

A Facility-Based Study of the Impact of COVID-19 on Supply Chain Performance of HIV/AIDS Commodities in Anambra State, Nigeria

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Abstract - The COVID-19 pandemic and its induced lockdown resulted in huge disruptions that affected access to and availability of healthcare commodities at different levels of the supply chain system. An understanding of the pandemic impact in different areas will help in designing strategies to mitigate future disruptions. This study was designed to evaluate the supply chain performance of HIV/AIDS commodities through the review of key performance indicators in health facilities in Anambra State, Nigeria, during the COVID-19 pandemic lockdown. A facility-based cross-sectional study was conducted across 27 selected health facilities in the state. Facilities were selected using a stratified random sampling technique. Data was collected using a combination of a semi-structured questionnaire and observational checklists adapted from a previous study and the Logistics Indicators Assessment Tool (LIAT). Data obtained were analyzed using SPSS software (version 23). A total number of 44 focal personnel managing the HIV/AIDS supply chain in 17 secondary health centres (SHCs) and 10 primary health centres (PHCs) participated in the study. Tenofovir/Lamivudine/Dolutegravir (300/300/50mg) and Nevirapine 10mg/ml oral suspension were the two most available drugs at 85.19% and 78% respectively whereas Determine and Uni-Gold were the most available non-drug commodities at 92.59%, and 81.48% respectively during the lockdown period. The Stat-Pak test kit was stocked out in 30% of the facilities during the lockdown

with emergency orders of at least one HIV commodity recorded in 37% of the facilities during this period. Expired products were recorded in 48% of the health facilities and this amounted to a loss of USD 4,027.25. The COVID-19 crisis exposed vulnerabilities in Anambra State's HIV/AIDS commodity supply chain. Instances of emergency orders, stock-outs, and wastage highlight the need for a more resilient system. Investing in an agile supply chain is crucial for ensuring uninterrupted access to essential healthcare commodities during disruptions.

Keywords - COVID-19 pandemic, HIV/AIDS, Supply Chain Performance, Health commodities.

1.0 Introduction

COVID-19 is a viral respiratory disease caused by the 2019 novel coronavirus (SARS-CoV-2) [1]. It was later reported to the World Health Organization (WHO) with the WHO declaring the outbreak a public health emergency of international concern and a pandemic in early 2020 [2]. As the number of people affected by this virus continued to increase rapidly across the globe, many countries considered and implemented a number of unprecedented responses targeted at reducing the transmission and spread of the virus. These responses

included quarantine measures, social distancing, travel restrictions, shutting down of different activities, and then, an ultimate lockdown [3].

These measures and decisions including the lockdowns disrupted economic activities in virtually every part of the world with strong impacts on the overall supply chains including health systems supply chains [2]. Consequently, there were disruptions in the flow of raw materials and semi-finished goods with severe effects on most organizations across the globe resulting in delays in the production of goods and increased costs of products and services [4]. One of the health systems severely affected by these disruptions is the HIV/AIDS programs with a great impact on the commodities' supply management [5].

The human immunodeficiency virus (HIV) epidemic remains a major global public health challenge, with more than 38.4 million people living with HIV worldwide and about 28.7 million people assessing antiretroviral therapy [6]. Although HIV treatment with highly active antiretroviral therapy has dramatically improved the health, quality of life, and general life expectancy of people living with the disease [7], availability and access to the medicines are critical to achieving these outcomes. Consequently, interruption of supplies and stock-outs of antiretroviral (ARV) agents will put individual patients at risk of drug resistance development, disease progression, and death [7].

Significant gaps persist in providing HIV care to all who are in need. Limited access and availability of antiretroviral agents due to pandemics and disasters can further widen this gap, especially in resource-limited settings such as Nigeria and other sub-Saharan African countries [8], [9]. This will result in an inability to deliver appropriate health commodities where and when needed in the right quantity, quality, and at the right cost and time affecting the overall program performance. Meanwhile, access to antiretroviral therapy (ART) for everyone who requires it is central to the attainment of the global goal of eliminating HIV.

Hence, this study aimed to assess the performance of the HIV/AIDS commodities supply chain with a focus on commodity availability, expiries, inventory management, and reporting systems during the COVID-19 lockdowns.

2.0 Methods

2.1 Study Design

This was an exploratory cross-sectional study that utilized both quantitative and qualitative approaches to evaluate the supply chain performance of HIV/AIDS commodities in health facilities in Anambra State during the COVID-19 lockdown.

