Effect of Supply Chain Management Practices on the Performance of the National Health Insurance Authority (NHIA) Medicine Supply Initiative (NMSI) (2020–2024)

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ABSTRACT

The performance of healthcare systems in developing economies is heavily dependent on the resilience and efficiency of medicine supply chains. This study examined the effect of Supply Chain Management (SCM) practices, specifically Strategic Sourcing (SS), Logistics and Distribution Management (LDM), Risk Management Practices (RMP), and Quality Assurance and Control Practices (QAC), on the performance of the National Health Insurance Authority (NHIA) Medicine Supply Initiative (NMSI) in Nigeria (2020–2024). Performance was measured through non-financial and operational metrics, including product availability (stock-out rates), economic efficiency (price affordability), and supply chain responsiveness. Using a descriptive survey design, data were collected from 121 valid strategic stakeholders across the NHIA headquarters, pharmaceutical partners, Drug Management Organisations (DMOs), and NAFDAC. Partial Least Squares Structural Equation Modelling (PLS-SEM) revealed that Strategic Sourcing ($\beta = 0.360$, $p < 0.001$), Logistics and Distribution Management ($\beta = 0.270$, $p = 0.001$), and Quality Assurance ($\beta = 0.167$, $p = 0.038$) significantly and positively affect NMSI performance. Collectively, these variables explain 82.7% of the variance in performance ($R^2 = 0.827$). Notably, Risk Management Practices ($\beta = 0.188$, $p = 0.052$) did not meet the threshold for statistical significance at the 5% level. The study concluded robust strategic sourcing and integrated logistics are essential drivers of success in Nigeria's universal health coverage efforts through the NHIA Medicine Supply Initiative. Recommendations include adopting AI-driven procurement analytics and centralized dashboards, accelerating eLMIS deployment with GPS tracking and SSHIS integration, strengthening quality assurance via automated verification, supplier audits, strategic reserves, and multi-sourcing, and enhancing risk management maturity with tailored identification, assessment, mitigation, and early warning tools.

Keywords: Supply chain performance, Strategic Sourcing, Logistics Management, Risk Management, Quality Assurance.

INTRODUCTION

Supply chain performance is the bedrock upon which the sustainability of universal health coverage rests, defining the degree to which essential medicines are available, affordable, and delivered with high responsiveness (Mandal, 2018). Globally, in the high-stakes environment of healthcare, maintaining high performance measured by metrics like reduced stock-out rates and optimized lead times is paramount for patient safety, compelling national health agencies to invest heavily in supply chain integration (Saha & Rathore, 2024). Vuong and Nguyen (2022) emphasized that performance is the measurable outcome of a network's efficiency and agility. The importance of SCM practices as a vital tool for improving this performance is widely supported, as effective sourcing and logistics lead to improved service levels, which subsequently enhance stakeholder confidence (Suryani & Nurmala, 2024). In developed contexts like the United Kingdom and the United States, organizations leverage robust digital procurement and value-based purchasing to manage medical supplies, recognizing that data visibility is non-negotiable for cost containment (Khan et al., 2025; Balogun et al., 2025). In Africa, the relevance of supply chain performance has gained urgency as financial institutions and health

authorities expand. Osogbah and Samikon (2024) demonstrated that addressing skills gaps and logistical bottlenecks significantly enhances customer service in the banking and health sectors alike.

In Nigeria, the NHIA Medicine Supply Initiative (NMSI) represents a significant transformation aimed at eliminating out-of-pocket spending through a structured supply framework (Olayiwola & Adeyemi, 2022). For the NMSI to remain effective, Strategic Sourcing the deliberate selection of manufacturing partners is foundational to ensuring medicine quality and price stability (Barton, 2025). Furthermore, Logistics and Distribution Management is vital for coordinating the "last-mile" delivery to remote facilities (Okoduwa et al., 2025), while Risk Management and Quality Assurance ensure the integrity of the medicines and the resilience of the system against market volatility (Ghamedi, 2025; Dawshi et al., 2022). Despite the implementation of the National Health Insurance Authority (NHIA) Medicine Supply Initiative (NMSI) since 2020, persistent operational inefficiencies continue to undermine its core mandate of ensuring medicine security. The central problem lies in the disconnect between supply chain management (SCM) routines and measurable performance outcomes, specifically product availability, affordability, and responsiveness.

While Olayiwola and Adeyemi (2022) established that strategic purchasing improves Nigerian health system efficiency, and Okoduwa et al. (2025) linked pharmaceutical performance in Southern Nigeria to effective logistics, a critical gap remains in the holistic integration of these practices within a public insurance framework. Research has often examined these variables in isolation; for instance, Ghamedi (2025) identified risk management failures as a driver of shortages in public sectors, while Kipo-Sunyehzi (2021) focused strictly on quality compliance in Ghana. These isolated studies leave a significant empirical gap regarding how strategic sourcing, logistics, risk management, and quality control collectively influence the NMSI's performance. Consequently, the NHIA faces recurring stock-outs and rising out-of-pocket costs because existing frameworks lack an empirically validated link to multidimensional performance. This study, therefore, evaluates the combined effect of these SCM practices between 2020 and 2024 to provide a data-driven strategy for achieving supply chain excellence and economic efficiency within the Nigerian non-interest health insurance sector. To achieve this, the following research objectives and corresponding null hypotheses have been formulated to guide the investigation:

i. To determine the effect of strategic sourcing on the performance of the NHIA Medicine Supply Initiative (NMSI).

H_{01}: Strategic Sourcing has no significant effect on the performance of the NHIA Medicine Supply Initiative.

ii. To examine the effect of logistics and distribution management on the performance of the NMSI.

H_{02}: Logistics and Distribution Management has no significant effect on the performance of the NHIA Medicine Supply Initiative.

iii. To ascertain the effect of risk management practices on the performance of the NMSI.

H_{03}: Risk Management Practices have no significant effect on the performance of the NHIA Medicine Supply Initiative.

iv. To evaluate the effect of quality assurance and control practices on the performance of the NMSI.

H_{04}: Quality Assurance and Control Practices have no significant effect on the performance of the NHIA Medicine Supply Initiative.

LITERATURE REVIEW

Conceptual Framework

Performance

Performance is defined by Mandal (2018) as a multidimensional construct encompassing cost reduction, reduced stockouts, improved delivery times, and enhanced service levels for patient care continuity. According to

Alahmad (2021), supply chain performance specifically refers to the extent to which the supply chain meets customer needs regarding product availability and delivery time. The integration of operational indicators with final economic goals allows for a holistic evaluation of effectiveness (Sangwa & Sangwan, 2018). Within healthcare, performance is increasingly measured by the ability to achieve equity and accountability through strategic purchasing (Ridde et al., 2018). Furthermore, Tangcharoensathien et al. (2015) highlighted that achieving universal coverage is highly dependent on controlling costs and ensuring service quality through active purchaser engagement.

According to Grubor et al. (2016), product availability is a fundamental performance indicator manifested by the ability to offer the right product at the preferred time. Economic efficiency, as noted by Geamănu (2011), compares outcomes against efforts to maximize growth through resource optimization. Additionally, Nyaude and Maunganidze (2024) explained that supply chain responsiveness represents the network's ability to adjust operations to meet changing demands, whereas lead time variability directly undermines this responsiveness by creating uncertainty in stock arrivals (Mohammed & Mandal, 2023). This study defined Performance as a multidimensional measure of the NMSI's success in eliminating stock-outs, ensuring medicine affordability through price differentials, and enhancing supply chain responsiveness through reduced lead times and improved fill rates.

