

Nearshoring and Cold Chain Logistics of Pharmaceutical Firms in Lagos State, Nigeria

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Abstract

The “logistics system for pharmaceutical products is entirely different from conventional and traditional logistics system for other products because these pharmaceutical products require sensitive temperature and conditions. This study examined the relationship between nearshoring and cold chain logistics of pharmaceutical firms in Lagos, Nigeria. The study adopted a cross sectional research design. The population of the study comprises sixty respondents drawn from twenty pharmaceutical firms in Lagos, Nigeria. Sixty questionnaires were distributed, however fifty-three were returned but fifty satisfied our requirements to be used and was used for the analysis. We used tables, percentages, Spearman’s Rank Order Correlation Coefficients with the aid of Statistical Package for Social Science, 23 for data presentation, analysis and hypotheses testing. The results of the hypotheses tests for 1, 2 and 3 on tables 3-5 as it is exemplified in the correlation co-efficient of 0.709, 0.680 and 0.726 respectively indicated a strong and significant relationship between nearshoring and cold chain logistics of pharmaceutical firms in Lagos”, Nigeria. This explains that, nearshoring plays a pivotal role in ensuring availability of sensitive pharmaceutical products to support vibrant health system and availability of pharmaceutical products. The study, therefore, recommend that, Pharmaceutical firms in Lagos should invest in localized cold chain infrastructure and technology to enhance logistics of sensitive pharmaceutical products from manufacturing location to distribution centres in Lagos and other locations in Nigeria

Keywords: *Nearshoring, Cold logistics chain, Temperature-controlled transportation, Temperature-mapping control and Cold storage*

Introduction

Globally, health service delivery takes a critical position in all disposition of governments. Olutuase et al. (2022) “explained that, one of the major targets of the United Nations’ third

Sustainable Development Goals (SDG), is to ensure access to safe, effective, quality, and affordable essential medicines and vaccines for all (UNSDG, 2016). This target is critical to achieving universal healthcare coverage just as effective health product supply chains are indispensable in ensuring access to quality medicines and vaccines (Chukwu et al., 2018). Health product supply chains assure consistent availability of high-quality medicines, vaccines and health products at health service delivery points in the most cost-effective and timely manner (Aigbavboa & Mbohwa, 2020). A functional health product supply chain system is indeed the backbone of quality healthcare services (Amadi & Tsui, 2018; Ogbonna, 2016). Nigeria is one of the major consumers of pharmaceutical products globally due to her large population and prevalent of diseases and illness. These pharmaceutical products are mainly produced in India, China and South Africa and transported to Nigeria. The logistics system for pharmaceutical products is entirely different from conventional and traditional logistics system for other products because these pharmaceutical products require sensitive temperature and conditions. Wang (2016) opined that the logistics and transport process for some sensitive products need to be well preserved, sometimes need cold chain, which requires a good refrigerated transport and cold chain transportation technology functions. WHO (2015) explained that cold chain logistics represents a critical component of pharmaceutical supply chain management? Yanxi Pan (2024) and Wang, et al. (2024) cold chain logistics as a coordinated system of facilities, equipment, processes and information and transportation activities used to maintain specified temperature conditions for temperature-sensitive products throughout their movement from manufacturer to end user. WHO (2015) argued that, the commonly encountered pharmaceutical cold-chain range is 2°C–8°C, however, pharmaceutical products may have different requirements, including controlled room temperature, refrigerated, frozen and ultra-low-temperature conditions?

WHO guidance, for example, identifies cold-chain requirements of +2°C to +8°C and controlled-room-temperature conditions of approximately +15°C to +25°C for relevant products (WHO, 2015) while The American Society of Health-System Pharmacists similarly notes that pharmaceutical cold-chain management can extend from conventional refrigerated conditions to ultra-low and cryogenic temperatures, depending on the product concerned (ASHP, 2023). The need for research on cold chain logistics arises from the sensitivity of pharmaceutical products to temperature expeditions because for example, excessive heat, freezing, inappropriate humidity or prolonged exposure outside the manufacturer's specified ecosystem range may reduce the product potency, stability, activeness and functionality (WHO, 2015; ASHP, 2023). NAFDAC (2021) states that cold-chain products must be maintained in controlled environments throughout manufacture, storage and distribution and that exposure to heat, freezing or inappropriate environmental conditions can compromise product effectiveness and potency. Research on pharmaceutical supply-chain configuration shows that firms consider nearshore and offshore arrangements when attempting to manage quality problems, manufacturing interruptions, delivery delays and mismatches between demand and supplier responsiveness (Schiele et al., 2016).

