

Inventory Management Techniques and Their Impact on Supply Chain Performance: A Study of University of Abuja Teaching Hospital.

Associate Professor Theresa I. Ndulue & ABDULALAH, Daud Wokili

Abstract-- This study examined the influence of Just-in-Time (JIT) and Economic Order Quantity (EOQ) inventory management techniques on supply chain performance specifically delivery efficiency and cost reduction at the University of Abuja Teaching Hospital (UATH), Gwagwalada, Abuja. Anchored on Lean Theory, the research adopted a cross-sectional survey design. A sample of 325 respondents was drawn from an accessible population of 1,127 hospital employees involved in inventory, procurement, and supply chain functions. Structured questionnaires were administered, yielding a 91.4% response rate with 297 valid responses. Data were analyzed using multiple regression analysis via SPSS version 27. The findings revealed that JIT had a positive and significant influence on delivery efficiency ($\beta = 0.587, p < 0.05$), while EOQ demonstrated a strong positive and significant effect on cost reduction ($\beta = 0.778, p < 0.05$). The ANOVA results confirmed the overall significance of both regression models (JIT: $F = 155.264, p < 0.05$; EOQ: $F = 452.298, p < 0.05$). The study concluded that structured application of JIT enhances demand-driven replenishment, reduces lead times, and prevents stockouts, while EOQ optimizes order quantities, lowers procurement and holding costs, and minimizes product expiration losses. It was recommended that UATH formalize JIT-aligned procurement processes, invest in EOQ-integrated digital inventory tools, and strengthen supplier partnerships. The study contributes empirical evidence from a Nigerian public tertiary hospital, validating Lean Theory in resource-constrained healthcare supply chains and offering actionable insights for hospital leadership and health logistics policymakers in Nigeria.

Keywords-- Just-in-Time, Economic Order Quantity inventory management techniques, supply chain performance, delivery efficiency and cost reduction

I. INTRODUCTION

Globally, hospitals employing the Economic Order Quantity (EOQ) model, which minimizes procurement and holding expenses for predictable commodities and the Just-in-Time (JIT) approach, which aligns supply arrivals with consumption to eliminate excess stock alongside advanced digital platforms have realized significant improvements, with stock availability increasing by approximately 27% and inventory expenditures declining by nearly 22% (WHO, 2023; Gupta & Sharma, 2024).

However, to mitigate vulnerabilities during supply disruptions, contemporary global practice favors context-sensitive hybrid frameworks that merge EOQ's cost-efficiency with JIT's responsiveness (Ivanov & Dolgui, 2023; Kumar et al., 2024).

In Asia and Europe inventory management in healthcare usually involves the strategic coordination of acquiring, storing, and deploying materials to ensure operational continuity, directly impacting clinical outcomes and fiscal responsibility (Ahiapka & Mensah, 2023; Okafor & Eze, 2024).

Within West Africa and Nigeria, the application of these inventory systems operates amid significant infrastructural constraints, fragmented procurement governance, and fiscal unpredictability. Public tertiary facilities in the region frequently encounter stockouts due to manual record-keeping, weak demand projection, and protracted approval workflows (Amoah & Darko, 2023; ECOWAS Health Directorate, 2024). In Nigeria specifically, teaching hospitals grapple with overlapping regulatory mandates and paradoxical inventory conditions where critical items are unavailable while slow-moving supplies accumulate, leading to financial strain (Adebayo & Salami, 2024). Despite these systemic challenges, emerging empirical work indicates that Nigerian public hospitals institutionalizing EOQ principles have achieved up to a 20% reduction in carrying costs, while JIT-inspired adaptations have shortened lead times and reduced expired stock in select federal medical centers (Ibrahim et al., 2025; Eze & Okonkwo, 2024).

The University of Abuja Teaching Hospital (UATH) in Gwagwalada serves as a pivotal tertiary healthcare provider managing a diverse, high-volume supply portfolio of pharmaceuticals, surgical consumables, and specialized equipment. Despite its strategic role and Abuja's relatively advanced logistical infrastructure, internal operational assessments highlight persistent inventory challenges at the facility. These include delayed procurement cycles, a heavy dependence on manual stock registers, recurrent expiration of low-velocity items, and reactive emergency purchases that significantly inflate operational expenditures (UATH Management Report, 2024).

Although UATH has begun integrating with the National Health Supply Chain Management Information System, the deliberate, department-wide application of structured inventory methodologies like EOQ and JIT remains inconsistent and largely under-documented.

Given the identified operational inefficiencies and the promising empirical evidence supporting structured inventory practices, a critical knowledge gap exists regarding the specific impact of these techniques within UATH. The inconsistent application of EOQ for cost-optimized ordering and JIT for demand-aligned replenishment limits the hospital's ability to fully optimize its supply chain performance. Therefore, this study aims to address this gap by examining the direct relationship between EOQ, JIT practices, and supply chain performance specifically focusing on delivery efficiency and cost reduction at UATH. Ultimately, the research seeks to generate contextually relevant, evidence-based insights for hospital leadership, health logistics practitioners, and policy stakeholders committed to strengthening public healthcare delivery in Nigeria.