2.2 Study area

This study was carried out in Anambra state, Nigeria. Anambra is one of the five states in the southeastern geopolitical zone of Nigeria with a population of 5,953,500 and a population density of 1,264/km² [10]. It is made up of 21 local government areas. The State is mainly inhabited by Igbo-speaking people and they are mainly traders who make up about 45% of the population and then, farmers, civil servants, and artisans [11].

The health care system in the state is made up of public, private for-profit, and private non-profit health systems with a three-tier structure of tertiary, secondary, and primary health facilities. There are an estimated 1386 hospitals in Anambra; out of these, 105 facilities are involved in comprehensive HIV/AIDS services and managed by implementing partners [12].

Anambra state with an HIV prevalence rate of 2.4% [13], has the highest in Southeastern Nigeria and the fifth highest state in terms of HIV transmission among people aged 15 and 49 years in Nigeria [14]. HIV/AIDS care in Anambra State, Nigeria is mainly dominated by funders and partners with the major ones being the Global Fund, Achieving Health Nigeria Initiative (AHNi), AIDS Healthcare Foundation (AHF), the US Presidential Emergency Program for AIDS Relief (PEPFAR), the United Nations system (UNAIDS), and recently, the private sector-driven HIV Trust Fund of Nigeria (HTFN).

2.3 Study Population and Study Sites

The study population consisted of one hundred and five (105) health facilities (HFs) that are involved in HIV interventions including voluntary counseling and testing (VCT), care and treatment activities as well as providing other ART services [12]. The selected centers are those managed by the two major HIV/AIDS implementing partners in Anambra state. These centers provide comprehensive HIV services including diagnosis and administration of ART. Only health facilities that have been offering both HIV testing and ART services for at least one year before the COVID-19 outbreak, and lockdowns, supported by funding organizations and managed by the implementing partners were included in the study. In addition, only commodities related to HIV programs were studied in the selected facility.

2.4 Study Sample and Sample Selection

The study sample was 15% of the targeted 105 health facilities identified in the state. This is in accordance with the recommendations of the Logistic indicators assessment tool (LIAT). Hence, a total of 16 health facilities were deemed appropriate for the study. However, to increase the representativeness of the results, an extra 10% of the number of health

facilities was added [15] to bring the sample size to a total of 27.

Therefore, 27 HFs distributed across the three senatorial districts in Anambra state namely; Anambra North, Anambra Central, and Anambra South were selected for the study. The state was stratified using the three senatorial districts in the state, and 9 health facilities were randomly selected from each of the strata. Tracer HIV products such as TDF/3TC/DTG (TLD) 300/300/50mg, Determine, Zidovudine (AZT)/Lamivudine (3TC) (60/30mg), Nevirapine 50mg/5ml (100ml bottle), Zidovudine (AZT) 50mg/5ml suspension, Dolutegravir 10mg, Atazanavir/Ritonavir 300/100mg and some other essential non-tracer commodities were assessed. In total, 20 ARV agents and four HIV test kits were selected for this study. The selection first considered commodities that are included in the tracer list of HIV/AIDS health commodities and then, front liners in regimen streamlining as well as products used by at least 90% of people designed to use the particular product.

2.5 Data collection instruments and procedures

A combination of semi-structured questionnaires and observation checklists adopted from a similar study carried out in 2020 by Damtie and his colleagues [16] and then, from the Logistics Indicators Assessment Tool (LIAT), were used for this study. The quantitative tool obtained information on stock on hand, physical count, emergency orders, expiries, and inventory control procedures from the different respondents. Whereas qualitative data was obtained from stakeholders and implementing partners including the heads of the pharmacy unit, ART dispensers, store managers and laboratory heads, VCT personnel, and ART coordinators, quantitative data was obtained from six-month information corresponding to the period when lockdown measures were implemented. The information was taken from the registers collected from the selected facilities. While data on bin cards, combined reporting and requisition form (CRRF), and patient per regimen (PPR) were retrospectively reviewed, data on the current stock status on the day of the visit were also taken. CRRF and PPR were used for the generation of quality and timely bi-monthly reports of HIV/AIDS commodities.

2.6 Ethical Consideration

Ethical approval for this study was obtained from the Health Research and Ethics Committee (HREC) of Chukwuemeka Odumegwu Ojukwu University Teaching Hospital (COOUTH), Awka with reference number, COOUTH/CMAC/ETH.C/Vol.1/FN:04/271). Also,

approval for site visits was obtained from the Anambra State Ministry of Health (Ref. No: MH/AWK/M/321/395). Verbal consent was obtained from all participants and confidentiality was assured. The anonymity of participants' data was maintained by excluding personal identifiers.

