**Volume 10, Issue 01, January 2024,**
**Publish Date: 29-01-2024**
**Doi https://doi.org/10.55640/ijmsdh-10-01-06**

INTERNATIONAL JOURNAL OF MEDICAL SCIENCE AND DENTAL HEALTH (Open Access)

# Current Practices and Risk Assessment in COVID-19 Vaccine Procurement in Nigeria

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**ABSTRACT**

The global battle against the COVID-19 pandemic has underscored the critical challenge of procuring and managing vaccines. This study delves into the Nigerian context, specifically within the framework of the Primary HealthCare Development Agency, to comprehensively explore the nuanced aspects of COVID-19 vaccine procurement. The primary objective is to elucidate current procurement practices, examining diverse sources, methods, and key stakeholders involved in the process. The analysis thoroughly evaluates potential risks, including corrupt policies, high costs, inadequate storage capacity, delayed deliveries, substandard and falsified vaccines, and unreliable implementation strategies. Delving into the intricate factors influencing these risks, the study utilizes correlation matrix and regression analysis to underscore the implications of key variables, emphasizing the imperative need for targeted interventions in COVID-19 vaccine procurement practices. Positioned as a timely resource in the dynamic field of public health, this research advocates for continuous collaboration, innovation, and strategic planning to fortify the resilience of the vaccine procurement and supply system.

**KEYWORDS:** Pandemic, Vaccine, Procurement, Stakeholder, Collaboration, Risk Mitigation.

**BACKGROUND**

Many African developing nations, like Nigeria, are experiencing rising levels of inadequacies in the ability of the government to manage their problems and put effective policies in place (Okafor et al., 2022). This has led to falling health care administration rule, compliance and rising doubts about a sustained economic recovery. In general, the global epidemic has sparked widespread misinformation that has damaged public policy and scientific understanding, and this applies to the question of vaccine supply. According to Gianfredi et al (2021), procuring vaccines is a complicated process that includes a pre-buying phase that includes determining needs, selecting pre-qualified goods and suppliers, establishing legal standards, preparing for evaluation and bidding, and a post-buying step that ensures quality.

Risks are associated with each of these phases and procedures, which are also distinguished by regular communication between public health experts, national politicians, and international authorities such as the World Health Organization (WHO), the European Union, and manufacturers. Procurement procedures were implemented to achieve the goals of fairness, accessibility, and high immunization coverage (Daems and Maes, 2022). Considering vaccine procurement is more important than ever, especially in light of the COVID-19 pandemic. Indeed, as outlined by this research, timely and adequate vaccine storage and

avoiding inequities among nations, particularly Nigeria would be significantly aided by well-planned and coordinated vaccine procurement. The purpose of this study is to look into the risks associated with the current vaccine procurement system utilized by the Nigerian Government. In essence to assess the effectiveness of the procurement strategy to supply, and manage adequate vaccine to control the Covid -19 pandemic. This study, in essence, is using the lens of COVID-19 vaccine procurement to assess the pandemic preparedness of the Country, the study will also look at existing ways to mitigate identified risks, and recommend other more efficient ways.

Governments' first priority in planning their remedies to the COVID-19 problem is public procurement since it is necessary to safeguard public health and maintain the continuation of public services. Governments are spending enormous amounts on research and development as well as on local and international purchases of vaccinations, medications, and diagnostics as a result of an illness. According to Loayza and Pennings (2020), Governments of OECD nations have invested a minimum of thirteen billion United States dollars in direct support for research and development and creation of production facilities for COVID-19 vaccines, even if complete and precise statistics are not yet available. This excludes extra money set aside to support healthcare systems, buy vital supplies, and establish other health innovations in response to the global epidemic, as well as upfront purchase agreements for vaccinations and broader funding. Governments have allotted much bigger sums—in the trillions of US dollars—to make up for lost revenue and assist economically disadvantaged areas. These actions were done in a fairly short period of time as the situation developed in the first half of 2020. Although the reaction has been swift, it is still necessary to uphold trustworthy and transparent requirements in order to promote trust and ensure that the resources are spent in the public's best interests.

Although a great deal of OECD Administrations had the essential legal structures established for emergency procurement by the public, they still had to strike a balance between the need to quickly purchase large quantities of products and services, commonly from providers they had never previously worked with, and the elevated commercial and proper conduct risks related to emergency procurement. Hoekman et al (2020) states that for instance, emergency regulations in Canada permit direct supplier purchases from unqualified suppliers. Despite the fact that all decisions were recorded, they are all susceptible to audit and legal challenge.

According to the Coronavirus Aid, Relief, and Economic Security Act of 2020 in the United States, public funds must be allocated towards the research and development of vaccinations, and any items created with those funds must be sold for a "fair and decent price (Aid, 2020). While these quick procurement processes acquire previously unheard-of quantities of needed supplies, the use of direct awards eliminates competition in procurement, which is essential

for preserving the confidence of the public and business in these procedures. Weimer and Vinings (2017) states that without rivalry in the procurement procedure, public buyers must clearly demonstrate how they have taken into account and accomplished possible conflicts related to interests or prejudice in their procurement choices and behaviours, broadcast their contract awards and contracts in a timely manner, and document the extensive due-diligence checks they conducted on suppliers as well as related parties in order to preserve the integrity of the purchasing activities.

