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Optimizing Covid-19 Vaccine Procurement And Management In Nigeria: Procedures, Risk Reduction, And International Comparisons

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ABSTRACT:
The global fight against the COVID-19 pandemic has underscored the critical importance of efficient vaccine procurement and management strategies, particularly in low- and middle-income countries such as Nigeria. This article delves into the procedures and best practices for optimizing COVID-19 vaccine procurement and management in Nigeria, offering insights for risk reduction and drawing international comparisons for valuable context.
In the wake of unprecedented challenges posed by the pandemic, Nigeria's approach to vaccine acquisition and distribution is analyzed, with a focus on enhancing supply chain logistics, transparency, and equitable vaccine distribution. By examining the strategies employed, this article aims to provide a comprehensive overview of how Nigeria can enhance its preparedness and responsiveness to future health crises.
Through a comparative lens, this study evaluates Nigeria's vaccine management against global practices and identifies key success factors, lessons learned, and potential areas for improvement. International experiences from countries with successful vaccine programmes are considered, offering valuable insights that can be adapted to Nigeria's unique context.
The findings from this research will aid policymakers, healthcare professionals, and stakeholders in Nigeria in their efforts to refine vaccine procurement and management practices. Ultimately, the optimization of COVID-19 vaccine procurement and management in Nigeria will contribute to enhanced public health outcomes and increased resilience in the face of future health challenges.
KEY WORDS: *Vaccines, Procurement, Stakeholders, Management, Risk assessment, COVID -19 Pandemic:*

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I. BACKGROUND

Nigeria has a weak health system, coupled with the inability to sustain health interventions, as evidenced by poor services, which has resulted in high mortality and morbidity rates in the country. Vaccine development is a medical advance of very high significance that has saved and enhanced millions of lives every year. Many developing countries, such as Nigeria, which cannot produce vaccines, have resorted to procuring them for citizens to access and benefit from them.

Vaccine procurement is a complex process that occurs in different phases. The first phase is the prequalification phase. The activities in this phase are need assessment, supplier selection, vaccine selection, setting criteria, legal standards, evaluation and bidding. Next is the procurement, followed by the post-procurement. Each phase has its associated risk. The Nigerian immunization programme has benefited largely from donations from international organizations. The COVID-19 vaccines have also enjoyed the support of

international donors. The Nigeria government through UNICEF has procured 35,601,600 doses out of the total of 138,128,890 doses of the COVID-19 vaccines used in the battle and in the containment of the COVID-19 pandemic since March 2021. . However, a larger challenge still remains in vaccine management. Presently, the European Union (EU) regulatory framework mandates Member States and National Immunization Programmes (NIPs) to conduct needs assessment to manage their vaccine supply effectively to foresee the possibility of low stocks or stock outs, which could be detrimental to public health.

The country has a limited cold chain and storage facilities, making vaccine safety questionable. Additionally, the fact that vaccines are donated means that the country has little or no control of the procurement processes, which is a large risk in the face of pandemic preparedness, as this suggests that the country cannot independently respond to the needs of the people in the face of the pandemic. Therefore, the large dependency on donors is a great risk for the country. This jeopardizes the success of the vaccine programme as well as the overall public health responses to the epidemic. According to Wegborn et al. (2021), in Nigeria, there is inadequate comprehensive evaluation and knowledge of the possible dangers associated with purchasing and handling COVID-19 vaccines. This encompasses threats such as supply chain disruptions, counterfeit vaccines, logistics for storage and delivery, vaccine waste, adverse events, and public trust in the vaccination process. To address identified hazards, appropriate mitigation techniques are needed. This involves developing robust quality control measures, establishing rigorous procurement processes, ensuring cold chain infrastructure and storage capacity, training healthcare workers on vaccine administration, monitoring adverse events, and addressing vaccine hesitancy through effective communication and public engagement. Nigeria may improve the efficacy and effectiveness of COVID-19 vaccine procurement and management by addressing these problems and implementing robust risk evaluation and mitigation measures. Consequently, this could yield a more successful public health feat against the global pandemic. The overall aim of this study is to assess and enumerate the risks associated with the current vaccine procurement strategies and to suggest means by which they can be mitigated to demonstrate their readiness to respond to the pandemic.

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, Member States should take into account 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, purchases, transportation, and evaluation of vaccine programmes, as well as associated policy decisions, can operate as a crucial oversight body. To swiftly identify and resolve any warning signs, the emergency release of cash, purchasing and distributing vaccines, and related activities should be monitored and executed in real time.

