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Article

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Evaluating a humanitarian supply chain network: Empirical findings from the HIV/AIDS program in Nigeria

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Abstract
Nigeria had the first 3 cases of HIV infection reported in 1984; today this has grown to over 2 million people. The Joint United Nations Program on HIV/AIDS (UNAIDS) plan aims to end the HIV scourge by the year 2030 and Nigeria like other countries has set up a humanitarian supply chain network connecting the various research and clinical laboratories. This paper presents the findings of the evaluation of this HIV/AIDS program in Nigeria. Facilities laboratories were visited by the researchers two times; before and after the application of the monitoring and supportive visits (MSV) activities. The findings included poor logistics management of commodities, lack of useful logistics data, poor reporting of utilization, stock-outs of commodities at some facilities and expiries of same in other facilities, wide knowledge gap on logistics management and poor storage condition. After two cycles of the adoption of the MSV, there was an improvement in the testing, reduced stock out, reduced expiries, proper storage of commodities, improved on-time logistics data reporting rate.

Keywords: Humanitarian supply chain, HIV/AIDS, Nigeria, Monitoring.

JEL classifications: I18, I11, H51, H57, H75, H76

Introduction

Several interventions have been enacted in Nigeria since the first case of Human Immune Virus HIV/AIDS was reported in 1984 in a 13-year-old girl in Lagos (FMHSS, 1992). These efforts include the first National Strategic Framework for Action tagged NSF 2005-2009 and the National Strategic Plan (NSP) 2015 (NACA, 2012). Equally, global efforts to curb the menace of HIV/AIDS have been on the increase in the past few decades.

At the 20th International AIDS Conference, the Joint United Nations Program on HIV/AIDS (UNAIDS) called for an ambitious treatment target "90-90-90" to eliminate the epidemic by 2030 (UNAIDS, 2014). This means that by 2020, 90% of people living with HIV should know their HIV status, 90% of those that know their HIV status should be placed on antiretroviral treatment, and 90% of those on treatment should have viral suppression (UNAIDS, 2014). The actualization of this noble vision requires aggressive efforts at reducing new infections amidst more efficient models of care (National Academy of Sciences, 2010). Early identification and treatment remain the gateway to achieving optimal viral suppression and reducing transmission rates of HIV/AIDS. Along with this, Davies, Pinto, and Bras (2015) said that

innovation, information, intersectoral and interagency collaboration are required to be able to achieve the 90-90-90 strategy.

Polymerase Chain Reaction (PCR) testing comprising Early Infant Diagnosis of exposed infants and viral load monitoring of adult patients on treatment is a vital component of the HIV/AIDS program of the Nigerian government supported by the United States President's Emergency Plan for AIDS Relief (PEPFAR). The 2010 and 2014 revised guidelines published by the WHO emphasized the urgent need for biological monitoring in the management of HIV/AIDS patients (WHO, 2010; WHO, 2014).

PCR testing in Nigeria in the past was handicapped by the inefficiencies that had hitherto plagued the HIV/AIDS program, key among which was multiple supply chain systems characterized by high cost and poor resource utilization. Similarly, poor logistics knowledge among staff and non-availability of logistics tools and enabling environment as well as poor inventory practices were the major constraints facing staff involved in logistics management of HIV commodities. These resulted in non-availability of quality data to support supply chain management decisions, PCR commodities overstocks and sometimes stock-outs at the service delivery points. The above scenarios were discussed in the research done by Roberts, Bygrave, Fajardo, and Ford (2012) as challenges prevalent in resource constrain countries implementing virologic testing. To overcome these challenges, a decision support system approach: where the Government of Nigeria (GON) and supporting partners organized monitoring and supportive visits (MSV) to the 29 out of 30 PCR facilities was adopted to provide support to the facilities using logistics management information system (LMIS) tool to mentor the facility personnel. During these visits, MSV providers interact with staff involved in the logistics management of PCR commodities at the testing sites to gain visibility into commodity management practices. These interactions were guided by the MSV checklist that periodically undergoes joint review by stakeholders to ensure that the tool adequately captures all relevant information during the visits to the sites.