Statement of the Problem

A persistent disconnect exists between globally recognized inventory frameworks, such as Just-in-Time (JIT) and Economic Order Quantity (EOQ), and their practical deployment in Nigeria's public healthcare sector. This implementation gap stems from contextual misalignment rather than a lack of awareness. Most established models assume stable infrastructure, digital procurement systems, and predictable funding conditions that rarely reflect the operational realities of Nigerian public hospitals (Adebayo & Salami, 2024; Federal Ministry of Health & Social Welfare, 2023). Consequently, supply units often default to reactive, experience-based ordering, perpetuating inefficiencies that undermine service delivery.

Empirical indicators highlight the severity of this challenge, with institutional records consistently reporting recurrent stockouts of critical supplies alongside the accumulation of near-expiry items (UATH Management Report, 2024; Okafor & Eze, 2024). Procurement cycles are frequently delayed by manual reconciliation, bureaucratic bottlenecks, and unreliable supplier lead times. These inefficiencies are widespread across public teaching hospitals in Nigeria and West Africa, where manual tracking and weak demand forecasting remain prevalent (Amoah & Darko, 2023; ECOWAS Health Directorate, 2024). This points to a systemic issue where supply chain performance remains suboptimal without structured, context-tailored inventory techniques.

The repercussions of these inefficiencies extend across multiple stakeholder groups, disrupting clinical services, burdening procurement teams with emergency sourcing, and inflating financial costs through wastage. Ultimately, patients experience compromised care quality, directly impacting the core variables of this study. Specifically, delivery efficiency the timeliness and reliability of item availability and cost reduction, achieved by minimizing procurement and holding expenses, are severely compromised when inventory decisions lack analytical grounding. This reinforces a cycle of inefficiency that strains institutional resources and erodes trust in the public healthcare system.

Despite valuable scholarly efforts, previous studies have not fully addressed this nexus within Nigeria's tertiary healthcare context, often generalizing findings from high-resource settings or failing to empirically test JIT and EOQ under local constraints (Gupta & Sharma, 2024; Ibrahim et al., 2025). Furthermore, limited research evaluates technique performance across a single hospital's diverse departments, where demand patterns and risks vary significantly. To bridge this gap, this study focuses on the University of Abuja Teaching Hospital (UATH), Gwagwalada, to generate context-specific evidence on how structured JIT and EOQ application correlates with measurable supply chain improvements, providing actionable insights for optimizing inventory in resource-constrained settings.

Research Questions

- i. To what extent does the application of the Just-in-Time (JIT) influence delivery efficiency at the University of Abuja Teaching Hospital, Gwagwalada?
- ii. How does the implementation of the Economic Order Quantity (EOQ) model affect cost reduction of the University of Abuja Teaching Hospital, Gwagwalada?

Objective of the Study

The main objective of this study is to examine the influence of selected inventory management techniques on supply chain performance at the University of Abuja Teaching Hospital, Gwagwalada,

- i. To assess the extent to which the application of the Just-in-Time (JIT) influences delivery efficiency at the University of Abuja Teaching Hospital, Gwagwalada.
- ii. To evaluate the effect of implementing the Economic Order Quantity (EOQ) model on cost reduction at the of the University of Abuja Teaching Hospital, Gwagwalada.

Research Hypotheses

H₀₁: The application of the Just-in-Time (JIT) inventory technique has no significant influence on delivery efficiency in the supply chain operations of the University of Abuja Teaching Hospital, Gwagwalada.

H₀₂: The implementation of the Economic Order Quantity (EOQ) model has no significant effect on cost reduction at the of the University of Abuja Teaching Hospital, Gwagwalada.

II. LITERATURE REVIEW

Conceptual Framework

Inventory Management Techniques

Inventory management techniques encompass the structured approaches organizations employ to plan, monitor, and regulate stock levels to support operational continuity while optimizing resource utilization (Ahiapka & Mensah, 2023). These techniques enable institutions to maintain sufficient stock availability without incurring excessive holding costs, product obsolescence, or supply disruptions. In healthcare settings, effective inventory management is particularly critical because it directly affects the availability of pharmaceuticals, surgical consumables, diagnostic reagents, and medical equipment essential for patient care (Okafor & Eze, 2024). Scholars affirm that well-designed inventory systems contribute to enhanced organizational productivity, service reliability, and financial sustainability by aligning procurement activities with actual consumption patterns (Nwankwo & Okeke, 2025).

Contemporary organizations deploy diverse inventory management frameworks, including Just-in-Time (JIT), Economic Order Quantity (EOQ), ABC classification, Material Requirements Planning (MRP), and Vendor Managed Inventory (VMI), to strengthen inventory control and supply chain responsiveness (Bello & Yusuf, 2024). These approaches help institutions reconcile the dual objectives of ensuring product availability and minimizing inventory-related expenditures. Within healthcare systems, structured inventory techniques play a strategic role in reducing stockouts of essential medicines, curbing emergency procurement, and improving service delivery outcomes (Eze & Okonkwo, 2024). Empirical evidence indicates that healthcare institutions with robust inventory management systems demonstrate superior delivery performance, lower operational costs, and stronger coordination across supply chain functions (Christopher, 2022).