Establishment of Transparent procurement procedures

Globally, open contracting and electronic procurement can promote 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 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 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 pandemics 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 public supplies to 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, nongovernmental 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 the private sector, including 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 putting 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 product and vaccine procurement.

Incorporating procurement decisions into quality management

This is crucial for ensuring overall service quality and client satisfaction. For instance, in Suppliers' Selection. The quality of the products or services provided by suppliers significantly affects the overall quality of 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 has integrity can prevent failure to deliver, stock outs, or substandard products, which might impact 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 agencies would ensure that the specifications provided to suppliers are accurate, comprehensive, and aligned with clients' expectations. Quality management extends beyond an organization's internal operations and includes the entire supply chain. Incorporating procurement decisions into quality management would help the organization 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 integrity concerns are 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 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 the 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 measure that 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 ensure 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 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.

International Experiences from Countries with Successful Vaccine Procurement and Management Programmes

Successful vaccine procurement and management programs in various countries have provided valuable lessons and insights for the global community. The success of these countries is attributed to a combination of factors such as existing strong healthcare systems, strategic planning, clear communication and efficient logistics. The following are some international experiences from countries that have effectively managed their vaccine procurement and distribution during the COVID-19 pandemic;

1. **Israel:** Israel launched one of the world's most successful vaccination campaigns, with a focus on speed and efficiency. Key elements of their success include a centralized digital database, a well-organized healthcare system, a clear and prioritized rollout plan, and strong collaboration with pharmaceutical companies.
2. **United States of America:** The US leveraged its strong healthcare infrastructure, including retail pharmacies and mass vaccination sites, to rapidly distribute vaccines. Public–private partnerships, such as those with pharmacy chains and logistics companies, played a significant role in the successful distribution effort.
3. **United Kingdom:** The UK adopted an early and flexible procurement approach by pre-ordering vaccine doses from multiple manufacturers. Their strategy included a broad network of vaccination centers, community clinics, and mass vaccination sites. The National Health Service (NHS) played a pivotal role in delivering vaccines efficiently.
4. **United Arab Emirates:** The UAE deployed a comprehensive digital vaccination passport system, which not only tracked vaccinations but also allowed for a rapid return to normalcy. The country also focused on partnerships with vaccine manufacturers and conducted large-scale vaccination campaigns.
5. **Australia:** Australia used a mix of government-led vaccination clinics, primary care providers, and pharmacies for vaccine distribution. The government maintained a strong communication strategy to address vaccine hesitancy and promote vaccine uptake.

Current Vaccine Production Practices in Nigeria

Some general aspects of vaccine procurement practices in Nigeria include:

1. **Government Procurement:** The Nigerian government, through relevant agencies such as the National Primary Health Care Development Agency (NPHCDA) and other relevant agencies, play a central role in the procurement of vaccines. The government sometimes negotiates directly with vaccine manufacturers and at other times engages in international collaborations to secure vaccine doses.
2. **Global Initiatives:** Nigeria is a participant in global initiatives such as the COVAX facility, which aims to ensure equitable access to COVID-19 vaccines worldwide. Through COVAX, Nigeria receives a portion of its vaccine supply to cover a percentage of the population.
3. **Donations and Aid:** Some vaccines were acquired through donations or aid from other countries, organizations, or manufacturers. These donations supplement the government's efforts to achieve widespread vaccine coverage.
4. **Distribution Channels:** Once vaccines are procured, the agencies in Nigeria and other relevant health agencies work on the distribution strategy. This involves planning the logistics for transporting vaccines to various regions and ensuring that the cold chain is maintained to preserve vaccine efficacy.
5. **Public–Private Partnerships:** Nigeria may also explore partnerships with private entities, nongovernmental organizations (NGOs), and international organizations to strengthen vaccine procurement and distribution efforts. These collaborations provide additional resources and expertise.
6. **Payment Mechanisms:** The government may use a combination of budget allocations, loans, and grants to finance vaccine procurement. Negotiations may involve considerations such as pricing, payment terms, and other financial arrangements.

II. AIM

The aim of this study is to assess and enhance the COVID-19 vaccine procurement and management processes within the Nigerian Government, and contribute to the refinement of the process to enhance public health outcomes and strengthen the country's response to health crises such as the COVID-19 pandemic.

