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Evaluating 4 Years' Cost of Managing Human Immunodeficiency Virus Pandemics using Enterprise Resource Planning for Supply Chain Management in Nigeria

Article by Theophilus Faruna[1], Dimitris Folinas[2]
[1] *Business and Management (Supply Chain Management), Texila American University, Guyana*
[2]*Department of Logistics, Technological Educational Institute of Central Macedonia (T. E. I. C.M.), Katerini, Greece*
E-mail: theofarus@yahoo.com[1], dfolinas@gmail.com[2]

Abstract

For over three decades the Human Immunodeficiency Virus (HIV) that causes acquired immune deficiency syndrome (AIDS) held humanity in captivity. Before 1990, HIV was a fairy tale in Nigeria. However, by 2000, HIV had become a public health concern with efforts to reduce the burden on people living with the virus. It started with a prevalent rate of 1.8% in 1991, peaked at 5.8% in 2001 before the decline. The cost of providing screening rapid test kits over four years was examined to explore the areas where enterprise resource planning (ERP) could be used to scale down the cost of HIV commodities management in Nigeria. Procurement, warehousing, distribution, and collection of logistics management information system data were examined. Management of HIV RTKs with and without ERP was compared. The result showed that without ERP, there was an increased cost of labor, recording errors, and poor data for decision-making. With ERP, it was different. Study was done for RTKs, there is room to do for other HIV commodities. Though initial cost of deploying ERP was high, on the long-run has cost benefit.

Keywords: *Enterprise Resource Planning; Logistics Management Information System; HIV Commodities; HIV Rapid Test Kits Algorithm; Supply Chain Performance Measures; Impact of HIV Pandemic.*

IntroductionThe only disease that held humanity in captivity for almost three decades without any final solution or cure of recent, is the Human Immunodeficiency Virus (HIV) that leads to Acquired Immunodeficiency Syndrome (AIDS) of those that are affected and have their immunity plunged into disaster level. The origin of HIV generated much controversy and debate in the early years of detection in the 1970s. Studies showed that HIV is a type of lent virus that attacks the natural immune system that is put in place by nature to protect it from foreign invasion of disease-causing agents. HIV was thus identified as the causative agent of AIDS. The HIV is similar to simian immunodeficiency virus (SIV) that attacks the immune system of monkeys and apes (Worobey, Telfer, Souquière, Hunter, Coleman, Metzger, & Roques (2010). Faria, Rambaut, Suchard, Baele, Bedford, Ward, ... and Posada (2014) reported that surveys of African apes identified chimpanzee [*Pan troglodytes troglodytes* (*Ptt*)] populations in southern Cameroon as harboring simian immunodeficiency viruses (SIVs) most closely related to the pandemic lineage of HIV-1. This led to the theory of hunter.

The most commonly accepted theory of how HIV came to affect human is the one that states a 'hunter' who may have killed a chimp that has SIV wherein the blood was eaten or the hunter has a cut (wound) through which the blood of the Chimps came in contact with and while the SIV entered into the hunter it mutated to HIV and subsequently transferred from human to human either through sex, blood transfusion or other blood product to wound contact that occurred (Avert, 2016).

The devastating effect of HIV pandemic was beyond the imagination of researchers for almost 30 years without any cure being established. The Similar remark came from Cohen, Seider, and Navia (2015) that

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there is mounting evidence of HIV exacerbating age-associated cognitive decline as well as vascular and metabolic comorbidity have been associated with HIV infection. In the developing countries of sub-Saharan African, it was worst in Nigeria. When Human Immunodeficiency Virus (HIV) was identified in the late 1970s as the causative agent of Acquired Immune Deficiency Syndrome (AIDS), researchers and scientists never expected it will take this long before a cure or vaccine is discovered. The pandemic is now almost three decades and more than 40 million people are presently infected with HIV worldwide; more than 90% of the victims live in developing countries. The 2016 Joint United Nations on AIDS (UNAIDS) report showed that in 2013, 9% of people living with HIV globally reside in Nigeria that shows prevalence among the adult to be 3.2% in comparison to 19.1% in South Africa, but because of the size of Nigeria population, the estimated population of people living with HIV in Nigeria in 2013 is said to be about 3.2 million (UNAIDS, 2014).

In the United States of America, it took the courage of people like Mary Fisher to publicly acknowledge the presence of HIV in the US during the 1992 Republican Convention to prompt the US to mount concerted effort to combat the disease by setting up the President's Emergency Plan for AIDS Relief (PEPFAR) to combat the HIV scourge (ABC News, 2012, June 27). Between 1985 and 1990, HIV was a fairy tale in Nigeria, so nothing was done. However, before the turn of 2000, HIV had become a pandemic and public health concern with concerted effort to stem the tide of the rising inferno caused by HIV on the larger Nigerian population. It started with a modest prevalent rate of 1.8% in 1991 and the peak of 5.8% in 2001 before the decline to the 3. 4% in 2015 (Awofala & Ogundele, 2016). Various efforts were mounted nationally and with the help of international community. The cost of the efforts that was put together to drag the epidemiology downward especially HIV screening through rapid test kit, antiretroviral drugs with their supply chain management is the focus of this article.