Nearshoring can shorten supply routes, facilitate communication, improve responsiveness and reduce exposure to long-distance transportation disruptions. However, Afolabi (2020) argued that, a study of pharmaceutical outbound value chains in Nigeria identified people and competency issues as well as infrastructural and regulatory inadequacies as major challenges affecting medicine delivery. Abubakar (2021) identified poor storage infrastructure, transportation challenges, financial constraints, storage infrastructure, inadequate human resource, unstable electricity supplies and difficulties maintaining appropriate vaccine temperatures during

transportation and weak policy implementation among the challenges confronting medicines and vaccines supply chains in Nigeria. These problems demonstrate the need for strategies that improve both the location of supply-chain activities and the quality of logistics operations. These challenges are particularly important for temperature-sensitive pharmaceutical products because interruptions in temperature control can compromise product integrity. Drawing from the key points outlined above, this study examined the relationship between nearshoring and logistics of pharmaceutical firms in Lagos state”, Nigeria

The specific objectives of this study are:

1. To examine the relationship between nearshoring and temperature-mapping control of pharmaceutical firms in Lagos, Nigeria
2. To determine the relationship between nearshoring and temperature-controlled transportation of pharmaceutical firms in Lagos, Nigeria
3. To investigate the relationship between nearshoring and cold storage of pharmaceutical firms in Lagos, Nigeria

The research questions are as follows:

- i. What is the relationship between nearshoring and temperature-mapping control of pharmaceutical firms in Lagos, Nigeria?
- ii. What is the relationship between nearshoring and temperature-controlled transportation of pharmaceutical firms in Lagos, Nigeria?
- iii. What is the relationship between nearshoring and cold storage of pharmaceutical firms in Lagos, Nigeria?

Review of Related Literature

Theoretical Foundation

Transaction Cost Theory

This theory was “propounded by Williamson in (1985) and it explains how organisations select governance and sourcing arrangements in ways that minimise the costs associated with transactions. These costs include searching for suppliers, negotiating and monitoring contracts, coordinating activities, managing uncertainty, enforcing agreements, and dealing with disruptions. Williamson (1985) argued that, when uncertainty and transaction-related risks increase, firms may change the structure and location of their activities to achieve greater control and reduce transaction costs. Nearshoring involves moving sourcing, manufacturing, distribution, or related supply-chain activities from distant foreign locations to geographically closer locations. Location-specific factors, process characteristics and firm-specific considerations jointly influence decisions concerning where supply-chain activities should be undertaken (Fratocchi et al., 2021). Similarly, research focusing specifically on pharmaceutical supply chains found that disturbances such as quality defects, unexpected manufacturing interruptions, order-processing difficulties, untimely delivery and mismatches between demand and supplier responsiveness influence pharmaceutical supply-chain configuration, including the choice of nearshore arrangements (Revilla & Saenz, 2017; Abubakar, 2021)). The theory has direct implications for this study. It suggests that pharmaceutical firms in Lagos may adopt nearshoring as a mechanism for reducing uncertainty and transaction costs associated with distant supply sources. Such reduced uncertainty can support more effective temperature mapping, temperature-controlled transportation and cold storage

because firms may have greater opportunities to coordinate logistics activities, monitor suppliers and respond quickly to deviations. This theoretical argument is consistent with supply-chain resilience research, which emphasises the importance of reducing vulnerability and improving the ability of supply chains to prepare for, respond to and recover from disruptions (Christopher & Peck, 2004; Ponomarov & Holcomb, 2009).