Supply Chain Management Practices

Supply Chain Management Practices (SCMP) are fundamentally described by Gbadeyan et al. (2017) as the strategic management of goods, information, and fund flows among partners to satisfy consumer needs efficiently while improving long-term organizational performance. Complementing this, Obiri-Yeboah et al. (2025) define the concept as a critical integration process coordinating materials and finances across units to enhance the overall competitiveness of the supply chain network, whereas Ben-Chioma and Obi (2024) view it within the public health sector as a strategic integration of procurement, supplier selection, and inventory management. The efficacy of these practices is deeply embedded in the ability of an organization to achieve operational excellence, as Manuela (2019) notes that integrating business processes from the end-user back to original suppliers adds significant value for stakeholders.

In a healthcare context, Suryani and Nurmala (2024) emphasize that SCMP has a direct effect on the quality of services provided, suggesting that reliability and product authenticity guarantees are the primary drivers of satisfaction and reduced operational disruptions. The complexity of these activities is further highlighted by Kadiane et al. (2023), who argue that multidimensional strategic processes, encompassing both upstream and downstream actions, allow firms to maintain stability amidst environmental dynamism. According to Alahmad (2021), SCMP acts as a multi-dimensional concept that integrates all levels from suppliers to end-users to enhance performance through continuous communication and information sharing. This study defined Supply Chain Management Practices as a multidimensional integration of procurement, inventory, and logistical activities coordinated across the NHIA framework to ensure the seamless flow of medical commodities and information for optimal healthcare delivery and institutional efficiency.

Strategic Sourcing

Strategic Sourcing, Barton (2025) defined this concept as a long-term, data-driven approach to procuring medical goods that prioritizes cost efficiency, quality, and patient safety while minimizing disruptions through advanced contract securing. Furthermore, Olayiwola and Adeyemi (2022) described this concept as an incessant search for the best method through deliberate decision-making regarding what to purchase, from whom, and how to pay to maximize system performance, while Wilson (2025) views it as a systematic process that minimizes supply risk by improving supplier selection and providing enhanced visibility into purchasing data. The implementation of these strategic approaches reduces inefficient resource allocation by shifting from passive to active engagement in service selection, which Kutzin (2013) identifies as a priority for universal health coverage.

According to Balogun et al. (2025), strategic procurement utilizes value-based purchasing and digital integration to address escalating costs while ensuring the availability of high-quality medical supplies. For instance, Boakye and Normanyo (2018) argue that upgrading sourcing strategies is essential for high organizational ground, as it

prompts greater sourcing capability and operational efficiency. The absence of robust monitoring in this area often leads to performance failures, as Sumankuuro et al. (2023) established that delays in reimbursement caused by paper-based systems undermine financial protection goals. Consequently, the strategic selection of suppliers has a total correlation with patient satisfaction, particularly when administrators prioritize supplier commitment and geographic location to reduce error rates and clinical complaints (Priyanka et al., 2024). This study defined Strategic Sourcing as a deliberate, data-driven procurement methodology utilized by the NHIA to identify manufacturing partners, negotiate pricing MoUs, and leverage bulk-purchasing to ensure the sustainable and affordable availability of quality medicines.

Logistics and Distribution Management

Logistics and Distribution Management is characterized by Okoduwa et al. (2025) as a cornerstone of operational success encompassing the planning, implementation, and control of the efficient flow of medicines and information to maintain product integrity. Additionally, Tanzubil and Veeraiyah (2025) defined the concept as the coordination and regulation of material and data flow to guarantee that necessary resources are available in the correct quantity at the right time, while Mekonen et al. (2025) described it through the lens of specialized information systems designed to oversee health commodity flows for accurate forecasting. Efficient logistics systems are foundational for operational excellence because they contribute to improved service delivery and reduced operational costs (Okoduwa et al., 2025). According to Nwankwo (2021), the operational elements of supply chain management include quantification, procurement, and fleet management, which collectively account for a substantial proportion of hospital budgets. The integration of these processes cross-boundary allows organizations to achieve superior delivery speed and flexibility (Obiri-Yeboah et al., 2025).

Furthermore, Duque-Uribe et al. (2019) noted that logistics consolidation can produce economic savings of up to thirty-five percent while substantially reducing delivery times. Conversely, inefficiencies in these diagnostic and distribution processes are often logistics-related rather than clinician-driven, binding healthcare delivery stages together through the accuracy of data flow (Tanzubil & Veeraiyah, 2025). As Sharipbekova and Raimbekov (2018) explained, logistics plays a critical role in developing countries by integrating storage and communication technology to support healthcare during disruptions. This study defined Logistics and Distribution Management as the systematic coordination of medical commodity flows, warehousing, and last-mile delivery mechanisms designed to reduce order-to-delivery lead times and maintain stock availability across accredited healthcare facilities.

Risk Management Practices

Risk Management Practices represent a protective mechanism, Ghamedi (2025) defined this concept as the systematic assessment and mitigation of triggering events, such as supplier failures or market disruptions, that threaten the supply chain's efficiency. Adala et al. (2022) expanded on this by describing it as a process involving risk workshops and dual-sourcing strategies aimed at ensuring business continuity and service delivery. Such proactive identification is essential because incident reporting and effective communication are critical drivers that minimize undesirable events before they escalate into serious errors (Adepoju & Esan, 2023). According to Senna et al. (2023), the integration of risk management enables proactive threat detection, which significantly enhances resilience, particularly in sectors that have adopted digitalization and supply chain 4.0 technologies (Turkes et al., 2025). For instance, Owich and Odero (2023) argued that integrating risk protocols into supply chain activities alters routines to limit adverse consequences like insolvency.

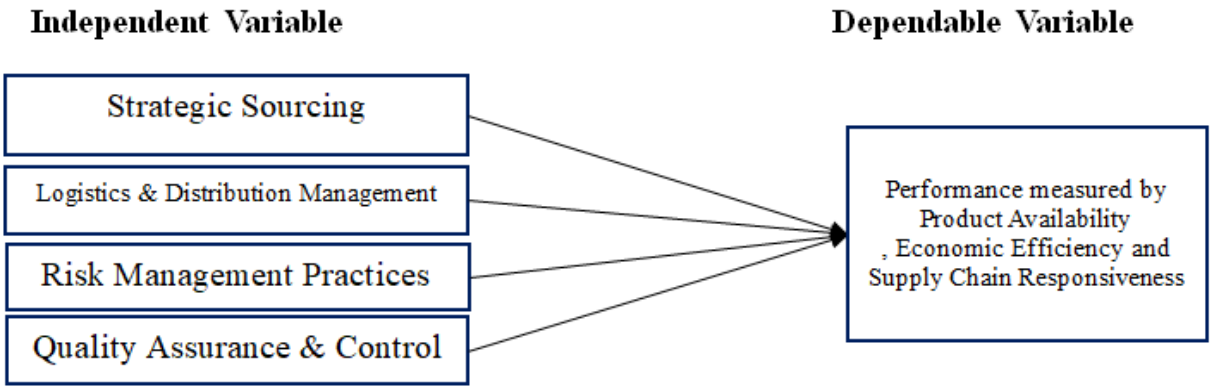
The reliance on single-source suppliers is frequently identified as a primary cause of disruptions and shortages (Ghamedi, 2025). Therefore, leveraging real-time data monitoring and AI allows healthcare providers to anticipate market volatility and safeguard the recovery of planned operations during global crises (Padmane et al., 2024). As Adepoju and Esan (2023) observed, an incident reporting culture is fundamental to ensuring clinicians can function optimally without the threat of resource scarcity. This study defined Risk Management Practices as the systematic application of contingency planning, manufacturing diversification, and security audits to identify and mitigate potential disruptions within the NMSI medicine supply network.