**Sources of Nigeria's Covid-19 Vaccine**

Most African countries depends on COVID-19 vaccine donation from European countries. The Federal Government of Nigeria (FGN) has secured 39.8 Million doses of J&J vaccines through the Afrexim Bank, other quantities were either through COVAX FACILITY or Multilateral donations (from countries and organisations like US MASTERCARD. Using the COVAX Facility, the United States donated COVID-19 vaccine to Nigeria. The African Union and the United States donated about 18 million doses of COVID-19 vaccines to Nigeria through the COVAX Facility, assisting in ensuring more equitable access to the vaccine. Single source in most cases through UNICEF except AstraZeneca COVISHIELD brand donated by India that came through the Indian government. Even though Nigeria received donations from other countries like India, some donations were risk for human use. For instance, after officials determined they were unable to be utilized before the time was up, Nigeria incinerated over 1 million obsolete dosages of the COVID-19 vaccine manufactured by AstraZeneca (Chinedu, 2021). Medical professionals in Nigeria, had few options after receiving supplied medicines with a limited shelf life. According to Faisal Shuaib, chairman of NPHCDA, developed countries that purchased and stored the vaccines decided to donate when the vaccines were close to expiry. Aside from the vaccines, there were collaborations between countries to combat the pandemic. Analysis shows that Nigeria government dependent more on donations from different sources of the world such as U.S, Italy, India amongst others. These vaccines were donated through their respective agencies in relation to NPHCDA of Nigeria.

**The current procurement system for health commodities in Nigerian agencies**

Nigeria adopts both manual and E-procurement system. Nigeria implemented the federal electronic procurement in 2016, which was a step toward reforming its government contracting system. Electronic procurement was implemented at a fortunate juncture in the development of the country, when the necessity for better financial restraint and the economic downturn brought on by the Covid-19 outbreak were both pressing issues (Guedhami et al., 2023). According to Kemi Adeosun, the Ex- Minister of finance, The e-Procurement is an unavoidable option for the country and helps to achieve transparency and

efficiency. These characteristics are required in our procurement system, both to improve the business environment and to reduce waste - e-Procurement provides appropriate solutions to the issues of transparency and accountability in public expenditure.

Nigeria's procurement public process is faced with a number of risks/challenges and weakness. The following are the major issues affecting procurement processes in Nigeria that need to be addressed; there is inadequate implementation of the current public procurement law/policies, and an inefficient monitoring authority to direct and oversee purchasing organizations. The Nigerian Finance Act of 1958 and the Financial Regulations, which establish the fundamental guidelines for managing public expenditures, have loop holes, flaws, and improper application of the law (Njoku, 2020). For example, there are no ongoing plans for control and monitoring, which provides prospects for corrupt practices. There were numerous tender boards, which private companies saw as causes of delays and lack of transparency. Additionally, it seemed that the authority to decide contracts rested de facto with the Permanent Secretaries and the Commissioners/Minister, giving these tender boards limited authority. The complicated customs systems and practices in the nation were a major cause of delays in the clearance of products and, as a result, a delay in delivering the products for use in a timely manner. Delays in delivery usually leads to stock outs, and subsequent disruption in service provision, which may lead to inability to provide adequate healthcare, hence health morbidity, and/ or even mortality.

**Vaccine procurement policies in Nigerian Government, Agencies, and Parastatals**

Vaccination provisions in law, rules, ministerial or executive decrees, and other legal instruments require the state, healthcare professionals, or patients to act to improve vaccination rates (Trumbo et al., 2019). With the right procurement guidelines, multi-year bids, open bidding procedures, and direct business discussions can all be options. However, some aspects of vaccine procurement procedures may encourage international bids. Such characteristics include the requirement for delegation of authority, the creation of language documentation, internet communication, and other similar requirements.

Furthermore, procurement law may allow for some wiggle room in joint procurement, allowing nations to source some items independently. Countries are not required in some cases to wait for WHO guidelines or pre-qualification before deploying a new vaccination. Nations can modify processes to meet their requirements and legal frameworks by handling their procurement. To monitor both foreign and domestic goods, a National Regulatory Authority is required (Agyekum et al., 2021). This authority, which is often an autonomous branch of a national drug regulatory agency, must be adequately staffed and have these powers in order to license vaccines for use in the country, set protocols for lot release, and

build a post-marketing surveillance framework. It is also necessary for accumulating sufficient reserves.

**Risk assessment in COVID-19 vaccine procurement**

Vaccination strategy and control is a major risk in the vaccine procurement seen in Nigeria. At the moment, the Country is largely dependent on donors for their vaccines, this has greatly impacted on the country's autonomy and the control of the vaccination strategies like procurement and supply, administration and monitoring. Also, due to competing demands, there are intermittent disruptions in the vaccine supply Chain, leading to inability to secure the actual quantity demanded.

**Limited infrastructure**

Nigeria has a limited cold chain storage infrastructure and transportation facilities to manage the vaccines storage and distribution (Olufunlilayo, 2021). This is largely caused by inadequate electricity supply, and poor road network in some areas. Therefore, the risk of wastage and compromising the quality of the vaccine is high. The challenge of limited infrastructure leads to inequity risk, which challenges the Country's ability to ensure equitable transportation and distribution of vaccines across different regions and populations, especially in areas with poor access to healthcare services. Corruption, and political interference also hinder the efficient and transparent vaccines distribution and geographical coverage. This delay in distribution could increase the chances of emerging new COVID-19 variants which has the potential of rendering the vaccination program less effective, and consequently, intermittent adjustment to the vaccination strategies.