Health4Africa (2013) cited Maquez and Kean (2002) in the description of monitoring supervision as a process that promotes quality service at all health care system that strengthens the relationships that exist within that system with the focus on identifying challenges and proffering solutions for the benefit of the patient who should receive high standards of care. One of the cornerstones of supportive supervision is, therefore, to work with health staff to set goals, monitor performance, identify and correct problems and proactively improve service quality. Together, the supervisor and health workers identify shortcomings in the field and directly work on it, thus avoiding the bad practices become habits. Supervision visits are also an opportunity to encourage good practices and help health workers to maintain high-quality delivery.

In this paper, the application of the above supportive system is examined and evaluated. 23 out of 30 PCR facilities PCR laboratories were visited by the researchers twice; before and after the application of the monitoring and supportive visits (MSV) activities. Case study approach in qualitative research was used to gather the data for analysis. The findings included poor logistics management of commodities, lack of LMIS data collection tool, poor reporting of utilization, stock-outs of commodities at some facilities and expiries of same in other facilities, wide knowledge gap on logistics management, poor storage condition.

Then, after two cycles of the adoption of the MSV, there was an improvement in the testing, reduced stock out, reduced expiries,

proper storage of commodities, improved on-time LMIS data reporting rate. Therefore, supply chain management through MSV can be used to improve the services of PCR laboratories to meet the UNAID 90-90-90 concept with a recommendation to continue a quarterly MSV to PCR facilities and extend this to other areas of laboratory services.

Examining the HIV/AIDS program

The aspects of supply chain management of PCR commodities of concern, entail the procurement of the commodities, warehousing, and distribution to the last mile. The connecting links for all these stages involve the generation of logistics management information system (LMIS) data which the personnel at the service delivery points must collect and report accurately in a timely manner to ensure smooth bimonthly resupply circle adopted for the country's use. This, in turn, enables efficient services to the clients on the ART. Monitoring and supportive visit are adopted as the approach to improve management of the PCR commodities and the collection of LMIS data for timely and accurate reporting for a decision on the resupply of commodities.

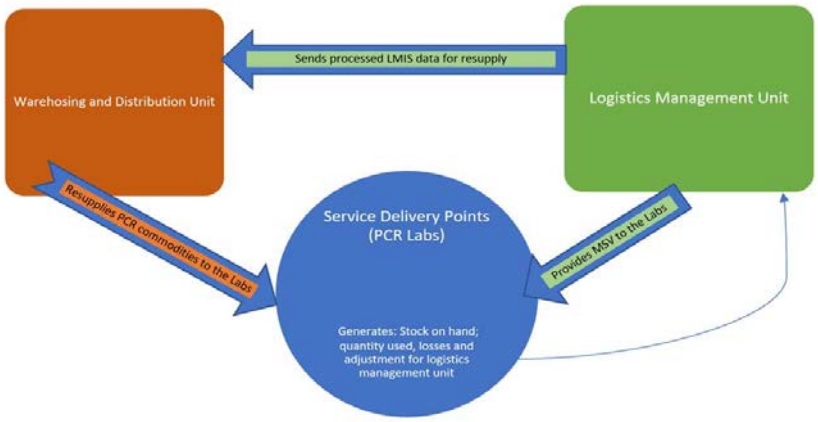

Figure 1. Diagram of the examined supply chain

The intervention provided by the MSV approach as shown in Figure 1 above is to ensure that the service delivery points (PCR laboratories) know how to properly keep the commodities in their custody, keep proper logistics data in an accurate reporting unit to submit a timely and correct Combined Report, Requisition, Issue and Receipt Form (CRRIRF). The reports submitted by all the PCR labs are then processed, analyzed for the quantity to be resupplied by the warehousing unit. Overstock and stock-out of PCR commodities are heavily dependent on the accuracy of the CRRIRFs. Correct and timely submission of CRRIRF is dependent on the knowledge of the personnel handling commodities at the facilities. To enhance the knowledge of the personnel, the MSV approach provided the enabling environment to do so. The logistics management unit then transmits to the warehouse the quantity of commodities to be resupplied to the PCR labs based on the logistics data reports that were collected from there.