Conceptual Review

Nearshoring

NASEM (2022) refers to nearshoring as the supply-chain configuration strategy in which an organisation moves selected sourcing, production, distribution or service activities from distant foreign locations to geographically proximate countries. It is conceptually different from reshoring because reshoring involves returning activities to the firm's home country, whereas nearshoring involves moving them to a nearby foreign location. Within the pharmaceutical sector, nearshoring is particularly relevant because medicines often have strict quality requirements and supply interruptions can have serious consequences. Pharmaceutical supply-chain research has identified nearshore configurations as an alternative to both traditional offshore outsourcing and fully internalised production (Schiele et al., 2016). Nearshoring can provide shorter transportation routes, faster replenishment, closer supplier relationships and greater visibility across the supply network. The main argument of nearshoring is that, it enhances shorter and more geographically concentrated supply networks that improve responsiveness and reduce some forms of disruption risk for sensitive pharmaceutical products. For example, there has been war between Iran and US/Israel in the Middle East which has led to the closure of the street of hormuz. The closure has negatively disrupted some major supply activities across the globe. This experience has reemphasized the importance of geographical proximity in pharmaceutical product manufacturing.

Geographical Proximity: Geographical proximity refers to the physical closeness between a pharmaceutical firm and its suppliers, manufacturing partners, logistics providers or other supply-chain partners. It is one of the most fundamental characteristics of nearshoring because the concept distinguishes relatively nearby international sourcing from distant offshoring. Ghemawat (2001) explains that geographical distance involves physical distance as well as factors such as transportation infrastructure, access to waterways and transportation networks while administrative proximity refers to similarities or compatibility in economic conditions, regulations, policies, trade arrangements and institutional requirements between the pharmaceutical firm's home environment and its nearshore sourcing location.

Cold Chain Logistics

Yanxi Pan (2024) opined that, cold chain logistics refers to the procurement, processing, storage, circulation, distribution and other steps, the final state of the goods will be controlled in the best cold chain state, and as far as possible, it will be placed in a lower temperature, so as to improve the quality of goods, and effectively extend its storage time. For in China, the common cold chain goods in China include: aquatic products, agricultural products, frozen food, pharmaceuticals, chemicals and electronic components that are easily affected by temperature (Yanxi Pan, 2024). In pharmaceutical supply chains, cold chain logistics encompasses facilities, refrigeration systems, packaging, vehicles, monitoring technologies, procedures and human resources required to preserve product quality. WHO identifies storage and distribution as important components of

pharmaceutical supply-chain quality assurance because medicines can be exposed to risks at multiple stages between procurement and final use (WHO, 2020)? Pharmaceutical cold-chain management can now involve conventional refrigeration, freezing, ultra-low-temperature storage and cryogenic conditions (ASHP, 2023). For Lagos-based pharmaceutical firms, the effectiveness of cold chain logistics is influenced by storage infrastructure, road transportation, electricity supply, backup power, traffic, monitoring technology, equipment maintenance and regulatory compliance. Accordingly, cold chain logistics provides the overarching conceptual construct under which temperature mapping, controlled transportation and cold storage can be examined. This study operationalized cold chain logistics into temperature-mapping control, Temperature-controlled Transportation and Cold Storage

Measures of Cold Chain Logistics

Temperature-mapping Control

Temperature control and monitoring refer to the ability of pharmaceutical firms to maintain and continuously observe the required temperature conditions for temperature-sensitive medicines throughout storage and transportation (Faggioni et al., 2023). This is a fundamental measure of cold-chain logistics because temperature excursions can compromise pharmaceutical quality and effectiveness. NAFDAC requires temperature-monitoring devices such as thermometers and temperature loggers and specifies that such instruments should be calibrated within the required storage range. Similarly, the WHO identifies temperature mapping and monitoring as integral to ensuring appropriate storage conditions for pharmaceuticals (WHO, 2015; ASHP, 2023; NAFDAC, 2021). Monitoring therefore provides firms with evidence that pharmaceutical products have remained within their specified temperature conditions

Temperature-controlled Transportation

Temperature-controlled transportation refers to the ability of pharmaceutical firms and logistics providers to maintain appropriate environmental conditions while medicines are moved from suppliers to warehouses, healthcare facilities, pharmacies or other customers (WHO, 2018; NAFDAC, 2021) It includes refrigerated vehicles, validated thermal packaging, cold boxes, temperature monitoring during transit and appropriate delivery procedures. Pharmaceutical transportation requires special attention because temperature conditions must be maintained not only during long-term storage but also during short-term movement between locations. The main objective of temperature-controlled transportation is to prevent temperature excursions between the point of dispatch and the destination. This requires more than simply using a refrigerated vehicle. Vehicles and containers need appropriate qualification, monitoring devices must be calibrated or appropriately verified, and transport procedures should address loading, unloading, route duration, environmental conditions and emergencies. WHO identifies temperature monitoring devices-including data loggers, event loggers and electronic monitoring systems; as important tools for monitoring temperature across cold chains (WHO, 2026)?