Quality Assurance and Control Practices

Quality Assurance and Control Practices represent a management philosophy that Xiong et al. (2017) characterized as an integrated system of techniques and principles designed to exceed customer expectations through process orientation and continuous improvement. From a procurement standpoint, Oriri and Okibo (2015) defined these practices as strategic oversight mechanisms used to establish checks and balances on suppliers to enhance institutional efficiency. This is further operationalized in laboratory and clinical settings by Dawshi et al. (2022), who described the concept as a systematic approach to maintaining the validity and reliability of results via standardized testing protocols. The efficacy of these quality-driven strategic pillars is largely determined by top management commitment and a robust customer focus, which Abdi (2020) argued are essential for minimizing service delivery delays. In the context of national health schemes, Kipo-Sunyehzi (2021) posits that institutional compliance with clinical guidelines serves as a cornerstone of service quality by preventing unauthorized out-of-pocket expenses and resolving information asymmetry.

Furthermore, the role of accreditation is highlighted by Shakya et al. (2025) as a vital catalyst for performance, leading to substantial improvements in patient experience and wait-time reduction. To maintain the accuracy of these medical outcomes, the implementation of internal quality control remains indispensable for identifying analytical shifts that could result in misdiagnosis (Dawshi et al., 2022). As Elfoghi (2025) explains, modern healthcare systems require sophisticated management controls that can integrate the dual objectives of care quality and financial solvency to eliminate operational bottlenecks. This study defined Quality Assurance and Control Practices as the systematic application of NAFDAC-compliant safety checks, batch testing, and serialized branding protocols to ensure the clinical integrity and authenticity of the medicines distributed under the NMSI.

Researcher's Conceptual Model Design (2025).



Source: Authors Compilation, 2025.

Empirical Review

Strategic Sourcing and Performance

Olayiwola and Adeyemi (2022) examined the strategic health purchasing and health system performance in Nigeria. The study investigated how purchasing strategies, payment mechanisms, and service utilizers influence the efficiency and responsiveness of the healthcare system. The variables included purchasing strategy, payment mechanism, providers, and service utilizers as independent proxies, while health system performance was measured using life expectancy, distribution of access, and fairness of financing. Utilizing a purposive sampling survey, the study targeted health insurance providers, HMOs, and consumers in Akure Metropolis, Nigeria. Data were gathered from 384 respondents through a structured questionnaire and analyzed using instrumental variables (2SLS) regression. The results indicated that purchasing strategy, payment mechanisms, and service utilizers significantly improved health system performance. The study recommended that healthcare payments be made more strategic through third-party agents and stricter auditing rules. A strength of this study was its comprehensive use of the OECD performance index; however, its primary critique is the limited geographical

focus on a single metropolis, which may constrain the generalizability of the findings to the entire Nigerian manufacturing or service landscape.

Balogun et al. (2025) synthesized the strategic procurement practices in healthcare organizations and their impact on Medicaid and Medicare cost containment. The study explored how innovative procurement transformations, such as value-based purchasing and digital integration, influence resource allocation and financial performance. The variables identified included value-based procurement, artificial intelligence integration, blockchain technology, and supply chain optimization as proxies for strategic practices, while cost containment served as the performance metric. The methodology employed a comprehensive systematic review of current literature and empirical evidence across various healthcare organizations. The findings indicated that healthcare organizations implementing strategic procurement achieved cost reductions between 12% and 18% in medical supplies and equipment while enhancing quality standards. The study recommended a systematic approach combining technological innovation, change management, and policy adaptation to sustain cost containment. A notable strength of the study was its forward-looking analysis of emerging technologies like AI and blockchain; however, a critique is that it focused primarily on high-level administrative reviews, lacking specific quantitative data from diverse geographical manufacturing contexts.

Sumankuuro et al. (2023) assessed the experiences of strategic purchasing of healthcare in nine middle-income countries. The study explored the extent to which strategic purchasing has been established and its impact on achieving universal health coverage goals. The variables utilized included health technology assessment (HTA) capacity, reimbursement mechanisms (capitation and DRGs), provider accreditation, and claims monitoring as proxies for strategic practices, while universal health coverage progress, out-of-pocket (OOP) payments, and financial protection served as performance indicators. The methodology employed a systematic qualitative review and case study analysis focused on Iran, Nigeria, China, Mexico, Ghana, Kenya, Thailand, Vietnam, and Indonesia. Data were extracted from 129 articles and synthesized qualitatively using a common analytical framework. The findings revealed that only Thailand and Indonesia effectively maintained low OOP payments (11% and 18% respectively) due to robust engagement and HTA research capacity. The study recommended investment in purchaser research capacity and stronger governance to build trusting relationships. A strength of this study was its extensive geographical spread and rigorous cross-country comparison; however, its primary critique is the reliance on heterogeneous published data which lacked specific contractual details.

Logistics & Distribution Management and Performance

Okoduwa et al. (2025) investigated the effect of logistics management on the performance of small and medium pharmaceutical companies in Southern Nigeria. The study identified indicators of effective logistics and their impact on operational efficiency and business growth. The variables utilized included real-time tracking, efficient transportation, inventory management, and warehousing as logistics proxies, while business performance was measured through service reliability, cost efficiency, and financial health. The methodology adopted a quantitative research strategy using a positivist philosophy. The population consisted of pharmaceutical small and medium enterprise owners in Southern Nigeria. Data were collected from a sample of 95 community pharmacy owners through a structured online questionnaire and analyzed using the Statistical Package for Social Sciences. The findings indicated that effective logistics management significantly enhances business profitability and service delivery, though delays and high costs remain major impediments. The study recommended adopting advanced logistics technologies and strategic policy reforms. A strength of the work was the high response rate and sector-specific focus; however, it was critiqued for using convenience sampling, which may introduce inherent biases in generalizing results.

Nwankwo (2021) evaluated logistics and supply chain management in Nigerian health sector. The study identified the vulnerabilities within healthcare departments and proposed measures to optimize the flow of medical products. The variables utilized included quantification, inventory management, transportation, and fleet management as logistics proxies, while performance was measured through cost containment, patient safety, and the achievement of Sustainable Development Goal targets. The methodology involved a conceptual review and evaluative analysis of the National Health Supply Chain Strategic and Implementation Plan (NHSCSP). The population focused on the Nigerian healthcare system, including global manufacturers, wholesale distributors,

and front-line providers. Data collection was based on policy documents and secondary research findings regarding hospital logistics budgets and clinician workflows. The findings indicated that logistics optimization acts as a key driver for sustainable supply chains, accounting for up to 46% of hospital budgets. The study recommended designing implementation frameworks that integrate safety monitoring and leverage private sector synergy. A strength of the work was its comprehensive breakdown of sector-specific logistics (pharmacy and blood bank); however, it was critiqued for relying heavily on a conceptual framework without primary empirical data from specific Nigerian health facilities.