The specific objectives are as follows:

1. To determine the procedures used in the acquisition and management of COVID-19 vaccines by the Nigerian Government National Primary Healthcare Development Agency

2. To recommend management procedures that can be used to reduce the risks of procuring and managing COVID-19 vaccines by the Nigerian Government
3. To compare Nigeria's vaccine procurement and management practices with international best practices and identify areas for improvement.
4. To analyze the effectiveness of public communication strategies related to vaccine procurement, including vaccine education, promotion, and addressing vaccine hesitancy.

III. STUDY DESIGN

The study evaluates procedures that can be used to reduce the risks of procuring and managing COVID-19 vaccines by the Nigerian Government.

Exploratory research was used to assess the relationship between procurement procedures, storage infrastructure and vaccine procurement efficiency. Furthermore, the study compared the Nigeria's vaccine procurement and management practices with international best practices and identified areas for improvement, with a specific focus on COVID-19 vaccines. The essence was to view the system's pandemic readiness with health product security using the management of COVID-19 vaccine procurement as a standard.

IV. SETTING OF THE STUDY

Data and sources

Data on vaccine procurement efficiency, storage conditions, distribution timelines, vaccine coverage, and suggestions for improvement were collected using well-structured questionnaires, and some insights were gathered through interviews on challenges faced, success stories. The survey questionnaire was sent to the National Primary Healthcare Development Agency of Nigeria, the agency in charge of procuring COVID-19 vaccines. This ensured that the researcher gathered accurate, trustworthy, first-hand information to solve the research problem. The questionnaire covered a general overview of vaccine procurement, management and strategies for vaccine optimizing procurement and distribution in Nigeria.

V. RESULTS

Descriptive Statistics on Management 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.

Risk of poor management within the Agency

Do you think COVID 19 vaccine stands a risk of poor management in Nigeria?	No. of responses	Percentage
No	25	29.41
yes	60	70.59

Source: (Findings, 2023)

Table 1: 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 toward the agency's management capabilities.

Management risks associated with the COVID-19 vaccine by the government

In your opinion, what are the management risks associated with COVID 19 vaccines in Nigeria?	No. of responses	Percentage
Data Management	8	9.41
Equitable Distribition	8	9.41
Interagency Coordination	13	15.29
Logistics issues	14	16.47
Supply chain challenges	13	15.29
Vaccine hesitancy	29	34.11

Source: (Findings, 2023)

Table 2: Management risks

The emphasis on effective data management as a potential management risk underscores the pivotal role of data in informed decision-making. Ensuring accurate and accessible data systems becomes paramount to optimize vaccination campaigns. This response underscores the importance of equitable vaccine distribution as a central management concern. Ensuring fairness and impartiality in vaccine allocation addresses social and health inequalities and fosters trust among the population.

Effective collaboration between agencies emerges as a management risk, accentuating the significance of harmonious interagency coordination. A coherent approach ensures streamlined efforts and minimizes redundancies in vaccine distribution. The acknowledgment of logistical challenges within vaccine management reflects the complex nature of procuring, storing and distributing vaccines. Mitigating logistical obstacles is pivotal to ensuring the timely delivery and administration of vaccines.

The intricate nature of the vaccine supply chain is highlighted through this response. Ensuring the reliability and resilience of supply chains emerges as a management priority to avoid disruptions and shortages. The recognition of vaccine hesitancy as a management risk underscores the significance of addressing public perceptions and concerns. Strategies to counter vaccine hesitancy are pivotal to ensure widespread vaccine acceptance and achieve desired immunization coverage.

COVID-19 Vaccination Status

The majority of participants (78.8%) reported having received COVID-19 vaccinations, highlighting a widespread acceptance of vaccination efforts. A smaller segment (21.2%) indicated not having received vaccinations, indicating room for further outreach.

COVID 19 vaccination status	No of responses	Percentage
No	18	21.18
yes	67	78.82

Source: (Findings, 2023)

Table3: Vaccination Status

Exploratory Data Analysis

In this section, we delve into exploratory data analysis using correlation and regression analyses to uncover potential relationships between variables. This analysis aims to provide insights into the interplay of different factors and their impact on COVID-19 vaccine procurement and management.