The study is still narrowed down to the records and reports available for the support provided through United States of America President's Emergency Program for AIDS Fund (PEPFAR) to Nigeria HIV/AIDS program. This is to evaluate the cost of HIV rapid test kits, antiretroviral drugs from 2012 to 2015, being the peak of the fight against the virus in Nigeria to see the cost of the supply chain and juxtapose the use of enterprise resource planning (ERP) to drive down the cost of the supply chain management (SCM). This study will provide an opportunity for organization and government to consider an improvement of the use of ERP for SCM of HIV commodities or otherwise.

Rationale of the study

Nigeria still has the third highest HIV/AIDS burden in the world (NACA, 2015) so it will continue to generate scientific interest in whatever way that can mitigate the impact. In tackling the scourge of HIV/AIDS in Nigeria, the cost of commodities is not easy to come by. Most of the funds used in prosecuting the war on HIV/AIDS so far come mainly from development partners and foreign aid from PEPFAR and Global Fund (GF) to fight against AIDS, Malaria, and Tuberculosis. Studies have shown that 40% of the cost of goods and services are attributed to supply chain management. Gunasekaran, Patel, and McGaughey (2004) supported this assertion that in the United Kingdom (UK), 40% of their gross domestic product went to logistics and supply chain management of services and commodities. This level of cost of distribution, therefore, calls attention to whatever that can be done to reduce the cost of logistics and supply chain management of HIV commodities in Nigeria, bearing in mind that funding is scarce and donor agencies are scaling down funding supports. After the review of the cost expended between 2012 and 2015, supply chain strategy adopted, examined the areas that ERP can be deployed to reduce this cost in subsequent years ahead. The hypothesis is that it is better to manage HIV commodities with ERP than without ERP in the Nigeria HIV PEPFAR Programme.

Objective of the study

a) To determine the financial cost and other accessories cost to the provision of HIV commodities (rapid test kits and antiretroviral drugs) from 2012 to 2015 that have resulted in stopping the wild spread of HIV infection in Nigeria from the prevalence of 5.8% to the current 3.1%.
b) Evaluate the cost of supply chain management from 2012 to 2015
c) Determine if enterprise resource planning (ERP) can help in driving down the cost of HIV commodities' supply chain in Nigeria
d) Can the use of ERP impact positively on the supply management of HIV commodities in Nigeria?

Review of literature

In this section, the origin of HIV is traced and how it was discovered in Nigeria. This section will also provide the summary of efforts that the Nigeria government had undertaken to reduce the scourge of HIV infection. The impact of the infection and trace the trend of 10 years HIV prevalence in the country. The cost of procurement and management of HIV rapid test kits and antiretroviral drugs over 4 years were closely examined

History of HIV in nigeria

HIV was first discovered in Nigeria in 1985 via the first two cases that were diagnosed and reported in the media in 1986 in the city of Lagos, South-West, Nigeria with the population of about 15.5 million people as at 1986. One of the two victims were a young female sex worker that the age was announced as 13 years from one of the neighboring West African countries (Nasidi & Harry, 2006; Awofala & Ogundele, 2016). This news jolted a docile country into a panic because all these while, it was thought to be an American disease and had tagged AIDS to mean **A**merican **I**nvention to **D**iscourage **S**ex. Eze (2009) chronicled the Nigerian reaction to these two reported cases by citing Caldwell and Orubuloye (1992); Mafemi and Fajemisin (2003); Orubuloye and Oguntimilehin (1999) with the conclusion that Nigerian believed it was a distant disease that would not find its way to Nigeria but will remain among the homosexuals of the USA.

However, the progression of the infection in Nigeria was phenomenal as it rose from 2 in 1985 to 18,490 in 1998 (Eze, 2009). After that, it never abated again until drastic efforts were deployed as from 2003, though the first surveillance of 1991 gave a prevalence rate of 1.8%. The highest prevalence rate of 5.8% was recorded in 2001 before the decline commenced to 3.4% in 2015 (NACA, 2015).

HIV programming in nigeria

To stem the tide of the HIV inferno in Nigeria, the government and people of Nigeria as well as supporting partners opened the floodgate of fight against HIV as soon as it became clear that the HIV infection was no longer American idea to discourage sex but a real threat that if not checkmated will wipe out the population of Nigeria especially the workforce and the economically viable age group between 20 and 60 years.