Ben-Chioma and Obi (2024) explored the influence of supply chain management practices on the operational performance of some public hospitals in Rivers State. The study determined how various supply chain activities enhance the delivery of healthcare services in a resource-constrained public setting. The variables utilized included flexible material procurement, supplier selection, logistics outsourcing, medical inventory management, and information technology integration as independent proxies, while performance measures served as the dependent variable. The methodology employed a quantitative approach using the Statistical Package for Social Sciences (SPSS) version 26 to conduct Chi-Square and Pearson's correlation tests. The population covered a sample frame of 109 hospitals, with data successfully captured from 58 public hospitals in Rivers State, Nigeria. The findings revealed a significant relationship between hospitals' performance and flexible material procurement, supplier selection, and inventory management strategies. The study recommended that public hospitals embrace automation and increase capacity through training for efficient demand forecasting and stock codification. A strength of the study was its practical focus on housekeeping and automation; however, it was critiqued for its limited sample size relative to the total hospital frame.

Risk Management Practices and Performance

Adepoju and Esan (2023) evaluated risk management practices and workers safety in University of Medical Sciences Teaching Hospital, Ondo State Nigeria. The study assessed the category of risk management strategies utilized and their subsequent impact on occupational safety. The variables utilized included incident reporting culture, communication, risk prevention procedures, and staff training as independent proxies, while workers' safety practices served as the dependent variable. The methodology employed a qualitative research approach using a structured questionnaire. The population comprised 124 health workers across the accident and emergency unit, surgical ward, and medical laboratory. Data were analyzed using descriptive statistics, ANOVA, and regression models. The findings indicated a significant positive effect of risk management on workers' safety, with incident reporting emerging as the most utilized strategy. The study recommended a well-designed risk management policy and systematic training to address the lack of commitment among staff. A strength of the study was its focus on a specialized teaching hospital environment; however, it was critiqued for its relatively small sample size which may limit broader generalizations.

Padmane et al. (2024) explored risk management frameworks in healthcare supply chains: a comprehensive review. The study assessed structured methodologies designed to identify, assess, mitigate, and monitor disruptions to enhance organizational resilience. The variables utilized included operational inefficiencies, inventory mismanagement, and regulatory changes as internal risk proxies, alongside external factors like market volatility and natural disasters, while healthcare supply chain performance and patient care outcomes served as the dependent variables. The methodology involved a systematic literature review across databases such as PubMed, Scopus, and Web of Science. The population focused on global healthcare logistics research from the last decade, synthesizing diverse studies into a holistic framework. The findings indicated that while traditional risk management is prevalent, there is a critical need for technology-enhanced approaches like artificial intelligence and real-time monitoring to safeguard supply chain continuity. The study recommended the development of innovative decision-support systems and increased collaboration between stakeholders. A strength of the work was its comparative analysis between developed and developing nations; however, it was critiqued for the underutilization of empirical validation for the proposed predictive models.

Senna et al. (2023) examined the influence of supply chain risk management in healthcare supply chains performance. The study aimed to develop and validate a conceptual framework linking supply chain integration, supply chain risk management, and supply chain 4.0 as antecedents to healthcare supply chain performance. Key

variables included supply chain integration (measured by collaboration and information sharing), supply chain risk management (proxied by risk identification, assessment, and mitigation), supply chain 4.0 (via digital technologies like IoT and AI), and performance (assessed through cost efficiency, service levels, and resilience). Employing covariance-based structural equation modeling, the study targeted healthcare professionals in public and private sectors in Brazil, surveying a sample of 312 respondents via online questionnaires for data collection. Analysis revealed positive causal relationships among the antecedents and performance, with sector (public or private) moderating effects; supply chain risk management significantly enhanced performance in private sectors but required cultural shifts in public ones. Recommendations urged managers to implement robust risk management, integration, and digital initiatives to boost resilience post-COVID-19. A strength of the study was its empirical validation of a new scale for constructs, providing practical tools for healthcare organizations; however, its critique lies in the Brazil-specific context, limiting generalizability to other regions without comparative data.

Quality Assurance & Control Practices and Performance

Abdi (2020) investigated the effect of strategic quality management initiatives and service delivery in the National Hospital Insurance Fund in Wajir County, Kenya. The study examined how quality-driven strategic pillars influence the efficiency and effectiveness of healthcare fund operations. The variables utilized included top management commitment, stakeholder involvement, customer orientation, and employee empowerment as independent proxies, while service delivery measured by claim processing time and customer satisfaction served as the dependent variable. The methodology employed a descriptive research design with a case study approach. The population consisted of five NHIF accredited facilities, targeting a census of 114 members. Data were collected using structured questionnaires and analyzed through descriptive and multiple regression analysis via SPSS. The findings indicated that all four quality initiatives have a positive and significant relationship with service delivery, collectively determining 50.1% of its variance. The study recommended that the fund involve stakeholders in decision-making and improve information awareness regarding card usage. A strength of the work was its focus on a marginalized region with low insurance coverage; however, it was critiqued for its reliance on a small sample of members which may limit the generalizability to the entire national population.

Kipo-Sunyehzi (2021) examined quality healthcare services under National Health Insurance Scheme in Ghana: perspectives from health policy implementers and beneficiaries. The study explored the factors that affect the quality of healthcare services in the implementation of the insurance scheme at the local level. The variables utilized included referrals, effectiveness in monitoring, timeliness, efficiency, reimbursement, and compliance with standard guidelines as independent proxies, while the dependent variable was quality healthcare services. The methodology employed a mixed research method incorporating in-depth interviews, focus group discussions, and document analysis. The population comprised health policy implementers and beneficiaries within the Tamale Metropolis, Ghana. Data were collected from a sample of 107 participants across four public and private health facilities. The findings indicated that referrals, monitoring effectiveness, and compliance with Ghana Health Service guidelines significantly impact service quality, though implementers and beneficiaries held divergent perspectives on service access. The study recommended that policymakers ensure adequate resource availability and that implementers prioritize beneficiary welfare. A strength of the study was its dual actor perspective; however, it was critiqued for its limited geographic focus on a single metropolis.

Dawshi et al. (2022) explored quality assurance and quality control in clinical laboratories: a review. The study explored the current practices and challenges of laboratory medicine to determine how systematic processes influence the reliability of test results. The variables utilized included training, standard operating procedures, internal quality control, and external quality assurance as independent proxies, while patient care outcomes and test accuracy served as the dependent variables. The methodology involved a structured literature search and analysis of secondary data from PubMed and ScienceDirect. The population focused on global clinical laboratory standards and regulatory guidelines. Data were extracted from various studies published over the last decade to identify common trends. The findings indicated that implementing robust quality management systems and adhering to international standards significantly enhance the accuracy of test results and patient safety. The study recommended that laboratories invest in continuous staff education and automation to minimize human error. A strength of the study was its comprehensive synthesis of regulatory frameworks; however, it was critiqued for

its reliance on secondary data, which may not fully capture the real-time operational challenges and resource constraints faced by clinical laboratories in low-resource or developing settings.

Theoretical Framework

Resource-Based View (RBV) Theory

The underpinning theory for this study is the Resource-Based View (RBV). Propounded by Birger Wernerfelt in 1984 and significantly expanded by Jay Barney in 1991, the Resource-Based View (RBV) posits that an organization's competitive advantage and superior performance are derived from its internal resources and capabilities, provided they are valuable, rare, inimitable, and non-substitutable (VRIN).