Out of the 25 PCR facilities visited during the maiden PCR MSV in January 2015, 72% had functional equipment while only 32% were running assays during the week of MSV. Early Infant Diagnosis (EID) and viral load reagents stock-outs were seen at 40% and 32% of the facilities respectively. 92% of the facilities had EID samples backlog while 36%

had viral load sample backlogs. The total number of EID and viral load backlog in the country at the time of the January MSV was 12,281 and 23,956 respectively. Many of the available viral load backlogs were older than 6 months bringing to question the diagnostic value of such samples to the clients. Key factors identified as constraints to optimal PCR service delivery included a poor demonstration of ownership and support for the PCR laboratories by Management of some health care facilities, poor logistics knowledge among PCR staff, shortage of trained logistics staff, non-availability of inventory tools and use of non-standardized tools among other. Recommendations from the MSV included; continuous capacity building in commodity management for PCR staff, the design of a Daily Worksheet for PCR laboratories by the Laboratory Technical Working Group (LTWG), resolution of power supply issues at PCR testing sites and regular supply of PCR commodities by SCMS. A major outcome of the January 2015 MSV was a collaborative approach by all stakeholders to ensure that all EID samples backlog in-country were logged and tested at selected PCR facilities.

As of August 2015, there were 28 PCR laboratory locations in Nigeria. However, 2 of these facilities (Federal Teaching Hospital Gombe, Our Ladies of Apostle Hospital (OLA), were yet to be automated and consequently were not running assays due to the phasing out of the Gene-Amp 9700 platform by the manufacturer Roche. Distribution of PCR commodities to the automated PCR laboratories via last mile delivery mechanism to these facilities commenced in March 2015.

Similarly, in line with the mandate for pooled procurement and distribution of PCR commodities to testing sites, LMIS data were collected and collated bimonthly from the PCR facilities for evidence-based decisions. The quality of data plowed back into strategic decisions is critical to the success of any program. PCR LMIS reporting from facilities has recently witnessed a marked improvement due in part to the mentoring provided to PCR staff during the maiden PCR laboratories MSV, as well as, ongoing support provided to the personnel through phone calls, emails, and other media.

However, a review of reports from these facilities indicates the persistence of infrastructural and capacity gaps that negatively impact the quality of service delivery at the testing sites. Equally, adherence to reporting deadlines has remained a challenge with some PCR laboratories reporting much later than the stipulated dates. This underscores the importance of continuous efforts to update the inventory management skills of health facility staff and their capacity to generate and transmit timely and quality reports which will not only guide resupplies but also provide the much-needed data for logistics and other decisions by stakeholders.

After three cycles of PCR commodities distribution and LMIS data collection, efforts were made for follow-up visits to the PCR facilities as part of the National MSV to ART facilities. The second edition of the PCR laboratories MSV was intended to help assess progress made since the January 2015 MSV as well as identify further areas for improvement. Teams of MSV providers administered the MSV checklist at the PCR facilities and made general observations on issues like product storage conditions, inventory management and Logistics Management Information System (LMIS) among others, capable of impacting commodity availability. Key stakeholders in the EID/ VL program, GON, NACA, CHAI, and IPs participated in the MSV that was conducted from 24th to 28th August 2015.

Description of the examined HIV/AIDS program and supply chain

The main objective of this study is to evaluate the usefulness of the monitoring and supportive visits that have been applied to improve the supply chain management of commodities for the running of PCR laboratories. Specifically, the study areas are the PCR laboratories located in 25 cities in Nigeria. Seven (7) teams of two (2) people went out for one (1) week to visit all the facilities except the University of Maiduguri Teaching Hospital that could not be visited due to security challenges in Borno State during the month of August 2015 when the MSV occurred.

Initially, a preparatory meeting of EID/VL stakeholders was held to review the MSV checklist and Job aid as well as develop an activity schedule for the PCR MSV that was integrated into the quarterly National MSV to ART facilities. Then, seven (7) teams working in pair of MSV providers drawn from SCMS, NACA, National Agency for the Control of Sexual Transmission Infection and AIDS Programme (NASCP) and Clinton Health Access Initiative (CHAI) worked with State Logistics Management Coordinating Unit (LMCU) Staff and Implementing Partners (IP) representatives to conduct MSV to 26 PCR facilities. On arrival at the facilities, the MSV providers met with available management staff to intimate them of the purpose and scope of the visit as well as solicit their support for the activity. Key staffs involved in the logistics management of PCR commodities were identified and interviewed using the semi-structured MSV checklist. Areas covered include; Availability personnel and SOP manual, LMIS tools availability, assessment of storage conditions, electronics logistics management information system (e-LMIS) readiness, program data and physical inventory of available commodities. Review of logistics records was performed to assess the quality of record keeping and reporting while other observed issues capable of impacting the supply chain management of PCR commodities was noted. The teams visited and inspected the storage areas and stored products to assess the level of compliance with storage guidelines. Stock levels of available products were reviewed to identify overstock or under-stock of commodities and redistribution was done as needed to avert stock outs and expiry.