**Inadequate stakeholder's engagement**

The Coordinating efforts among the various stakeholders in the public and private sector in Nigeria is inadequate. One of the challenges is because the private sector would often charge a fee for service provision (Oyewole Tomori, 2021). Carrying all the stakeholders (NGOs, CSOs, government agencies, International Organization and donors) along could be complex. However, pandemic preparedness requires a collaborative effort between all sectors. Therefore, an effective communication is required in to effectively manage the stakeholders.

**Corruption risk**

Also noted was the corruption risk. Among all governmental tasks, the public procurement procedure presents one of the highest risks for corruption in normal conditions. Public procurement is extremely susceptible to corruption issues due to the massive volumes employed. Public procurement is thought to account for between 15 and 30 percent of the

gross domestic product in several countries (Ngunjiri, 2018). Although procurement controversies involving corruption are common, the purchase of drugs and medical equipment is particularly vulnerable in the healthcare industry.

**Substandard or falsified vaccines**

This study also uncovered chances in the procurement of substandard and falsified produced vaccines coming into the marketplace due to the growing worldwide need for vaccines; when resources are scarce in the initial phases of vaccine manufacturing and distribution (Zaman and Zaman, 2018). This risk is enhanced if quality assurance procedures are not followed or are disregarded during the emergency response, which might have a detrimental impact on population health and undermine public confidence in the security and effectiveness of a vaccination. The COVID-19 epidemic is exploited by organized crime groups by going for weak points and weaknesses in the criminal justice and health systems. This involves the production and distribution of fake medical items, which is fueled by the intense worldwide demand for COVID-19 prevention, diagnosis, treatment, and mitigation solutions and the resulting fierce competition, endangering the purchasing procedure

**Poor implementation of procurement policy**

According to Storeng et al (2021), it's possible for the business sector and other important parties to try to influence government choices about procurement and vaccine policy. People in public offices may ignore the policy and decide to deal in a way that works for them. The essence of policy is to set direction in line with the quality standards mapped out by the country to govern the procurement procedures and processes. The policy outlines the stepwise procurement processes including the pricing. Governments may set prices for vaccines and other important medical products directly in light of the public health emergency (Sodhi et al., 2021). The decision-making and procurement processes for vaccines must incorporate the key stakeholders from all sectors concerned.

**Measures to reduce and Mitigate COVID-19 vaccine procurement risks**

To detect and reduce risks associated with procurement that might endanger people's access to secure and efficient COVID-19 vaccines, the Member States should take into account the subsequent short- and long-term reaction measures (Forman et al, 2021). The United Nations Convention against Crime is the sole internationally recognized anti-corruption law. It offers a broad framework and important resources to encourage responsibility, honesty, and openness during and after the COVID-19 pandemic

**Establishment of a dedicated Committee**

Waele (2021) posit that in a public health emergency, the establishment of a dedicated committee with a clear anti-corruption mission to supervise the prioritizing, purchase, transportation, and evaluation of vaccine programs, as well as associated policy decisions, can operate as a crucial oversight body. In order to swiftly identify and resolve any warning signs, it should be able to monitor the emergency releases of cash, purchasing and distributing of vaccines, as well as related activities, in real time.

**Establishment of Transparent and accountable procurement procedures**

Globally, open contracting and electronic procurement can promote the transparent and accountable public emergency procurement procedures that are essential (McEvoy and Ferri, 2020). Since it informs the general public exactly who is purchasing what, from which individuals, at whatever quantity and price, open procurement may be successful at preventing corruption. Electronic procurement can also be useful in the pandemic preparedness. Through a dedicated website, it enables the public disclosure of pertinent data, including the solicitation of bids and the awarding of contracts, providing the component of openness. In moments of turmoil, laws governing public procurement may also improve accountability and lower the chance of making purchases from unauthorized vendors. In accordance with its public procuring system for buying of commodities, services, and works connected to dealing with the COVID-19 pandemic, the European Union has released a guidance sheet on alternatives and flexibilities (Spataru and Cioni, 2021).

**Secured storage and distribution system**

Every country preparing against pandemic should have a secure storage and distribution system. The secure storage, and transportation of COVID-19 vaccines and the reduction of the risk of vaccinations being shifted from the public supplies to the end users depend on reliable preservation and distribution methods (Ramakanth et al., 2021).

**Involvement of Private sector and Civil Society organizations**

An essential component of measures to reduce malpractice in the health sector is strengthening the involvement of the private sector which includes civil society Organizations in policy formation and monitoring of the overall health system (Vian 2020). The social sector, non-governmental groups, and grassroots organizations can assist the government's attempts to fight corruption in the provision of services and procurement amid the COVID-19 pandemic. According to Evans and French (2021), allowing and promoting private sector, including the civil society involvement in pertinent processes of decision-making regarding the planning and distribution of COVID-19 vaccines, including those regarding the selection of suppliers, the purchase of vaccines, and the flow of emergency funds for vaccine programs,

are important ways to encourage the proactive involvement of society as a whole. The tracking and reporting of any abnormalities in the vaccination installation procedure might be greatly aided by civil society.

**Policy implementation**

Nigeria has a policy for Procurement and Supply Chain Management developed with support from the Global Fund Resilience and Sustainable Systems for Health grant. All agencies could support to put this Law's provisions into effect in accordance with the UNCITRAL and trade law models (Ibrahim, 2007). The implementation of the existing regulations would provide guidance and inject quality into health products and vaccines procurement.