In the context of the National Health Insurance Authority (NHIA) Medicine Supply Initiative (NMSI), the theory suggests that the performance of the initiative is not merely a result of market positioning but of how the NHIA leverages its specific Supply Chain Management (SCM) practices as strategic assets. For example, Strategic Sourcing serves as a "valuable" resource by allowing the authority to negotiate favorable prices with vendors, thereby improving economic efficiency (Sumankuuro et al., 2023). Logistics and Distribution Management represent "inimitable" organizational routines; a well-integrated tracking system reduces drug delivery lead times, directly enhancing supply chain responsiveness (Okoduwa et al., 2025). Furthermore, Risk Management and Quality Assurance act as "non-substitutable" capabilities that safeguard product availability by identifying supplier failures and ensuring medicine integrity before they reach the patient (Adala et al., 2022).

The primary strength of RBV is its focus on internal management control, empowering the NHIA to optimize what it owns its procurement policies and logistical networks to achieve goals like universal health coverage (Mohamed & Bett, 2018). However, a weakness is that it may undervalue external environmental factors, such as sudden government policy shifts or global pandemics, which can overwhelm internal resources (Upadhyay et al., 2020). Despite this, the theory is highly applicable to this study as it provides a robust lens to evaluate how the four IVs (Sourcing, Logistics, Risk, and Quality) function as the strategic "bundle of resources" necessary to drive the DV of multidimensional performance within the NMSI framework.

The Resource-Based View (RBV) underpins this study because it shifts the focus from external medicine market fluctuations to the internal strategic capabilities of the NHIA. It best explains the study by asserting that the NMSI's success in reducing stock-out rates and improving order fill rates is a direct consequence of how effectively the authority transforms its logistical and sourcing routines into rare and valuable organizational strengths.

METHODOLOGY

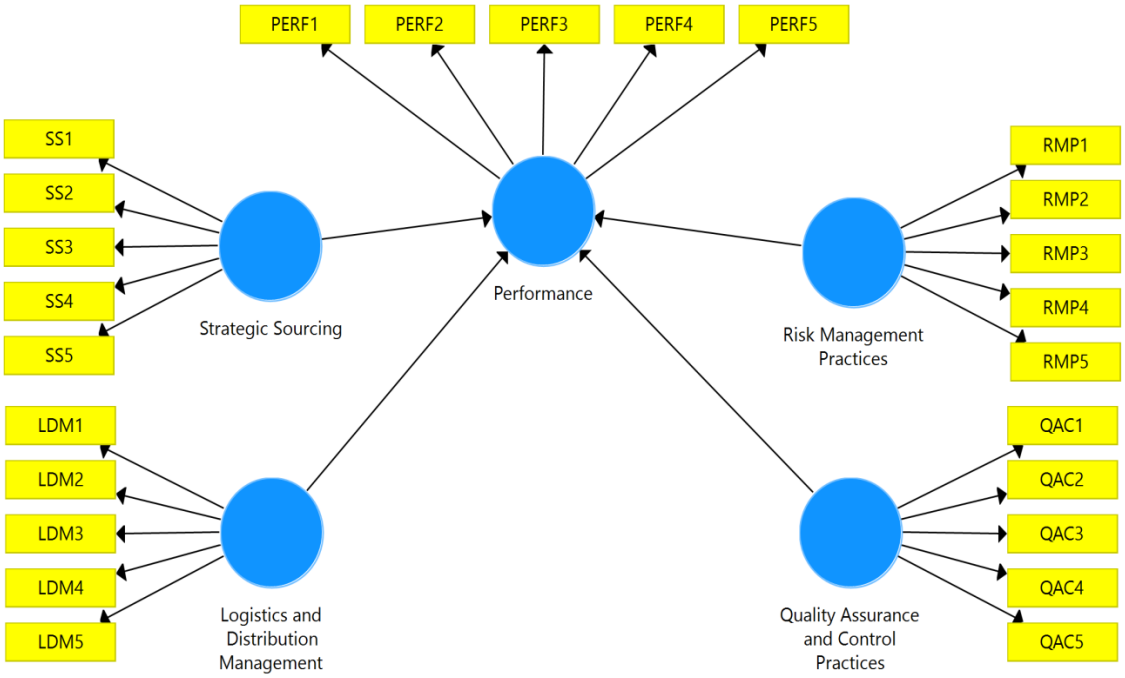
A descriptive survey research design was employed for this study to allow for the systematic collection of data from selected stakeholders at a single point in time, which is essential for examining the relationship between supply chain management practices and organizational performance. This approach enabled the assessment of various practices and their effect on the performance of the National Health Insurance Authority (NHIA) Medicine Supply Initiative (NMSI) in Nigeria from 2020 to 2024. By utilizing a descriptive survey, the study gathered valuable insights into stakeholder perceptions and operational outcomes within the NHIA's medicine supply framework. The population for this study comprised 176 strategic stakeholders across the NHIA supply chain, including 38 NHIA management and staff from the Abuja headquarters, 68 representatives from the 12 MoU pharmaceutical partners, 54 logistics and warehouse managers from accredited Drug Management Organisations, and 16 regulatory officers from NAFDAC. A census approach was adopted due to the specialized nature and manageable size of the population, aiming for inclusive representation and minimizing sampling bias to ensure the data accurately reflected the multi-actor reality of the NMSI during the period under review.

Data collection for the NHIA Medicine Supply Initiative (2020–2024) utilized a structured questionnaire on a five-point Likert scale. Items for Strategic Sourcing were adapted from Boakye and Normanyo (2018) and Olayiwola and Adeyemi (2022), focusing on supplier selection and price stability. Logistics and Distribution Management items drew from Okoduwa et al. (2025) and Nwankwo (2021) to assess tracking and last-mile

delivery. Risk Management Practices were informed by Adala et al. (2022) and Padmane et al. (2024) regarding identification and mitigation, while Quality Assurance items were adapted from Oriri and Okibo (2015) and Xiong et al. (2017) centering on NAFDAC standards and audits. Organizational Performance was evaluated through product availability based on Grubor et al. (2016), economic efficiency as defined by Geamănu (2011), and responsiveness using frameworks from Mohammed and Mandal (2023) and Nyaude and Maunganidze (2024).

The reliability of these constructs was rigorously established using Cronbach's Alpha, with all values exceeding the 0.70 threshold. Specifically, Strategic Sourcing recorded an alpha of 0.890, Logistics and Distribution Management achieved 0.915, Risk Management Practices stood at 0.917, Quality Assurance and Control Practices reached 0.895, and the dependent variable, Performance, scored 0.919. These high values confirm that the measurement instruments possessed strong internal consistency and were robust enough to capture the intended data accurately. For the analysis phase, Partial Least Squares Structural Equation Modeling (PLS-SEM) using SmartPLS was selected. This method was deemed appropriate as it effectively handles complex models with multiple path relationships, accommodates the non-normal data distributions often found in survey research, and provides high predictive power for assessing performance outcomes. Ethical standards, particularly regarding informed consent and the confidentiality of the pharmaceutical partners, were strictly maintained throughout the process. Below is the model of the study:

Figure 1: Model of the study

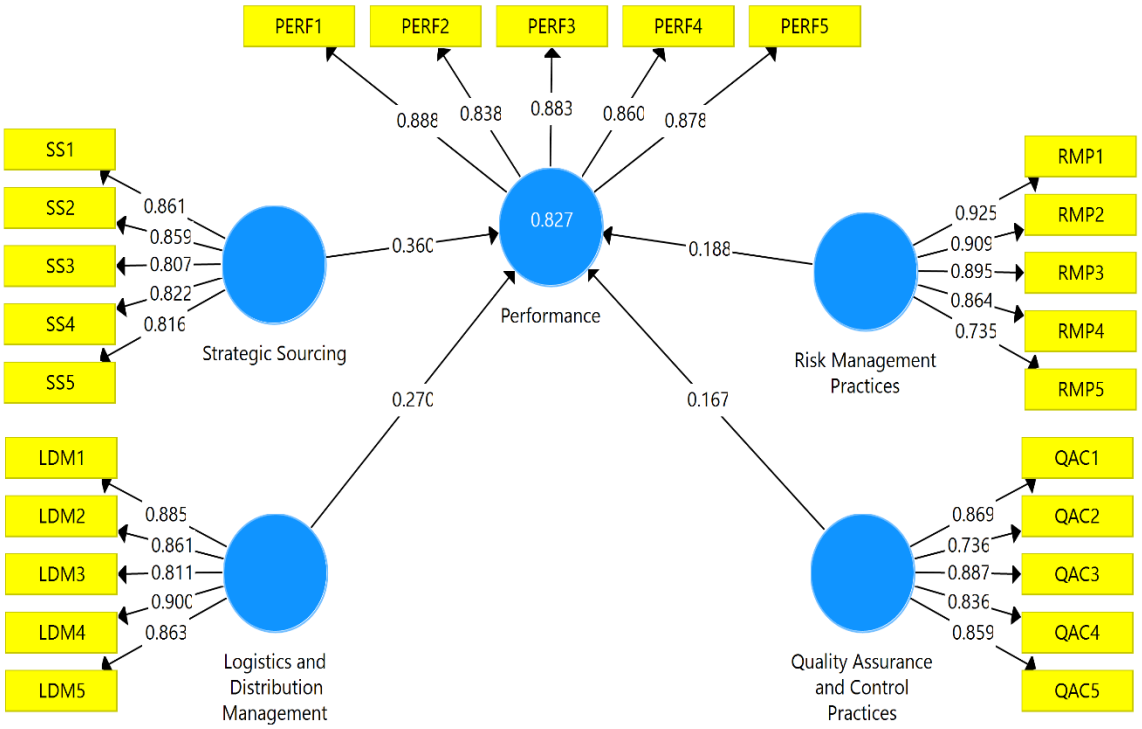


Source: SmartPLS Output, 2025.

RESULTS AND DISCUSSIONS

A total of 176 copies of the questionnaire were administered to strategic stakeholders across the NHIA supply chain. Out of these, 121 copies were properly completed and retrieved, representing a response rate of 68.7%. After screening for completeness, consistency, and missing values, all 121 copies were found valid and included in the final analysis. This participation level was considered sufficient for statistical analysis and provided a reliable basis for interpreting the study's results, ensuring the findings were representative of the NMSI stakeholder landscape in Nigeria. Consequently, the data offers a robust foundation for examining the effect of Strategic Sourcing, Logistics and Distribution Management, Risk Management Practices, and Quality Assurance and Control Practices on the performance of the NHIA Medicine Supply Initiative between 2020 and 2024.

Figure 2: Factor Loadings



Source: SmartPLS Output, 2025.

Table 1: Factor Loadings

Construct	Item	Measurement Items	Factor Loading
Strategic Sourcing (SS)	SS1	Selection of the 12 partners followed strict technical audits.	0.861
	SS2	Negotiated MoUs provided a stable long-term pricing framework.	0.859
	SS3	Strategic bulk-purchasing achieved the 50% cost reduction target.	0.807
	SS4	Procurement prioritized local firms for national drug security.	0.822
	SS5	Competitive bidding for partners was transparent and merit-based.	0.816
Logistics & Distribution (LDM)	LDM1	DMOs effectively managed last-mile delivery to pilot states.	0.885
	LDM2	Framework significantly reduced order-to-delivery lead times.	0.861
	LDM3	DMO warehouses maintained optimal storage for NMSI products.	0.811
	LDM4	Distribution networks reached remote healthcare facilities.	0.900
	LDM5	Integrated systems allowed effective tracking of drug batches.	0.863

Risk Management (RMP)	RMP1	Contingency plans mitigated currency fluctuation disruptions.	0.925
	RMP2	Specialized branding prevented medicine diversion to open markets.	0.909
	RMP3	Periodic audits identified distribution security vulnerabilities.	0.895
	RMP4	Financial risk-sharing helped manufacturers manage rising costs.	0.864
	RMP5	Strategic reserves were maintained to cushion demand surges.	0.735
Quality Assurance (QAC)	QAC1	Branded packaging assured enrollees of product authenticity.	0.869
	QAC2	NAFDAC conducted rigorous batch testing for safety compliance.	0.736
	QAC3	Partner firms adhered to Good Manufacturing Practices (GMP).	0.887
	QAC4	Unique serialization codes enabled efficient batch recalls.	0.836
	QAC5	Routine quality inspections were performed at hospital pharmacies.	0.859
NMSI Performance (PERF)	PERF1	Initiative successfully eliminated out-of-stock incidents.	0.888
	PERF2	Branded medicines remained more affordable than private options.	0.838
	PERF3	Enrollees experienced reduced out-of-pocket spending.	0.883
	PERF4	The supply chain demonstrated high agility in replenishment.	0.860
	PERF5	Stakeholders report increased confidence in NHIA reliability.	0.878

Source: SmartPLS Output (2025).

Table 1 presents the measurement model assessment for the effect of supply chain management practices on the performance of the National Health Insurance Authority (NHIA) Medicine Supply Initiative (NMSI). All factor loadings exceed the recommended threshold of 0.70 (Hair et al., 2019), confirming strong indicator reliability for the study. Strategic Sourcing (SS) loadings range from 0.807–0.861 (>0.70), with SS1 (0.861) reflecting the importance of manufacturing capacity audits and SS3 (0.807) showing the impact of bulk-purchasing on cost reduction. Logistics and Distribution Management (LDM) exhibits high reliability ranging from 0.811–0.900 (>0.70), where LDM4 (0.900) strongly represents the reach of distribution networks to remote facilities.

Risk Management Practices (RMP) exhibits the strongest internal consistency in this model (0.735–0.925), led by RMP1 (0.925) regarding currency fluctuation mitigation, while RMP5 (0.735) remains a satisfactory measure for strategic reserves. Quality Assurance and Control (QAC) ranges from 0.736–0.887 (>0.70) with QAC3 (0.887) capturing adherence to Good Manufacturing Practices and QAC2 (0.736) verifying the role of regulatory batch testing. Performance (PERF), measured via stock-out rates, affordability, and responsiveness, ranges from 0.838–0.888 (>0.70; Fornell & Larcker, 1981). PERF1 (0.888) is the strongest indicator, representing the elimination of out-of-stock incidents, while PERF2 (0.838) confirmed the initiative's success in price differentials. These consistently high loadings provide a statistically significant foundation for proceeding to structural model testing (Inner Model) using PLS-SEM.

Table 2: Construct Reliability and Validity

Construct	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Strategic Sourcing	0.890	0.896	0.919	0.694
Logistics and Distribution Management	0.915	0.916	0.937	0.747
Risk Management Practices (RMP)	0.917	0.919	0.938	0.754
Quality Assurance and Control Practices	0.895	0.908	0.922	0.704
Performance	0.919	0.921	0.939	0.756

Source: SmartPLS Output, 2025.

