reducing inefficiencies. Improvements in procurement practices cascade through equipment management and digitization subsystems, ultimately enhancing the quality, accessibility, and efficiency of healthcare services (Rahmani et al., 2022; Muberarugo & Madichie, 2022). Conversely, weaknesses in any of these subsystems trigger negative ripple effects across the entire service delivery system.

Despite its strengths, Systems Theory has notable limitations. First, it often assumes that subsystems function rationally and predictably, whereas real-world hospital environments are influenced by political, social, and cultural dynamics that complicate systemic interactions (Mele et al., 2010). Second, the theory faces epistemological challenges due to its broad and sometimes conflicting perspectives; scholars have argued that Systems Theory is better understood as a set of alternative viewpoints rather than as a unified framework (Sepúlveda et al., 2022). Third, its emphasis on interdependence and feedback loops can obscure the role of power dynamics and agency in shaping system behavior, particularly in resource-constrained settings like Kenya. Finally, the theory risks subjectivity in interpretation, as different observers may focus on different subsystems and draw divergent conclusions (Justus et al., 2021).

Nonetheless, these limitations do not diminish its utility in this study. Rather, they highlight the importance of contextualizing Systems Theory within healthcare environments that are complex, resource-limited, and politically embedded. By acknowledging these constraints, the study applied Systems Theory pragmatically, using it to frame the interconnectedness of procurement, equipment management, and digitization, while recognizing that other external factors may also shape healthcare service delivery.

In conclusion, Systems Theory provided a valuable foundation for understanding how Kenya's referral hospitals operate as interconnected systems where procurement, equipment management, and digitization subsystems collectively shape healthcare service delivery. Its emphasis on holism, interdependence, and feedback loops aligned closely with the study's conceptual framework, which hypothesized direct, mediating, and moderating relationships among the study variables. While limitations exist, Systems Theory offered a

robust lens to interpret how strengthening subsystem integration can reduce inefficiencies, improve supplier collaboration, and ultimately enhance patient outcomes in referral hospitals.

Empirical Review

Beaulieu and Bentahar (2021) set out to chart a comprehensive roadmap for digitalizing healthcare supply chains by first exploring the mechanisms through which digital technologies, specifically internet of things (IoT) sensors, blockchain-based tracking systems, and artificial intelligence (AI)-driven demand forecasting, can enhance procurement performance and then identifying the principal barriers that impede the widespread adoption of these tools (Beaulieu & Bentahar, 2021). Conducted across three distinct national contexts (Canada, France, and Morocco), their comparative study taps into high-income and middle-income health systems to yield insights that are both generalizable and sensitive to differing institutional, regulatory, and infrastructural environments.

In operationalizing their key constructs, Beaulieu and Bentahar (2021) measured digitalization levels by the extent of IoT, blockchain, and AI deployment within procurement processes and quantified supply chain performance through reductions in delivery delays, cost savings percentages, and declines in documented procurement error rates. Framed by the Technology Acceptance Model (TAM), which posits that perceived usefulness and ease of use drive technology uptake, and structured through the Supply Chain Operations Reference (SCOR) Model's five core functions (plan, source, make, deliver, and return), the study articulates clear hypotheses, such as IoT usage predicting reduced delays and AI forecasting leading to cost savings to be tested via SEM.

A cross-sectional survey design gathered data from 200 hospital and supplier supply chain managers via an online questionnaire that combined subjective assessments (e.g., perceived ease of use) with objective system metrics, including error logs. SEM enabled rigorous examination of multiple interrelated latent constructs while accounting for measurement error, and country-level comparative case studies enriched the quantitative findings with contextualized insights into adoption barriers. The authors report a 30 percent average reduction in procurement errors and significant cost savings attributable to digital tools and also highlight organizational resistance steeped in legacy procedures and digital skill gaps as the chief obstacle to realizing these benefits fully (Beaulieu & Bentahar, 2021).

The study's cross-national dataset and robust SEM analysis stand out as strengths, bolstering external validity and the credibility of causal inferences; however, the overrepresentation of high-income settings such as Canada and France relative to Morocco limits transferability to more resource-constrained or rural environments, and its single-time-point design leaves long-term impacts unexamined. This research on Kenyan referral hospitals validates metrics for digitalization and performance and provides a valuable benchmarking framework, while the documented change-management challenges mirror those likely to arise under Kenya's devolved governance and varied connectivity contexts. Beaulieu and Bentahar (2021) do not address rural healthcare settings, a gap that this study will fill by including all rural and urban referral hospitals in Kenya to ensure that digital procurement roadmaps are actionable across the full spectrum of operational environments.

Yadav (2024) proposes and validates a comprehensive, multi-stage framework for analyzing digital transformation within health product supply chains, drawing on global best practices and case studies from India, South Africa, and Brazil. His framework, grounded in the Supply Chain Maturity Model and the Digital Capability Framework (SCMMD), delineates five transformation stages: ad hoc, managed, standardized, integrated, and predictive, each characterized by proxy indicators such as e-procurement adoption rate, forecast accuracy, and stock out frequency. Employing a comparative case study design, the study analyzed six national supply chains through policy documents, system logs, and interviews with key informants, using descriptive benchmarking to map digital maturity against performance outcomes. He found

that advanced maturity stages consistently delivered 25 to 40 percent reductions in both stock outs and procurement lead times, thereby empirically validating the five-stage model against real-world data.

While the multi-country evidence enhances the framework's generalizability, its reliance on secondary data and the absence of inferential statistical validation limit empirical rigor. Nevertheless, Yadav's digital maturity framework offers a valuable blueprint for this study by providing metrics, particularly around e-procurement cycle times and e-records management, that can be adapted to assess digitization in Kenyan referral hospitals. Importantly, Yadav stops short of linking supply chain digital maturity to downstream healthcare service outcomes. This research will extend his work by empirically testing how progression through these digital stages impacts patient turnaround times and the availability of medical equipment, thereby filling a critical gap in the literature.

Simon et al. (2024) convened a three-round Delphi panel of 30 international experts, clinicians, engineers, and ethicists between January and March 2023 to develop consensus guidelines on deploying home-based digital diagnostic tools in primary care (Simon et al., 2024). Panelists evaluated draft recommendations on a nine-point scale for feasibility, patient safety, and data security, with consensus defined as at least 80 percent agreement and interquartile ranges of two or less. Framed by the development consensus conference (DCC) model and patient-centered care principles, the study used percentage agreement and interquartile quality range (IQR) analyses to retain 15 recommendations, ranging from minimum device accuracy standards and seamless integration with electronic health records to comprehensive protocols for patient training and data privacy safeguards. A modified Delphi design combined structured questionnaires and iterative feedback rounds, with thematic analysis of qualitative comments refining each subsequent draft, ensuring that both technical and governance aspects of home diagnostics were thoroughly vetted.