Consequently, inventory management techniques are increasingly viewed as strategic enablers of organizational competitiveness and sustainable supply chain performance in resource-constrained environments.

Just-in-Time (JIT) Technique

The Just-in-Time (JIT) inventory technique emphasizes acquiring or producing materials only when they are needed for immediate use in service delivery or operational processes (Slack & Brandon-Jones, 2022). Originating from the Toyota Production System in Japan, JIT was designed to eliminate waste, reduce inventory holding costs, and enhance operational efficiency through precise synchronization of procurement, production, and distribution activities. The approach relies on accurate demand forecasting, reliable supplier partnerships, and efficient logistics coordination to ensure materials arrive in the required quantities at the exact time of need (Ivanov & Dolgui, 2023).

Implementation of JIT offers multiple operational and financial benefits. By minimizing inventory storage requirements, organizations can reduce warehousing expenses, lower risks of product expiration or obsolescence, and improve cash flow management (Gupta & Sharma, 2024). In healthcare institutions, JIT supports timely availability of medical supplies while mitigating losses associated with expired drugs and excessive stock accumulation. However, JIT effectiveness depends on stable supplier performance, predictable transportation networks, and robust communication systems. Any disruption in supply can compromise operations because JIT systems maintain minimal buffer stock (Kumar et al., 2024). Despite these vulnerabilities, empirical studies confirm that JIT, when adapted to local constraints, significantly enhances delivery efficiency, operational flexibility, and cost control in both manufacturing and healthcare contexts (Jacobs & Chase, 2023).

Economic Order Quantity (EOQ) Technique

The Economic Order Quantity (EOQ) model is a quantitative inventory management technique used to determine the optimal order size that minimizes total inventory-related costs, including ordering, holding, and stockout expenses (Stevenson, 2021). First introduced by Ford W. Harris in 1913, EOQ remains one of the most widely applied inventory optimization frameworks in operations management due to its simplicity and practical relevance. The model assists organizations in balancing the trade-off between frequent small orders (which increase ordering costs) and infrequent large orders (which elevate holding costs) (Render et al., 2020).

Application of EOQ enables institutions to optimize inventory levels and reduce unnecessary expenditures linked to overstocking or understocking. In healthcare settings, EOQ is particularly valuable for managing pharmaceuticals, medical consumables, and laboratory supplies with relatively stable demand patterns. By identifying the most economical order quantity, hospitals can prevent stock shortages while controlling storage and procurement costs (Adeyinka et al., 2023). EOQ also strengthens purchasing efficiency and budget planning by promoting systematic, data-driven procurement decisions. Although the model assumes constant demand and fixed ordering costs, conditions that may not always hold in dynamic healthcare environments, EOQ remains a foundational tool for inventory cost minimization and supply chain coordination (Ibrahim et al., 2025). Recent adaptations of EOQ incorporate demand variability and lead time uncertainty, enhancing its applicability in resource-constrained public health systems.

Supply Chain Performance

Supply chain performance denotes the degree of effectiveness and efficiency with which an organization coordinates procurement, inventory control, logistics, and distribution activities to ensure timely delivery of goods and services to end users (Chopra & Meindl, 2022). It reflects how well an institution manages the flow of materials, information, and resources across its supply network to achieve operational objectives. In contemporary organizations, supply chain performance has gained strategic importance due to rising customer expectations, global competition, technological advancement, and increasing pressure to optimize resource utilization (Monczka et al., 2021). Effective supply chain performance enables institutions to enhance service quality, reduce operational costs, improve stakeholder satisfaction, and sustain competitive advantage.

Within healthcare institutions, supply chain performance is critically important because it directly influences the availability of medicines, medical devices, surgical equipment, and consumables required for patient treatment. Poor supply chain performance in hospitals can result in delayed care, stockouts of essential items, inflated procurement costs, and compromised patient outcomes (Okafor & Eze, 2024). Consequently, healthcare administrators increasingly prioritize efficient inventory management, strategic procurement planning, and integrated logistics coordination to strengthen service delivery.

Research demonstrates that healthcare institutions with efficient supply chain systems achieve improved delivery reliability, reduced wastage, lower operational expenditures, and higher patient satisfaction (Eze & Okonkwo, 2024). Supply chain performance is typically assessed through indicators such as responsiveness, delivery accuracy, inventory turnover, cost efficiency, and service reliability.

Delivery Efficiency

Delivery efficiency refers to an organization's capacity to ensure the timely, accurate, and reliable movement of goods and services from suppliers to end users with minimal delays or disruptions (Christopher, 2022). It measures how effectively materials and products are delivered according to required schedules, quantities, and quality standards. Delivery efficiency is a vital dimension of supply chain performance because delayed or inaccurate deliveries can impair operational continuity, diminish service quality, and reduce stakeholder trust. In healthcare institutions, delivery efficiency is especially critical because delays in supplying drugs, medical consumables, or emergency equipment can jeopardize patient care and increase clinical risks (Nwankwo & Okeke, 2025).

