



A 2-YEAR ASSESSMENT OF THE PERFORMANCE OF THE SUPPLY CHAIN OF ANTIRETROVIRAL MEDICINES IN SUPPORTED HEALTH FACILITIES IN OSUN STATE, SOUTH WEST NIGERIA

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ABSTRACT

An effective, efficient and uninterrupted antiretroviral drug supply chain management system is not an option but a necessity in order to curb the menace of drug resistance and HIV/AIDS epidemic. This study aimed to assess the logistics and inventory of antiretroviral drugs in supported HIV treatment centres. Combined Report and Requisition Forms of antiretroviral medicines prepared and transmitted to the Osun State Logistics Management Coordinating Unit, between January 2017 and December 2018 from the HIV clinics of supported health facilities were reviewed using key indicators. The collated data were analyzed using 2020 Microsoft Excel. Evaluation of the supply chain management system revealed that 32% of the antiretroviral medicines investigated fell within the recommended inventory level of 2 to 4 months of stock. Cumulative average reporting rate of 85% logistics management information system, 89% Timeliness of report submission, lead time of 16.1±5.238 days and 9.7% stock-out rate were observed. The findings of the study revealed that the practice in PEPFAR supported facilities was better compared to the GFATM supported sites, although some indicators were similar for both centres. However, the average stock-out rate (20.8%) for PEPFAR supported sites is above the tolerance rate and need to be improved on.

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INTRODUCTION

Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS) remain a major global public health concern. In 2015, an estimated 36.7 million people were living with HIV/AIDS (PLWHA), while about 78 million people have become infected with HIV and 39 million people have died of HIV/AIDS-related illnesses. Antiretroviral therapy is the mainstay in suppression of the virus and reducing transmission. The coverage of antiretroviral therapy (ART) is around 60% [1,2]. In 2014, United Nations Programs on HIV/AIDS

(UNAIDS) proposed new targets to increase HIV treatment scale-up in low- and middle-income countries. The targets described as “90-90-90”, proposes that 90% of PLWHA will know their HIV status, 90% of all people with diagnosed HIV infection will receive sustained ART and 90% of all people receiving ART will have viral suppression by 2020 which is now extended to 2030 [2,3]. To achieve this plan, there is need for a reliable supply and distribution of ART medicines to assure availability.

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Supply chain can be defined as a set of three or more organizations linked directly by one or more of the upstream or downstream flow of products, services, finances, and information from a source to a customer. Weaknesses or disruptions in antiretroviral medicine supply chains are frequently underestimated contributors to the development of HIV drug resistance (HIV-DR), particularly in low- and middle-income countries (LMICs) [4,5]. Health products supply chain in Nigeria is complex and consists of various organizations which include the Federal Ministry of Health, State Governments through their State Ministries of Health, Local Governments through the primary health care delivery system, the pharmaceutical sector including the manufacturers, wholesalers and retailers, national regulatory agencies, as well as the donors or funders. However, the Nigerian Federal Ministry of Health HIV/AIDS logistics system is charged with the responsibility to ensure a secure and dependable supply of HIV/AIDS commodities for diagnosing and treating people living with HIV and AIDS [6].

The inventory control system used in Nigeria is a pull forced ordering system. At the end of every review period, facilities review their HIV/AIDS commodities and order all stocks to the established maximum level. In Nigeria, Ordering is done bi-monthly on a requisition basis using the appropriate Combined Report and Requisition Form (CRRF) for ART and OI Drugs, HIV Test, Laboratory Commodities. Order quantities are based on the quantities of supplies that are used to serve clients (consumption) and quantities of stock on hand at the time the order is placed [6-8].

This study aimed at assessing the supply chain practice and inventory control performance of facilities providing ART medicines in Osun State over a 2-year period.