Cold Storage

Cold storage and handling capability refer to the availability, adequacy, reliability and proper maintenance of facilities and equipment used to store temperature-sensitive pharmaceutical products (WHO, 2015). These may include refrigerators, freezers, cold rooms, temperature-controlled warehouses and appropriate packaging systems. NAFDAC (2021) cold-chain

guidelines emphasize that pharmaceutical and biopharmaceutical products must be held and distributed under controlled conditions. The guidelines also require preventive maintenance programmes for cold-chain equipment and products. The importance of adequate storage infrastructure is also supported by evidence from Nigeria, where poor storage infrastructure and unreliable electricity have been identified as important medicines and vaccine supply-chain challenges (Olutuase et al., 2022). The World Health Organization (WHO) emphasizes that storage and distribution are integral components of pharmaceutical quality assurance because medical products are exposed to risks during purchasing, storage, repackaging, transportation and distribution (WHO, 2020). Yaroson et al. (2021) consequently, pharmaceutical firms require logistics systems capable of maintaining product integrity from the point of manufacture” to the final user

Empirical Review

Wang, et al., (2024) “carried out a study on empirical research of cold-chain logistics Service Quality in Fresh Product E-Commerce. Logistics service quality (LSQ) plays a vital role in providing excellent customer experience, particularly in e-commerce. Using mobile devices for food and fresh product orders is very common, but delivering these products is very challenging. In this study, we aim to evaluate the factors influencing logistics service quality (LSQ) in the context of fresh product e-commerce. The relevant literature was reviewed and a preliminary survey among field experts was conducted to establish the proposed LSQ scale. A qualitative study was carried out on fresh product e-commerce customers. A survey involving 222 participants was analyzed, and an LSQ evaluation scale was formed and evaluated scientifically and empirically. Research results showed that reliability, convenience, fresh ness, and personnel contact quality are the four key dimensions of the LSQ scale in the e-commerce platform for fresh and perishable items. The results of the study can help the managers of e-commerce companies to understand the LSQ criteria that determine customer satisfaction and consequently make the appropriate LSQ improvements Platas-López and Cruz-Mejía (2025) carried out a study on the nearshoring loop: a review of triggers, location choice, and captured outcomes. Nearshoring has risen aftershocks and policy shifts. We synthesize evidence in a compact loop linking triggers (trade frictions, supply-chain risk, new agreements) to location choices mediated by multidimensional proximity (geographic, institutional, organizational, social, cognitive, functional) to components (manufacturing footprint, Foreign Direct Investment (FDI), employment) and outcomes (spillovers, productivity, innovation) conditioned by absorptive capacity and institutions. We conducted a literature review using major bibliographic databases. A staged screening pipeline (duplication, pre-eligibility, and title–abstract screening) preceded full-text coding aligned with the re view framework (triggers, proximity, components, outcomes, mediators). Studies were appraised with a five-criterion checklist, and themes were consolidated with basic biblio metric checks. Results: Evidence is North Atlantic and manufacturing-centric. Supply-chain disruptions dominate triggers; non-geographic proximity strongly moderates relocation. FDI anchors ecosystems, while employment effects are lagged and compositional. Strong capability and policy mixes yield broader spillovers; otherwise, benefits remain enclave like. Sustainability and transformative outcomes are rarely assessed. Conclusions: The loop clarifies feedback from outcomes to future siting. Firms should build proximity beyond geography and pair early FDI with supplier and skills upgrading; policymakers should align instruments to governance, capability

formation, and logistics. Research should expand Global South coverage and integrate environmental and inclusion” metrics.

In view of the foregoing empirical review, the following hypotheses were drawn and stated below:

H01: There is no relationship between nearshoring and temperature-mapping control in pharmaceutical firms in Lagos state, Nigeria

H02: There is no relationship between nearshoring and temperature-mapping control in pharmaceutical firms in Lagos state, Nigeria

H03: There is no relationship between nearshoring and temperature-mapping control in pharmaceutical firms in Lagos state, Nigeria.