Several factors influence delivery efficiency, including supplier reliability, transportation infrastructure, inventory availability, communication technology, and procurement planning. Organizations that implement structured inventory management systems are better positioned to enhance delivery speed and minimize supply disruptions. Techniques such as JIT and EOQ contribute to delivery efficiency by ensuring appropriate inventory replenishment and reducing stock shortages (Bello & Yusuf, 2024). In healthcare environments, delivery efficiency supports uninterrupted clinical operations and improves treatment outcomes. Empirical studies confirm that institutions with efficient delivery systems experience reduced lead times, higher operational productivity, and increased user satisfaction (Heizer et al., 2020). Therefore, delivery efficiency remains a fundamental indicator of effective supply chain performance in public healthcare settings.

Cost Reduction

Cost reduction denotes the systematic effort to minimize operational expenditures while maintaining or enhancing the quality and effectiveness of organizational activities (Chopra & Meindl, 2022). Within supply chain management, cost reduction involves lowering procurement expenses, inventory holding costs, transportation charges, warehousing fees, and administrative overhead associated with the movement and storage of goods and services.

Achieving cost reduction has become a strategic priority for organizations because rising operational expenses can significantly affect financial sustainability and service delivery capacity. Effective inventory management techniques contribute substantially to cost reduction by minimizing excess inventory, reducing waste, preventing product obsolescence, and improving procurement efficiency (Stevenson, 2021).

In healthcare institutions, cost reduction is essential because hospitals operate under increasing financial pressure resulting from rising healthcare demands, expensive medical technologies, and constrained budgetary allocations. Efficient inventory management helps healthcare institutions control pharmaceutical expenditure, reduce emergency procurement costs, and minimize losses from expired medical supplies (Adebayo & Salami, 2024). Techniques such as EOQ support cost reduction by identifying optimal purchasing quantities that lower ordering and holding costs, while JIT reduces warehousing and inventory maintenance expenses (Ibrahim et al., 2025). However, cost reduction initiatives must be carefully managed to avoid compromising service quality or patient care standards. Empirical evidence indicates that healthcare organizations with robust inventory control systems often achieve improved financial performance, better resource utilization, and enhanced operational efficiency (Render et al., 2020). Consequently, cost reduction remains a critical objective of supply chain optimization in public healthcare institutions.

Theoretical Framework

This study is anchored in Lean Theory, a foundational operational excellence perspective that emerged from the Toyota Production System and was subsequently articulated in global management scholarship by Womack and Jones (2020). Lean Theory posits that sustainable organizational effectiveness in resource-constrained settings depends not on the sheer quantity of available inputs, but on an institution's capacity to cultivate strategic operational capabilities that systematically eliminate non-value-adding activities while enhancing value delivery to end users. Central to this theoretical perspective are five interdependent principles: defining value through the customer lens, mapping and streamlining the value stream, establishing uninterrupted process flow, implementing pull-based systems driven by actual demand, and pursuing continuous improvement through iterative learning (kaizen). Together, these principles enable organizations to lower operational costs, strengthen service responsiveness, and improve quality outcomes through disciplined process optimization and waste reduction (Slack & Brandon-Jones, 2022).

Notwithstanding its broad adoption across sectors, Lean Theory has faced scholarly critique concerning the contextual translation of lean practices and the empirical measurement of their performance effects, especially in emerging economy settings where infrastructural gaps, supply chain volatility, and institutional inconsistencies pose implementation challenges (Adegbite, Ogunlana, & Nkengfack, 2021; Kumar, Singh, & Patel, 2024). Nevertheless, the theory's core emphasis on integrating waste elimination and demand-aligned coordination into everyday operational processes renders it particularly appropriate for investigating inventory management practices within resource-intensive public healthcare institutions. In this study, the Just-in-Time (JIT) technique is conceptualized as a demand-responsive inventory capability that curtails excess stock accumulation and minimizes holding-related expenditures, while the Economic Order Quantity (EOQ) model is framed as a quantitative decision-support capability that optimizes order sizing to balance procurement and storage costs. These structured inventory approaches constitute the operational microfoundations of lean capability, fostering enhancements in delivery timeliness, supply reliability, and procurement cost efficiency, which collectively shape supply chain performance outcomes at the University of Abuja Teaching Hospital, Gwagwalada, Abuja.

Empirical Review

Tsioumas et al (2026) aimed to quantify the economic impact of just-in-time (JIT) systems on freight rates, specifically examining how lower average sailing speeds and reduced port waiting times influenced ship operators' expected earnings. Their study employed a Random Forest model, using the Capesize freight rate on a key route as the dependent variable, while independent variables included the average sailing speed and the Port Congestion Index, alongside control variables for supply and demand factors. The findings indicated that freight rates could be reduced by up to 11%, revealing a threshold effect from JIT implementation. However, a gap remained in that their study focused narrowly on Capesize vessels and a specific route, leaving unanswered questions about how JIT's impact on freight rates might vary across different vessel sizes, shipping segments, or geographical contexts.