MATERIALS AND METHODS

Study Design and Setting

This was a two-year longitudinal and retrospective study, which set to evaluate the efficiency of the supply management practices of HIV/AIDS medicines supplied to the State of Osun, from January 2017 to December 2018, as being coordinated by the State Logistics Management Unit (LMCU) domiciled in the Department of Pharmaceutical Services of the State Ministry of Health, State of Osun, in the Southwestern part of Nigeria. Health facilities (HF) offering HIV services in the State are either supported by Global Fund to fight AIDS, Tuberculosis and Malaria (GFATM) or the USAID President's Emergency Plan for AIDS Relief

(PEPFAR). GFATM supports 6 ART and 25 PMTCT (Prevention of Mother To Child Transmission) health facilities while PEPFAR supports 8 ART and 6 PMTCT health facilities making a total of 45 facilities. The State Logistics Management Coordinating Unit (LMCU) was set up in the Department of Pharmaceutical Services, in the State Ministry of Health, Osogbo, in June 2014, in line with the approval of the National Council on Health in 2014 to coordinate the activities in all 45 centres. Before the establishment of LMCU, the different programs managed their logistics data individually resulting in less effective coordination of the activities as well as insufficient inter-program data visibility.

Ethical Consideration

Ethical clearance for this study was obtained from the Osun State Health Research Ethics Committee (OSHREC) of the State Ministry of Health, Osogbo, State of Osun with reference number OSHREC/PRS/569T/160.

Data Collection

The antiretroviral medicines that are currently being stocked and dispensed to HIV/AIDS clients in the State at the time of conducting this study were determined from the individual facility-based CRRFs submitted to the State Logistics Management Unit (LMCU). This is with a view of eliminating obsolete regimens during the retrospective study. The ARV medicines are Lamivudine (3TC), Abacavir (ABC), Atazanavir (ATV), Atazanavir/ritonavir (ATV/r), Zidovudine (AZT), Zidovudine/Lamivudine/Nevirapine (AZT/3TC/NVP), Nevirapine (NVP), Tenofovir (TDF), Tenofovir/Lamivudine/Efavirenz (TDF/3TC/EFV), Lopinavir/ritonavir (LPV/r) and Dolutegravir (DTG). For this study, the bimonthly-prepared Combined Report and Requisition Forms (CRRFs) for Antiretroviral and Opportunistic Infection (OI) Medicines were used in the gathering of information on antiretroviral medicines only; medicines supplied for the treatment of Opportunistic Infections (OIs) were not evaluated. The following data were extracted for the study as indicators to assess the supply management practices of ART medicines from all 45 facility-based CRRRIFs submitted to the State Logistics Management Unit (LMCU).

Stock Status of Antiretroviral Medicines

The stock status of ARV medicines was evaluated by computing their individual months of stock. The Months of Stock (MoS) gives clue to the number of months the available stock of a particular item will last in a maximum-minimum inventory control

system [9]. Using the stock on hand (SoH) data and the consumption data obtained from the completed bimonthly CRRF transmitted electronically by each of the supported health facility to the State LMCU throughout the entire 2 years under investigation, the Months of Stock for the various drug regimens were computed using the formula below:

$$\text{Months of Stock (MOS)} = \frac{\text{Stock on Hand (SoH)}}{\text{Average Monthly Consumption(AMC)}} \dots\dots\dots 1$$

Logistics Management Information System (LMIS) Reporting Rate

The reporting rate indicates the regularity of the health facility in submitting the LMIS reports for the bimonthly review periods. The LMIS reporting is done on a standardized Combined Report and Requisition Form (CRRF), and are sent by electronic mail to the State Logistics Management Unit (SLMCU) domiciled in the Department of Pharmaceutical Services of the State Ministry of Health and also to the supporting Implementing Partners (Hygeia Foundation/Prime Health Response Initiative or Institute of Human Virology of Nigeria/ APIN Healthcare Initiative) for onward transmission to National Agency for the Control of AIDS (NACA) where approval for supply of ordered HIV/AIDS health products would be actualized.

Formula: In this study, the reporting rate is calculated bimonthly as follows:

$$\text{LMIS Reporting Rate} = \frac{N_s}{N_e} \times 100\% \dots\dots\dots 2$$

where

Ns = number of reports submitted in a given bimonthly period,

Ne = number of expected reports for the same bimonthly period.

Timeliness of LMIS Reports

This indicates whether the LMIS reports are submitted on time. The LMIS report (CRRF) for HIV commodities is to be submitted on or before the 7th day of the reporting month. The date the LMIS report was prepared was usually indicated on the CRRF by each health facility before transmission by e-mail to the necessary quarters. Date indicated on CRRF was taken as the date it was sent to the State LMCU.