**Incorporating procurement decisions into quality management**

This is crucial for ensuring overall service quality and client's satisfaction. For instance, in Suppliers' Selection. The quality of the products or services provided by suppliers significantly affects the overall quality of the healthcare services. By incorporating procurement decisions into quality management, the Country can establish robust supplier selection criteria based on quality standards and performance indicators. Choosing a reliable supplier that have integrity can prevent failure to deliver, or stock outs, or delivering substandard products which might impact on the overall quality of the services provided. Including procurement in the quality management process, would encourage the agency to develop quality standards and specifications. That way, the government of Nigeria would ensure that the specifications provided to suppliers are accurate, comprehensive, and aligned with clients' expectations. Quality management extends beyond Organization's internal operations and includes the entire supply chain. Incorporating procurement decisions into quality management would help the organization to address quality issues at every stage of the supply chain. Collaborative efforts can lead to joint problem-solving, shared knowledge, and the development of more effective procurement strategies. According to Kohler and Dimancesco (2020) since there are integrity concerns present at every stage of the public procurement process, a thorough risk management and anti-corruption plan is needed.

**Incorporating Information Technology (IT) into procurement or strengthening the use of E procurement**

This is strongly recommended to ensure procurement quality and product security.

Nigeria implemented the federal electronic procurement in 2016, which was a step toward reforming its government contracting system (Guedhami et al., 2023). This system needs to be improved on with adoption of a robust information technology. Information Technology (IT) introduces Automation and Efficiency into the system, and enables automation of

procurement processes, eliminating manual and paper-based tasks. IT facilitates enhanced visibility across the supply chain, enabling procurement professionals to track shipments, monitor inventory levels, and gain real-time insights into supplier performance. Supply chain management systems integrated with procurement systems provide end-to-end visibility, allowing organizations to proactively identify and mitigate potential disruptions or bottlenecks. According to Nani and Ali (2020), electronic procurement, or the adoption of technological advances in communication and information for government procurement, can improve accountability. A prime instance of an integrated online procurement infrastructure is Korea's KONEPS, a system for electronic procurement (Shin, 2016).

**Adopting transparency and system view approach**

This is an important mitigating measures which is highly recommended. In addition to fostering accountability and data access, transparency in public procurement is crucial for leveling the playing field between companies and enabling micro, small, and medium-sized businesses to compete on an equal footing (Nkonge, 2013). As a result, the foundation of OECD measures encouraging good governance in the public sector is openness. In accordance with the recommendations provided by the OECD on Public Procurement, adhering nations are encouraged to make sure that the public procurement system is transparent at all times. An easy way to achieve this is to adopt a 'system view' in the procurement system. As procurement encompasses various interconnected processes, stakeholders, and dependencies that make it a complex system, thinking of how procurement impacts on different organs of the Nation, rather than seeing it as a business of a particular department or agency, would help in procurement management: The systems view recognizes that procurement management is not an isolated function within an organization. It is interconnected with other functions such as production, operations, finance, and quality management.

**AIM**

The aim of this study is to comprehensively analyze the current COVID-19 vaccine procurement practices in Nigeria, including the sources, and methods. And to assess associated risks within the framework of the Nigeria Primary HealthCare Development Agency, and elucidate the roles and collaborative strategies of government agencies, pharmaceutical companies, and healthcare facilities in mitigating these risks.

**The study objectives are;**

1. To understand how COVID-19 vaccines are currently procured in Nigeria, including the sources, methods, and stakeholders involved.

2. To assess the risks associated with the current procurement of COVID-19 vaccine services in Nigeria Primary HealthCare Development Agency

## METHODS

### Study Design

This study combined description and explanation methods. Descriptive studies were used to describe data in their current form (Doyle et al., 2020). The study described the risk associated with the current procurement strategies utilized by the Nigerian government for covid-19 vaccines. Exploratory research was used to assess the relationship between vaccines procurement and associated risks. Furthermore, the study sought to recommend mitigation strategies that can be implemented to reduce procurement risks in the Nigerian health sector, especially the NPHCDA, with a specific focus of Covid-19 vaccines. The essence was to view the system's pandemic readiness with health product security using the COVID -19 vaccines procurement and management as a standard.

### Data and sources

This research data was primarily gathered using a survey questionnaire. The survey was sent to the that oversee procuring COVID-19 vaccines. This ensured the gathering of accurate, trustworthy, first-hand information to solve the research problem. The survey questionnaire had three sections to administer: organizational/participant background, questions, and answers. This assists the reader in comprehending the information source as an individual or an organization. The other section of the survey sought to answer the research study's objectives, and thus directly evaluated the participants based on the objectives. The study focused solely on the risks associated with the procurement of the COVID-19 vaccine in Nigeria, as well as the procurement procedures and mitigation strategies.

### Sample Size and sampling techniques

The study used stratified random sampling. With this, the study obtained the desired description from participants working in the agency and are responsible for procurement. Individuals were chosen randomly and stratified based on the department to ensure that all population subsets are adequately represented. The advantage of this approach is that respondents volunteered on their own initiative rather than being forced to participate. The Yamane formula was used to calculate the sample size for the study population (Israel, 1992). A sample size of 85 participants was achieved out of 100 distributed questionnaire links.

## SETTING OF THE STUDY

*Data Collection Methods/Choices*

This research adopted quantitative methods. Structured questionnaires were used to collect primary data from a healthcare Agency. The surveys included both closed- and open-ended questions, and participants received a questionnaire through Google form link. To increase confidence in the research instrument and its results, a pilot study was conducted with at least ten workers from the Nigeria Primary HealthCare Development Agency. The pilot study findings were not used in the final analysis. The pilot project was used to test the research tool. To improve validity and reliability, instrument items were clarified for respondents. The pilot study acquainted the researcher with the research and its administration method and assisted in identifying areas for improvement (Siew et al., 2017). The findings assisted in fine-tuning the instruments to eliminate discrepancies and ensure the precision of the calculated value.