On the job training and mentoring was provided to staff on key elements of health care commodities management to help address observed anomalies. Constructive feedback was provided to management on the strengths and gaps that exist in the supply chain management of commodities and recommendations were made for the improvement of identified weaknesses. Data collected from the PCR facilities were analyzed using Microsoft Excel. The comparison was done with baseline data from the January 2015 PCR laboratories MSV to identify instances of progress or otherwise in logistics management of PCR commodities at the service delivery points.

Observations / Finding

Figure 2 below shows the PCR laboratories concentration based on states at the time of MSV. Presently, the PCR laboratories are spread out across 17 states with Lagos and FCT having the largest concentration of 4 PCR facilities each, followed by Plateau state with 3 PCR laboratory locations.

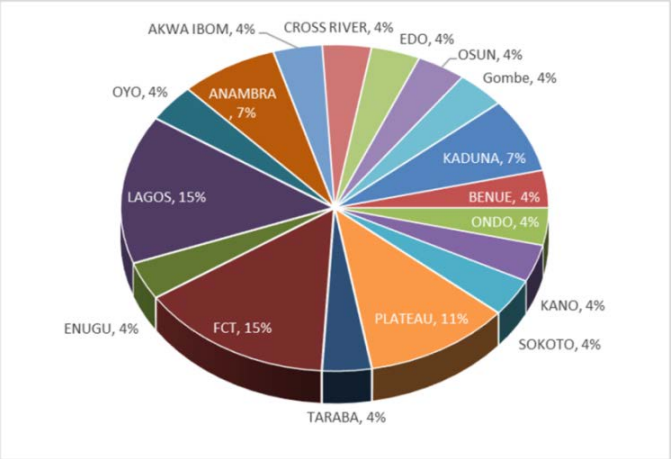

Figure 2. Percentage of PCR machine locations in states

Pre and post-state of the PCR laboratories are examined based on the following parameters:

- Trained personnel and standard operating procedure (SOP).
- LMIS tools and resupply strategy.
- PCR commodities storage conditions.
- Electronic-LMIS readiness, and
- Program data.

Trained personnel and standard operating procedure (SOP) manual for the logistics management of HIV/AIDS commodities (LMHC)

Findings from the August 2015 MSV indicated a 21% increase in the number of PCR laboratories with personnel who had received the 5 days comprehensive training on logistics management of health care commodities (LMHC) compared to the January 2015 MSV figures. However, 10 out of the 26 PCR facilities visited in August 2015 still lacked personnel trained on LMHC. Equally, compared to baseline findings in January 2015, there was no significant increase in availability of the LMHC SOP at the PCR facilities during the August 2015 MSV. Only 35% of the PCR laboratories could produce a copy of the LMHC SOP at the time of visit.

LMIS tools and resupply strategy

A general improvement in LMIS tool availability was noticed during the August MSV as seen in Figure 4 below. Inventory control cards were available in 23 (88%) of the PCR facilities as against 68% in January. Daily consumption records were available in 21 (81%) of the PCR labs while Internal Requisition voucher and Return and Transfer forms were sighted at 15 (58%) and 19 (73%) respectively of the facilities visited. All 23 automated PCR laboratories visited during the MSV had electronic copies of the PCR LMIS bimonthly Combined Report Requisition Issue and Receipt Form (CRRIRF) and 22 (92%) of these had submitted reports for the May-June cycle at the time of visit. This is in sharp contrast to the 39% LMIS report submission rate recorded during the baseline visit in January.