2.7 Data entry and analysis

Collected data were manually checked for completeness and consistency, entered into Excel, and exported to SPSS (version 23) for analysis. Quantitative data were analyzed by computing the frequencies, means, and percentages, and summary results were presented using tables and graphs. The stock-out rate was calculated by dividing the number of health facilities that encountered stock out of a product by the total number of health facilities that manage the product. Combined reporting and requisition form (CRRF) per-patient regimen (PPR) data quality was calculated by dividing the number of facilities that sent completed and accurate RRF on time by the total number of facilities that used CRRF and PPR reports.

For health facilities, the availability rate at HF was calculated by dividing the number of facilities with available products at the time by the total number of facilities reviewed. The availability of products was calculated by dividing the available products on the visit by the total products managed. The inventory accuracy rate of the commodities was calculated by dividing the physical inventory count by the recorded stock count. The frequency of emergency orders was calculated by dividing the number of health facilities that faced emergency orders by the total number of the selected facilities. Expiries were calculated by multiplying the expired quantity of each product with the price (prices were obtained from the 2020 updated list of HIV/AIDS commodities from UNICEF) and then, summing up the results from all products. The qualitative data obtained from in-depth interviews were summarized using the thematic analysis approach.

3.0 Results

3.1 Functional Capacity of the Selected Health Facilities

TABLE 1 shows the characteristics of selected health facilities used for the study. The selected 27 health facilities (HFs) were made up of 17 Secondary Health Centres (SHCs) (comprising 17 pharmacy stores and 17 laboratory stores), and then, 10 stores from the Primary Healthcare Centers (PHCs) with a total of 44 stores that were assessed in the study. Eight (8) pharmacists, 10 pharmacy technicians, and 10 medical laboratory scientists from SHCs were respondents in the study while 4 SHC-based nurses and 7 PHC nurses

participated. Five community Health Extension Workers (2 from SHC and 3 from PHC facilities) also

participated. Only 24 SHCs had the presence of product storage guidelines.

TABLE 1: Characteristics of Selected Health Facilities

Health Facilities	Variable	Frequency n (%)	SHCs n (%)	PHCs n (%)
Store	Number of stores	44 (100)	34 (77.27)	10 (22.73)
Human Resource	Pharmacists	8 (18.18)	8 (100)	0 (0)
	Pharmacy Technicians	10 (22.73)	10 (100)	0 (0)
	Med. Lab. Scientists	10 (22.73)	10 (100)	0 (0)
	Nurses/OIC	11 (25.00)	4 (36.36)	7 (63.64)
	CHEW (ART Officer)	5 (11.36)	2 (40)	3 (60)
Work Experience	6 months - 1 year	9 (20.45)	4 (44.44)	5 (55.56)
	1 - 2 years	11 (25.00)	10 (90.91)	1 (9.09)
	2 - 4 years	11 (25.0)	10 (90.91)	1 (9.09)
	> 4 years	13 (29.55)	10 (76.92)	3 (23.08)
LMIS Training	Received	43 (97.73)	34 (79.07)	9 (20.93)
	Not Received	1 (2.27)	0 (0)	1 (100)
Presence of HCMIS in store	Present	44 (100)	21 (66.67)	8 (33.33)
	Not present	0 (0)	0 (0)	0 (0)
Presence of STG & List of ARV	Present	24 (88.89)	17 (70.83)	7 (29.17)
	Not present	3 (11.11)	0 (0)	3 (100)
Presence of storage guideline	Present	24 (54.55)	24 (100)	0 (0)
	Not present	20 (45.45)	10 (50)	10 (50)
Supervision	The present month	21 (47.73)	13 (61.90)	8 (38.10)
	The past month	23 (52.27)	21 (91.30)	2 (8.70)
New Commodity Awareness training	Not oriented	0 (0)	0 (0)	0 (0)
	Oriented	44 (100)	34 (77.27)	10 (22.73)

Abbreviations: n - number; LMIS - Logistic Management Information System; HCMIS - Health Commodities Management Information System; STG - Standard Treatment Guideline; ARVs - Antiretroviral; HIV - Human Immunodeficiency Virus.