Nasidi and Harry (2006) traced the efforts and response of Nigeria government from the early day of the two cases that were reported in 1986 to 2001 when the President of the country then publicly hosted conference on HIV, Malaria, and Tuberculosis in 2001 and openly subjected himself to have HIV screening to encourage others to do same. The Federal Ministry of Health in 1986 set up a committee called National Expect Advisory Committee on AIDS (NEACA) to advise the government on the best way to respond to the emergent of HIV/AIDS in Nigeria. NEACA solicited the help of World Health Organization (WHO) to provide protocols on how best to tackle the epidemics. This led to the setting up of the first 9 HIV screening centers in Nigeria in 1987 (Nasidi & Harry, 2006). The advice of NEACA led to the setting up of National AIDS and STDs Control Program (NASCP) that initiated the responses through the syndromic management of the disease, voluntary counseling and testing (VCT) and the prevention of mother to child

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transmission (PMTCT). This attempt was lacking in multi-sectorial approach that HIV/AIDS response required. Subsequently, an agency under the presidency was created and named National Agency for the Control of AIDS (NACA) to give more bite to the fight.

The setting up of NACA at the federal level got the replica at the state level and named State Agency for the Committee on AIDS (SACA). NACA then developed a medium-term action plan called HIV/AIDS Emergency Action Plan (HEAP) with the aim and objective of breaking down the barrier to HIV/AIDS prevention at the community level and provide supports to prevention, treatment and care services to people living with HIV/AIDS (FMOH, 2001). Following this was the formulation of the National HIV Strategic Framework (2005-2009) to succeed the HEAP strategy (NACA, 2005).

Immediately the Federal Government put in place her strategy to fight HIV/AIDS, the Civil Society and the Uniformed Services waded into the fight. It was at this point that a coalition of the civil society called Civil Society Consultative Group on HIV/AIDS in Nigeria (CISCGHAN) was formed. The Global Fund to Fight AIDS, Tuberculosis and Malaria provided the fund to help strengthen the enormous work involved in fighting HIV/AIDS. Likewise, the National Network of People Living with HIV/AIDS in Nigeria (NEPWHAN) got organized to join in the fight to exterminate HIV/AIDS. The military haven observed that large number of its personnel that return from peacekeeping mission outside the country tested HIV-positive set up the Armed Forces Program on AIDS Control to provide a specific response because of the peculiarity of that population. The United States (US) government provided tremendous support through Department of Defense Walter-Reed Project in Nigeria (DOD-WRPN) to Nigeria Military Ministry of Defense Armed Forces response.

Impacts of HIV pandemic in nigeria

The impacts of HIV in Nigeria can be viewed from social, psychological, economical and wellness aspects. This could further be considered from the personal, organizational and country-wide basis. Per Nwosu, Wannah, and Olaore (2014), the impact of HIV/AIDS goes beyond individual but includes household level, firms, business because those likely to be affected by HIV are mostly in the active employment and in their prime working years. The UNDESA – United Nations Department of Economics and Social Affairs stated that HIV prevalence could reach an alarming proportion in a country or organization that the impact may be dramatic and affect the costs, productivity and profitability of such organization (UNDESA (2012).

In the social aspect, stigmatization of people diagnosed with HIV infection has resulted in the hiding from intervention and fueling the spread of the virus from infected to others that could have been spared of the infection. In some extreme cases, potential candidate for employment and recruitment into the Nigeria Armed Forces had been turned down based on their HIV status. Many intended couple or even married couples had canceled wedding/marriage arrangement or divorce if married due to HIV positive status.

Those that are infected and begin to lose good health become a candidate of frequent hospital visitation. The impact shows in the financial spending and loss of working hours. If it results in death, the bread-winner of the family would have been lost. The place of work suffers the loss of staff and recruitment for replacement comes at an impact on the company as well as the nation because of the skill that might be difficult to replace. The more disturbing aspect is the fact that those affected are adults (men and women) who are the key component of the labor force. The estimate of those affected by HIV is put at 3.2 million people with the dangerous trend that 1 out every 7 Africans living with HIV is a Nigerian (Boler & Archer, 2008). However, the adult prevalence has declined but that of the children is still unabated.

Azuh et al. (2014) succinctly capture this scenario by saying HIV/AIDS is a very serious health and a social threat that affects the economy of an individual and a country in more than one way. This is because poor returns of human capital come from the poor health of the active labor force that gulps financial fortune of the affected people. This was rightfully so with Nigeria as sickly people flood the available healthcare centers for diagnosis and treatment. Between 2006 and 2010, being diagnosed HIV positive meant death sentence and the commencement of stigmatization in Nigeria as there was barely any

treatment. The rate of saving dropped, death toll increased, many orphan children were created, children dropped out of school due to death of parents and no means of keeping them in school where available.

Tackling the widespread of HIV in nigeria

The spread of HIV was likened to hurricane disaster that required urgent attention. Though there was lethargy in the early years of HIV diagnosis in Nigeria, the country was sluggish in providing an immediate response. No meaningful response was noticed till 2005. A contributory factor to this was the political environment from 1985 to 1999. Nigeria was under military rule, especially the one under General Ibrahim Babaginda that annulled the presidential election that was held under free and fair condition and that of General Sani Abacha that detained the acclaimed winner of that election, Moshood Abiola which turned Nigeria into a pariah nation thereby depriving the country international support that would have provided immediate response to the epidemics. Concerted efforts began to be seen when the democracy governance returned under President Olusegun Obasanjo from 1999 to 2007 (Olamilekan, 2015).