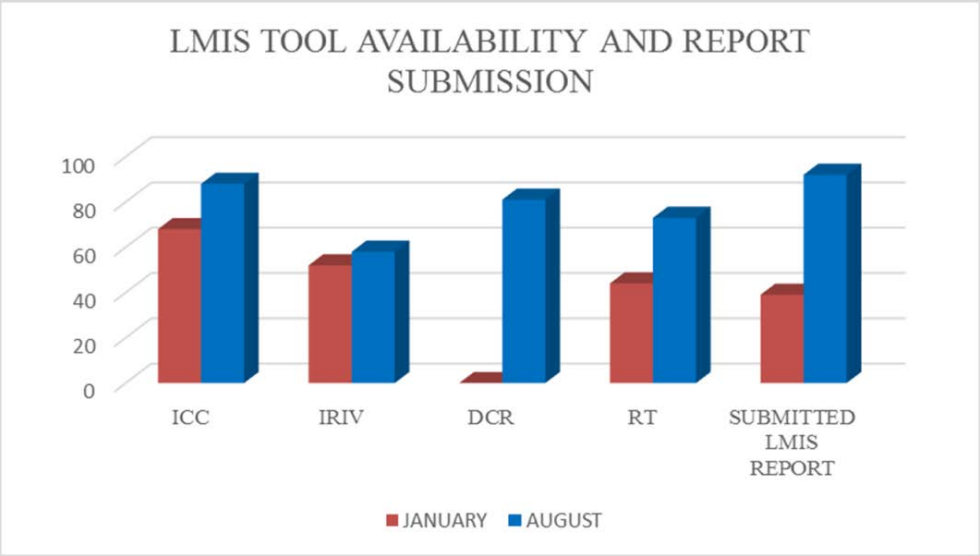

Figure 3. LMIS tools availability and report submission

Out of the 23 automated PCR labs visited, one laboratory in Lagos was stocked out of Viral load reagent although EID kits were available at the time of the MSV. Similarly, Federal Medical Centre (FMC), Jalingo was stocked out SPU, Sample tubes, K-Tubes and K-Tips. No other facility had records of PCR commodity stock out in the 6 months preceding the MSV. A minimal quantity of expired products was observed during the MSV with only 1 pack of expired wash reagent sighted at FMC Makurdi.

PCR commodities storage conditions

Poor storage condition for PCR products was a critical finding at some facilities visited during the August 2015 MSV. Product storage is vital to adequate commodity handling and impacts greatly on the quality of stored commodities. The duo of Dr. Lawrence Henshaw Memorial Hospital (DLHMH) Calabar and University of Uyo Teaching Hospital (UUTH) Uyo were noted to lack designated storage spaces for PCR commodities while the store at LASUTH Ikeja was considered unsecured by the MSV providers. Similarly, 11 (42%) facilities had stores considered inadequate for the stored products while 9 (35%) lacked air conditioners for ambient temperature control. However, all 26 PCR labs visited had cold chain storage facilities for cold chain dependent PCR commodities.

Electronic-LMIS readiness

All 23 fully automated PCR labs visited had access to information technology resources for transmission of LMIS reports. Report submission via electronic means was not considered an added burden at any of the facilities visited.

Program data

PCR platforms: Figure 4 below shows the automation status of the PCR laboratories at the time of the August MSV. Twenty-three (88%) of the

facilities visited were fully automated and providing EID and Viral load testing services at the time of visit, as against 18 (72%) automated laboratories recorded in January 2015, only 8 (32%) of which were providing services. OLA hospital had only the TaqMan 48 component of the automated Roche PCR equipment while manual platforms were available at Federal Tertiary Hospital (FTH) Gombe and University of Nigeria Teaching Hospital (UNTH) Enugu. However, only 18 (78%) of the automated PCR platforms were under service maintenance contracts at the time of the August 2015 MSV.