3.2 Report and Requisition Form (RRF) Data Quality

Stock cards were available in all SHCs and 8 PHCs visited but not available in 2 PHCs. In 88.24% of the SHCs and 60% of the PHCs, stock cards were up to date on the day of the visit (FIGURE 1). Also, 22 health facilities composed of 15 SHCs and 7 PHCs used Combined Reporting and Requisition Form (CRRF) and Patient Per Regimen (PPR) for reporting during the COVID-19 lockdown.

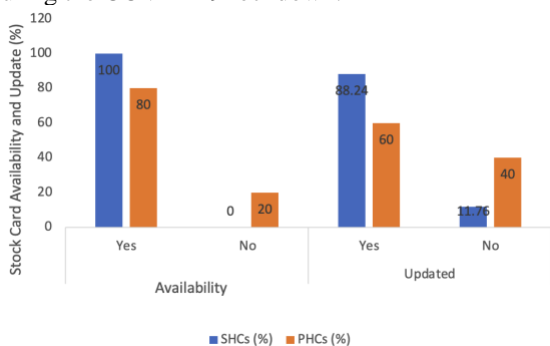


FIGURE 1: Stock Card Availability and Updating Practices at Health Facilities.

In FIGURE 2, data on the quality of CRRF and PPR reports for HIV products was shown. During the COVID-19 lockdown, 76.5% (13) of the secondary health centers (SHCs) and 50% (5) of the primary health centers (PHCs) filled completely, accurately, and submitted the reports on time, on or before the 7th day of the second month of the review period.

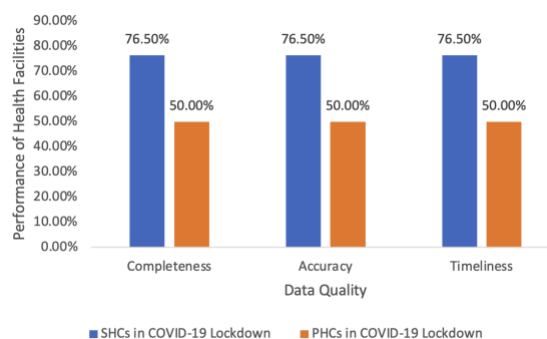


Figure 2.0: Data Quality of CRRF and PPR Reports for HIV Commodities in Health Facilities

3.3 Inventory Accuracy Rate

Out of the 27 HFs, 77.78% properly filled the stock cards (the physical stock count tallied with the recorded stock count). Among these, 55.56% of the facilities were secondary health centers while 22.22% were primary healthcare centers. The rest (22.22%) did not fill their stock cards properly.

3.4 Emergency Order of HIV/AIDS Commodities

Emergency orders of at least one HIV commodity were recorded in 37% (10) of the facilities during the lockdown. At 3 facilities (2 SHCs and 1 PHC), only 1 emergency order was recorded while 2 emergency orders were placed at 5 HF's (3 SHCs and 2 PHCs) and 2 placed at 2 HF's only. This is shown in FIGURE 3.0.

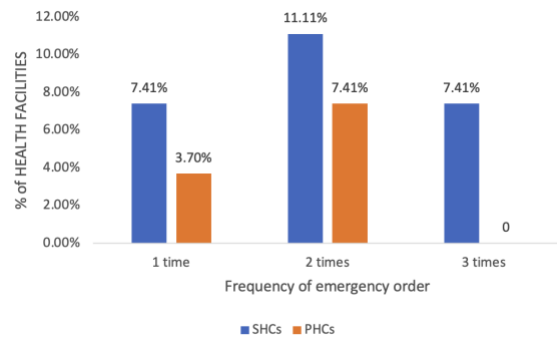


FIGURE 3: Emergency Orders in Health Facilities

3.5 Availability and Stock Out Rate of HIV/AIDS Commodities

Availability of HIV commodities at the health facilities are shown in FIGURE 4 with Tenofovir/Lamivudine/ Dolutegravir (TLD) (300/300/50mg) fixed-dose combination and Nevirapine 10mg/ml oral suspension being the two most available drugs with a percentage of 85.19% and 78% respectively. Determine, Uni-Gold, and Stat-Pak were available at 92.59%, 81.48%, and 70.37% respectively. The most frequently stocked out product was Stat-Pak which was stocked out in approximately 30% (8) of HF's, followed by Nevirapine and Uni-Gold which were stocked out in 22% and 19% of the facilities respectively (TABLE 2).