From the inception of the civilian administration in Nigeria, the government cried out to the international community to lend a helping hand. With the transition of Nigerian government from military to civilian rule, the door of cooperation with the international community was widely opened.

Help came from Global Fund and the United States President's Emergency Program for AIDS Relief (PEPFAR) under President W. G. Bush in 2002 and was lunch in 2003 to tackle and combat global HIV/AIDS which Nigeria became a beneficiary. The initiative got congressional approval to spend about $48b (the biggest by any country for single disease) in five years to help treat AIDS, Tuberculosis, and Malaria in sub-Saharan African and elsewhere including India. PEPFAR currently operates in about 20 countries providing treatment, prevention and care for people affected by HIV/AIDS and train healthcare providers to build their capacities to handle the initiative. Nigeria and the United States (US) governments entered a signed a memorandum of understanding in 2004 and ever since then, PEPFAR has disbursed more than 3.4 billion U.S. dollars (more than 544 billion Naira) to strengthen the Nigeria HIV/AIDS response. Some of the outcomes are the success stories of enrolling more than 750,000 people including children on ART and about 10 million people annually tested to know their HIV status thereby preventing transmission, death and its myriads of impacts (Nigeria US Mission, 2015).

The strategy evolved in Nigeria was to disburse the fund through four agencies: United States Agencies for International Development (USAID), US Centre for Disease Control and Prevention (CDC), US Department of Defense (DOD) and US Embassy Public Affair Section (PAS). The agencies, in turn, engage implementing partners (IPs) through cooperative agreement award for a specific number of year and specific areas of focus. There are more than 20 IPs in Nigeria. Few of the IPs in Nigeria are: John Snow Incorporated (JSI) Family Health International 360, (FHI360), AIDS Prevention in Nigeria (APIN), Institute of Human Virology Nigeria (IHVN), Management Sciences for Health (MSH), Safe Blood for African Foundation, Catholic Relief Services (CRS) and others. These implementing partners cascade the prevention, treatment, and care to the targeted group of people either directly or through the existing health care centers.

Fifteen years' trend of HIV infection in nigeria (2000-2015)

Within 15 years of intensive intervention by the government of Nigeria with funding and technical support from international agencies through PEPFAR, many success stories had been recorded (NACA, 2015). HIV prevalence rate that climbed from 1.8% in 1991 to 5.8% in 2001 when intervention was not actively supported began its decline journey from the 5.8% to the 3.2% recorded in 2013. The detail trend of HIV prevalence in Nigeria from 1991 to 2013 is presented in the graph below.

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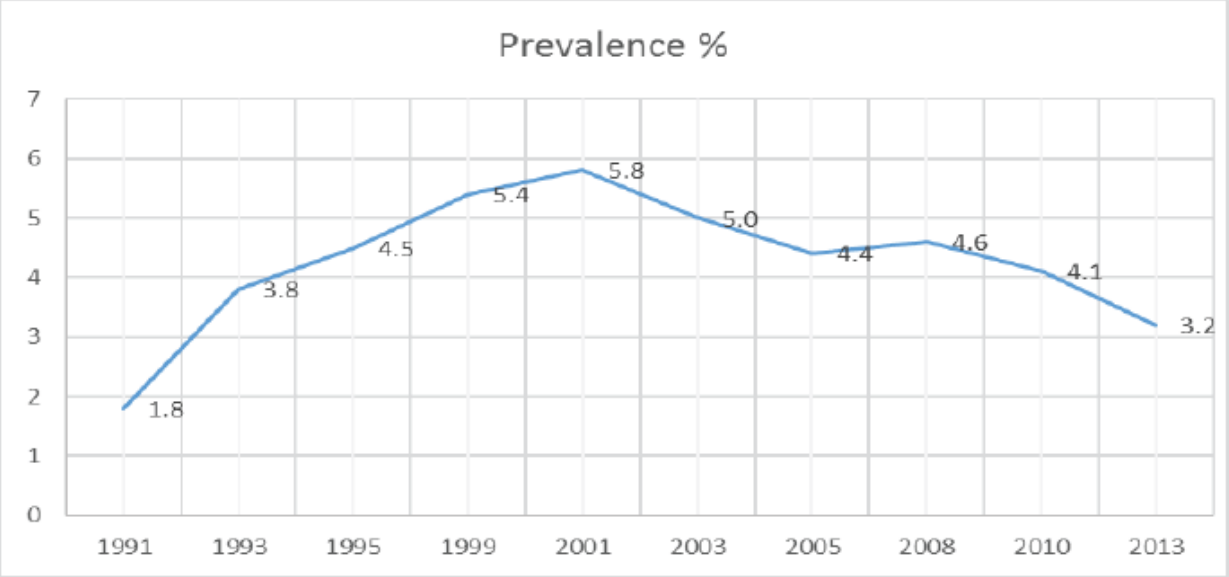

Figure 1. Nigeria HIV Prevalence Trend

To be able to achieve the decline in the HIV prevalence rate more testing sites were set up to ensure people know their HIV status with a counsel to those that tested negative to imbibe the prevention strategies that will ensure they remain negative and for those that tested positive, counsels were offered to ensure they do not spread the virus and get enrolled in the ART care and treatment program. From 2006 to 2013, the testing sites rose from 200 to 7075. The graph below shows the growth trend for HIV testing sites.