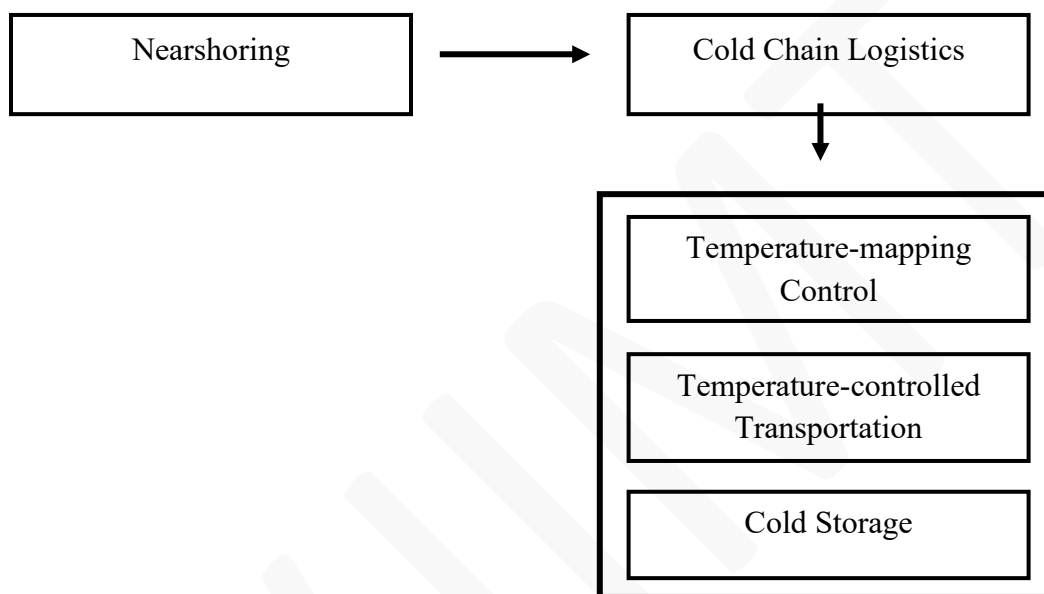


Fig. 1.1: Conceptual framework of Nearshoring and Cold Chain Logistics of Pharmaceutical firms in Lagos state, Nigeria.

Source: (Fratocchi et al. 2022; Ghemawat, 2001; Platas-López & Cruz-Mejía, 2025)

Methodology

This study “examined the relationship between nearshoring and cold chain logistics of pharmaceutical firms in Lagos state, Nigeria. The study adopted a cross sectional research design and the population of the study comprises a total of sixty (60) respondents drawn from twenty (20) pharmaceutical firms in Lagos state, Nigeria. The top twenty pharmaceutical firms in Lagos were selected based on their operational spread and logistics activities and census sampling method was adopted to study all respondents. Data was collected through structured questionnaire via online video conference, personal interview and email posting. Sixty (60) questionnaire were distributed. However, fifty-three (53) were returned but fifty (50) were certified suitable for data analysis. We used tables, percentages, Spearman’s Rank Order Correlation Coefficients with the aid of Statistical Package for Social Science (SPSS version 23) for data presentation, analysis and hypotheses testing to examine the relationship between Nearshoring and Cold Chain Logistics of Pharmaceutical firms in Lagos state, Nigeria