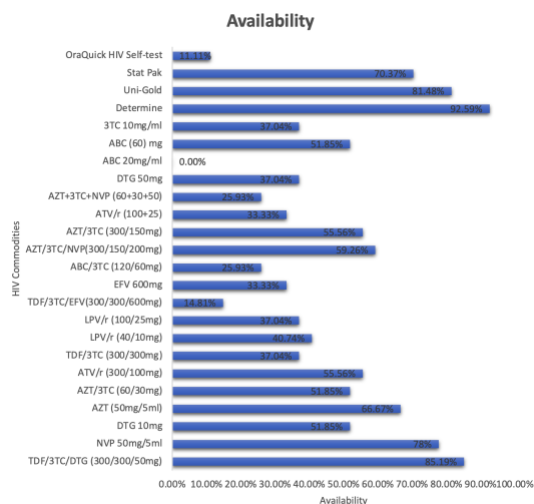


Figure 4.0: Availability of HIV/AIDS Commodities in Health Facilities

Table 2.0: Stock outs of Commodities in Health Facilities.

HIV/AIDS Products	COVID-Lockdown
TDF+3TC+DTG 300/300/50mg	15%
NVP 10mg/ml	22%
Determine	7%
Uni-Gold	19%
Stat-Pak	30%

3.6 Wastage of HIV/AIDS Commodities

Overall, USD 4,027.25 worth of expired HIV/AIDS products were found in the HF's studied. Expiry was recorded in 48% (13) of the health facilities; out of these, 37% (10) was from SHCs while 11% (3) was from PHCs. TDF/3TC/EFV (300/300/600mg) and Determine accounted for the majority (55%) of expiry worth \$2,189.55. TDF/3TC/EFV (300/300/600mg) contributed the highest at 34% and Determine accounted for 21% of the total expiry. Other expired products with their percentage contributions and cost are presented in TABLE 3.

TABLE 3: Percentage Expiry of HIV/AIDS Commodities in US dollars

HIV/AIDS Commodities	Value in USD	Percentage Contribution (%)
TDF/3TC/EFV 300/300/600	1,356.25	33.7
Determine	833.30	20.7
3TC/AZT 30/60	39.90	1
EFV 600	22.05	0.6
Uni-Gold	160.00	4.0
Stat-Pak	224.00	5.6
TDF/3TC 300/300	164.50	4.1
LPV/r 40/10	345.00	8.6
LPV/r 100/25	510.00	12.7
3TC/AZT 150/300	120.75	3
AZT 50mg/5ml(240ml)	3.00	0
ABC/3TC 120/60		6
Total	248.50	100
	4,027.25	

4.0 Discussion

This study utilized the assessment of some logistics indicators, including the product availability, stock out rate, inventory accuracy rate, frequency of emergency orders, reporting and requisition form (RRF) data quality, logistics record updating practice and product expiries, to determine HIV/AIDS commodities performance during COVID-19 lockdown in a Nigerian state. With a moderately

defective performance recorded during the study period including a minimal product stock-outs rate that resulted in emergency orders and then, wastages, there is a need for building a more resilient supply chain that will be efficient and effective during disruptions in the state and Nigeria at large.

Data and effective data management through logistics management information systems (LMIS) is key to managing supply chain systems and optimizing program performance while guiding decision-making processes. LMIS in addition to providing complete and timely data is the backbone for information flow and product visibility in the supply chains. Generating quality LMIS is important in monitoring key indicators of system performance in a supply chain [17], [18] with the quality being dependent on personnel training. Our study showed that 98% of the assessed staff had received training on the use of LMIS with all the HIV focal personnel in the secondary health centers (SHCs) already being trained. This high number of trained staff may have contributed to the high data quality observed in the study, especially with the secondary health facilities with an average data quality record of 76.50%. Although data quality has always been a challenge in supply chain systems, appropriate and effective personnel training together with adequate data entry time ameliorates these challenges [19]. However, the type and quality of the training were not ascertained during this study with more attention needed in the primary healthcare centers. Furthermore, the completeness, accuracy, and timeliness of the LMIS records and reports have been described as having a huge impact on the sustainable accessibility of essential health products [20].

Stock cards, reports, and requisition forms are among the tools that are used for inventory management in health facilities in Anambra state with their availability observed in all the secondary health facilities and in 80% of the primary health centers. However, updated forms were seen in 88.24% of the SHCs and only 60% of the PHCs with reports submitted on time in an appreciable percentage of the SHCs and in just about half of the PHCs studied. Reports are forms on which data are moved from one level in a logistics system to another and they are the mechanism through which logistics information is communicated and are usually transmitted from the lower to the upper levels of the supply chain [21]. Hence, supply chain facilities including service delivery points (SDP) should document and report their data and also ensure to submit reports generated from the data within the specified schedule or review period.