While the Delphi methodology lends rigor and expert validity, its reliance on a single panel raises the possibility of selection bias, and the absence of subsequent field validation limits confidence in real-world applicability. Nonetheless, these guidelines directly inform this study's measures of diagnostic digitization within healthcare digitization, ensuring that survey items capture not only technological functionality but also critical governance and safety requirements. Importantly, Simon et al. (2024) do not address how home-acquired diagnostic data can be incorporated into hospital procurement and maintenance workflows. This research will fill this gap by examining the integration of remote diagnostics within referral hospitals' equipment management cycles, thereby linking digital diagnostics to procurement efficiency and service delivery outcomes.

Conceptual Framework

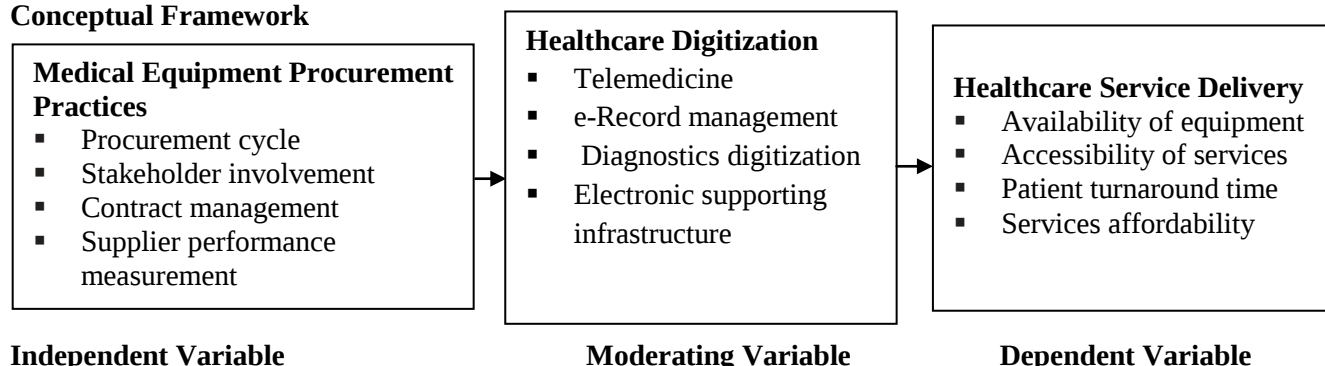


Figure 1: Conceptual Framework

METHODOLOGY

This study adopted the positivist research philosophy, which is grounded in the belief that reality is objective and can be observed, measured, and analyzed through empirical evidence. This study adopted explanatory cross-sectional survey design, which was most appropriate for examining the hypothesized relationships among medical equipment procurement practices, healthcare digitization and healthcare service delivery in

referral hospitals in Kenya. The target population for this study comprised all 52 referral hospitals in Kenya, consisting of 47 county referral hospitals (classified as Level Five) and 5 national referral hospitals (classified as Level Six), under the Kenya health policy framework. The unit of observation for the study consisted of departmental heads drawn from three critical functional areas within each referral hospital. The sampling frame was derived from official records maintained by the Ministry of Health, which has oversight over all referral hospitals in Kenya. Data was collected using instruments developed by the researcher under the supervision of university supervisors. This entailed data sources, data collection procedures and data collection tools.

The study relied exclusively on primary data as the main source of information. This data was obtained directly from key departmental heads in referral hospitals across Kenya, specifically those responsible for medical equipment procurement, healthcare digitization and healthcare service delivery. Primary data was deemed appropriate for this research because it offered firsthand, original information tailored to the specific objectives of the study. Primary data were collected through self-administered questionnaires, either physically distributed or sent via email to respondents who preferred the electronic option. The study utilized a structured, close-ended questionnaire as the primary tool for data collection.

This study adopted a structured approach to data analysis and presentation, utilizing JASP software as the principal tool for both descriptive and inferential statistical procedures. The choice of JASP was informed by its advanced capabilities in SEM, CFA, reliability and validity testing, as well as its efficient graphical and tabular data presentation functionalities. The analysis was conducted in two major phases: assessment of the measurement model and evaluation of the structural model, each aligned to support the investigation of the study's conceptual framework involving medical equipment procurement practices, and healthcare service delivery.

FINDINGS

Descriptive Statistics

The descriptive statistics presented in this section provide a summary of the responses collected using a 5-point Likert scale, where 1 represented "Strongly Disagree" and 5 represented "Strongly Agree." These statistics offer an overview of the central tendency and dispersion of the data through the use of mean (M), standard deviation (SD), and coefficient of variation (CV). The analysis focuses on the main study variables: medical equipment procurement practices, healthcare digitization and healthcare service delivery. In examining these metrics, the study captured the general perceptions and consistency of responses among participants, laying the groundwork for deeper inferential analyses and interpretation of relationships between variables.

Table 1: Descriptive Statistics for Study Variables

Variable	Indicator Description	M	SD	CV
Medical Equipment Procurement Practices	Procurement cycle	4.328	0.329	7.60
	Stakeholder involvement	4.333	0.330	7.62
	Contract management	4.331	0.328	7.58
	Supplier performance measurement	4.330	0.324	7.48
Healthcare Digitization	Telemedicine	4.245	0.263	6.20
	e-Record management	4.266	0.260	6.09
	Diagnostics digitization	4.256	0.261	6.14
	Electronic supporting infrastructure	4.279	0.256	5.98
Healthcare Service Delivery	Availability of equipment	4.191	0.298	7.11
	Accessibility of services	4.195	0.285	6.80
	Patient turnaround time	4.202	0.297	7.07
	Services affordability	4.210	0.289	6.86

Source: Research Data (2025)

Table 1 presented the descriptive statistics for the study's main variables, namely: medical equipment procurement practices, healthcare digitization, and healthcare service delivery, measured using means, standard deviations, and coefficients of variation. These statistics provide a snapshot of the central tendencies and consistency of responses across all indicators.

Medical equipment procurement practices were rated highly by respondents, with all indicators demonstrating means above 4.3. Specifically, stakeholder involvement had the highest mean ($M = 4.333$, $SD = 0.330$), closely followed by contract management ($M = 4.331$, $SD = 0.328$), supplier performance measurement ($M = 4.330$, $SD = 0.324$), and procurement cycle ($M = 4.328$, $SD = 0.329$). The coefficients of variation for these indicators ranged narrowly between 7.48% and 7.62%, indicating low relative variability and a strong consensus among respondents regarding the effectiveness and consistency of procurement practices.