**Data analysis**

Completed surveys were checked for correctness and completeness before processing. The primary analysis was carried out using Excel and the R package. To test for associations between the variables, descriptive statistics and Pearson correlation analysis were used. The model that suggested changing the essential variables for procurement practices and risk management was developed using regression analysis. Descriptive analysis demonstrated descriptive and inferential statistics, such as the frequency of vaccination purchases. To establish a direct link between the processes used to purchase vaccines and the risk involved, regression and correlation analysis were used.

**RESULTS**

*Descriptive Statistics on vaccine procurement risks*

This research presents a summary of the descriptive statistics and distributions of responses for key variables related to COVID-19 vaccine procurement and management. The insights garnered from participants shed light on various aspects of the procurement processes, risks, and key players involved.

**Foreseeable Risk in Procurement**

| Is there a foreseeable risk in the procurement? | No of responses | Percentage |
|---|---|---|
| Not sure | 10 | 11.76 |

| | | |
|---|---|---|
| Yes | 66 | 77.65 |
| No | 9 | 10.59 |

*Source: (Findings, 2023)*

*Table 1: (Level of procurement risk)*

Participants acknowledged the presence of foreseeable risks in procurement, with 77.65% recognizing potential challenges. A segment (11.76%) expressed uncertainty about the existence of such risks., while 10.59% perceived no risk.

***Foreseeable Procurement Risk***

| Foreseeable procurement risks | Number of Responses | Percentage |
|---|---|---|
| Corrupt policies | 13 | 15.294118 |
| High cost | 13 | 15.294118 |
| Inadequate storage capacity | 22 | 25.882353 |
| Late deliveries | 1 | 1.176471 |
| Substandard and falsified vaccines | 25 | 29.411765 |
| Unreliable implementation strategies | 11 | 12.941176 |

*Source: (Findings, 2023)*

*Table 2:(Foreseeable Procurement Risks)*

Respondents recognized a range of procurement risks. Corrupt policies (15.29%) underscore the importance of transparency, while high costs (15.29%) emphasize financial considerations. Concerns about vaccine quality are evident with substandard and falsified vaccines (29.41%), and inadequate storage capacity (25.88%) highlights logistical limitations. Late deliveries (1.18%) indicate potential logistical challenges. Unreliable implementation strategies (12.94%) also emerged as a concern, emphasizing the need for effective execution.

**Key Players in COVID-19 Procurement Process**

| Key players in COVID-19 procurement process | No_of_Responses | Percentage |
|---|---|---|
| Government Authorities | 20 | 23.52941 |
| International Organizations | 14 | 16.47059 |
| Ministries of Health | 27 | 31.76471 |
| Non-Governmental Organizations (NGOs) | 13 | 15.29412 |
| Pharmaceutical Companies | 11 | 12.94118 |

*Source: (Findings, 2023)*

*Table 3: (Players in COVID-19 Procurement)*

Various stakeholders were recognized as key players in the COVID-19 procurement process: Federal Ministries of Health led with 31.76%, highlighting their Central role. Other Government Authorities followed closely with 23.53%, showcasing governmental involvement. International Organizations accounted for 16.47%, signifying global collaboration. Non-Governmental Organizations (NGOs) and Pharmaceutical Companies each constituted 12.94%, indicating their contributions and collaborative dispositions.

**Vaccine Corruption Risks at Agency**

| Vaccine corruption risk | No of responses | Percentage |
|---|---|---|
| Conflict of interest | 11 | 12.94 |
| Embezzlement and misappropriation | 19 | 22.35 |
| Ghost suppliers of services | 16 | 18.82 |
| Kickbacks and bribery | 18 | 21.18 |
| Lack of accountability | 9 | 10.59 |
| Lack of transparency | 7 | 8.24 |
| Procurement fraud | 5 | 5.89 |

*Source: (Findings, 2023)*

*Table 4. (Vaccine Corruption Risks at the Agency)*

Corruption risks pertaining to vaccine procurement were identified with Embezzlement and misappropriation, kickbacks and Bribery accounting for 22.35% and 21.18% respectively highlighting potential unethical practices. Other factors were identified to be potential risks as illustrated in the table. These insights provide a comprehensive overview of participants' perspectives on COVID-19 vaccine procurement and management, offering valuable considerations for future strategies and risk mitigation efforts. However, these were their respective perceived views which will require concrete further investigations and research.

**Risk of poor management within the Agency**

| Do you think that the covid vaccine stands a risk of poor management by the Nigerian government? | No of responses | Percentage |
|---|---|---|
| No | 25 | 29.41 |
| yes | 60 | 70.59 |

*Source: (Findings, 2023)*

*Table 5: (Risk of poor management)*

A substantial majority of respondents, comprising 70.59%, express apprehensions about the potential risk of poor management within the Agency. This finding underscores the importance of addressing the intricacies of managing vaccine-related processes, ensuring efficiency, transparency, and adherence to best practices. Conversely, a minority of respondents (29.41%) hold a more optimistic perspective, indicating that they do not perceive the COVID-19 vaccine to be at risk of poor management within the Agency. This contrasting viewpoint highlights a spectrum of perspectives and perceptions among stakeholders, suggesting diverse attitudes towards the agency's management capabilities.