Although these numbers are high compared to what was reported in other studies where cards were updated in 69% of the facilities similar to the reports

of MAUL, 2013 [22] and Desale and colleagues in 2013 [23], these high reporting and update values may be because of the lockdown that reduced the number of people accessing their medications thereby creating more time for the personnel to do their routine data entry and other paper works. Again, it may be due to improvement in work ethics and understanding which may be directly linked to the level of training earlier reported. However, because there were no earlier studies in these centers prior to the lockdown, direct conclusions may not be obtainable at this point.

The inventory accuracy rate is one of the components of data quality that has a crucial impact on a report and it shows the paperwork (recorded data) compared to the physical count in a facility [24]. Of the 27 HFs studied, 77.78% properly filled their stock cards. Although training, supportive supervision, and constructive feedback are major factors influencing inventory accuracy rate, discrepancies observed in this study may not be unconnected with the choice and number of facilities studied, the size of the study area, and of course the quality of the training with staff motivation and commitment playing major roles.

COVID-19 restrictions disrupted the entire supply chain system with restrictions in movement and travels affecting the ordering and supply of commodities throughout the entire supply system. This effect was seen in our study with a good number of products recording low availability that resulted in stockouts of even some tracer commodities and subsequent emergency ordering. Stockout for fully supplied products such as HIV/AIDS commodities could be very expensive as they can result in resistance development and the cost associated with emergency orders is also usually high, further straining the already strained system.

Wastages are usually encountered in the supply chain management of HIV/AIDS commodities and they are products that can no longer be used because of being expired, unused, spilled, withdrawn, recalled, damaged, contaminated, or for any other reason [25]. This research explored only expiries as a wastage factor and recorded expiries in both laboratory HIV commodities and ARVs. Nearly half (48%) of the health facilities assessed recorded the expiry of at least one HIV/AIDS commodity with more expired products seen in the SHCs. Although restriction of movement and non-availability of transportation means during the lockdowns may have impeded the HIV patients' ability to access facilities for refills resulting in expiry, other factors may have also contributed to the number of recorded expired products.

Expiries had been recorded in other studies including a study of health commodity supplies in Cross River, Nigeria in 2017 that valued total expired

products between March 2013 and August 2014 to be around USD51,369.02 [26]. While these values are far higher than our present findings despite the lockdown, the previous studies were carried out long ago before the optimization of supply chain performance by most partners. The higher amount of wastage associated with secondary health facilities in this study may be traced to the fact that SHCs manage more volumes of HIV products than primary health centers.

The more contribution of TDF/3TC/EFV (300/300/600mg) to the total percentage of expired products may be associated with the policy of WHO to phase it out from the system in 2019. A mandate to phase out TDF/3TC/EFV (300/300/600mg) was transmitted to facilities by implementing partners and to switch about 50% of the HIV patients to TDF+3TC+DTG (300+300+50mg).

Handling expired products are usually expensive and a huge loss to the HIV program [25], [26]. Extra funds, time, energy, and expertise will still be invested in the reverse logistics including retrieval, transportation, and destruction of these expiries which might also increase the loss of resources significantly [26]. Even though the COVID-19 pandemic and its associated lockdowns have severely impacted on the global economic activities [27], including health systems management, it is believed that proper training, coordination of distribution, supportive supervision, routine monitoring, and periodic evaluation should complement well-trained program technical staff to enhance their capacity towards ensuring quality and efficient logistics management of HIV/AIDS commodities as well as improve expiries management. These chains of activities should be enhanced in pandemics or emergencies so as to heighten response, and preparedness and avert possible dangers in the supply chain management that will reduce wastage.

5.0 Conclusion

Overall, the COVID-19 crisis exposed vulnerabilities in Anambra State's HIV/AIDS commodity supply chain. Instances of emergency orders, stock-outs, and wastage highlight the need for a more resilient system. Investing in an agile supply chain is crucial for ensuring uninterrupted access to essential healthcare commodities during disruptions. This will help in the improvement of the overall performance of the HIV/AIDS supply chain.

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7.0 Disclosure

The authors show no conflict of interest in this research.

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9.0 Author Contributions

SON and JON designed the study. JON was responsible for data collection. JON and CCR analysed and interpreted the data. SON and JON drafted the manuscript. All authors reviewed and approved the manuscript.

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