Healthcare digitization was assessed through indicators that also exhibited high means and the lowest variation across all constructs. Electronic supporting infrastructure had the highest mean ($M = 4.279$, $SD = 0.256$), followed closely by e-record management ($M = 4.266$, $SD = 0.260$), diagnostics digitization ($M = 4.256$, $SD = 0.261$), and telemedicine ($M = 4.245$, $SD = 0.263$). The coefficients of variation for these indicators ranged from 5.98% to 6.20%, indicating that digitization efforts in healthcare facilities were not only widely adopted but also consistently implemented across the institutions surveyed. These results highlight the role of digital systems in enhancing the quality, accessibility, and efficiency of healthcare services.

Lastly, healthcare service delivery indicators were rated slightly lower, though still highly. Services affordability had the highest mean ($M = 4.210$, $SD = 0.289$), followed by patient turnaround time ($M = 4.202$, $SD = 0.297$), accessibility of services ($M = 4.195$, $SD = 0.285$), and availability of equipment ($M = 4.191$, $SD = 0.298$). The coefficients of variation were moderate, ranging from 6.80% to 7.11%, suggesting that while service delivery is generally perceived positively, there may still be some variability in how consistently services are experienced by patients across facilities. These findings imply that continued efforts are needed to enhance the availability and affordability of services to ensure equitable and reliable healthcare delivery.

Therefore, the descriptive statistics reveal a strong and consistent performance in procurement and robust digitization initiatives with minimal variation, and a generally positive but more variable perception of healthcare service delivery. These findings underscore the importance of maintaining and scaling up investments in digital health systems, while also addressing gaps in service delivery that may affect patient experience and access.

The Moderating Effect of Healthcare Digitization on the Relationship between Medical Equipment Procurement Practices and Healthcare Service Delivery

This section presents the findings related to the moderating role of healthcare digitization in the relationship between medical equipment procurement practices and healthcare service delivery within referral hospitals in Kenya. This analysis corresponds to the third objective of the study, which sought to examine whether healthcare digitization significantly moderates the influence of medical equipment procurement practices on healthcare service delivery. The related null hypothesis (H_{03}) was formulated as follows:

H_0 : Healthcare digitization does not moderate the relationship between medical equipment procurement practices and healthcare service delivery in referral hospitals in Kenya.

To test this hypothesis, a SEM method was applied using JASP software. In the specified moderation model, medical equipment procurement practices was modeled as the independent latent variable, healthcare service delivery as the dependent latent variable, and healthcare digitization was introduced as the moderating variable. The interaction term between medical equipment procurement practices and healthcare digitization was computed and included in the structural model to test for moderation.

The analysis aimed to determine whether the strength or direction of the relationship between medical equipment procurement practices and healthcare service delivery varies depending on the level of healthcare digitization in referral hospitals. Through examining the significance of the interaction effect, the study provides insights into whether digitization enhances or diminishes the effectiveness of procurement practices in improving service delivery. This section presents the empirical results of the moderation analysis, followed by an interpretation of their implications for healthcare systems in Kenya.

Path Coefficients and Hypothesis Testing

This segment details the results of the moderation analysis conducted to evaluate whether healthcare digitization influences the strength or direction of the relationship between medical equipment procurement practices and healthcare service delivery in Kenya's referral hospitals. The analysis directly responds to the third objective of the study, which seeks to examine the moderating role of healthcare digitization in medical equipment procurement practices – healthcare service delivery linkage. The corresponding null hypothesis (H_{03}) posited that healthcare digitization does not moderate this relationship.

To empirically test this proposition, SEM was utilized, incorporating an interaction term (MEPP * HD) into the model. This analytical approach enabled the examination of both the independent (main) effects of medical equipment procurement practices and healthcare digitization on healthcare service delivery, as well as the conditional (interaction) effect, thus determining whether the relationship between procurement practices and service delivery varies based on the level of digitization present in the healthcare context. The outcome is displayed in Table 29.

Table 2: Moderation Analysis Estimates for the Interaction Between Medical Equipment Procurement Practices and Healthcare Digitization on Healthcare Service Delivery

Path	Effect Type	β	SE	z	p
MEPP → HSD	Main Effect	0.224	0.0394	5.69	0.001
HD → HSD	Main Effect	0.786	0.0477	16.48	0.001
MEPP * HD → HSD	Interaction Effect	0.420	0.1777	2.36	0.018

Source: Research Data (2025)

The findings from the moderation analysis were detailed in Table 2. The main effect of medical equipment procurement practices on healthcare service delivery was found to be significant ($\beta = 0.224$, $SE = 0.0394$, $z = 5.69$). This indicates that, regardless of the level of digitization, effective procurement practices exert a meaningful and positive influence on the quality of healthcare services provided by referral hospitals. This relationship underscores the importance of structured and efficient procurement processes such as transparent tendering, timely acquisition, and supplier management in supporting the delivery of critical health services.

In parallel, healthcare digitization exhibited a strong and highly significant main effect on healthcare service delivery ($\beta = 0.786$, $SE = 0.0477$, $z = 16.48$, $p < 0.05$). This demonstrates that increased integration of digital tools, such as automated procurement platforms, electronic inventory systems, and integrated clinical and administrative information systems considerably enhances the effectiveness, responsiveness, and aggregate quality of healthcare services. It affirms that digital transformation is a powerful enabler of service delivery improvements across functional areas within hospital settings.

Most notably, the interaction effect between medical equipment procurement practices and healthcare digitization on healthcare service delivery was significant and positive ($\beta = 0.420$, $SE = 0.1777$, $z = 2.36$, $p < 0.05$). This provides clear empirical evidence of a moderating effect, leading to the rejection of the null hypothesis (H_{03}), which states that healthcare digitization does not moderate the nexus between medical equipment procurement practices and healthcare service delivery. The significance and direction of the

interaction term indicate that the influence of procurement practices on service delivery becomes stronger as healthcare digitization levels rise. In other words, digital systems magnify the positive outcomes associated with effective procurement.

From the estimation results, synergistic moderation was affirmed. In the context of this research, both medical equipment procurement practices and healthcare digitization independently enhance healthcare service delivery. However, when these two factors interact, the improvement in healthcare service delivery is significantly amplified. This suggests that digitization does not merely support procurement processes, but actively enhances their effectiveness, creating a compounding or multiplicative effect on service outcomes. For instance, when procurement systems are digitized through automated purchasing, real-time inventory tracking, or integrated supplier management the efficiency, transparency, and responsiveness of procurement operations increase substantially. This enhanced procurement capability, in turn, directly translates into faster equipment availability, reduced service interruptions, and more reliable care delivery. Thus, the synergy between medical equipment procurement practices and healthcare digitization creates a high-performance operational environment where the two variables complement and reinforce each other, leading to superior healthcare service delivery. This type of interaction confirms that digitization acts not only as an enabler but as a strategic amplifier of well-structured procurement practices. Based on these findings, the null hypothesis (H_{03}) which stated that healthcare digitization does not moderate the relationship between medical equipment procurement practices and healthcare service delivery is therefore rejected.