Formula:

$$\text{Timeliness of LMIS Report} = \frac{N_{sr}}{N_{er}} \times 100\% \dots\dots\dots 3$$

where:

Nsr = number of reports received within expected timeframe in the reporting period,

Ner = number of reports received any time for the review period.

Lead Time for Delivery of HIV Medicines

The Lead Time is the number of days it takes from the ordering of HIV medicines till the day it is received at the last mile delivery - the service delivery point and is available for dispensing to clients. Weekends and public holidays were excluded in the calculated number of days as the distribution of commodities to health facilities were expected to be made during working hours on working days (Mondays to Fridays) in accordance with distribution best practices [10]. So, the dates of finalized orders sent out and dates of SDP confirmed receipts of delivery were noted. The difference in both dates was regarded as the order lead time.

Stock-out Rate

The stock-out rate refers to the rate at which a product was not available in the store or clinic for use, and was also expected to give an indication on sustainability of the ART drug supply programme. For the purpose of the study, the percent stock-out rates were calculated for each bimonthly reporting period using the following formula:

$$\text{The \% stock – out rate} = \frac{T_r}{T_s} \times 100\% \dots\dots\dots 4$$

where

Tr = total number of facilities with reported stock-out in at least one ARV medicine,

Ts = total number of HIV supported facilities that submitted reports.

Data Analysis

Data on order, supply, consumption, months of stock, LMIS reporting rate, Timeliness, Lead time for delivery, reported expiry rate and stock out rate over two years were computed for the two consortiums (PEPFAR-14 facilities and GFATM-31 Facilities) using Microsoft Excel, their descriptive statistics such as percentages, average values and standard deviations were compared.

RESULTS

The Stock Status of ARV Medicines

The months of stock of individual ART medicines for each of the six reporting periods of the year was determined as presented in Table 1. Eleven ART

drug regimens had their mean MoS within the recommended inventory level of 2 to 4 months in PEPFAR supported sites while five ART drug regimens were observed for GFATM supported sites. AZT/3TC (300/150mg) tablets had the highest mean MoS of 41.3, which is astronomically higher than the recommended inventory level of 4 months in GFATM supported sites. The number of ART drug regimens that had mean MoS above the recommended inventory level in PEPFAR and GFATM supported health facilities were five and twelve respectively. Also, the number of ART drug regimens that had mean MoS below the recommended inventory level in PEPFAR supported

health facilities were three as against none in GFATM supported sites.

The LMIS Reporting Rate

The Logistics Management Information System (LMIS) reporting rate is as presented in Figure 1 below, in which 100% was recorded in six out of 12 bimonthly review periods of the 2 years under investigation for Global Fund supported sites. Reporting rate was 100% for PEPFAR supported sites in all the 12 bimonthly review periods. An overall performance of 85% LMIS reporting rate was achieved.