Biswas and Sarker (2020) sought to develop optimal operational planning strategies for supply chains involving a production and distribution centre with JIT delivery, particularly addressing scenarios where leftover finished goods inventory remained after shipments.

They formulated a mixed-integer nonlinear programming model for a semi-continuous manufacturing facility producing multiple products, assuming rotational cycles and imperfect matching conditions. The study found optimal numbers of orders and shipments, rotational cycle policies, and minimum total system costs for facilities following JIT delivery. Nevertheless, the research contained a significant gap, as it explicitly omitted transportation costs from the model and adopted only the manufacturer's perspective, thereby failing to account for the broader supply chain dynamics involving suppliers and retailers jointly.

Chukwuemeka and Uzoamaka (2021) investigated the relationship between JIT delivery practice and customer satisfaction specifically within brewing plants in South East, Nigeria. Their methodology was not detailed in the available abstract, but the study appeared to employ a survey or correlational design. The findings were not reported in the abstract, leaving the empirical outcomes unclear. A notable gap existed in that the study provided no measurable results or statistical evidence, making it difficult to draw concrete conclusions about the JIT-customer satisfaction link in that industry or region.

García-Cutrín and Rodríguez-García (2024) examined the correlation between JIT practices and financial performance outcomes, with the objective of enhancing corporate sustainability through a meta-analytic lens. They applied a meta-analytical approach to assess JIT's influence on Return on Investment (ROI), Return on Sales (ROS), Asset Turnover, and profit margins across multiple studies. The results demonstrated a robust positive correlation between JIT implementation and enhanced financial outcomes, with larger firms and stable economic conditions experiencing the most pronounced benefits. However, the study's gap lay in its finding that smaller firms faced challenges in harnessing JIT's full financial potential, yet the meta-analysis did not offer tailored implementation strategies or detailed mechanisms to overcome these size-related constraints, nor did it empirically test JIT's direct contributions to broader sustainability initiatives beyond financial metrics.

Khanna et al (2023) conducted a review presentation aimed at providing a thorough overview of different Economic Order Quantity (EOQ) models and their real-world applications across various industries. Their methodology involved a literature-based review that explored the fundamental EOQ model and extended it to incorporate models accounting for perishable items, quantity discounts, and scarcity prices. The findings indicated that businesses could optimize order amounts, reduce costs, and improve operational efficiency by understanding and applying these diverse EOQ models.

However, a notable gap in their study was that it remained purely a review presentation without empirical testing or case study validation, meaning it did not offer quantitative evidence of how specific EOQ models perform under real-time dynamic demand or supply chain disruptions.

Imarah and Jaelani (2020) sought to test the effectiveness of implementing several inventory control methods specifically ABC analysis, forecasting, and EOQ to improve the smooth operation process in a trading company of industrial equipment components that faced inventory data inaccuracy, shortages, and excess unwanted stock. Their methodology used quantitative methods, with data sourced from ERP and manual reports between 2016 and 2018, employing purposive sampling of 2,498 SKUs, followed by ABC and FSN analysis to select 10 SKUs in category A and Fast Moving group. The findings revealed that ABC analysis effectively reduced the workload of periodic counting and improved data accuracy, exponential smoothing forecasting showed the least gap to actual values, and EOQ effectively optimized ordering and holding costs while reducing the risk of inventory control failure. Nevertheless, a gap persisted in that their study focused on only one trading company and a limited sample of 10 SKUs, which restricted the generalizability of the findings to other industries, geographical regions, or larger-scale manufacturing firms.

Rabta (2020) aimed to develop an EOQ inventory model for a product incorporating a circular economy indicator, assuming that products could be manufactured with a variable level of circularity that influenced demand, cost, and selling price. The methodology involved an analytical modeling approach where both order quantity and circularity level were treated as decision variables, with linear and nonlinear relationships proposed and numerical examples provided. The findings demonstrated from a company's perspective that making circular products could be justified financially under certain parameter conditions. However, a clear gap existed in that the study remained theoretical and numerical without empirical validation using real-world data from companies implementing circular economy practices, nor did it address how external factors such as government regulations, taxes, or subsidies might dynamically alter the optimal decisions over time.

Siraj et al (2024) conducted a comprehensive analysis aimed at optimizing inventory management by leveraging inventory data to determine optimal lot sizes, safety stock, maximum inventory levels, and reorder quantities aligned with a firm's capacity. Their methodology involved the application of EOQ models across multiple sectors, providing a simplified format to understand inventory system dynamics for retailers and distribution centers.

The findings indicated that EOQ models offered a straightforward calculation of the most cost-effective order quantity, thereby minimizing overall expenses and avoiding overtime costs, production fluctuations, unnecessary subcontracting, and delayed purchase penalties. Despite these contributions, a significant gap remained in that their study did not present primary empirical data or case-specific results from a real firm; rather, it offered a general analysis without testing the proposed strategies against varying demand patterns, lead time uncertainties, or multi-echelon inventory systems, thus limiting actionable insights for practitioners facing complex operational environments.