Simple Slope Analysis Results

To further examine the nature and strength of the moderating effect of healthcare digitization on the relationship between medical equipment procurement practices and healthcare service delivery, a simple slope analysis was conducted. This analysis decomposes the interaction by estimating the effect of medical equipment procurement practices on healthcare service delivery at three distinct levels of the moderator: low (-1 standard deviation), average (mean), and high ($+1$ standard deviation) levels of healthcare digitization. The goal of this analysis is to provide a more crucial understanding of how variations in digitization influence the strength and significance of the relationship between procurement practices and service delivery. The results, presented in Table 30.

Table 3: Simple Slope Estimates for the Effect of Medical Equipment Procurement Practices on Healthcare Service Delivery at Varying Levels of Healthcare Digitization

Path	HD Level	β	SE	z	p
MEPP $\rightarrow$ HSD	Low (-1 SD)	0.116	0.0523	2.22	0.026
MEPP $\rightarrow$ HSD	Average	0.224	0.0406	5.53	0.001
MEPP $\rightarrow$ HSD	High ($+1$ SD)	0.333	0.0695	4.78	0.001

Source: Research Data (2025)

The findings highlighted in Table 30 provide insight into how the effect of medical equipment procurement practices on healthcare service delivery varies across different levels of healthcare digitization, thus offering a detailed understanding of the nature of the moderation effect.

At low levels of healthcare digitization (i.e., one standard deviation below the mean), medical equipment procurement practices had a positive and significant effect on healthcare service delivery ($\beta = 0.116$, $SE = 0.0523$, $z = 2.22$, $p < 0.05$). Although the effect size is modest, this finding indicates that even in environments where digitization is limited, improvements in procurement practices can lead to better healthcare service delivery.

At the average level of digitization, the effect of medical equipment procurement practices on healthcare service delivery increased notably ($\beta = 0.224$, $SE = 0.0406$, $z = 5.53$, $p < 0.05$). This suggests that when

hospitals operate under standard digitization conditions, the relationship between procurement practices and service delivery becomes stronger and more pronounced. Efficient procurement systems, even without advanced digital tools, still contribute significantly to service outcomes.

Most importantly, at high levels of healthcare digitization (i.e., one standard deviation above the mean), the effect of medical equipment procurement practices on healthcare service delivery was strongest ($\beta = 0.333$, $SE = 0.0695$, $z = 4.78$, $p < 0.05$). This finding demonstrates that in highly digitized hospital environments, the impact of procurement practices on service delivery is significantly amplified. The availability of digital systems such as automated ordering, integrated supplier databases, and real-time inventory monitoring enhances the responsiveness, transparency, and overall effectiveness of procurement operations leading to improved service quality and patient care.

Overall, the results affirm that the relationship between procurement practices and healthcare service delivery is moderated positively by healthcare digitization, and this moderation exhibits a synergistic pattern: as digitization increases, the effect of procurement practices on service delivery becomes progressively stronger. These findings provide strong empirical support for strategic investment in digitization as a means to optimize procurement functions and, by extension, improve healthcare service outcomes.

Simple Slope Interaction Plot

To gain deeper insights into how healthcare digitization influences the relationship between medical equipment procurement practices and healthcare service delivery, a simple slope interaction plot was developed. This graphical representation illustrates the varying strength and direction of the relationship between medical equipment procurement practices and healthcare service delivery across different levels of digitization. It helps determine whether the effect of medical equipment procurement practices on healthcare service delivery intensifies or weakens depending on the extent of digital integration within healthcare facilities. The plot features three lines, grey for low, blue for average, and yellow for high digitization levels offering a visual comparison of these interaction effects as indicated by Figure 2.

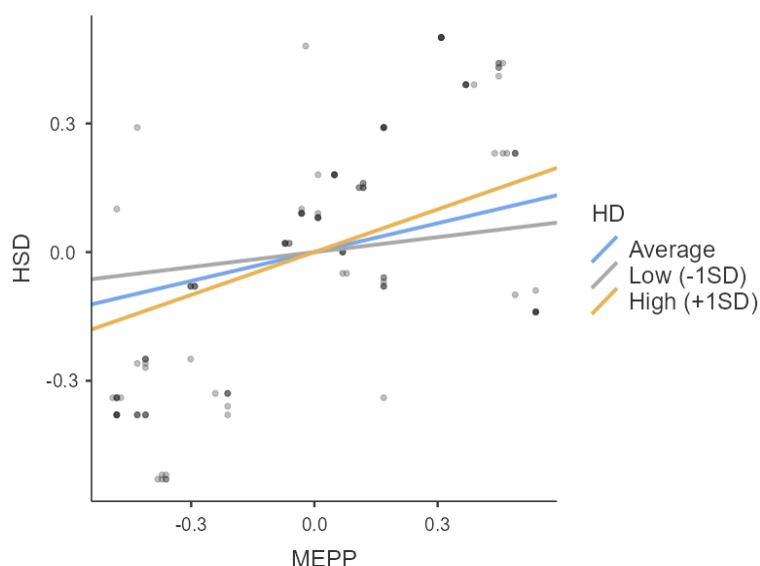


Figure 2: Mediation Analysis Estimation Plot

The simple slope interaction plot visually illustrates how the relationship between medical equipment procurement practices and healthcare service delivery changes across different levels of digitization. The plot presents three distinct lines representing low, average, and high levels of digitization, grey for low digitization (-1 SD, low HD), blue for average digitization (0 SD, mean HD), and yellow for high digitization ($+1$ SD, high HD) each depicting the slope of the relationship between medical equipment

procurement practices and healthcare service delivery.

The slope for high digitization, represented by the yellow line (+1 SD, high HD), is the steepest, indicating that as healthcare digitization increases, the positive effect of procurement practices on service delivery becomes more pronounced. This means that in hospitals where digital tools and technologies, such as automated procurement systems, electronic inventory management, and integrated digital platforms are more advanced, improvements in procurement practices result in significantly greater enhancements in service delivery. In these highly digitized settings, procurement efficiency is maximized, resulting in better resource allocation, faster equipment availability, and streamlined operations, which directly translate into better healthcare outcomes.