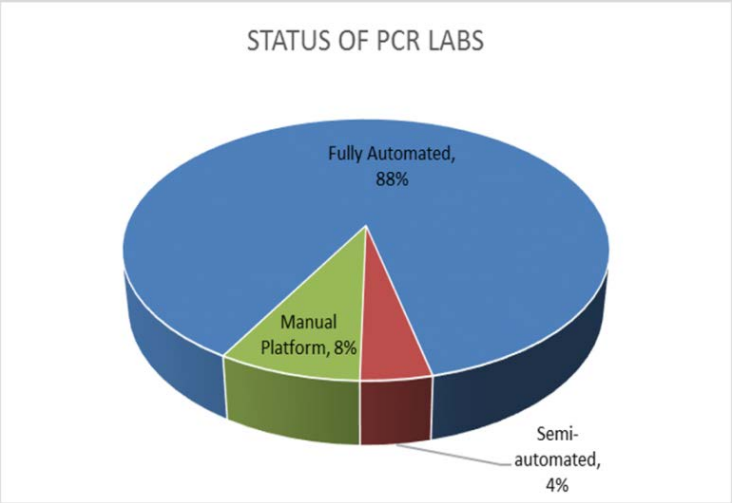

Figure 4. PCR Laboratories automation status at August 2015

Five laboratories Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nigeria Institute of Medical Research (NIMR), Jos University Teaching Hospital (JUTH), University of Benin Teaching Hospital (UBTH) and Ahmadu Bello University Teaching Hospital (ABUTH), Zaria reported equipment downtime during the three cycles preceding the visit with the maximum duration of downtime (103 days) recorded at NAUTH. University College Hospital (UCH), Ibadan and ABUTH experienced equipment downtime of 42 days and 38 days respectively while the equipment at JUTH and UBTH were both down for 14 days.

EID and VL backlogs: Table 1 below shows the quantity of testable EID and Viral load sample backlog at the facilities at the time of visit. A total of 3,454 EID samples was awaiting testing at 5 facilities with FMC Makurdi accounting for 73% (2000) of the backlog while 6,525 viral load samples were awaiting testing at 6 facilities with the bulk of the backlog, 74% (4800) at NIMR.

Table 1. EID and viral load samples backlog during August 2015 MSV

NAME OF FACILITY	LOCATION	IP	EID BACKLOG	VL BACKLOG
68 Nigeria Army Reference Hospital	Lagos	APIN	0	1161
Lagos State University Teaching Hospital	Lagos	APIN	12	10
Aminu Kano Teaching Hospital	Kano	IHVN	142	58
Plateau State Research Laboratory	Jos	IHVN	900	0
Federal Medical Centre Jalingo	Jalingo	NACA	400	400
Federal Medical Centre Makurdi	Makurdi	IHVN	2000	96
Nigeria Medical Research Institute	Lagos	APIN	0	4800

TOTAL	3454	6525

- Power supply:16 (62%) of the PCR facilities visited during the August 2015 MSV have regular access to 6 hours or more of power supply per assay day from a combination of PHCN, a backup generator or inverter supply.
- Actions taken: The immediate actions taken by the MSV providers to address issue and observations at the PCR facilities are outlined below.
    - PCR staffs were given on the job training on key components of LMHC to further update their logistics management capacity and help resolve observed deficiencies in the supply chain management of PCR commodities. Mentoring was provided to address gaps capable of negatively impacting commodity management at the PCR facilities.
- Copies of lacking LMIS tools were made available to the facilities while assistance was provided in opening ICC for commodities lacking such records.
- MSV providers paid advocacy visits to hospital management for optimal support of PCR labs. Critical issues covered during the visits include manpower and power supply challenges. For sites with backlog samples occasioned by human resource deficits, management was urged to allow staff to run calls in the PCR labs to help increase the number of man-hours available for operations.
- MSV providers assisted in organizing commodities where necessary to enhance ease of access to commodity and product information.
- Hands-on practice in LMIS report generation was provided for PCR staff to help update their skills.
- A physical inventory of available products was taken, and stock status assessment performed to identify cases of overstock or stock out of PCR commodities.
- The MSV providers also facilitated commodity transfers where necessary to help avert expiry at the originating facilities and avert disruption of services at the beneficiary facility.
- Debriefs were held with Facility managements, LMCU and IP representatives to provide constructive feedback as well as make recommendations for improving supply chain performance of PCR commodities.
- Contact details of PCR facility staff were updated during the visits.

Conclusions

Nigeria had the first 3 cases of HIV infection reported in 1984 that has now grown to over 2 million people. Innovation, information, intersectoral, and inter-agencies collaborations are requirements to achieve the 90-90-90 UNAIDS plan of ending the HIV scourge by the year 2030. The last 90 is hinged on the success of PCR laboratory performances which the supply chain management of the commodities is crucial. Monitoring and supportive visit as a vital component of decision support system approach of SCM promotes quality of services at health care centres in achieving targets and strengthens performances. MSV encourages an open, 2-way communication that builds team works, mentorship, and joint problem approach. The hypothesis is that supply chain management of PCR commodities enhances the achievement of the third 90% of the UNAID 90-90-90 concept.