Table 1. Months of Stock of ART

ART Medicine	PACK SIZE	PEPFAR		GFATM		PEPFAR + GF	
		mMOS	Standard deviation	mMOS	Standard deviation	mMOS	Standard deviation
AZT/3TC/NVP (300/150/200mg)	60 tabs	2.1	± 0.253	2.6	± 0.732	2.3	± 0.593
ABC/3TC (600/300mg)	60 tabs	2.6	± 1.358	-	± 0.000	2.6	± 1.358
AZT/3TC (300/150 mg)	60 tabs	1.9	± 0.751	41.3	± 76.152	21.6	± 56.365
TDF/3TC (300/300 mg)	30 tabs	1.9	± 0.359	2.8	± 3.435	2.4	± 2.434
TDF/3TC/EFV (300/300/600mg)	30 tabs	2.1	± 0.499	2.0	± 0.525	2.1	± 0.505
TDF/3TC/DTG (300/300/50mg)	30 tabs	7.2	± 0.024	6.7	± 6.830	6.9	± 3.957
DTG 50mg	60 tabs	4.8	± 7.725	-	± 0.000	4.8	± 7.725
EFV 600 mg	30 tabs	2.3	± 0.780	15.8	± 20.625	9.1	± 15.861
AZT 300mg	60 tabs	2.3	± 0.645	2.6	± 0.000	2.4	± 0.629
ATV/r 300/100mg	30 tabs	1.9	± 0.615	10.5	± 13.496	6.2	± 8.457
LPV/r 200/50mg	120 tabs	2.0	± 0.531	6.5	± 0.931	4.2	± 5.064
AZT/3TC/NVP (60/30/50mg)	60 tabs	2.4	± 0.641	2.2	± 0.920	2.3	± 1.067
ABC/3TC (60/30mg)	60 tabs	2.8	± 1.640	10.5	± 4.477	6.6	± 8.593
AZT/3TC (60/30mg)	60 tabs	2.7	± 1.102	17.7	± 22.539	10.2	± 16.636
EFV 200mg Scored	90 tabs	3.1	± 1.094	38.4	± 27.329	20.7	± 21.968
AZT 50mg/5mL	240 mL	5.6	± 1.937	9.3	± 10.371	7.5	± 4.579
NVP 50mg/5mL	100 mL	5.4	± 2.198	4.8	± 3.293	5.1	± 2.754
LPV/r 100/25mg	60 tabs	2.5	± 1.515	11.8	± 8.753	7.1	± 6.966
LPV/r 40/10mg Pellets	300 mL	6.7	± 2.768	6.1	± 3.466	6.4	± 2.947

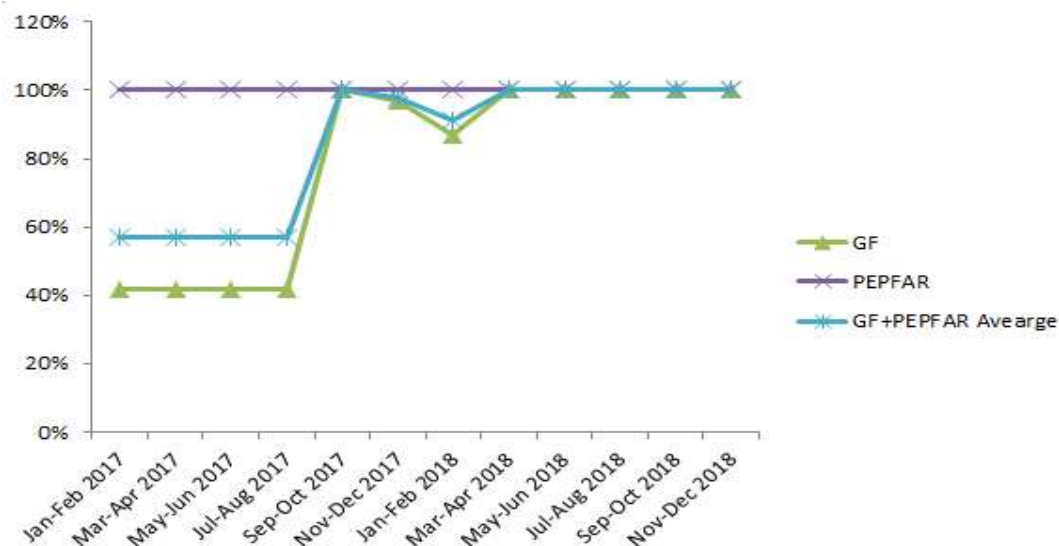


Figure 1. LMS reporting rate for the submission of CRRF by supported sites in the State of Osun

Table 2. Timeliness of report (CRRF) submission by supported sites in the State of Osun

Reporting period	Global Fund			PEPFAR			GF + PEPFAR		
	Number of submitted reports	Number of reports submitted timely	Timeliness rate	Number of submitted reports	Number of reports submitted timely	Timeliness rate	Number of submitted reports	Number of reports submitted timely	Timeliness rate
Jan-Feb 2017	13	6	46%	11	11	100%	24	17	71%
Mar-Apr 2017	13	6	46%	11	11	100%	24	17	71%
May-Jun 2017	13	6	46%	11	11	100%	24	17	71%
Jul-Aug 2017	13	6	46%	11	11	100%	24	17	71%
Sep-Oct 2017	31	31	100%	11	11	100%	42	42	100%
Nov-Dec 2017	31	30	97%	10	10	100%	41	40	98%
Jan-Feb 2018	29	27	93%	14	14	100%	43	41	95%
Mar-Apr 2018	30	29	97%	14	14	100%	44	43	98%
May-Jun 2018	30	29	97%	14	14	100%	44	43	98%
Jul-Aug 2018	30	29	97%	14	14	100%	44	43	98%
Sep-Oct 2018	30	29	97%	14	14	100%	44	43	98%
Nov-Dec 2018	30	29	97%	14	14	100%	44	43	98%
Total	293	257	80%	149	149	100%	442	406	89%