Conversely, the slope for low digitization, shown by the grey line (−1 SD, low HD), is much flatter, demonstrating that in environments with limited or no digital infrastructure, improvements in procurement practices lead to relatively modest gains in healthcare service delivery. This suggests that in the absence of digitization, the potential benefits of procurement reforms are constrained by manual processes, poor tracking, and delayed service execution.

The blue line (0 SD, mean HD) represents the average level of healthcare digitization and displays a moderate slope, indicating an intermediate effect of procurement practices on service delivery under typical digitization conditions. The divergence in the slopes: yellow, blue, and grey confirms that healthcare digitization functions as a significant moderator in the relationship between medical equipment procurement practices and healthcare service delivery.

The plot confirms that healthcare digitization functions as a powerful enhancer in the relationship between medical equipment procurement practices and healthcare service delivery. The divergence of the slopes across digitization levels reinforces the presence of a synergistic moderation effect, where digitization not only supports but amplifies the effect of procurement strategies. This visual insight strengthens the argument that digitization should be pursued alongside procurement reforms to unlock the full potential of operational improvements in the healthcare sector.

Discussion of Empirical Findings

Medical Equipment Procurement Practices, Healthcare Digitization and Healthcare Service Delivery

The objective of this study was to examine the moderating effect of healthcare digitization on the relationship between medical equipment procurement practices and healthcare service delivery in referral hospitals in Kenya. The null hypothesis (H_{03}) posited that healthcare digitization does not moderate the relationship between medical equipment procurement and healthcare service delivery. However, the study established a statistically significant synergistic moderation effect of healthcare digitization on the relationship between medical equipment procurement practices and healthcare service delivery. This finding points to the vital part that digital tools, systems, and processes play in amplifying the effectiveness of procurement strategies, ultimately enhancing healthcare service outcomes.

The findings of this study mirror those of Yadav (2024), who proposed and validated a robust multi-stage framework for assessing digital transformation within health product supply chains, based on case studies from India, South Africa, and Brazil. Anchored in the supply chain maturity model and the digital capability framework, the research model delineates five progressive transformation stages ad hoc, managed, standardized, integrated, and predictive, operationalized through proxy metrics such as e-procurement adoption rate, forecast accuracy, and stock out frequency. The researchers' comparative case-study approach revealed that supply chains in the advanced digital maturity stages experienced 25–40% reductions in both stock outs and procurement lead times, offering compelling evidence for the value of digital transformation.

While study's use of descriptive benchmarking and policy analysis enhances the external validity of his model, his reliance on secondary data and absence of inferential statistical tests limit causal inference. More critically, the inquiry does not empirically examine the moderating role of digital transformation on downstream service delivery metrics. The current study fills this empirical and theoretical gap by testing the moderating influence of healthcare digitization on the relationship between medical equipment procurement practices and healthcare service delivery, thus extending Yadav's framework to include patient-facing outcomes such as service responsiveness and availability of essential equipment.

Similarly, this study's findings align with the digital governance principles proposed by Simon et al. (2024), who employed a three-round Delphi process involving 30 international experts to formulate consensus guidelines for deploying home-based digital diagnostic tools in primary care. Guided by the consensus development conference model and patient-centered care principles, the panel produced 15 validated recommendations addressing device accuracy, integration with electronic health records, data security, and patient training protocols. Although methodologically rigorous, the reviewed study is constrained by its exclusive reliance on a single panel and lacks subsequent field-level validation.

The present study advances the work of Simon et al.'s (2024) by operationalizing these governance and technical standards as components of healthcare digitization in the Kenyan referral context. It further extends their work by empirically examining how digital diagnostic tools, particularly those integrated into procurement workflows enhance the efficiency and accuracy of equipment acquisition and deployment. In doing so, this study demonstrates that healthcare digitization does not merely serve a technical or compliance function but acts as a strategic moderator that strengthens the linkage between procurement systems and service delivery outcomes.

In addition, the synergistic moderation effect identified in this study corroborates the empirical work of Yao et al. (2021), who piloted an IoT-based equipment monitoring system across two tertiary hospitals in Eastern China. Grounded in the IoT reference architecture and the DeLone and McLean Information Systems Success Model, their quasi-experimental study showed significant gains in device uptime from 87% to 95% and a 35% reduction in maintenance response times. These improvements were accompanied by high user satisfaction levels among clinicians and technicians.

While the researcher offers strong internal validity through pre-post comparisons, its lack of randomized control and limited geographical scope restrict generalizability. Notably, their study stops short of exploring how improved equipment performance metrics translate into broader healthcare service outcomes. The present study extends these findings by empirically linking digital equipment monitoring and preventive maintenance to enhanced healthcare service delivery through moderated pathways. This not only affirms the operational utility of IoT-based systems in low-resource settings but also demonstrates their strategic value when embedded within procurement and digitization ecosystems.

Collectively, the findings of this study reinforce and expand upon the insights of Yadav (2024), Simon et al. (2024), and Yao et al. (2021) by illustrating that healthcare digitization plays a transformative moderating role in procurement-driven service delivery improvements. The integration of digital platforms into procurement, diagnostics, and equipment management frameworks significantly enhances the efficiency, reliability, and responsiveness of healthcare services. Through situating this analysis within the real-world operational environment of Kenyan referral hospitals, the study contributes novel evidence to the global discourse on digital health transformation and addresses a critical research gap at the intersection of technology, procurement, and patient care.

CONCLUSIONS AND RECOMMENDATIONS

The objective focused on the moderating role of healthcare digitization in the relationship between medical equipment procurement practices and healthcare service delivery. The hypothesis (H_0) posited that no such

moderating effect exists. Findings from the SEM analysis revealed a significant synergistic moderation effect, meaning that the presence of digital technologies, systems, and processes strengthens the relationship between procurement practices and service delivery outcomes. Thus, the null hypothesis was rejected. The moderating role of healthcare digitization further strengthens the procurement-service delivery nexus by introducing enhanced transparency, accountability, and operational efficiency into procurement processes. The study demonstrates that digital tools such as e-procurement platforms, digital inventory tracking, and automated requisition systems increase the responsiveness of healthcare facilities to equipment needs. Digitization reduces manual errors, accelerates communication across departments, and facilitates real-time monitoring of procurement cycles, hence mitigating delays and stock outs. This synergistic effect highlights the transformative potential of digital health technologies in complementing traditional procurement and management practices to achieve superior healthcare outcomes. These findings resonate with broader trends in healthcare emphasizing digital transformation as a key enabler of system efficiency, governance, and quality improvement. The implication is that investment in healthcare digitization is not merely supportive but strategic, augmenting the effectiveness of procurement interventions.