**Correlation and Regression Analysis**

**Correlation analysis**

This section embarked on a comprehensive correlation analysis to uncover the relationships between various factors and the "Foreseeable Procurement Risks" associated with COVID-19 vaccines. The aim was to unveil potential trends and patterns that elucidate the factors influencing the perception of procurement risks. This analysis assessed whether certain variables are correlated with higher or lower perceived risks, contributing to a deeper

understanding of the dynamics surrounding COVID-19 vaccine procurement. The correlation matrix below presents the correlation coefficients among the analyzed variables:

| | Foreseeable Procurement Risk | Vaccine Corruption Risk at the Government Facility | Why do you think procurement process is a stage for corruption scandals in Nigeria | Do you think that the COVID-19 Vaccine a risk of poor management within the Government Facility | In your opinion, what are the management risks associated with COVID-19 Vaccine at the Government Facility | What means of transportation does the Nigerian Government use for the supply of vaccine | What storage system does the Nigerian Government use prior to and during the supply of vaccine | Strategies are employed by the Nigerian Government to ensure vaccine integrity |
|---|---|---|---|---|---|---|---|---|
| Foreseeable Procurement Risk | 1.00000000 | 0.29603551 | -0.20225834 | -0.14264815 | 0.05999736 | 0.12714721 | 0.49479044 | 0.59561223 |
| Vaccine Corruption Risk at the Government Facility | 0.29603551 | 1.00000000 | -0.14024816 | 0.13067840 | -0.08060030 | -0.03293300 | 0.32555766 | 0. 09660523 |
| Why do you think procurement process is a stage for corruption scandals in Nigeria | -0.20225834 | -0.14024816 | 1.00000000 | -0.3728506 | -0.20182974 | 0.10137453 | -0.27297111 | 0.018888714 |
| Do you think that the COVID-19 Vaccine a risk of poor management within the Government Facility | -0.20225834 | 0.13067840 | -0.3728506 | 1.00000000 | 0.03509159 | -0.5962037 | 0-02330471 | 0.04650750 |
| In your opinion, what are the management risks associated with COVID-19 Vaccine at the Government Facility | 0.05999736 | -0.08060030 | -0.20182974 | 0.03509159 | 1.00000000 | -0.01655346 | 0.21710993 | -0.16881277 |
| What means of transportation does the Nigerian Government use for the supply of vaccine | 0.12714721 | -0.03293300 | 0.10137453 | -0.5962037 | -0.01655346 | 1.00000000 | -0.03703093 | 0.09748794 |
| What storage system does the Nigerian Government use prior to and during the supply of vaccine | 0.49479044 | 0.32555766 | -0.27297111 | 0.02330471 | 0.21710993 | -0.03703093 | 1.00000000 | 0.30578442 |
| What other Strategies are employed by the Nigerian Government to ensure vaccine integrity | 0.59561223 | 0. 09660523 | 0.018888714 | 0.04650750 | -0.16881277 | 0.09748794 | 0.30578442 | 1.00000000 |

*Table 6: (Correlation matrix)*

Correlations between Foreseeable Procurement Risks and Key Factors:

Exploration examining the relationship between individuals' perceptions of vaccine corruption risks by the Nigeria agency, and their perception of foreseeable procurement risks was done. With a correlation coefficient of 0.29604, a mild positive relationship emerges. This suggests that individuals who perceive higher vaccine corruption risks also tend to anticipate higher foreseeable procurement risks. This correlation underscores the interconnectedness between concerns about corruption and broader procurement challenges.

Furthermore, a correlation between participants' perceptions of the likelihood of poor management within the agency and their perception of foreseeable procurement risks. Was done. The correlation coefficient of -0.14265 signifies a weak negative relationship. This indicates that individuals who anticipate a higher risk of poor management also tend to

perceive higher foreseeable procurement risks. This connection highlights the impact of management concerns on the overall perception of procurement challenges.

Further investigation of the correlation between participants' opinions on management risks associated with COVID-19 vaccines in the agency and their perception of foreseeable procurement risks. The correlation coefficient of 0.05999 suggests a very weak positive relationship. This implies that individuals who identify specific management risks also tend to perceive slightly higher foreseeable procurement risks. This correlation accentuates the intricate relationship between management and procurement risk perceptions.

Finally, the correlation between the strategies implemented by the government and participants' perceptions of foreseeable procurement risks. The correlation coefficient of 0.12715 indicates a mild positive relationship. This suggests that individuals who are aware of the strategies employed by the agency also tend to perceive slightly higher foreseeable procurement risks. This correlation underscores the link between transparency in strategies and perceived procurement challenges.

**Regression Analysis**

A summary of the regression model to explore the relationships between "Foreseeable Procurement Risks" associated with COVID-19 vaccines and various influencing factors was conducted. To understand how these factors, contribute to the perception of procurement risks a linear regression was employed.

Summary of Regression Model: The following variables were used. Vaccine corruption risks at the agency, Perception of Corruption Scandals, Perception of Poor Management Risk, and Opinion on Management Risks, Strategies Implemented, Transportation Methods, and Storage Systems. The analysis yielded the following results

| **Coefficients** | **Estimate** | **Std. Error** | **t value** | **Pr(>\|t\|)** |
|---|---|---|---|---|
| Intercept | 0.13154 | 0.69887 | 0.188 | 0.8512 |
| Vaccine corruption risks at the agency | 0.15573 | 0.06704 | 2.323 | 0.0228 |
| Why do you think procurement process is a stage for corruption scandals in Nigeria? | -0.05733 | 0.03843 | -1.492 | 0.1399 |

| | | | | |
|---|---|---|---|---|
| Do you think that the COVID vaccine stands a risk of poor management in Nigeria? | -0.60313 | 0.23291 | -2.590 | 0.0115 |
| In your opinion, what are the management risks associated with COVID 19 vaccine in Nigeria? | 0.08151 | 0.06746 | 1.208 | 0.2306 |
| Which transportation means does the government use to supply the vaccines in Nigeria? | 0.17768 | 0.14866 | 1.195 | 0.2357 |
| Which storage systems does the NPHCDA use to supply the vaccines in Nigeria | 0.29519 | 0.12028 | 2.454 | 0.0164 |
| What Strategies does the agency use to manage vaccines | 0.27415 | 0.04346 | 6.308 | 1.65e-08 |