Table 2 presents the construct reliability and validity results for Supply Chain Management Practices and NHIA Medicine Supply Initiative (NMSI) performance (2020–2024). All constructs show excellent internal consistency, with Cronbach's Alpha ranging from 0.890 to 0.919 (well above the 0.70 threshold; Hair et al., 2019; Nunnally & Bernstein, 1994). Composite Reliability ranges from 0.919 (Strategic Sourcing) to 0.939 (Performance), confirming strong scale reliability. Average Variance Extracted (AVE) exceeds 0.50 for all constructs (Fornell & Larcker, 1981), ranging from 0.694 (Strategic Sourcing) to 0.756 (Performance). The high AVE of 0.756 for Performance assessed via product availability, economic efficiency, and supply chain responsiveness demonstrates robust convergent validity.

Table 3: Heterotrait-Monotrait Ratio (HTMT)

Construct	SS	LDM	RMP	QAC	PERF
Strategic Sourcing (SS)					
Logistics and Distribution Management (LDM)	0.659				
Risk Management Practices (RMP)	0.534	0.607			
Quality Assurance and Control Practices (QAC)	0.664	0.586	0.631		
Performance (PERF)	0.624	0.620	0.600	0.599	

Source: SmartPLS Output, 2025.

Table 3 presents the Heterotrait-Monotrait Ratio (HTMT) results for assessing discriminant validity in the study of Supply Chain Management Practices on NHIA Medicine Supply Initiative (NMSI) performance. Following Henseler, Ringle, and Sarstedt (2015), discriminant validity is established when HTMT values fall below the conservative threshold of 0.85 or the liberal threshold of 0.90. All HTMT values in this analysis are below 0.90, confirming strong discriminant validity among the constructs. The highest value observed was 0.664 (between Strategic Sourcing and Quality Assurance and Control Practices), well within acceptable limits. These findings indicate that the four SCM practice dimensions (SS, LDM, RMP, QAC) and the dependent variable (PERF) are empirically distinct.

Table 4: Collinearity Statistics (Inner VIF Values)

Construct	Performance (PERF)
Strategic Sourcing (SS)	3.045
Logistics and Distribution Management (LDM)	4.167

Risk Management Practices (RMP)	4.812
Quality Assurance and Control Practices (QAC)	4.609

Source: SmartPLS Output, 2025.

Table 4 presents the inner Variance Inflation Factor (VIF) values for assessing multicollinearity in the structural model. According to Hair et al. (2019), VIF values below 5.0 are acceptable in organizational research. All inner VIF values range from 3.045 (Strategic Sourcing) to 4.812 (Risk Management Practices), well below the conservative threshold. This indicates no significant multicollinearity, confirming that Strategic Sourcing (SS), Logistics and Distribution Management (LDM), Risk Management Practices (RMP), and Quality Assurance and Control Practices (QAC) each provide unique, non-redundant explanatory power for NHIA Medicine Supply Initiative (NMSI) performance.

Table 5: Effect Size (f^2)

Construct	**Effect Size (f^2)**	**Cohen's Threshold Assessment**
Strategic Sourcing (SS)	0.246	**Medium Effect**
Logistics and Distribution Management (LDM)	0.101	**Small Effect**
Risk Management Practices (RMP)	0.043	**Small Effect**
Quality Assurance and Control Practices (QAC)	0.035	**Small Effect**

Source: SmartPLS Output, 2025.

Table 5 illustrated the practical effect of each supply chain management practice on the NMSI performance based on Cohen's (1988) thresholds. Strategic Sourcing (SS) exerts the most substantial influence ($f^2 = 0.246$), indicating a medium effect; this confirms that active purchasing is the primary driver of medicine affordability. Logistics and Distribution Management (LDM) recorded a small effect ($f^2 = 0.101$), while Risk Management (RMP) and Quality Assurance (QAC) yielded effect sizes of 0.043 and 0.035 respectively, also falling within the small effect category as supporting safeguards.

Table 6: Predictive Power (R^2)

Endogenous Construct	**R Square**	**R Square Adjusted**
Performance (PERF)	0.827	0.824

Source: SmartPLS Output, 2025.

Table 6 presents the coefficient of determination (R^2), which indicates the proportion of variance in the dependent variable explained by the predictors. The R^2 value of 0.827 shows that Strategic Sourcing, Logistics and Distribution Management, Risk Management Practices, and Quality Assurance and Control Practices collectively explain 82.7% of the variance in NMSI performance. As Hair et al. (2019) noted, an R^2 above 0.75 is considered substantial in social science research. The adjusted R^2 of 0.824 further confirms the model's robustness and lack of overfitting, demonstrating strong predictive power for multidimensional performance metrics (product availability, economic efficiency, and supply chain responsiveness).

Table 7: Model Fit Indices

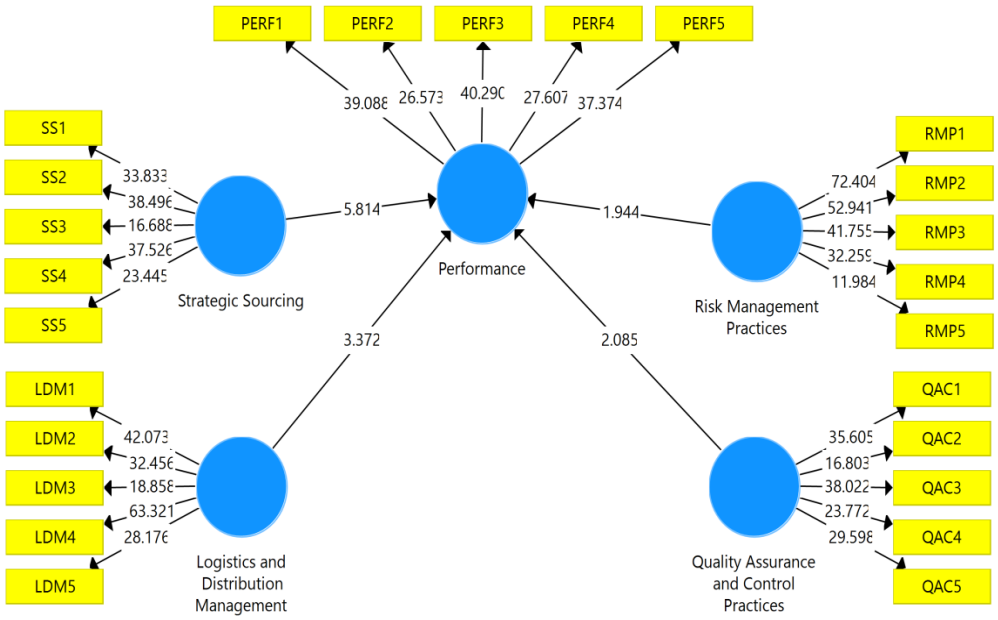
Index	**Saturated Model**	**Estimated Model**
SRMR	0.069	0.069

d_ULS	1.560	1.560
d_G	1.008	1.008
Chi-Square	1391.334	1391.334
NFI	0.796	0.796

Source: SmartPLS Output, 2025.

The Standardized Root Mean Square Residual (SRMR) is 0.069, well below the accepted threshold of 0.08 (Henseler et al., 2016), indicating good model fit and low residual error. The Normed Fit Index (NFI) of 0.796 shows the model explained about 80% of the covariance structure relative to the null model; while values near 0.90 are preferred, ~0.80 is acceptable in complex healthcare supply chain models involving behavioral and operational factors. Identical d_ULS and d_G values between the saturated and estimated models confirm that discrepancies are statistically insignificant, supporting valid inferences about product availability, economic efficiency, and supply chain responsiveness.

Figure 3: Structural Model Path Coefficients for SCM Practices and NMSI Performance



Source: SmartPLS Output, 2025.