This section outlines the key contributions of the study, detailing how its findings advance theoretical understanding, provide empirical evidence, inform managerial practice, shape policy thinking, and enhance methodological approaches in research on healthcare service delivery. The study investigated the direct, mediating, moderating, and joint effects of medical equipment procurement practices, equipment management practices, and healthcare digitization on service delivery in Kenya's referral hospitals. In employing a quantitative design and conducting SEM, the research generated statistically validated results that have wide-ranging implications.

Healthcare digitization contribute to better healthcare service delivery in referral hospitals. This validates and extends the RBV by showing how internal capabilities in public health institutions can drive performance in resource-constrained settings. As such, the study provides a theoretical foundation for understanding healthcare service delivery not merely as a policy or infrastructure issue, but as a function of how hospitals mobilize and deploy their strategic resources.

Furthermore, the study advances systems theory by conceptualizing public healthcare procurement as a complex and interdependent system involving procurement activities and healthcare digitization. Systems theory posits that the performance of any organizational unit depends on the dynamic interactions among its components rather than the components functioning in isolation. The study empirically confirms that healthcare service delivery is an emergent outcome of these interconnected components.

The findings regarding the moderating role of healthcare digitization offer managerial insight into the power of integrating digital tools into procurement and equipment management workflows. For hospital managers, this presents an opportunity to adopt electronic procurement platforms, computerized maintenance management systems (CMMS), and real-time inventory tracking systems that enhance transparency, speed, and data-driven decision-making. Digitization can also facilitate better monitoring of vendor performance, reduce paper-based inefficiencies, and create audit trails that support accountability. Through digitizing procurement and equipment management processes, managers can significantly reduce turnaround times, anticipate equipment shortages, and improve coordination among clinical, procurement, and technical teams. In turn, these improvements translate into better service delivery and a more responsive healthcare environment. Overall, the study equips hospital managers with evidence-based insights that support more informed, integrated, and performance-oriented operational strategies in healthcare delivery.

The findings of this study offer critical policy insights for health sector regulators, policymakers in the Ministry of Health, and other relevant public bodies tasked with shaping and overseeing healthcare systems in Kenya. The confirmation that medical equipment procurement practices significantly enhance healthcare service delivery suggests an urgent need for policymakers to re-evaluate existing procurement frameworks to

ensure they are aligned with strategic health outcomes. Current procurement regulations, while offering a foundation for transparency and accountability, may fall short in promoting flexibility, responsiveness, and needs-based acquisition. The study underscores the importance of shifting from compliance-driven procurement to performance-oriented procurement systems. Therefore, policy frameworks such as the Public Procurement and Asset Disposal Act (2015) and related procurement guidelines should be reviewed to incorporate mechanisms that allow health facilities to undertake contextualized procurement planning, vendor performance tracking, and lifecycle cost analysis, which are essential for optimizing equipment functionality and service delivery outcomes.

Moreover, the study identifies equipment management practices as a partial mediator between procurement and service delivery, highlighting the need for integrated national policies that address equipment use beyond the point of acquisition. Most national healthcare policies tend to focus heavily on acquisition while neglecting maintenance, calibration, and replacement planning. The findings advocate for the institutionalization of national biomedical equipment management policies that include standard operating procedures for equipment lifecycle management across all levels of care. The Ministry of Health, through agencies such as the Kenya Medical Supplies Authority (KEMSA), should develop and enforce guidelines that mandate regular equipment audits, staff training, and budgetary allocations specifically for maintenance. These guidelines would ensure uniformity, reduce regional disparities in equipment availability and functionality, and enhance the sustainability of healthcare infrastructure investments.

The observed moderating role of healthcare digitization in strengthening the relationship between procurement and service delivery also has important policy implications. It reinforces the need for regulatory support for digital transformation in public healthcare institutions. Policies should encourage the adoption of e-procurement platforms, digital inventory management systems, and computerized maintenance management systems through dedicated funding and capacity-building programs. Furthermore, regulatory bodies such as the ICT Authority and the Ministry of Health should establish data security standards, interoperability protocols, and national guidelines for digital health infrastructure that support the full integration of technology into procurement and asset management systems. These reforms would not only streamline procurement processes but also enhance data-driven decision-making, accountability, and transparency across healthcare institutions. As a result, the study provides compelling evidence for a policy shift toward integrated, technology-enabled, and performance-driven procurement and asset management frameworks that are essential for improving healthcare service delivery in public institutions.

This study makes a significant methodological contribution by employing SEM using JASP software, a statistical tool that remains underutilized in public health operational research, particularly within the Kenyan healthcare context. Through integrating SEM through JASP, the study was able to model complex relationships among latent variables: medical equipment procurement practices, healthcare digitization, and healthcare service delivery with precision and statistical rigor.

This study identified and empirically validated specific drivers of improved service delivery that had previously been under-explored or insufficiently quantified in similar settings. These include procurement strategies, management routines, and the role of digitization factors that emerged as significant determinants of service delivery effectiveness. Through doing so, the study not only introduces these variables into the empirical discourse surrounding healthcare service performance but also measures their relative impact, thus enabling a clearer prioritization for practitioners and policymakers. The identification of these actionable levers provides a practical contribution to hospital administrators and healthcare managers, who can now make data-driven decisions to enhance operational performance.

The synergistic moderating effect of healthcare digitization revealed by this research highlights the critical role of digital health governance units, such as the Ministry of Health's Health Informatics Unit and the National Health Insurance Authority (NHIA), in fostering the adoption and regulation of digital procurement

and inventory management systems. Developing national guidelines for digital health tools can enhance transparency, accountability, and responsiveness in healthcare service delivery. These findings support policy reforms aimed at integrating e-procurement and digital tracking systems across referral hospitals, aligning with Kenya's broader digital health agenda.

The study's demonstration of healthcare digitization as a strong moderator between procurement practices and service delivery highlights the need for accelerated digital transformation in hospital operations. Practical steps include adopting interoperable digital platforms that integrate procurement, equipment inventory, and maintenance management into a unified system. Such digital tools enhance transparency, facilitate real-time tracking of assets, and support data-driven decision-making, thereby improving responsiveness and accountability. Investment in staff capacity building for digital competencies is also critical to ensure successful system adoption and utilization.

Areas for Further Study

Lastly, the rapid advancement of digital technologies presents a promising frontier for further investigation. Emerging innovations such as artificial intelligence, blockchain for supply chain transparency, and the Internet of Medical Things (IoMT) have the potential to revolutionize healthcare procurement and management. Future studies could assess the practical implications, challenges, and benefits of integrating these cutting-edge technologies into healthcare systems, guiding policymakers and practitioners aiming to harness digital transformation to improve service delivery outcomes.