*Source: (Findings, 2023)*

*Table 7: (Regression analysis)*

The intercept of 0.13154 indicates the expected value of the dependent variable when all independent variables are zero. It is statistically insignificant (p = 0.8512), suggesting that there are other factors beyond the variables in the model that influence the perception of foreseeable procurement risks.

The coefficient of 0.15573 suggests a small positive effect of "Vaccine corruption risks in Nigeria" on the perception of foreseeable procurement risks. This effect is statistically significant (p = 0.0228), indicating that higher perceived vaccine corruption risks are associated with a higher perception of foreseeable procurement risks.

The coefficient of -0.05733 suggests a small negative effect of the "Perception of Corruption Scandals" variable on the perception of procurement risks. However, this effect is not statistically significant (p = 0.1399), indicating that the perception of corruption scandals may not significantly impact the perception of foreseeable procurement risks.

The coefficient of -0.60313 indicates a moderate negative effect of the "Perception of Poor Management Risk" variable on the perception of procurement risks. This effect is statistically significant (p = 0.0115), suggesting that individuals who perceive a higher risk of poor management within the agency are more likely to have a higher perception of foreseeable procurement risks.

The coefficient of 0.08151 suggests a negligible positive effect of the "Opinion on Management Risks" variable on the perception of procurement risks. This effect is not statistically significant (p = 0.2306), indicating that individuals' opinions on management risks may not significantly impact the perception of foreseeable procurement risks.

The coefficient of 0.17768 suggests a small positive effect of "Transportation Methods" on the perception of procurement risks. However, this effect is not statistically significant (p = 0.2357), suggesting that the method of transportation used by the government to supply vaccines may not have a significant impact on the perception of foreseeable procurement risks.

The coefficient of 0.29519 indicates a moderate positive effect of "Storage Systems" on the perception of procurement risks. This effect is statistically significant (p = 0.0164), suggesting that the storage systems used by the agency to supply vaccines are associated with a higher perception of foreseeable procurement risks.

The coefficient of 0.27415 indicates a substantial positive effect of "Strategies Implemented" on the perception of procurement risks. This effect is highly statistically significant (p < 1.65e-08), indicating that the strategies implemented by government to reduce procurement and management risks have a significant positive impact on the perception of foreseeable procurement risks.

The overall model's performance, as indicated by the Adjusted R-squared value of 0.5124, suggests that the independent variables included in the model explain a substantial portion of the variation in the perception of foreseeable procurement risks.

The p-value of the F-statistic (p = 2.543e-11) indicates that the model is highly statistically significant in predicting the perception of foreseeable procurement risks. While the regression analysis provides insights into the potential relationships between the factors and the perception of foreseeable procurement risks, it's important to consider the limitations and assumptions of the model.

**DISCUSSION**

The analysis successfully examined a range of foreseeable procurement risks, including corrupt policies, high costs, inadequate storage capacity, late deliveries, substandard and falsified vaccines, and unreliable implementation strategies. The research investigated complex factors contributing to the risks in the procurement process. The implications of each significant variable from both the correlation matrix and regression analysis on current practices in COVID-19 vaccine procurement, emphasizing the need for targeted interventions.

Various risk management theories emphasize the identification, assessment, and mitigation of risks. The outcome of the data analysis aligns with these theories by identifying specific risks (corruption, poor management, storage issues) and emphasizing the need for targeted interventions to mitigate these risks. It impresses upon the principles of supply chain risk management by highlighting the interconnectedness of various factors (storage, management, corruption) in the vaccine procurement process. Interventions can draw upon supply chain risk management strategies to enhance resilience and responsiveness.

**Vaccine Corruption Risks at the Agency (Regression Coefficient: 0.15573, p-value = 0.0228);** A positive correlation suggests that as vaccine corruption risks at the agency increase, there is a corresponding positive impact on the overall procurement strategy. Current practices may benefit from targeted interventions focused on identifying and mitigating corruption risks within the agency. Institutional theory posits that organizations are influenced by their institutional environments. In this context, the positive correlation between vaccine corruption risks and overall procurement strategy aligns with the idea that institutional factors, such as corruption norms within an agency, can significantly impact decision-making.

**Risk of Poor Management of COVID Vaccine (Regression Coefficient: -0.60313, p-value = 0.0115);** The strongly negative correlation indicates that concerns about poor management have a significant negative impact on the overall procurement strategy. This emphasizes the critical importance of effective management practices to ensure the success of vaccine procurement. The strongly negative correlation with poor management aligns with Resource Based View (RBV), emphasizing the critical role of effective management practices as a valuable resource in the procurement process

**Storage Systems Used for Vaccine Supply (Regression Coefficient: 0.29519, p-value = 0.0164);** The positive and statistically significant coefficient suggests that the choice of storage systems significantly influences the overall procurement strategy. This triggers the Resource Dependency Theory which emphasizes the importance of external resources for organizational survival. This impresses the need to focus on robust storage infrastructure to ensure the integrity and efficacy of COVID-19 vaccines during the supply chain.