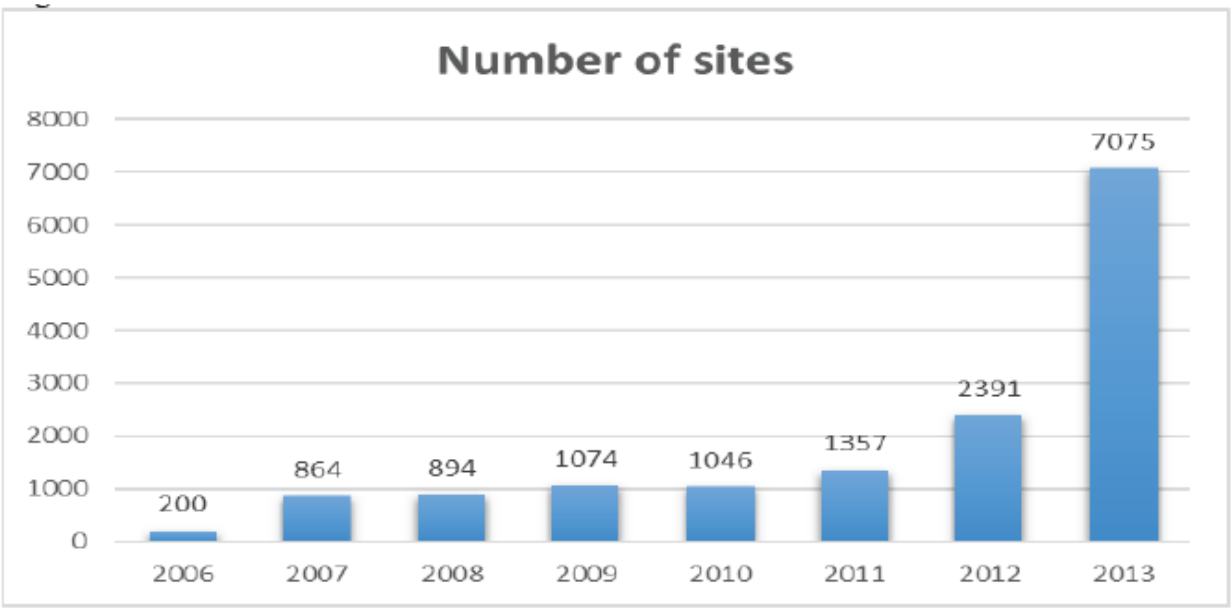

Figure 2. Number of HIV testing sites: 2006-2013

This effort saw an increase in the number of people counseled, tested and collected their result. The number rose from the 60,364 tested in 2006 to 3,517,441 tested in 2013. The figure below provides a graphic representation of the data retrieved from NACA website.

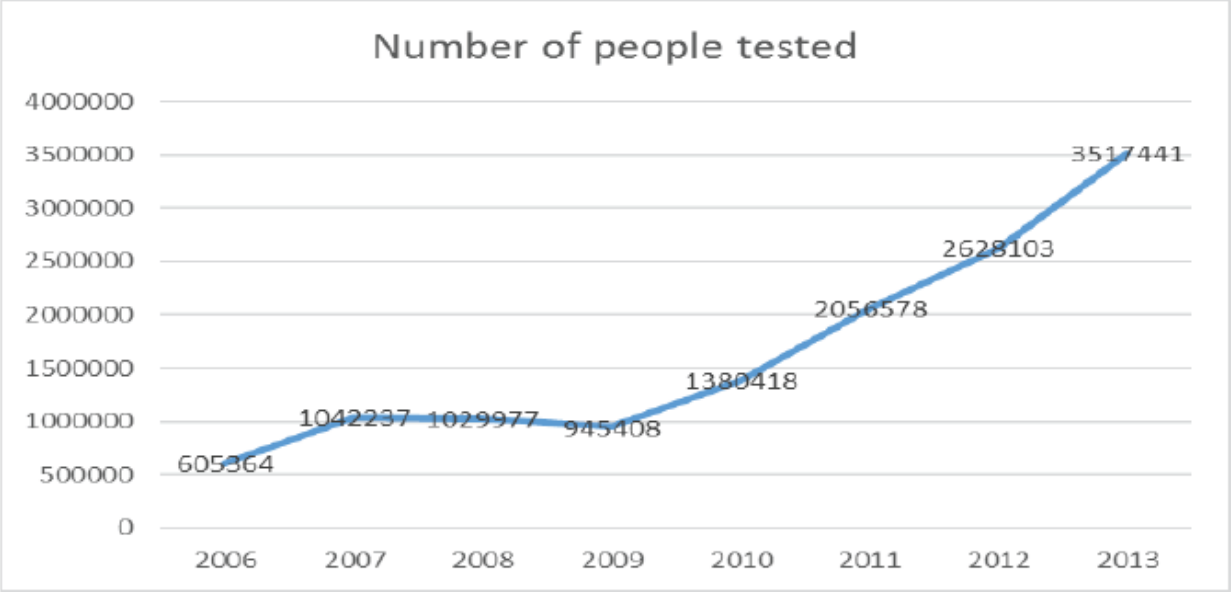

Figure 3. Number of tested for HIV status

With the increase in the number of people knowing their HIV status, the number of ART clinic and the number of people placed on ART equally increased as a response. The number of ART clinic increased from 107 in 2006 to 820 in 2013 while the number of people placed on ART increased from 132,428 in 2006 to 639,397 in 2013. The figure below depicts the data gotten from NACA website.