REFERENCES

- Adebayo, V. I., Paul, P. O., Eyo-Udo, N. L., & Ogugua, J. O. (2024). Procurement in healthcare: Ensuring efficiency and compliance in medical supplies and equipment management. *Magna Scientia Advanced Research and Reviews*.
- Adjagba, A. O., Oguta, J. O., Akoth, C., Wambiya, E. O. A., Nonvignon, J., & Jackson, D. (2024). Financing immunisation in Kenya: examining bottlenecks in health sector planning and budgeting at the decentralised level. *Cost Effectiveness and Resource Allocation*, 22(1).
- Afwande, M., Mbugua, S., & Kilwake, J. (2021). Framework for Evaluation of Effectiveness of Integrated Financial Management Information Systems Architecture Implemented in Public Hospitals in Kenya. *International Journal of Scientific Research in Science Engineering and Technology*, 38–41.
- Ahmed, I., & Ishtiaq, S. (2021). Reliability and validity: Importance in medical research. *Journal of Pakistan Medical Association*, 71(10), 2401–2406.
- Beaulieu, M., & Bentahar, O. (2021). Digitalization of the healthcare supply chain: A roadmap to generate benefits and effectively support healthcare delivery.
- Bouh, M. M., Hossain, F., Paul, P., Rahman, M. M., Islam, R., Nakashima, N., & Ahmed, A. (2024). The impact of limited access to digital health records on doctors and their willingness to adopt electronic health record systems. *Digital Health*, 10.
- Boulding, H., & Hinrichs-Krapels, S. (2021). Factors influencing procurement behaviour and decision-making: An exploratory qualitative study in a UK healthcare provider.
- Brownie, S., & Oywer, E. (2016). Health professionals in Kenya: strategies to expand reach and reduce brain drain of psychiatric nurses and psychiatrists. *BJPsych International*, 13(3), 55–58.
- Carini, E., Villani, L., Pezzullo, A. M., Gentili, A., Barbara, A., Ricciardi, W., & Boccia, S. (2021). The impact of digital patient portals on health outcomes, system efficiency, and patient attitudes: Updated systematic literature review. *Journal of Medical Internet Research*, 23(9), e26189.

- Cerchione, R., Centobelli, P., Riccio, E., Abbate, S., & Oropallo, E. (2023). Blockchain's coming to hospital to digitalize healthcare services: Designing a distributed electronic health record ecosystem.
- Chen, J., Lv, Y., & Fan, T. (2023). Research on the evolution and driving factors of digitalization of energy in China—A new perspective based on coupling coordination. *Heliyon*, 9(3), e14138.
- Chikophe, R. M., Tenambergen, W. M., & Kyalo, C. K. (2024). Influence of procurement process on availability of essential drugs in public health facilities in Mombasa County, Kenya. *International Journal of Health Sciences*, 7(3), 44-56.
- Cresswell, K., & Williams, R. (2024). Essential strategic principles for planning and developing digitally enabled interventions in health and care settings. *BMC Health Services Research*, 24(1), 11819.
- Davis, M. J. (2024). Procurement practices influencing service delivery: A case of Kenya Power. *European Journal of Logistics Purchasing and Supply Chain Management*, 2(3), 79–137.
- Fähndrich, J. (2022). A literature review on the impact of digitalisation on management control. *Journal of Management Control*, 34(1), 9–65.
- Fraser, H. S., Mugisha, M., Bacher, I., Ngenzi, J. L., Seebregts, C., Umubyeyi, A., & Condo, J. (2024). Factors influencing data quality in electronic health record systems in 50 health facilities in Rwanda and the role of clinical alerts: Cross-sectional observational study.
- Freitas, A. T. (2023). Data-driven approaches in healthcare: Challenges and emerging trends. In *Law, Governance and Technology Series* (pp. 65–80).
- Give, C., Ndimba, S., Steege, R., Ormel, H., McCollum, R., Theobald, S., Taegtmeier, M., Kok, M., & Sidat, M. (2019). Strengthening referral systems in community health programs: A qualitative study in two rural districts of Maputo Province, Mozambique. *BMC Health Services Research*, 19(1).
- Gupta, N., Coates, M. M., Bekele, A., Dupuy, R., Fénelon, D. L., Gage, A. D., ... & Bukhman, G. (2020). Availability of equipment and medications for non-communicable diseases and injuries at public first-referral level hospitals: A cross-sectional analysis of service provision assessments in eight low-income countries.
- Guyow, H. A. (2021). Factors affecting medical equipment utilization in health service delivery in Mandera County Referral Hospital, Kenya (Doctoral dissertation, KeMU).
- Haider, M., & Mohailan, S. (2020). Supply chain operations reference model: An analytical study.
- Hair, J. F., Howard, M. C., & Nitzl, C. (2019). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. *Journal of Business Research*, 109, 101–110.
- Ham, C. (2020). *Health policy in Britain: The politics and organization of the National Health Service*. Routledge.
- Hinrichs-Krapels, S., Ditewig, B., Boulding, H., Chalkidou, A., Erskine, J., & Shokraneh, F. (2022). Purchasing high-cost medical devices and equipment in hospitals.
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6, 1–55.
- Huang, L., Lv, W., Huang, Q., Zhang, H., Jin, S., Chen, T., & Shen, B. (2024). Transforming medical equipment management in digital public health: A decision-making model for medical equipment replacement.
- Justus, M. G., Kinyua, J. M., & Kariuki, S. N. (2021). Effect of system capability on the performance of level four public hospitals in Kenya.