The World Health Organization (WHO) viral load testing algorithm adopted by Nigeria like other countries for example, Botswana; according to Gaolathe, Wirth, Holme, Makhema, Moyo, Chakalisa and Okui (2016)recommends viral load monitoring six months after initiation of treatment and six months after the first viral load test and subsequently once in a year for all the people living with HIV/AIDS (PLWHA) in the country (WHO, 2013). The patients that are not virally suppressed whose viral load count is >1,000 copies/mL would require further counseling to see if they are adhering to their treatment regimen or a change of treatment regimen would be considered as an option which is in agreement with Bonner, Mezochow, Roberts, Ford, and Cohn(2013) in using viral load to monitor the efficacy and adherence of patients to antiretroviral drugs regimen. This study considered the availability of capacity and PCR commodity that is required for test viral load samples that are collected from patients already on treatment. Nigeria currently has about 600,000 people on ART as at 2015 out of the estimated 2 million people that are living with HIV/AIDS in Nigeria (NACA, 2015). These numbers of people require about 1.2million viral load testing to cover almost all the people that require the testing. This study looked at the supply chain management of the commodities require for the viral load test and consider the role play by SCM in the scaling up of viral load testing in Nigeria.

Twenty-six (26) which is (93%) of the PCR facilities providing EID and Viral load testing in Nigeria were visited during the second round of PCR MSV conducted by SCMS in August 2015 in collaboration with GON, IPs, and other stakeholders. The findings in Table 2 below from the MSV provided a snapshot of supply chain management environment of PCR commodities at service delivery points in a bid to assess progress or otherwise since the baseline visit in January 2015.

Table 1: Summary of the findings during the first and second MSV

S/N	Issues	Findings first MSV	Finding second MSV
1	Trained Personnel and Standard Operating Procedure (SOP) Manual for the Logistics Management of HIV/AIDS Commodities (LMHC)	Majority of PCR labs lack trained personnel on logistics management of health care commodities	The high-level of logistics knowledge was exhibited by the staff compared to the first MSV
2	LMIS Tools and Reporting Resupplies	Inventory control card (ICC) availability 68% Daily utilization record (DCR) 71%	ICC availability 88%. DCR 81%. A general improvement in the availability of LMIS tools was recorded
3	Electronic LMIS Readiness	Resources for electronic transmission of LMIS reports and timely report submission rate was 39%	Resources for electronic transmission of LMIS reports and timely report submission rate moved to 92%
4	PCR Platforms	Facilities with Installed Roche CAP/CTM-48/96 model and Abbott M2000 were 18	Facilities with Installed CAP/CTM-48/96 model & Abbott M2000 were 24

5	Equipment Functionality and Testing Status	16 out of 18 were functional equipment	All the Roche CAP/CTM equipment, except 1 were functional. One Abbott machine was non-functional; 22 out of 24 functional in totality
6	Power supply	The power supply situation at the PCR facilities has improved 38%	The power supply situation at the PCR facilities has improved to 62% due to advocacy during MSV
7	PCR commodities availability	Rampant reported cases of stock-out and expiries recorded.	PCR commodity stock-outs was at minimal levels during the August 2015 MSV with only 2 facilities stocked out of viral load kits and consumables
		Recommendations	
1	Continuous capacity building	It is important to ensure that all PCR facilities are covered for continuous capacity building. IPs supporting sites with yet untrained personnel should expedite actions for the training of the staff while already trained staff should be assisted in providing step down training to their colleagues.	
2	LMIS tools Availability	LMIS tool availability may have improved across the PCR labs, it is important to strive for 100% availability and utilization of these tools to further enhance commodity management practices at the facilities. The stakeholders and the National Laboratory Technical Working Group (NLTWG) should finalize the design of a standardized DCR for EID and VL commodities to ensure uniformity across all the labs.	
3	Power Supply Challenges	Continued advocacy for management support around power supply is essential to ensure uninterrupted testing at the PCR laboratories. Efforts should be geared towards the attainment of at least 6 hours of power supply at the remaining 38% of PCR laboratories yet to enjoy such access.	
4	PCR Equipment downtime and service maintenance agreements	Implementing Partners should ensure punctual renewal of PCR equipment service maintenance agreements at their supported sites while conducting a routine review of vendor performance to ensure adherence to the terms of the contract.	
5	Reagents supply	Warehouses should ensure continuous availability of PCR commodities at the PCR labs to support continuous testing while IPs should ensure that all other consumables required for	

		PCR sample collection like sample tubes are in constant availability.
6	EID and viral load backlog	Implementing Partners should liaise with their supported facilities to clear any existing EID and viral load backlog samples.