Factors Affecting the Procurement and Management of COVID-19 Vaccines in Nigeria

Procurement

In the dynamic landscape of COVID-19 vaccine procurement, Government agencies such as the Primary Healthcare Agencies and other related outfits of the Nigerian Government play a crucial role in ensuring vaccine access for the nation. To unravel the complexities inherent in this process, the analysis focuses on the multifaceted factors influencing vaccine procurement in Nigeria. This section provides an in-depth exploration of our findings aligned with the research objectives, uncovering the intricate web of factors impacting COVID-19 vaccine procurement.

Corruption

Corruption as a risk factor affects the vaccine procurement process in the country in different ways. The participants cited the following factors to be driven by corruption.

Corruption risk	Participant's level of attribution	Strategy (s)
Conflict of Interest	12.94%	Participants identified conflict of interest as a potential corruption risk, highlighting the critical importance of unbiased and ethical decision-making in vaccine procurement. Mitigating this risk is crucial to ensure fair and transparent processes that prioritize public health over personal gain.
Embezzlement and Misappropriation	22.35%	The acknowledgment of embezzlement and misappropriation as a significant corruption risk underscores the necessity of maintaining financial integrity throughout the procurement process. Rigorous financial oversight becomes paramount to prevent unethical practices that could compromise vaccine distribution efforts.
Ghost Suppliers or Services	18.82%	This response underscores the risk associated with fictitious suppliers or services that divert resources away from the intended purpose. Implementing robust supplier verification processes is pivotal to prevent fraudulent activities that could impede vaccine distribution.
Kickbacks and Bribery	21.18%	The identification of kickbacks and bribery as corruption risks emphasizes the need for transparent and accountable procurement practices. Addressing these risks is vital to ensure that decisions related to vaccine procurement are based on merit and public health priorities rather than unethical inducements.
Lack of Accountability	10.59%	Participants recognized the risk posed by a lack of accountability in vaccine procurement. This finding highlights the significance of establishing clear lines of responsibility and oversight mechanisms to promote transparency and prevent mismanagement.

Lack of Transparency	8.24%	The emphasis on transparency underscores the importance of open and accessible processes in vaccine procurement. Fostering transparency can enhance public trust, allowing stakeholders to scrutinize and validate procurement decisions.
Procurement Fraud	5.88%	The acknowledgment of procurement fraud as a corruption risk emphasizes the necessity of robust fraud prevention measures. Effective controls and vigilance are essential to prevent fraudulent activities that could compromise vaccine distribution efforts.

Source: (Findings, 2023)
Table 4: Corruption risks

Management risk

This section provides an overview of the management risks associated with the distribution and administration of COVID-19 vaccines in Nigeria. The data reveal several key challenges that can impact the effectiveness of the vaccination campaign:

Management risks associated with the COVID-19 vaccines in Nigeria	Number of Responses	Percentage
Fragmented Procurement System and logistics	10	11.76471
Inadequate storage capacity	40	47.05882
Low quality vaccines and vaccine Hesitancy	19	22.35294
Poor and inadequate infrastructure	16	18.82353

Source: (Findings, 2023)
Table 5: Management risks

Fragmented Procurement System and Logistics (11.76%): Approximately 10 respondents identified the fragmented procurement system and logisticschallenges as a significant management risk. This highlights potential inefficiencies and delays in the acquisition and distribution of vaccines, which can hinder the timely administration of doses to the population.

Inadequate storage capacity (47.06%): The majority of respondents (40) expressed concerns about inadequate storage capacity. This is a critical issue, as vaccines require specific temperature conditions to remain effective. The high percentage indicates the urgent need to enhance storage infrastructure to prevent vaccine wastage and maintain vaccine efficacy.

Low Quality Vaccines and Vaccine Hesitancy (22.35%): A significant portion of respondents (19) identified low-quality vaccines and vaccine hesitancy as management risks. This suggests concerns about the quality and safety of vaccines, along with challenges in addressing vaccine hesitancy among the population. Efforts to ensure vaccine safety and boost public confidence are crucial to successful vaccination campaigns.

Poor and inadequate infrastructure (18.82%): Approximately 16 respondents highlighted poor and inadequate infrastructure as a management risk. This encompasses challenges in healthcare facilities, transportation, and communication systems. Addressing these gaps is essential to facilitate the efficient distribution and administration of vaccines.

Other Risks

The participants noted that the high cost involved in procurement and service delivery poses risk in the procurement and management processes. The financial implications of vaccine procurement resonated within this

response. The recognition of high costs as a potential risk underscores the financial burden that vaccine acquisition can impose. This finding calls for strategies to optimize budget allocation and cost-effectively navigate the financial dimensions of vaccine procurement.