- Kabeta, S. H., Chala, T. K., & Tafese, F. (2023). Medical equipment management in general hospitals: Experience of Tulu Bolo General Hospital, South West Shoa Zone, Central Ethiopia.
- Karim, A., de Savigny, D., Awor, P., Muñoz, D. C., Mäusezahl, D., Tshefu, A. K., ... & Alegbeleye, A. (2022). The building blocks of community health systems: A systems framework for the design, implementation and evaluation of iCCM programs and community-based interventions.
- Kitila, S. B., Tesema, A. A., Bekele, G., Olika, A. K., Terfa, Y. B., Sinkie, S. O., & Olika, A. K. (2022). Average time spent in referral process and its determinants among clients of maternal and child health service in 2 districts of Jimma Zone, Ethiopia. *Journal of Patient Experience*, 9, 23743735221086757.
- Leonardi, P. M., & Treem, J. W. (2020). Behavioral visibility: A new paradigm for organization studies in the age of digitization, digitalization, and datafication. *Organization Studies*, 41(12), 1601–1625.
- Li, M., Zhang, Y., Lu, Y., Yu, W., Nong, X., & Zhang, L. (2017). Factors influencing two-way referral between hospitals and the community in China: A system dynamics simulation model. *SIMULATION*, 94(9), 765–782.
- Likert Scale in Social Sciences Research: Problems and Difficulties. (2022). *FWU Journal of Social Sciences*, 89–101.
- Lingg, M., Wyss, K., & Durán-Arenas, L. (2016). Effects of procurement practices on quality of medical device or service received: A qualitative study comparing countries. *BMC Health Services Research*, 16(1).
- Liu, Y., Liu, B., & Yang, H. (2024). Optimal pricing and financing strategies for leased equipment considering maintenance and lessees' options. *International Journal of Production Economics*, 269, 109157.
- Mackey, T. K., & Cuomo, R. E. (2020). An interdisciplinary review of digital technologies to facilitate anti-corruption, transparency and accountability in medicines procurement.
- Modi, S., & Feldman, S. S. (2022). The value of electronic health records since the health information technology for economic and clinical health act: Systematic review.
- Musiega, A., Tsofa, B., Nyawira, L., Njuguna, R. G., Munywoki, J., Hanson, K., Mulwa, A., Molyneux, S., Maina, I., Normand, C., Jemutai, J., & Barasa, E. (2022b). Examining the influence of budget execution processes on the efficiency of county health systems in Kenya. *Health Policy and Planning*, 38(3), 351–362.
- Mwihia, F. (2020). *Performance of public hospitals in Kenya: The essential role of management* (Doctoral dissertation, University of Nairobi).
- Ndlovu, K., Scott, R. E., & Mars, M. (2021, December). Interoperability opportunities and challenges in linking mHealth applications and eRecord systems: Botswana as an exemplar. *BMC Medical Informatics and Decision Making*, 21(1), 246.
- Ngenzi, J. L., Scott, R. E., & Mars, M. (2021). Information and communication technology to enhance continuing professional development (CPD) and continuing medical education (CME) for Rwanda: A scoping review of reviews.
- Nguru, K., & Ireri, L. (2022). Challenges influencing proper implementation of quality health care referral system in Kaloleni Sub-county, Kilifi County in Kenya.
- Njanwe, P. J., Marete, I., & Ayaya, S. (2021). Adherence to national healthcare referral guidelines and its effect on the management outcomes among children seen at a teaching hospital in western Kenya.

- Nyawira, L., Tsofa, B., Musiega, A., Munywoki, J., Njuguna, R. G., Hanson, K., Mulwa, A., Molyneux, S., Maina, I., Normand, C., Jemutai, J., & Barasa, E. (2022). Management of human resources for health: Implications for health systems efficiency in Kenya. *BMC Health Services Research*, 22(1).
- Ohando, E. O., Minja, D., & Muna, W. (2024). Health infrastructure and implications on provision of health care services to nurses and medium level bureaucrats in health facilities in Siaya County and nationally, Kenya.
- Okoroafor, S. C., Kwesiga, B., Ogato, J., Gura, Z., Gondi, J., Jumba, N., Ogumbo, T., Monyoncho, M., Wamae, A., Wanyee, M., Angir, M., Almudhwahi, M. A., Evalyne, C., Nabyonga-Orem, J., Ahmat, A., Zurn, P., & Asamani, J. A. (2022). Investing in the health workforce in Kenya: trends in size, composition and distribution from a descriptive health labour market analysis. *BMJ Global Health*, 7(Suppl 1), e009748.
- Putri, Y. D., Huda, L. N., & Sinulingga, S. (2019, May). The concept of supply chain management performance measurement with the supply chain operation reference model (Journal review). In *IOP Conference Series: Materials Science and Engineering*, 505(1, p. 012011). IOP Publishing.
- Rahmani, K., Karimi, S., Raeisi, A. R., & Rezayatmand, R. (2022). Comparative study of medical equipment procurement in selected countries. *Medical Journal of the Islamic Republic of Iran*, 36.
- Schwen, L. O., Kiehl, T.-R., Carvalho, R., Zerbe, N., & Homeyer, A. (2023). Digitization of pathology labs: A review of lessons learned. *Laboratory Investigation*, 103(11), 100244.
- Sepúlveda, M. B., Molina, C. E. Z., & Salazar, E. a. G. (2022). Validity of the general systems theory for applications in management. *Revista En-contexto*, 11(18).
- Simon, D. A., Raza, S., Shachar, C., & Cohen, I. G. (2024). Using digital technologies to diagnose in the home: Recommendations from a Delphi panel. *npj Digital Medicine*, 7(1), 18.
- Simeoni, C., & Kinoti, W. (2023). Medical equipment leasing in Kenya: Neocolonial global finance and misplaced health priorities. In C. Rodríguez Enríquez & M. Llavaneras Blanco (Eds.), *Corporate capture of development: Public-private partnerships, women's human rights, and global resistance* (pp. 19–44).
- Stoumpos, A. I., Kitsios, F., & Talias, M. A. (2023). Digital transformation in healthcare: Technology acceptance and its applications. *International Journal of Environmental Research and Public Health*, 20(4), 3407.
- Verhoef, P. C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Dong, J. Q., Fabian, N., & Haenlein, M. (2019). Digital transformation: A multidisciplinary reflection and researchagenda. *JournalofBusinessResearch*, 122, 889901.
- Villalobos-Quesada, M., Ho, K., Chavannes, N. H., & Talboom-Kamp, E. P. (2023). Direct-to-patient digital diagnostics in primary care: Opportunities, challenges, and conditions necessary for responsible digital diagnostics. *European Journal of General Practice*, 29(1), 2273615.
- Von Bertalanffy, L. (1951). Problems of general system theory. *Human Biology*, 23(4), 302.
- Wachira, B. W., & Mwai, M. (2021). A baseline review of the ability of hospitals in Kenya to provide emergency and critical care services for COVID-19 patients. *African Journal of Emergency Medicine*, 11(2), 213–217.
- Yadav, P. (2024). Digital transformation in the health product supply chain: A framework for analysis. *Health Systems & Reform*, 10(2).

- Yao, L., Shang, D., Zhao, H., & Hu, S. (2021). Medical equipment comprehensive management system based on cloud computing and internet of things. *Journal of Healthcare Engineering*, 2021, 1–12.
- Zaagsma, G. (2022). Digital history and the politics of digitization. *Digital Scholarship in the Humanities*, 38(2), 830–851.
- Zhang, Y., Hou, Z., Yang, F., Yang, M. M., & Wang, Z. (2021). Discovering the evolution of resource-based theory: Science mapping based on bibliometric analysis. *Journal of Business Research*, 137, 500-516.