Table 3. Lead time for supply of antiretroviral medicines to supported health facilities in the State of Osun

Reporting period	Date HIV LMD order plans were finalized and transmitted	Date Health facilities received supplies	Number of days from LMD order plans transmission to receipt of HIV products by HFs
Jan-Feb 2017	NA	28-03-17	NA
Mar-Apr 2017	NA	30-05-17	NA
May-Jun 2017	13-07-17	31-07-17	18
Jul-Aug 2017	12-09-17	26-09-17	14
Sep-Oct 2017	13-11-17	24-11-17	11
Nov-Dec 2017	12-01-18	25-01-18	13
Jan-Feb 2018	12-03-18	23-03-18	11
Mar-Apr 2018	11-05-18	01-06-18	21
May-Jun 2018	12-07-18	25-07-18	13
Jul-Aug 2018	12-09-18	24-09-18	12
Sep-Oct 2018	12-11-18	05-12-18	23
Nov-Dec 2018	11-01-19	05-02-19	25
Average			16.1±5.238

NA: Record Not available/ Not found LMD: Last Mile Distribution

Table 4: Reported stock outs by supported sites in the State of Osun

Reporting period	Global Fund			PEPFAR			GF + PEPFAR		
	Number of submitted reports	Number of reports with stock outs	Stock out rate	Number of submitted reports	Number of reports with stock outs	Stock out rate	Number of submitted reports	Number of reports with stock outs	Stock out rate
Jan-Feb 2017	13	0	0.0%	11	4	36.4%	24	4	16.7%
Mar-Apr 2017	13	0	0.0%	11	0	0.0%	24	0	0.0%
May-Jun 2017	13	1	7.7%	11	3	27.3%	24	4	16.7%
Jul-Aug 2017	13	0	0.0%	11	2	18.2%	24	2	8.3%
Sep-Oct 2017	31	0	0.0%	11	2	18.2%	42	2	4.8%
Nov-Dec 2017	31	3	9.7%	10	0	0.0%	41	3	7.3%
Jan-Feb 2018	29	0	0.0%	14	2	14.3%	43	2	4.7%
Mar-Apr 2018	30	2	6.7%	14	4	28.6%	44	6	13.6%
May-Jun 2018	30	0	0.0%	14	2	14.3%	44	2	4.5%
Jul-Aug 2018	30	3	10.0%	14	5	35.7%	44	8	18.2%
Sep-Oct 2018	30	1	3.3%	14	3	21.4%	44	4	9.1%
Nov-Dec 2018	30	2	6.7%	14	4	28.6%	44	6	13.6%
Total	293	12	4.1%	149	31	20.8%	442	43	9.7%

Timeliness of LMIS Reports

Complete (100%) timeliness of LMIS reports was recorded in all the two years of retrospective study for PEPFAR supported sites. There was varying timeliness of reports in Global Funded facilities

ranging from 46% to 100% over the different months of the study period but 80% was computed for GFATM supported sites, while an overall performance of 89% timeliness of submission of LMIS reports was achieved for all supported sites in

the State of Osun. The Timeliness was poor in both centres in the first half of 2017, but improved drastically in throughout the remaining study period (Table 2).

The Lead Time for Delivery of ARV Medicines

The dates order plans were finalized and transmitted for Jan-Feb 2017 and Mar-Apr 2017 reporting periods could not be located. However, the average number of days from last mile distributed order plans transmission to receipt of HIV products by HFs for the remaining 10 reporting periods under investigation was computed to be 16.1 ± 5.238 days as depicted in Table 3. The Lead Time fell within the program-specified limit of 14 days in 6 out of 10 reporting periods.