III. METHODOLOGY

The study adopted a cross sectional survey research design. This design was considered appropriate because it enabled the researcher to collect data from respondents at a single point in time in order to examine the relationship between inventory management techniques and supply chain performance. The cross-sectional design was justified on the basis that it allowed the researcher to capture real-time perceptions of employees without manipulating any of the study variables, thereby reflecting actual operational conditions within the University of Abuja Teaching Hospital, Gwagwalada, Abuja. It also supported the generation of quantitative data suitable for statistical analysis and hypothesis testing.

The population of the study comprised all employees of the University of Abuja Teaching Hospital, Gwagwalada, Abuja. However, the accessible population was 1,127 employees of the hospital. The unit of analysis for the study was the individual employee of the University of Abuja Teaching Hospital. This was considered appropriate because employees were directly involved in inventory handling, procurement, pharmacy operations, and supply chain processes, and therefore possessed relevant and reliable information required to assess inventory management techniques and supply chain performance in the hospital context.

The sample size for the study was determined using the Yamane (1967) statistical formula, which is expressed as:

$$n = \frac{N}{1 + N(e)^2}$$

Where:

n = required sample size

N = accessible population size (1127)

e = margin of error at 95% confidence level (0.05)

Substituting the values: $n = 1,127 / (1 + 1,127(0.05)^2) = 1,127 / (1 + 2.8175) = 1,127 / 3.8175 = 295.22$

The sample size obtained is 295 respondents. However, to account for possible non-response, incomplete questionnaires, and attrition, a 10% margin of safety was added. The Number of questionnaire to be distributed was calculated as follows:

$$10\% \text{ of } 295 = 29.5 \approx 30$$

$$\text{Number of questionnaire to be distributed} = 295 + 30 = 325$$

Thus, the Number of questionnaire to be distributed for the study is 325 respondents. The use of a 10% adjustment was justified because it enhanced the reliability of the study findings by ensuring that even if some questionnaires were not returned or were improperly filled, the minimum required sample size for valid statistical analysis would still be achieved.

The study employed both convenience and purposive sampling techniques. Convenience sampling was used to select respondents who were readily available and willing to participate in the study due to time and operational constraints within the hospital environment. Purposive sampling was also adopted to ensure that only employees directly involved in inventory control, procurement, pharmacy, stores, and supply chain-related functions were included. This approach was justified because it ensured that respondents had relevant knowledge of inventory management practices and could provide accurate and informed responses.

The study relied on primary data, which were obtained directly from respondents. Data were collected using a structured questionnaire designed to measure inventory management techniques and supply chain performance. The questionnaire was considered appropriate because it allowed for standardized responses, ease of administration, and effective coding for statistical analysis.

Reliability of the research instrument was tested using Cronbach's Alpha coefficient, which measured the internal consistency of the constructs. The reliability results indicated acceptable levels of consistency as follows: Inventory Management Techniques ($\alpha = 0.87$), Just-in-Time ($\alpha = 0.84$), Economic Order Quantity ($\alpha = 0.81$), Supply Chain Performance ($\alpha = 0.86$), Delivery Efficiency ($\alpha = 0.83$), and Cost Reduction ($\alpha = 0.85$). All values exceeded the recommended threshold of 0.70, confirming that the instrument was reliable. Validity of the instrument was established using content validity, where the questionnaire items were developed based on extensive literature review and were further assessed by experts in supply chain management and research methodology to ensure clarity, relevance, and adequacy.

Data collected were analyzed using multiple regression analysis with the aid of Statistical Package for Social Sciences (SPSS version 27). This technique was used to determine the extent to which inventory management techniques (Just-in-Time and Economic Order Quantity) influenced supply chain performance (delivery efficiency and cost reduction).

Multiple regression was considered appropriate because it allowed for the simultaneous estimation of the predictive effects of multiple independent variables on the dependent variable, thereby providing a comprehensive understanding of the relationships among the study variables.

IV. RESULTS AND DISCUSSION

Table 4.1 Response Rate

Category	Frequency	Percentage (%)
Questionnaires Distributed	325	100
Questionnaires Returned	297	91.4
Questionnaires Not Returned	28	8.6
Valid Questionnaires for Analysis	297	91.4
Total	325	100

Source: Field Survey, 2026

A total of 325 questionnaires were distributed to respondents representing 100% of the study sample. Out of these, 297 questionnaires were successfully returned, representing a response rate of 91.4%, while 28 questionnaires were not returned, accounting for 8.6% of the total distributed. The high return rate indicates strong participant engagement and suggests that the data collected is adequate and reliable for analysis. Furthermore, all 297 returned questionnaires were found to be valid and suitable for analysis, representing 91.4% of the total distributed instruments. This implies that the study achieved a robust response level, as the valid responses significantly exceeded the minimum threshold generally considered acceptable for

statistical analysis in survey research, thereby enhancing the credibility and generalizability of the findings.

Diagnostic Tests for multicollinearity (Variance Inflation Factor < 5), normality (skewness and kurtosis within ± 2), and homoscedasticity (residual plots) were performed to ensure model assumptions are met (Hair et al., 2023).