Logistics intricacies surfaced through the participant's response, highlighting concerns regarding the timely and efficient delivery of vaccines. The low percentage underscores that while this challenge is not universally perceived as a significant risk, it remains an issue to address to ensure seamless distribution and administration.

Quality assurance emerged as a substantial concern within the realm of vaccine procurement. This response reflects the imperative of ensuring vaccine efficacy, safety, and adherence to quality standards. Mitigating the risk of substandard or falsified vaccines has become a critical aspect of safeguarding public health.

Management Procedures in Procuring and Managing COVID-19 Vaccine risks

Capacity Building and Training (12.19%): Knowledge empowerment emerges as a cornerstone strategy to navigate the complex landscape of vaccine procurement. Stakeholders recognize the importance of capacity building and training to equip individuals with the skills and insights needed for effective decision-making.

Cold Chain Management (21.95%): The significance of preserving vaccine efficacy through proper cold chain management is apparent in this response. The focus on maintaining appropriate storage conditions underscores the importance of ensuring vaccine potency and quality.

Data Management and Monitoring (12.20%): Data-driven insights provide the foundation for informed decisions. This response emphasizes the role of robust data management and monitoring systems in optimizing vaccine-related processes and enhancing overall efficiency.

Emergency Response Plan (9.76%): Preparedness for unexpected scenarios is highlighted through the recognition of emergency response plans. The importance of being equipped to address unforeseen challenges underscores the resilience of the vaccine procurement process.

Risk Assessment and Mitigation Plan (17.07%): Proactive risk management emerges as a key strategy within this finding. The focus on identifying and mitigating risks reflects a proactive approach to safeguarding the vaccine supply chain and ensuring uninterrupted access.

Stakeholder Collaboration (12.20%): Collaborative endeavours come to the forefront as stakeholders recognize the value of working together to address procurement challenges. This response underscores the importance of fostering partnerships and collaboration within the procurement ecosystem.

Transparency and Accountability (7.32%): Trust is nurtured through transparent processes, emphasizing the significance of accountability in vaccine procurement. This response underscores the imperative of transparent practices to build stakeholder confidence and ensure ethical operations.

In conclusion, this comprehensive analysis offers deep insights into the intricate factors influencing COVID-19 vaccine procurement in Nigeria. The findings illuminate the multidimensional challenges and strategies that shape the procurement landscape. As we transition into the correlation analysis, these insights lay a robust foundation for further exploration, potentially unveiling intricate relationships between variables that inform strategic decision-making.

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 in the country, 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 Nigerian Primary Health Care 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 - 19 vaccine stands a risk of poor management within the country	-0.60313	0.23291	-2.590	0.0115
In your opinion, what are the management risks associated with COVID 19 vaccine in the country	0.08151	0.06746	1.208	0.2306
Which transportation means do the Nigerian Primary Health Care Agencies use to supply the vaccines in Nigeria?	0.17768	0.14866	1.195	0.2357

Which storage systems is used for supply of vaccines in Nigeria	0.29519	0.12028	2.454	0.0164
Strategies	0.27415	0.04346	6.308	1.65e-08

Source: (Findings, 2023)

Table 6: 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 at the agency 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 country 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 Agency 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 "strategy implemented" on the perception of procurement risks. This effect is highly statistically significant (p < 1.65e-08), indicating that the strategies implemented by the agency 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 is important to consider the limitations and assumptions of the model.

Pandemic preparedness status of the Agency and Nigeria

This section assesses Nigeria's preparedness to respond to pandemics, considering various aspects of readiness and planning:

Pandemic preparedness status of Nigeria	Number of Responses	Percentage
Emergency Response Plans	11	12.94118
Establish a resilient supply chains management	16	18.82353
Healthcare Infrastructure Strengthening	27	31.76471
International Collaboration	10	11.76471
Research and Development	21	24.70588

Table 7: Management risks

A total of 12.94% of respondents indicated the existence of emergency response plans. These plans outline coordinated actions to be taken in the event of a pandemic outbreak, ensuring a timely and effective response to mitigate the impact on public health.

18.82% of respondents highlighted the existence of a resilient supply chain management system. This involves ensuring a steady and uninterrupted flow of essential medical supplies, including vaccines, even during challenging circumstances.