**Strategies Used by the Agency to Manage Vaccines (Regression Coefficient: 0.27415, p-value = 1.65e-08);** The highly significant positive coefficient indicates a substantial positive impact of strategies employed by the agency on the overall procurement strategy. This is in line with the Strategic Management Theory that posits that organizations achieve success through strategic planning and implementation. The highly significant positive coefficient aligns with this theory, emphasizing the critical role of strategies in the overall procurement strategy.

**RECOMMENDATIONS**

In line with the results of data analysis and discussions, it is recommended that;

1. To Mitigate Corruption Risks, there is need to Develop and implement robust anti-corruption measures within the agency, including transparent procurement processes, accountability mechanisms, and periodic audits. Conduct training programs to raise awareness about the risks of corruption and promote a culture of integrity among procurement stakeholders.

2. To ensure Robust Management Practices, the implementation of stringent quality assurance protocols to ensure proper handling, storage, and distribution of vaccines; also, training and capacity-building programs for personnel involved in vaccine management should be conducted to enhance their skills and knowledge.

3. Strategic Planning for Transportation through evaluation and optimization of transportation logistics to minimize delays and ensure the timely delivery of vaccines. Partnerships with reliable transportation providers and leverage technology for real-time tracking of vaccine shipments should be explored.

4. Strategic Planning for Storage requires Investment in state-of-the-art storage facilities with temperature-controlled environments to maintain the efficacy of vaccines. Contingency plans for storage-related emergencies, such as power outages or equipment failures should also be developed.

5. Establishment of a cross-functional team to oversee all aspects of vaccine procurement, ensuring coordination and collaboration among different departments and regular review and update of procurement protocols based on evolving best practices and lessons learned from previous experiences will boost the overall vaccine management.

## CONCLUSION

In the pursuit of a resilient and effective COVID-19 vaccine procurement and management system, this study has delved into the current practices, identified risks, and examined the pivotal roles played by stakeholders within the Nigerian government and the agency responsible for the management of the vaccines in Nigeria. The insights gained provide a nuanced understanding of the multifaceted landscape surrounding vaccine acquisition and distribution in the Nigerian context. The risk assessment illuminated potential vulnerabilities, ranging from supply chain disruptions to logistical constraints, emphasizing the need for proactive measures to safeguard the integrity of the vaccine supply chain.

Mitigation strategies, examined through the lens of international best practices and contextualized for Nigeria, emerge as key pillars in fortifying the vaccine procurement framework. Implementing robust contingency plans, enhancing cold chain infrastructure, and leveraging technological advancements were identified as instrumental strategies to mitigate identified risks. In the ever-evolving landscape of public health, this study serves as a timely resource, encouraging ongoing collaboration, innovation, and strategic planning, by fortifying vaccine procurement practices, managing associated risks, and optimizing stakeholder engagement. The Nigerian government through its health agencies can further enhance its pivotal role in safeguarding public health and contributing to the global effort to overcome the challenges posed by COVID-19 procurement and management.

## LIST OF ABBREVIATIONS

NPHCDA - Nigeria Primary Healthcare Development Agency

OECD – Organization for economic cooperation and development

WHO - World Health Organization

FGN - Federal Government of Nigeria

NGOs-Non Governmental Organizations

CSOs – Civil Society Organisations

UNCITRAL – United Nations Commission on International Trade Law

KONEPS – Korea On-line E-Procurement System

## REFERENCES

1. Agyekum, E. B., Amjad, F., Mohsin, M., & Ansah, M. N. S. (2021). A bird's eye view of Ghana's renewable energy sector environment: a Multi-Criteria Decision-Making approach. Utilities Policy, 70, 101219.
2. Aid Coronavirus (2020). Relief, and Economic Security Act, HR 748. In 116th Congress.
3. Daems, R., & Maes, E. (2022). The race for COVID-19 vaccines: Accelerating innovation, fair allocation and distribution. Vaccines, 10(9), 1450.
4. Gianfredi, V., Filia, A., Rota, M. C., Croci, R., Bellini, L., Odone, A., & Signorelli, C. (2021). Vaccine procurement: A conceptual framework based on literature review. Vaccines, 9(12), 1434.
5. Guedhami, O., Knill, A., Megginson, W., & Senbet, L. W. (2023). Economic impact of COVID-19 across national boundaries: The role of government responses. Journal of International Business Studies, 1-20.
6. Hoekman, B., Fiorini, M., & Yildirim, A. (2020). COVID-19: Export controls and international cooperation. COVID-19 and trade policy: Why turning inward won't work, 77.
7. Loayza, N., & Pennings, S. M. (2020). Macroeconomic policy in the time of COVID-19: A primer for developing countries. World Bank Research and Policy Briefs, (147291).
8. Njoku, I. O. (2020). Impact of e-Payment Systems on the Management of Public Funds in Nigeria.
9. Okafor, I. A., Mbagwu, S. I., Chia, T., Hasim, Z., Udokanma, E. E., & Chandran, K. (2022). Institutionalizing open science in Africa: Limitations and prospects. Frontiers in Research Metrics and Analytics, 7, 855198.
10. Trumbo, S. P., Silver, D., Domenti, O., Gasoyan, H., Paatashvili, E., Gellin, B. G., & Gordon, J. L. (2019). Strengthening legal frameworks for vaccination: the experiences of Armenia, Georgia, and Moldova. Vaccine, 37(35), 4840-4847.