Table 8: Path Coefficients and Hypothesis Testing Results

Path (Hypothesis)	**Original Sample (O)**	**T Statistics**	**P Values**	**Decision**
Strategic Sourcing (SS) → Performance	0.360	5.814	0.000	**Supported**
Logistics and Distribution Management (LDM) → Performance	0.270	3.372	0.001	**Supported**
Risk Management Practices (RMP) → Performance	0.188	1.944	0.052	**Not Supported**
Quality Assurance and Control Practices (QAC) → Performance	0.167	2.085	0.038	**Supported**

Source: SmartPLS Output, 2025.

Key Findings

1. **Strategic Sourcing (SS)** significantly and positively affects the performance of the NHIA Medicine Supply Initiative. With the highest path coefficient (beta = 0.360, $p < 0.001$), it is the most critical driver of medicine affordability and availability.

2. **Logistics and Distribution Management (LDM)** significantly and positively affects the performance of the NHIA Medicine Supply Initiative (beta = 0.270, $p < 0.01$). This underscored the importance of efficient transportation and inventory tracking in enhancing supply chain responsiveness.

3. **Risk Management Practices (RMP)** does not have a statistically significant effect on the performance of the NHIA Medicine Supply Initiative at the 5% level (beta = 0.188, $p = 0.052$). This suggests that while risk identification is present, it has not yet translated into measurable gains in stock-out reduction or cost efficiency during the period under review.

4. **Quality Assurance and Control Practices (QAC)** significantly and positively affects the performance of the NHIA Medicine Supply Initiative (beta = 0.167, $p < 0.05$), confirming that adherence to clinical standards and supplier appraisals improves service quality and patient safety.

DISCUSSION OF FINDINGS

H_{01}: Strategic Sourcing has no significant effect on the Performance of the NHIA Medicine Supply Initiative (2020–2024).

The hypothesis was rejected, as the path coefficient of 0.360 ($t = 5.814$, $p = 0.000$) indicates a strong significant positive effect. This implies that between 2020 and 2024, the NHIA's shift toward active, data-driven decision-making regarding vendor selection and payment models served as the primary driver for the NMSI's success. By leveraging spend analytics during this period, the initiative effectively maximized available funds to ensure consistent drug availability. This aligns with Olayiwola and Adeyemi (2022), who argued that strategic purchasing reduces inefficient resource allocation. Similarly, Balogun et al. (2025) noted that strategic procurement leads to substantial cost reductions while maintaining high-quality medical standards.

H_{02}: Logistics and Distribution Management has no significant effect on the Performance of the NHIA Medicine Supply Initiative (2020–2024).

The hypothesis was rejected, with a path coefficient of 0.270 ($t = 3.372$, $p = 0.001$), confirming a significant positive impact during the 2020–2024 review period. This suggests that the coordination of material and information flow was foundational for operational excellence in the NMSI. The implementation of optimized delivery routes during these years directly improved order fill rates by reducing product search times. These results are consistent with Okoduwa et al. (2025), who found logistics management to be a cornerstone of pharmaceutical success. Furthermore, Tanzubil and Veeraiyah (2025) established that distribution management acts as a vital chain binding healthcare delivery stages together.

H_{03}: Risk Management Practices have no significant effect on the Performance of the NHIA Medicine Supply Initiative (2020–2024).

The hypothesis was retained at the 5% significance level (beta = 0.188, $t = 1.944$, $p = 0.052$). While the relationship is positive, it did not meet the threshold for statistical significance within the 2020–2024 timeframe. This implies that although the NHIA identified risks like single-source dependency during this period, these practices have not yet matured enough to proactively eliminate stock-outs or mitigate lead time variability. This period coincided with extreme Naira volatility, characterized by sharp depreciation (e.g., significant losses against the USD, with parallel market rates reflecting ongoing instability through 2024), alongside broader macroeconomic shocks including inflation spikes, supply chain disruptions from COVID-19 and global events, and persistent foreign exchange constraints. These factors placed immense pressure on imported medicines and raw materials, amplifying costs and uncertainties in healthcare supply chains. This findings during the review

period contrast with Senna et al. (2023), who found significant benefits in private healthcare, but supports Ghamedi (2025), who noted that persistent supply shortages often remain in public sectors lacking standardized, context-specific mitigation tools.

H_{04}: Quality Assurance and Control Practices have no significant effect on the Performance of the NHIA Medicine Supply Initiative (2020–2024).

The hypothesis was rejected (beta = 0.167, t = 2.085, p = 0.038), indicating that quality checks significantly enhanced NMSI performance during the 2020–2024 period. Standardizing services and adhering to clinical guidelines minimized clinical risks, ensuring beneficiaries received efficacious medication. This result corroborates Oriri and Okibo (2015), who found that proactive supplier appraisal improves inventory flow. Additionally, Kipo-Sunyehzi (2021) highlighted that institutional compliance with standard guidelines during this period minimized information asymmetry and prevented unauthorized out-of-pocket expenses for patients.

CONCLUSION

In conclusion, this study found that Strategic Sourcing, Logistics and Distribution Management, and Quality Assurance and Control Practices significantly and positively affect the performance of the National Health Insurance Authority (NHIA) Medicine Supply Initiative (NMSI) from 2020 to 2024. Strategic Sourcing emerged as the strongest predictor, followed by Logistics and Distribution Management and Quality Assurance and Control Practices. Risk Management Practices did not meet the threshold for statistical significance at the 5% level. Collectively, these supply chain management practices explain a substantial portion of variance in performance metrics (product availability via stock-out rates, economic efficiency using price differentials to assess affordability, and supply chain responsiveness by evaluating delivery lead times and order fill rates), highlighting the critical role of integrated supply chain practices in achieving operational excellence in Nigeria's public health insurance medicine supply sector. Based on the empirical strength and significance of the tested relationships, the following recommendations are proposed to enhance the performance and reliability of the National Health Insurance Authority (NHIA) Medicine Supply Initiative (NMSI):

i. Given that Strategic Sourcing is the most powerful driver of performance ($\beta = 0.360$), the NHIA should invest in advanced digital tools, such as AI-driven spend analytics and real-time procurement platforms. Establishing centralized dashboards for vendor evaluation will enhance negotiation leverage and payment model efficiency, directly improving cost containment and drug availability.

ii. To leverage the significant impact of Logistics and Distribution Management, the NHIA should accelerate the rollout of an electronic Logistics Management Information System (eLMIS). Integrating GPS-enabled tracking and automated inventory tools with State Social Health Insurance Schemes (SSHISs) is crucial for real-time stock visibility. This integration will reduce delivery lead times and mitigate the "bullwhip effect" in primary healthcare replenishment.

iii. To sustain the significant gains found in Quality Assurance and Control, the NHIA should collaborate with NAFDAC to institutionalize automated medicine authenticity checks. Implementing serialized mobile authentication and rigorous digital supplier audits will ensure that the clinical integrity of NMSI-branded medicines is maintained across all accredited facilities.

iv. Since Risk Management Practices were not statistically significant, the NHIA must transition from passive risk identification to active mitigation. The Authority should develop context-specific tools for risk assessment, including the implementation of multi-sourcing contingency plans and early-warning systems to address supply variability. Crucially, to protect the NMSI from external shocks like the foreign exchange volatility observed during 2020–2024, the NHIA should establish a "Strategic Medicine Reserve." This combination of manufacturing diversification and physical buffer stocks will proactively eliminate persistent stock-outs and safeguard the public health supply chain against macroeconomic disruptions.

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