Supervision provides an effective supply chain management strategy to enhance the performance of health care operations, including the logistics management of commodities and quality of service (Mogasale, Wi, Das, Kane, Singh, George, & Steen, 2010). This is line with the position of Bailey, Blake, Schriver, Cubaka, Thomas, and Martin (2016); Chishty, Singh, and Agarwal (2016). that supportive supervision effectively builds the capacity of healthcare workers, improves the quality of care provided by workers and ultimately impacts clinical outcomes for patients. A remarkable level of improvement in supply chain management practices was observed at the PCR laboratories in this second round of PCR labs MSV, this finding agrees with Hernández, Hurting, Dahblom, and Sebastian(2014) as well as Marshall and Fehringer (2014) that evaluated impacts of supervision visit to healthcare centres. Similarly, a high level of progress has been made in PCR products availability for EID and viral load testing while data availability for evidence-based decision-making has greatly improved. This assertion affirms the findings of Annan (2013) that the supply chain system of health care services must receive constant monitoring and evaluation to achieve health care commodity security. This was an obvious outcome of energy and resources expended during the baseline visit as well as continuous support provided to the PCR facilities over the subsequent months. Supply chain indicators like stock-out, expiries, an emergency request for resupply, complete and timely bimonthly report improved due to the intervention provided by the MSV. This is diagrammatically summarized in Figure 5 below.

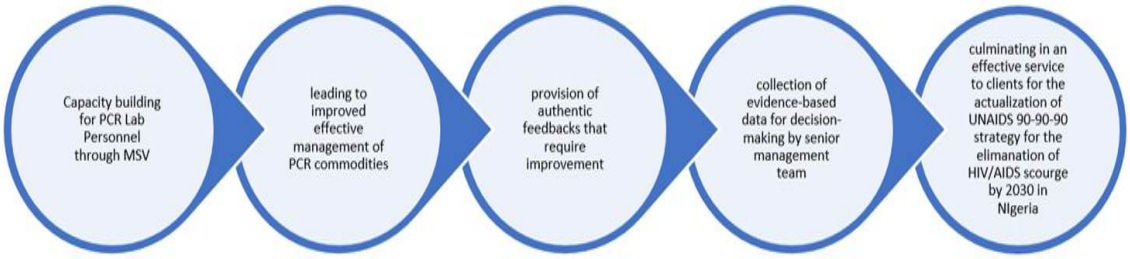

Figure 5. Role of MSV in the actualization of UNAIDS 90-90-90 strategy

However, human and material resource gaps persist in some instances which continue to pose a threat to the continuous availability PCR testing to the large population of HIV/AIDS patients. Key among the findings in the current MSV is the lack of logistics trained personnel at some sites, non-availability of some logistics tools, the absence of equipment service contracts for PCR equipment and lengthy equipment downtime at some sites as well as poor access to power supply and persistence of EID and viral load backlogs at others.

To ensure maximization of installed in-country capacity for PCR testing, a collaboration of all stakeholders is essential to further bridge the observed human and resources gaps at the PCR facilities. Implementation of the recommendations from the current MSV is key to addressing the identified supply chain and programmatic challenges at the PCR laboratories. Furthermore, there is an urgent need for

increased government ownership and support for the PCR laboratories in the country to ensure sustainability beyond the PEPFAR funding era. Commodity security is key to achieving effective biological monitoring for paediatrics and adult patients on ART. For the nation to achieve any meaningful success in actualization of set targets of 90-90-90 strategy for HIV/AIDS, all hands must be on deck to continuously identify and eliminate risks in the supply chain management of PCR commodities which proved to be a dependable tool in making the right quality PCR commodities in the right quantity available to the right facility at the right time at the right cost.

The limitation of this study hinges on the high cost of frequent monitoring and supportive visits to these 25 facilities to monitor the sustenance of the gains achieved with the two monitoring and supportive visits that were conducted. Further studies can be done in other areas of health services provided to the patient like the provision of pharmaceutical commodities, ante-natal, and post-natal care services to determine the effect of monitoring and supportive visits tailored towards the enhancement of these health care delivery services.

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