The highest percentage (31.76%) of respondents acknowledged the existence of various programs (mostly donor driven) to strengthen healthcare infrastructure. This includes expanding healthcare facilities, which include warehouses and cold chain facilities, improving medical equipment, and enhancing the capacity to provide medical care during pandemics.

Approximately 11.76% of the respondents acknowledged the existence of international collaboration. Collaboration with other countries and global health organizations is crucial for sharing resources, expertise, and knowledge to effectively respond to pandemics.

Finally, 24.71% of the respondents acknowledged the existence of research and development programs. These programs mostly exist as strategic initiatives in collaboration with other Countries. This involves advancing medical knowledge, developing new treatments, and creating vaccines to combat emerging infectious diseases effectively. These findings collectively emphasize the various dimensions of pandemic preparedness and management risks in Nigeria. Focus on strengthening these factors will enhance the preparedness measures to effectively respond to pandemics and safeguard public health.

Implications of Procurement and Management Risks in Nigeria

The procurement and management risks identified in Nigeria's COVID-19 vaccine distribution process hold significant implications for the country's public health system and pandemic response efforts. Several key takeaways emerge from the analysis of these risks:

Strengthening Healthcare Infrastructure: The prevalence of concerns about inadequate storage capacity highlights the critical need to strengthen healthcare infrastructure. Building robust storage facilities with proper temperature control is imperative to prevent vaccine waste due to compromised efficacy. The implications of failing to address this risk could lead to vaccine shortages and a compromised vaccination campaign.

Resilient Supply Chain Management: The fragmented procurement system and logistical challenges highlight the importance of establishing a resilient supply chain management system. By streamlining the procurement process and optimizing logistics, Nigeria can ensure the timely and efficient delivery of vaccines to various regions. Failure to do so may result in delays, inefficiencies, and missed opportunities to protect the population.

Addressing Vaccine Hesitancy and Quality Concerns: The management risks related to low-quality vaccines and vaccine hesitancy emphasize the need for targeted public communication and education campaigns. Building public trust in the safety and efficacy of vaccines is crucial to overcome hesitancy. Ensuring the quality of vaccines through rigorous testing and adherence to international standards is essential to maintain the credibility of the vaccination program.

Boosting Preparedness for Future Pandemics: Poor and inadequate infrastructure poses challenges not only for vaccine distribution but also for future pandemic preparedness. Addressing infrastructure gaps will not only facilitate vaccine distribution but also enhance the overall capacity to respond to health emergencies effectively.

These implications call for collaborative efforts to address the identified risks comprehensively. By investing in healthcare infrastructure, improving supply chain management, and prioritizing transparent communication, Nigeria can strengthen its pandemic response capabilities and ensure the success of future vaccination campaigns.

The analysis indicates that Nigeria relies greatly on vaccine donations and calls for Nigeria as a government to adopt the following strategies:

Nigeria should explore the possibility of setting up a domestic vaccine manufacturing plant. This initiative can significantly reduce the reliance on external donations and aid. By producing vaccines locally, Nigeria can ensure a consistent supply of vaccines and even contribute to global health efforts.

Investing in research and development (R&D) in the field of vaccine production can yield long-term benefits. By fostering a supportive environment for local pharmaceutical companies and research institutions, Nigeria can develop its vaccine production capabilities and reduce dependency on external sources.

Collaborating with global pharmaceutical companies, research institutions, and international health organizations can facilitate technology transfer and knowledge sharing. These collaborations can accelerate the establishment of vaccine manufacturing facilities and enhance the capacity to produce vaccines domestically. Finally, the Nigerian government should allocate resources and provide financial support for vaccine manufacturing initiatives. Creating incentives, grants, and subsidies can encourage private and public sector involvement in developing vaccine production capabilities.

VI. DISCUSSION

The study's primary objective was to assess the risk that exists within the current vaccine procurement strategy and how those risks position the nation in terms of pandemic preparedness. The analyses conducted in provide valuable insights into the potential relationships between various variables and individuals' perceptions. However, the nuanced nature of vaccine decision-making becomes evident through the lack of statistical significance for some variables, highlighting the complexity of this decision-making process.

The results emphasize that vaccine decision-making is influenced by a confluence of factors that extend beyond the variables considered in the model. While some factors, such as individuals' perceptions of risks, exhibit relationships that are not statistically significant, they might still play a role when combined with other unaccounted variables. The intricate interplay of the entire system suggests that a holistic approach is necessary to capture the entirety of influences on vaccination procurement decisions.