The Reported Stock-out

An average of 4.1% and 20.8% stock outs were reported for GFATM and PEPFAR supported sites respectively, while an overall average of 9.7% reported stock out was computed as observed in Table 4.

DISCUSSION

This study sought to assess the supply management practices and inventory control status of ART medicines in Osun State. The supply chain practices were generally good in the combined sites, but the PEPFAR supported sites have better efficient supply chain compared to the GFATM supported sites. The computation of Months of Supply (MoS) assists in recommending potential solutions to mitigate problems of stock-outs and expiries of antiretroviral medicines in order to avert drug supply interruptions and wastages respectively [10]. MoS is better monitored in PEPFAR supported sites than in GFATM supported sites, so the problem of stock-out was unlikely before the supply of reordered medicines were delivered.

AZT/3TC (300/150mg) tablets that had the highest mean MoS of 41.3 in GFATM supported sites, which is astronomically higher than the recommended inventory level of 4 months. This means that, with the average consumption rate, the product could last for a period of 41.3 months (3.4 years) before it will be completely consumed. From the number of ART drug regimens that had mean MoS above and below the recommended inventory level, the GFATM supported sites have higher tendency of expiries than PEPFAR supported sites. The tendency of stock outs is higher in PEPFAR than GFATM supported sites. However, in GFATM, stock out was evident in some ART medicines.

The sub-optimal performance in the reporting rate in GFATM supporting sites mainly in year 2017 might be due to little or no training and experience of health workers managing HIV products in LMIS, and hence, they might be ignorant of the importance of proper record keeping. This constitutes barrier to optimal performance in LMIS reporting rate, uninterrupted supply of ARV medicines and effective care service delivery to HIV clients. Similar challenge has been reported in many settings in LMICs [10-12]. This shows that more improvement should be made so that ART medicines could get to the facilities within acceptable time frame. In order to evaluate how well a logistics system is operating, the lead time should be measured, and concerted efforts should be made to reduce it for ART medicines to be available at the right time [6-9].

There is no warehouse for HIV/AIDS commodities in the State of Osun, as the State does not procure and store these commodities as at the time of this study [9,10]. Hence, it takes time for these commodities to be transported from long distances before getting to the service delivery points. A study emphasized that the time required for replenishment of stocks from a central warehouse to ART centre can be long for some countries due to the number of distribution points and the efficiency of information sharing between points [13].

Stock-out in the GFATM supported sites was within the acceptable limit, but for the PEPFAR supported sites it was 20.8%, which means ART medicines were not available in the supported facilities 20.8% of the time which is quite high. The problem of stock outs of ARTs was also reported in a North-Central State of Nigeria with 4.8% of the prescribed medicines that were out-of-stock in public hospitals. Similar trend was noted in other States where most government-owned hospitals were plagued with the out-of-stock or stock-out phenomenon [14-17].

With many countries scaling up antiretroviral therapy, it is vital to avoid interrupted drug supplies or stock-outs, which would lead to drug resistance and treatment failure. Considering the fact that adherence to ART must not be less than 95%, thus a mere failure to take ART medications for 2 days could have terrible implications [15,18]. Government's commitment towards promoting a sustainable drug supply system, and to implement sustainable ART scheme cannot be overemphasized. The strength of this study lies in the fact that all healthcare facilities involved in providing ART were included, hence results presented is a picture of logistics and inventory practices of ART in Osun State as at the time of the study. However, the supply chain practice of other

medicines used in HIV management such as those used for opportunistic infections and non-drug supplies were not included in the study. A comprehensive assessment of these items may be the direction for future research. A limitation of this study is time bias since current realities may be different from reported data of some years ago.

CONCLUSION

Findings from this study revealed that performance of the supply chain as well as the inventory control practices of antiretroviral medicines to supported HIV clinics of the State of Osun, South west of Nigeria was good. The practice in GFATM supported facilities was generally poor using the months of stock and stock-out compared to the PEPFAR supported sites, although other indicators were similar for both centres. However, the average stock-out rate (20.8%) for PEPFAR supported sites is above the tolerance rate and need to be improved upon.

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CONFLICT OF INTEREST

None

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