Table 1.1: Population of the study

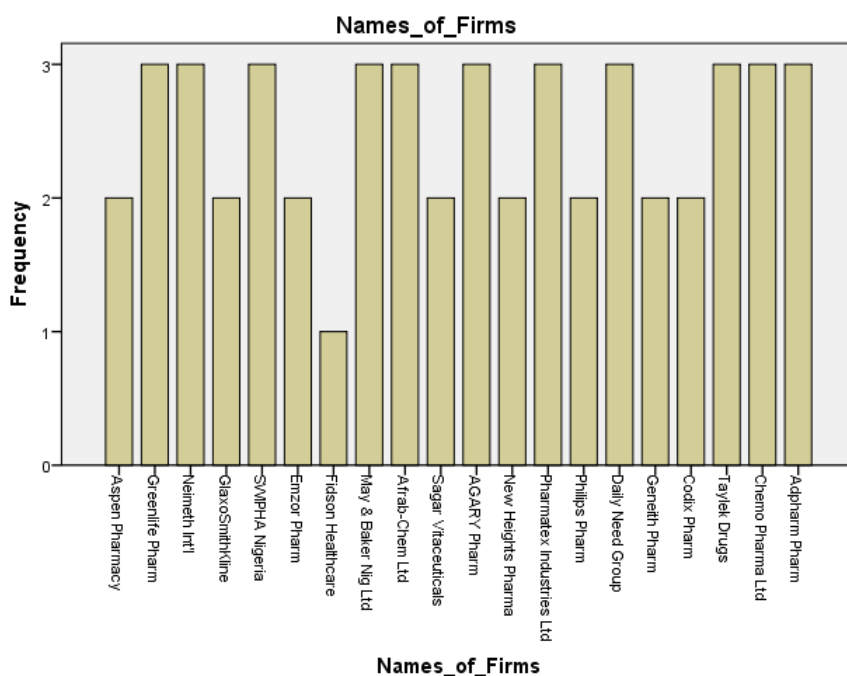
S/N	Name	Address	Respondents
1	Aspen Pharmacare nig ltd	Plot 28, Ilupeju Byepass, Ilupeju	3
2	Greenlife pharmaceutical ltd	35A Association avenue, Ilupeju	3
3	Neimeth Int'l Pharmaceuticals PLC	Plot 16, Akanni Doherty Layout Oregun	3
4	GlaxoSmithKline	1 Ilupeju industrial Avenue, Mushin	3
5	SWIPHA Nigeria	5 Dopemu Road, Dopemu	3
6	Emzor Pharmaceutical Industries Ltd	Plot 3C, Block A, Aswani Market Road, Osolo	3
7	Fidson Healthcare Plc	268 Ikorodu Road, Obanikoro	3
8	May & Baker Nigeria Ltd	Ikeja, Lagos	3
9	Afrab-Chem Ltd	22 Abimbola Street, Isolo	3
10	Sagar Vitaceuticals Nigeria Ltd	Ikeja, Lagos	3
11	AGARY Pharmaceutical Ltd	Plot C39A, Alakoso Avenue, Amuwo-Odofin	3
12	New Heights Pharma Ltd	Ilupeju industrial Avenue, Ilupeju	3
13	Phamatex Industries Ltd	Amuwo-Odofin industrial Estate	3
14	Phillips Pharmaceuticals Nigeria Ltd	122/123 Afprint Complex, Isolo	3
15	Daily Need Group	9-10 DailyNeed Lane, Mushin	3
16	Geneith Pharmaceuticals Ltd	12 Adewale Crescent, Orile Oshodi	3
17	Codix Pharma Ltd	207 Ikorodu Road, Ilupeju	3
18	Taylek Drugs Company Ltd	Block M, Plot 8, Abimbola Street, Oshodi-Isolo	3
19	Chemo Pharma Laboratories Ltd	13 Olanrewaju Street, Ikeja	3
20	Adpharm Pharmaceuticals Ltd	60 Ajao Street, Surulere	3
	Total		60

Source: (NPS, 2026)

Table 1.2: Administration of Questionnaire

		Frequency	Valid Percent	Cumulative Percent
Valid	Aspen Pharmacy	2	4.0	4.0
	Greenlife Pharm	3	6.0	10.0
	Neimeth Int'l	3	6.0	16.0
	GlaxoSmithKline	2	4.0	20.0
	SWIPHA Nigeria	3	6.0	26.0

Emzor Pharm	2	4.0	30.0
Fidson Healthcare	1	2.0	32.0
May & Baker Nig Ltd	3	6.0	38.0
Afrab-Chem Ltd	3	6.0	44.0
Sagar Vitaceuticals	2	4.0	48.0
AGARY Pharm	3	6.0	54.0
New Heights Pharma	2	4.0	58.0
Pharmatex Industries Ltd	3	6.0	64.0
Philips Pharm	2	4.0	68.0
Daily Need Group	3	6.0	74.0
Geneith Pharm	2	4.0	78.0
Codix Pharm	2	4.0	82.0
Taylek Drugs	3	6.0	88.0
Chemo Pharma Ltd	3	6.0	94.0
Adpharm Pharm	3	6.0	100.0"
Total	50	100.0	



Data Analysis and Results

Bivariate Analysis

This “study adopted spearman’s rank order correlation coefficient at 95% confident level for the data analysis. The tests cover hypotheses **H₀₁**, **H₀₂** and **H₀₃** which are bivariate and all stated in the null form. The 0.005 significance level was adopted as the basis for accepting or rejecting the null hypotheses