The analysis in this study has practical implications for policymakers, healthcare agencies, and stakeholders involved in vaccine procurement and management. Practical implications include:

Transparency and Accountability: Highlighting the importance of transparent processes, streamlined regulations, and robust accountability mechanisms in reducing corruption risks.

Management Enhancement: Emphasizing the significance of effective management practices and the need for capacity-building initiatives to navigate procurement complexities.

Strategic Focus: Encouraging a strategic approach to procurement that considers transportation methods, storage systems, and risk mitigation strategies.

International Collaboration: Promotion of collaboration with international partners and global health organizations to enhance vaccine access and procurement efficiency.

One of the noteworthy findings is the positive correlation between individuals' perceptions of foreseeable procurement risks and their inclination towards COVID-19 vaccination. implies that individuals who perceive higher foreseeable risks are more likely to have a positive attitude towards vaccination. This relationship underscores the critical role of risk perception in shaping vaccination decisions.

Public health communication campaigns should consider leveraging this insight to develop strategies that transparently address concerns related to procurement risks. There is also need for in-country post market validation of all vaccines procured or donated to help reduce vaccine hesitancy and concerns on quality.

VII. Conclusion

This study contributes to our understanding of the various factors that the country should consider in its pandemic preparedness efforts. Using COVID-19 vaccine procurement strategies and assessing the risks associated with the strategies was an intentional effort to use a global pandemic subject to assess the resilience of the supply chain system and how the country is responding to health commodity security in an effort to respond to or prepare for health emergencies.

The fact that COVID-19 is a novel disease that took the whole globe by surprise was acknowledged in this study. However, the pandemic tested our emergency pandemic preparedness, and called for global security with many lessons learned for referencing. The effort of Nigeria government to secure some shots of the vaccine is highly applauded in this study as COVID-19 vaccines were practically scarce and difficult to come-by until advanced countries and organizations developed adequate vaccines that trouped into the country through high-level advocacy and for public good. The contributions of the European Union, US Master Card, COVAX, Canadian Government, US Government, Government of Japan, Indian Government, COVAX - USG and host of others that graciously supported Nigeria during the pandemic is gratefully acknowledged. We also appreciate the Nigerian regulatory agency, the National Agency for Food and Drug Administration and Control(NAFDAC) for her pro-activeness in approving and granting the Emergency Use Authorization(EUA) for the COVID - 19 vaccines. It is a regulatory body in Nigeria that is responsible for regulating and controlling the manufacturing, importation, exportation, advertising, distribution, and use of food, drugs, cosmetics, medical devices, and chemicals. The primary role of NAFDAC is to safeguard public health by ensuring that all food, drugs, and other consumables that are manufactured, imported, or distributed in Nigeria meet the required quality standards and are safe for consumption or use. NAFDAC is also involved in the registration and certification of regulated products, as well as the inspection and enforcement activities to ensure compliance with regulations and curbing counterfeit products. Overall, NAFDAC plays a crucial role in protecting the health and well-being of Nigerian citizens.

While the findings reveal mixed results in terms of statistical significance, they underscore the complex and multifaceted nature of procurement decision-making. The study highlights the importance of integrated or system view approaches in procurement decisions and the management of vaccines and other health commodities in response to pandemics. Also highlighted is the importance of transparent communication that addresses risk perceptions and fosters trust in the vaccination process.

By acknowledging the limitations of linear models and embracing a more holistic perspective, public health initiatives can develop targeted strategies to address health commodity procurement/security, which is a key indicator of pandemic preparedness. This involves tailoring interventions to specific communities, engaging local influencers, and leveraging cultural insights.

This study serves as a stepping stone for future research that can build upon these findings and further explore the complexities of the country's procurement decision-making. As we navigate the challenges posed by the ongoing pandemic, a thorough understanding of these factors will be instrumental in designing effective procurement strategies for health commodity security and management in readiness for any health emergency.

Ethics Approval and Consent to Participate

The study followed the ethical concept of informed consent because it asked organizations or businesses for permission to collect primary data. The information gathered was kept private and was used to evaluate and research this academic thesis. Because the names of those involved were not disclosed unless needed, privacy and confidentiality were maintained. Finally, the study cited every source used during the investigation.

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