V. TEST OF HYPOTHESES

Test of hypotheses one

H₀₁: The application of the Just-in-Time (JIT) has no significant influence on delivery efficiency at of the University of Abuja Teaching Hospital, Gwagwalada.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.587 ^a	.345	.343	.48327

a. Predictors: (Constant), JIT

Source SPSS Version 27

A total of 325 questionnaires were distributed to respondents representing 100% of the study sample. Out of these, 297 questionnaires were successfully returned, representing a response rate of 91.4%, while 28 questionnaires were not returned, accounting for 8.6% of the total distributed. The high return rate indicates strong participant engagement and suggests that the data collected is adequate and reliable for analysis.

Furthermore, all 297 returned questionnaires were found to be valid and suitable for analysis, representing 91.4% of the total distributed instruments.

This implies that the study achieved a robust response level, as the valid responses significantly exceeded the minimum threshold generally considered acceptable for statistical analysis in survey research, thereby enhancing the credibility and generalizability of the findings.

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	36.262	1	36.262	155.264	.000 ^b
	Residual	68.898	295	.234		
	Total	105.160	296			

a. Dependent Variable: DE

b. Predictors: (Constant), JIT

Source SPSS Version 27

The ANOVA result indicated that the regression model examining the effect of Just-in-Time (JIT) on Delivery Efficiency (DE) was statistically significant. This was evidenced by the F-statistic value of 155.264 with a significance level of 0.000, which was less than the acceptable threshold of 0.05. The result implied that Just-in-Time inventory management technique significantly predicted delivery efficiency at the University of Abuja Teaching Hospital, Gwagwalada Abuja.

The regression sum of squares of 36.262 compared to the residual sum of squares of 68.898 further showed that a substantial proportion of the variation in delivery efficiency was explained by JIT. Therefore, the model was considered fit and appropriate for explaining the relationship between Just-in-Time technique and delivery efficiency in the study area.

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.673	.189		8.859	.000
	JIT	.598	.048	.587	12.460	.000

a. Dependent Variable: DE

Source SPSS Version 27

The coefficient result showed that Just-in-Time (JIT) had a positive and significant effect on Delivery Efficiency (DE) at the University of Abuja Teaching Hospital, Gwagwalada Abuja. The unstandardized coefficient for JIT ($B = 0.598$) indicated that a one-unit increase in Just-in-Time practices would lead to a corresponding increase of 0.598 units in delivery efficiency. The standardized beta coefficient ($\beta = 0.587$) further revealed a moderate positive relationship between JIT and delivery efficiency. The t-value of 12.460 with a significance level of 0.000, which was less than 0.05, confirmed that the effect of JIT on delivery efficiency was statistically significant.

Additionally, the constant value of 1.673 implied that when JIT was held constant at zero, delivery efficiency would still maintain a baseline value of 1.673. Overall, the findings suggested that effective implementation of Just-in-Time inventory management technique significantly enhanced delivery efficiency within the hospital's supply chain operations.

Test of hypotheses two

H_{02} : The implementation of the Economic Order Quantity (EOQ) model has no significant effect on cost reduction at the of the University of Abuja Teaching Hospital, Gwagwalada.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.778 ^a	.605	.604	.33397

a. Predictors: (Constant), EOQ

Source SPSS Version 27

The model summary result revealed that Economic Order Quantity (EOQ) had a strong positive relationship with the dependent variable, as indicated by the correlation coefficient ($R = 0.778$). The coefficient of determination ($R^2 = 0.605$) showed that EOQ explained approximately 60.5% of the variation in supply chain performance within the University of Abuja Teaching Hospital, Gwagwalada Abuja, while the remaining 39.5% was influenced by other factors not captured in the model.

The adjusted R Square value of 0.604 further confirmed the robustness and explanatory strength of the model after adjusting for possible sampling error. In addition, the standard error of the estimate (0.33397) indicated a relatively low level of prediction error, suggesting that the regression model provided a good fit for explaining the effect of Economic Order Quantity on supply chain performance in the study area.

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	50.448	1	50.448	452.298	.000 ^b
	Residual	32.903	295	.112		
	Total	83.351	296			

a. Dependent Variable: CR

b. Predictors: (Constant), EOQ

Source SPSS Version 27

The ANOVA result showed that the regression model examining the effect of Economic Order Quantity (EOQ) on Cost Reduction (CR) was statistically significant. This was evidenced by the F-statistic value of 452.298 with a significance level of 0.000, which was lower than the acceptable threshold of 0.05. The result indicated that EOQ significantly predicted cost reduction at the University of Abuja Teaching Hospital, Gwagwalada Abuja.

Furthermore, the regression sum of squares value of 50.448 compared to the residual sum of squares of 32.903 demonstrated that a substantial proportion of the variation in cost reduction was explained by EOQ. Therefore, the model was considered suitable and fit for explaining the relationship between Economic Order Quantity and cost reduction within the hospital's supply chain operations.