Table 1.3 The Relationship between Nearshoring and Temperature-mapping control

			Nearshoring	Temperature-mapping control
Spearman's rho	Nearshoring	Correlation Coefficient	1.000	.709**
		Sig. (2-tailed)	.	.000
		N	50	50
	Temperature-mapping control	Correlation Coefficient	.709**	1.000
		Sig. (2-tailed)	.000	.
		N	50	50

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

Source: Research Data, 2026

H₀₁: There is no relationship between nearshoring and temperature-mapping control in pharmaceutical firms in Lagos, Nigeria

The data analysis on table 1.3 above shows that, the correlation co-efficient (rho) between nearshoring and temperature-mapping control yielded ($r = 0.709$) which demonstrates a strong and positive relationship between the variables and it is statistically significant at ($p = 0.01 < 0.05$). This result shows that there is a positive relationship between nearshoring and temperature-mapping control in pharmaceutical firms in Lagos, Nigeria. Based on the empirical findings the null hypothesis earlier stated, is hereby rejected and the alternate hypothesis stated as, there is a positive relationship between nearshoring and temperature-mapping control in pharmaceutical firms in Lagos, Nigeria, Nigeria is accepted

Table 1.4 The Relationship between Nearshoring and Temperature-controlled Transportation

			Nearshoring	Temperature-controlled transportation
Spearman's rho	Nearshoring	Correlation Coefficient	1.000	.680**
		Sig. (2-tailed)	.	.000
		N	50	50
	Temperature-controlled transportation	Correlation Coefficient	.680**	1.000
		Sig. (2-tailed)	.000	.
		N	50	50

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

Source: Research Data, 2026

H₀₂: There is no relationship between nearshoring and temperature-controlled transportation in pharmaceutical firms in Lagos, Nigeria

The data analysis on table 1.4 above shows that, the correlation co-efficient (rho) between nearshoring and temperature-controlled transportation yielded ($r = 0.680$) which indicates a strong and positive relationship between the variables and it is statistically significant at ($p = 0.01 < 0.05$). This result shows that there is a positive relationship between nearshoring and temperature-controlled transportation in pharmaceutical firms in Lagos, Nigeria. Based on the empirical findings the null hypothesis earlier stated, is hereby rejected and the alternate hypothesis stated as, there is a positive relationship between nearshoring and temperature-controlled transportation in pharmaceutical firms in Lagos, Nigeria, Nigeria is accepted

Table 1.5 The Relationship between Nearshoring and Cold storage

Spearman's rho	Nearshoring	Correlation Coefficient	Nearshoring	Cold storage
			1.000	.726**
		Sig. (2-tailed)	.	.000
		N	50	50
	Cold storage	Correlation Coefficient	.726**	1.000
		Sig. (2-tailed)	.000	.
		N	50	50

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

Source: Research Data, 2026

H₀₃: There is no relationship between nearshoring and cold storage in pharmaceutical firms in Lagos, Nigeria

The data analysis on table 1.5 above shows that, the correlation co-efficient (rho) between nearshoring and cold storage yielded ($r = 0.726$) which indicates a strong and positive relationship between the variables and it is statistically significant at ($p = 0.01 < 0.05$). This result shows that there is a positive relationship between nearshoring and cold storage in pharmaceutical firms in Lagos, Nigeria. Based on the empirical findings the null hypothesis earlier stated, is hereby rejected and the alternate hypothesis stated as, there is a positive relationship between nearshoring and cold storage in pharmaceutical firms in Lagos, Nigeria, Nigeria” is accepted.

Discussion of Findings

Drawing “from the results of the analysis on the study variables above, the study showed that there is a positive relationship between nearshoring and the measures of cold chain logistics in pharmaceutical firms in Lagos, Nigeria using Spearman’s rank order correlation co-efficient at 95% confident interval. The nearshoring and the measures of cold chain logistics hypotheses tests for 1, 2 and 3 on tables 3-5 as indicated in the correlation co-efficient of 0.709, 0.680 and 0.726 respectively indicated a strong and positive relationship between the variables.