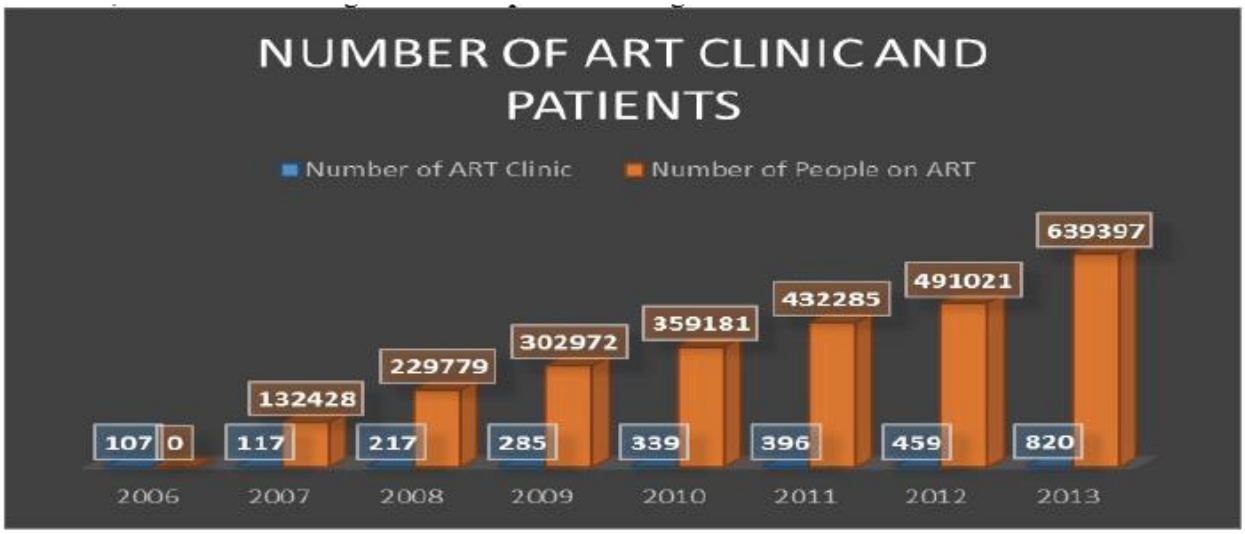

Figure 4. Number of ART clinics patients on ART

These concerted efforts have drastically reduced the number of new cases, the number of death because of HIV infection and decline is expected as the report for 2015 is being expected from National Agency for the Control of HIV/AIDS (NACA).

Review of the cost of HIV rapid test kits and antiretroviral provision: PEPFAR contribution

To initiate clients on treatment, clients' HIV status must be confirmed. The process of HIV testing in Nigeria has evolved through some stages where any rapid HIV test kits were in use until the Federal

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Government of Nigeria adopted an algorithm in 2007 as advised for adoption by resource-constrained nations as strategy for reaching out to majority and larger number of population (Bassey, Bond, Adedeji, Oke, Abubakar, Yakubu …., & Deyde, 2015). This strategy agrees with the algorithm in used in other countries like India where 2 test kits are as good as 3 test kits for diagnosis of HIV infection in program setting as affirmed by Kale, Beri, Thakar, Dar, Bembalkar, Goel, ... & Paranjape, (2017). Similarly, studied by Galiwango, Musoke, Lubyayi, Ssekubugu, Kalibbala, Ssekweyama ... and Gray, (2013) in Uganda accepted that serial algorithm was acceptable, effective and cost saving. Before 2007, a parallel algorithm was employed in Nigeria where two rapid test kits were used simultaneously. When there is discordance result, a third one is used as a tiebreaker. However, because of the cost of the parallel algorithm, a serial algorithm was adopted as recommended by Bassey et al. (2015) to reduce the cost of the rapid test kits and free-up fund to buy more test kits without compromising the quality of results that are issued to the clients. The kits adopted for use in Nigeria are Determine, Uni-Gold, and Stat-Pak as contained in the table below:

Table 1. Recommended HIV test kits in nigeria

Assay Name	**Determine**	**Uni-Gold**	**Stat-Pak (Dipstick)**
Manufacturer and Address	Alere Medical, Matsudo-Shi Japan	Trinity Biotech Plc, Wicklow, Ireland	Chembio Diagnostics System, New-York, USA
Distributor	Acouns Nig Ltd,	Trinity Biotech, Nig	Biomedics, Nig
Tests/kit	100	20	30
Assay method	Immunochromatography (lateral flow)	Immunochromatography (lateral flow)	Immunochromatography (lateral flow)
Test volume	50ul	60ul	5ul
NAFDAC registration #	03-0622	03-1011	03-0936
Recommended storage temperature range	$2 – 30^0$C	$2\text{-}30^0$C	$8\text{-}30^0$C

In supporting Nigeria's effort to stem the tide of HIV spread, massive testing of the people to know their HIV status with counsel so that either positive or negative, the chances of infecting others would be truncated was intensified. Behavioral change is possible through HIV test and counsel (HTC), which in turn limits the chances of spreading the virus (Coates, 2009). The cost of testing a client that turns out negative is $0.89 by using Determine. For a positive client, it is using Determine and Uni-Gold. The cost of Uni-Gold is $1.22, therefore, using Determine and Uni-Gold becomes $2.11. When the test is discordant, the third tiebreaker would be used which is Stat-Pak. The cost of Stat-Pak is $1.22. Hence any test that goes to the tiebreaker cost $3.33. By factoring all these into the number of test kits that were procured from 2006 to 2015 and juxtaposed with the number of positive cases recorded and the discordant results, an idea of the cost of the HIV rapid test kits that have been used over this period becomes available. Another cost will be the logistics management considered in the next sub-topics.

Supply chain management of ART commodities in nigeria

To ensure the ART commodities get to the clients that needed them, the PEPFAR project in Nigeria engages implementing partners that manage the logistics of the commodities. Prominent amongst them after the consolidation is John Snow Incorporated managing the supply chain for the United States Agency for International Development (USAID) project in Nigeria. The cost of logistics management is put at 12% of the cost the rapid test kits procured for the HIV program in Nigeria.

Warehousing and Distribution of these commodities are done from the central warehouse and 6 other axial warehouses where the receipt, issues, quarantined, losses, and adjustment must be captured, and from the central position, there must be visibility into the stock situation.

To do this, reports are either sent electronically, or hard copies collected from the service delivery points (SDPs), then input into the computer system for analysis. This is an enormous cost in human resources and financial implications. The typical scenario in the management of HIV test kits deals with the receipt of the commodities after procurement processes into the warehouse and prepares them for post-market validation sampling. When the rapid test kits passed the evaluation, they become available for distribution to service delivery points. The Kits are transported to the axial warehouses nearer to the service delivery points. Utilization reports are received from the SDPs that form the basis of a resupply through the last mile distribution (LMD) mechanism. HIV Kits' utilization reports are sent via email for collation or hardcopy report received for review from SDP and the outcome is used for resupply to the SDP. The cost of going around to collect reports from over 6000 facilities is huge. The cost in terms of human resources is great too. Is there a better way of managing these commodities at a lower cost? The purpose of this work is to evaluate the cost of supply chain management of HIV commodities with ERP and without ERP to ascertain and be used for mitigating the cost escalation of management commodities in Nigeria.

Methodology

This study was predicated on the use of case study scenarios to examine available records to infer the situation of logistics management of HIV RTKs without and with ERP over a period of four months. The study area, materials, cost of procurement and management of the commodities that were procured between 2012 and 2015 were examined. The use of ERP in the management of HIV RTKs was then accounted for in this section.

Study area and study materials

The area of this study and the study materials are limited to descriptive analysis of the procurement, logistics management of the three major HIV test kits on the serial algorithm of HIV testing in Nigeria that involves the use of Determine as the first line, Uni-Gold for the confirmation and Stat-Pak as the tiebreaker. The data were retrieved from the supply planning procurement software called PIPELINE^{R} used by Supply Chain Management System (SCMS) and organization that manages the procurement, warehousing, and distribution of HIV test kits for PEPFAR program in Nigeria. Other sources of information are gotten through Google Scholar search engine as well as governmental and other institutional reports available to the authors.

Cost of procurement and management of commodities procured for HIV program by pepfar from 2012 to 2015

The records reviewed from the PIPELINE software used by SCMS (JSI), record of procurement of Determine, Uni-Gold, and Stat-Pak from August 2012 to December 2015 were the ones available for review. In 2012, a total of 35,579 packs of 100 tests were received with the total cost of $3,546.514.72 received. In 2013, it was a total of 162,455 for the cost $16,193,514.39. In 2014, the total for Determine was 135,678 packs for $13,524,383.01 while that of 2015 has 167,999 packs at the cost $16,746,140 giving a total of $50,010,552.39 for the first line HIV kit. The second line confirmatory kit of Uni-Gold from 2012 to 2015 was $46,389,505.12. The Stat-Pak from 2012 to 2015 was $10,250,052.96. The table 2 below provides the detail.