Coefficients^a

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.248	.131		9.522	.000
	EOQ	.691	.032	.778	21.267	.000

a. Dependent Variable: CR

Source SPSS Version 27

The coefficient result indicated that Economic Order Quantity (EOQ) had a positive and significant effect on Cost Reduction (CR) at the University of Abuja Teaching Hospital, Gwagwalada Abuja. The unstandardized coefficient ($B = 0.691$) implied that a one-unit increase in EOQ practices would lead to a corresponding increase of 0.691 units in cost reduction. The standardized beta value ($\beta = 0.778$) further showed a strong positive relationship between EOQ and cost reduction. The t-value of 21.267 with a significance level of 0.000 ($p < 0.05$) confirmed that the effect of EOQ on cost reduction was statistically significant. The constant value of 1.248 suggested that when EOQ was held constant, cost reduction would still exist at a baseline level of 1.248. Overall, the result demonstrated that effective implementation of Economic Order Quantity significantly enhanced cost reduction in the hospital's supply chain system.

VI. DISCUSSION OF FINDINGS

The study revealed that the Just-in-Time (JIT) technique significantly improved delivery efficiency, while the Economic Order Quantity (EOQ) model substantially reduced costs in the University of Abuja Teaching Hospital's supply chain. These findings align with prior research on JIT's operational benefits (García-Cutrín & Rodríguez-García, 2024; Tsioumas et al., 2026) and EOQ's cost-saving potential (Imarah & Jaelani, 2020; Khanna et al., 2023).

However, unlike earlier studies focused on manufacturing or theoretical reviews, this research extends empirical evidence to a Nigerian public healthcare setting. By utilizing primary, multi-departmental data, it demonstrated that synchronizing procurement with clinical consumption reduces lead times and stockouts, while structured order-sizing minimizes procurement and expiration expenses under real-world budgetary constraints. This addresses existing methodological gaps (Biswas & Sarker, 2020; Chukwuemeka & Uzoamaka, 2021; Rabta, 2020; Siraj et al., 2024) by providing statistically significant, context-specific quantitative results.

These findings carry critical managerial implications for applying Lean Theory in emerging economy healthcare institutions. Hospital administrators are advised to transition from reactive procurement to demand-driven, data-informed decision-making by integrating real-time stock monitoring and staff capacity building. Developing a process-oriented culture is essential, requiring managers to foster cross-functional collaboration, improve stock visibility, and strategically allocate limited resources toward basic digital tracking and context-appropriate buffer strategies. Because Nigerian public hospitals operate with manual processes, transportation unreliability, and fragmented governance unlike the automated systems in developed economies combining analytical inventory rigor with adaptive operational practices is vital for achieving sustainable improvements in both delivery efficiency and cost reduction.

In conclusion, by addressing empirical gaps and providing context-specific evidence, this study offers actionable insights for optimizing inventory management in resource-constrained public healthcare settings. The significant positive effects of JIT on delivery efficiency and EOQ on cost reduction validate the applicability of Lean Theory to healthcare supply chains in emerging economies. These results support the broader adoption of structured inventory frameworks across Nigeria's Federal Capital Territory. Furthermore, the study lays a foundation for future research, recommending the use of longitudinal designs, triangulated data sources, and expanded performance metrics to further strengthen evidence-based management practices in public healthcare delivery..

VII. CONCLUSION AND RECOMMENDATION

This study examined the impact of Just-in-Time (JIT) and Economic Order Quantity (EOQ) on supply chain performance at the University of Abuja Teaching Hospital. The findings confirm that JIT significantly enhances delivery efficiency by minimizing lead times and preventing stockouts, while EOQ drives substantial cost reductions by optimizing order sizes and reducing expiration losses. Ultimately, embedding these structured, data-driven inventory techniques is highly strategic for improving service reliability and fiscal discipline in resource-constrained public healthcare settings within Nigeria's Federal Capital Territory.

Beyond managerial benefits, the findings highlight critical policy implications for Nigeria's public healthcare sector. Policymakers must strengthen national health infrastructure by expanding digital inventory tracking and upgrading warehousing facilities to support effective inventory optimization. Additionally, fostering public-private partnerships among the Federal Ministry of Health, hospital administrators, and technology providers is essential to establish standardized procurement protocols, build staff capacity, and develop sector-wide performance benchmarks for a more resilient healthcare system.

Based on the findings of this study, the following recommendations are made:

- i. The University of Abuja Teaching Hospital, Gwagwalada, Abuja should formalize the adoption of structured inventory control frameworks by embedding demand-aligned procurement processes, vetted supplier partnership arrangements, and live inventory visibility platforms within a unified supply chain oversight mechanism.

This approach will enable timely, data-informed decisions on stock optimization strategies and enhance the hospital's capacity to respond effectively to clinical consumption trends and stakeholder demands for service consistency and financial transparency.

- ii. The hospital should prioritize investment in inventory enablement tools, including EOQ-integrated procurement modules, digital consumption tracking systems for key medical categories, and automated reorder notification features, to consistently achieve procurement cost savings, improve order fulfillment reliability, and build supply chain adaptability within Nigeria's fiscally constrained and infrastructurally challenged public healthcare sector.

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