The result indicates that there is a positive and relatively strong relationship between nearshoring and temperature-mapping control among pharmaceutical firms in Lagos State, Nigeria ($r = 0.702$). The positive sign means that increases in the extent to which pharmaceutical firms adopt

nearshoring are associated with increases in the effectiveness of their temperature-mapping control. In practical terms, firms that report greater use of nearshoring also tend to report stronger temperature-mapping practices (Wang, 2016; Abubakar, 2021). When pharmaceutical supply-chain activities are located closer to the market or key supply-chain partners, firms may experience lower coordination difficulties and greater opportunities for direct supervision and information exchange. Reduced geographical distance may make it easier for firms to monitor logistics processes and investigate temperature deviations promptly. This is important because temperature mapping involves systematically recording and analysing temperature distribution within storage environments to identify areas where temperatures may fall outside specified conditions. WHO considers temperature mapping and temperature monitoring integral to appropriate pharmaceutical storage conditions and recommends regular mapping of warehouses and relevant storage areas (WHO, 2026)? Chukwu and Adibe (2022), in a Nigerian study of cold-chain facilities, found weaknesses in quality-management practices, including inadequate calibration of equipment and limited use of automated systems for power failures. Their findings demonstrate that temperature-controlled pharmaceutical logistics requires more than the physical availability of refrigerators or cold rooms; it also requires effective monitoring and quality-management systems

The study found a positive relationship between nearshoring and temperature-controlled transportation control among pharmaceutical firms in Lagos State, with a correlation coefficient of $r = 0.680$. This means that pharmaceutical firms with higher levels of nearshoring tend, in the observed sample, to report better temperature-controlled transportation practices. The finding is particularly relevant to pharmaceutical products requiring controlled temperatures. WHO guidance emphasises that time- and temperature-sensitive pharmaceutical products must be stored and transported under appropriate conditions to maintain their quality? WHO's guidance includes requirements concerning temperature and humidity monitoring, transport operations, refrigerated vehicles and route qualification (WHO, 2011). The Nigerian evidence reinforces this interpretation. A scoping review of medicines and vaccines supply chains in Nigeria identified transportation and distribution problems as important challenges and reported difficulties associated with maintaining optimum vaccine temperatures in delivery vehicles. The review also identified logistics distance between manufacturers and Nigeria as one of the challenges affecting vaccine supply chains (Olanrewaju et al., 2022). These challenges make geographical proximity potentially relevant to the control of temperature-sensitive pharmaceutical transportation.

The result also shows a positive relationship between nearshoring and cold storage among pharmaceutical firms in Lagos State, with $r = 0.726$. This is the strongest of the three reported relationships. The positive coefficient means that pharmaceutical firms with greater adoption of nearshoring tend to report stronger cold-storage practices. Therefore, the $r = 0.726$ result provides evidence of a strong positive association between nearshoring and cold-storage control among the pharmaceutical firms investigated. Among the three dimensions examined, cold storage has the highest reported correlation with nearshoring. The finding suggests that supply-chain proximity may be particularly relevant to the ability of pharmaceutical firms to coordinate and control temperature-sensitive storage operations. Chukwu and Adibe (2022) found substantial weaknesses in cold-chain storage practices in Nigeria. Their study reported that 66.7% of the storage facilities assessed did not meet required quality-management standards, while many facilities lacked equipment calibration and automated systems for dealing with power failures. These findings demonstrate that effective cold storage requires appropriate infrastructure and quality-management systems, rather than simply having a refrigerator or cold room.

Conclusion and Recommendations

The pharmaceutical industry is one of the most quality-sensitive industries in the global economy because the effectiveness, availability, safety and stability of medicines depend not only on manufacturing processes but also on how products are stored, handled and transported throughout the supply chain from different parts of the world to consumption destination. This is important for vaccines, biologics, insulin, blood products, some injectable medicines and other time- and temperature-sensitive pharmaceutical products. Nearshoring will enhance the logistics process and reduce the risk involve in-between. Based on the findings, we made the following recommendations

- i. Pharmaceutical firms in Lagos should invest in localized cold chain infrastructure and technology to enhance logistics of sensitive pharmaceutical products from manufacturing location to distribution centres in Lagos and other locations in Nigeria
- ii. Pharmaceutical firms should explore the opportunities of bringing the manufacturing facilities in Lagos to help solve the temperature-controlled transportation conundrum that some pharmaceutical firms face in Lagos.
- iii. The pharmaceutical firms should strengthen and improve their cold storage facilities to state-of-the art and ensure regular training of staff to handle cold storage” functions effectively and professionally.

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