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Table 2. Procured HIV rapid test kits from 2012 to 2015

Year	Commodity	Quantity	Product Costs	Freight Costs	Total Costs
2012	Determine	35,579.00	3,166,531.00	379,983.72	3,546,514.72
2013		162,455.00	14,458,495.00	1,735,019.39	16,193,514.39
2014		135,678.00	12,075,342.00	1,449,041.01	13,524,383.01
2015		167,999.00	14,951,911.00	1,794,229.27	16,746,140.27
				5,358,273.39	**50,010,552.39**
		50,171,100.00	**44,652,279.00**		
2012	Uni-Gold	402,040.00	35,781,560.00	4,293,787.20	40,075,347.20
2013		30,865.00	2,746,985.00	329,638.20	3,076,623.20
2014		56,092.00	1,794,944.00	215,393.28	2,010,337.28
2015		34,241.00	1,095,712.00	131,485.44	1,227,197.44
				4,970,304.12	**46,389,505.12**
		10,464,760.00	**41,419,201.00**		
2012	Stat-Pak	88,040.00	7,835,560.00	940,267.20	8,775,827.20
2013		10,489.00	933,521.00	112,022.52	1,045,543.52
2014		6,824.00	218,368.00	26,204.16	244,572.16
2015		5,137.00	164,384.00	19,726.08	184,110.08
		2,209,800.00	**9,151,833.00**	**1,098,219.96**	**10,250,052.96**
Grand Total 2012-2015			**95,223,313.00**	**11,426,797.47**	**106,650,110.47**

Examination of enterprise resource planning (ERP) tools

Supply chain management (SCM) provides the platform by which organizations and companies optimize their internal interaction and processes between the customers and the suppliers. SCM aims to get the commodity in the right place at the right time, at the right cost and the right condition (Zheng, Yen, & Tarn, 2000). An enterprise resource planning (ERP) ensures that this ideal is achieved. An ERP is a combination of software that can enable an organization to integrate information and makes such information available for decision makers which ensure efficiency. ERP system improves the management decisions and increases their flexibility to react to changes based on the availability of information. This ensures that businesses are conducted in an efficient manner. Many organizations deploy the use of ERP to gain a competitive advantage over their competitors because ERP is used as a strategic tool that can integrate various organization's systems into a unit that allows a flawless transaction and production (Shaul & Tauber, 2013).

A typical ERP allows an organization to collect, store, manage and interpret data from various platforms such as product planning, procurement, manufacturing and service delivery. An ERP integrates data and processes generated by an organization into one platform that includes the hardware, software and documentation procedures so that an improved inventory management can be achieved. There are different types of ERP designed for specific purpose and depending on the size of the business. In warehousing and

distribution of HIV commodities, an ERP add value and efficiency to the management of the commodities and at the same time save cost and excessive labor from the human resources angle. Analysis of using an ERP that integrates supply chain management with a competency of SCM optimization can provide an advantage of low cost, eliminate time and efforts, expensive add-ons wastage that always occurs in using multiple and separate systems (Jason, 2016). The ERP has provision for warehouse management system functionality, transport management system functionality, demand and forecasting, customer experience and third-party system and any other additional enhancement mechanism.

The study evaluated the records of using ERP in the management of HIV rapid test kits procured with the support of PEPFAR funding mechanism in Nigeria for 6 months' period and the finding compared to when ERP was not in place for use. The findings are presented in the next section.

Observations and findings

Observations and findings from the investigation done through case study methodology by examining all the available records in regards to the management of HIV RTKs are recorded. Comparison cost with or without ERP deployment and provided the discussion with recommendation

Comparison cost of supply chain management with or without ERP

When HIV rapid test kits are managed without ERP, the warehouse personnel are engaged to take physical records, provides documentation at any time they are required. The cost of labor increase and the speed of providing information takes beyond 48 hours to be available. Knowing the stock on hand was not readily possible due to manual way of counting. Human error was more in writing and transcribing the data recorded on paper. Tracing expiry date to be able to follow "First to Expire, First Out" based on looking out for the writing on the carton was an arduous task that impeded logistics management of HIV rapid test kits. Without an ERP in place, decision-making processes were very slow due to non-availability of data (information) as at when needed. Tracking inventory with manual labor was not an efficient system that can be used at the warehouse location. At best, it was a waste of time and money guzzler. Visibility into the stock reports and the stock level was almost impossible within the expected time that can improve the service rendered to customers.

An ERP that uses barcode scanner was put in place to capture detail information like the lot number, expiry date, the quantity of HIV RTKs, bin location into the computer. Good-in-transit tracking system was also built into the ERP to shows the delivery at a facility of commodities needed to render services to the clients. The system was operated for 12 months and reports generated are the cost of running with ERP compared with the cost of managing HIV RTKs without ERP.

At the end of the evaluation, the findings showed that it was more efficient and effective to use ERP to manage HIV RTKs which led to the availability of logistics data for decision making as well as reduced cost of labor and financing. With barcode scanning information input into the computer was easier. Retrieving commodities based on first to expire was easier as well as to generate and move them out for use at service delivery points thus reducing the chances of having an expired commodity that the cost would be enormous. Barcode reader at the delivery point provides an immediate response about the delivery status rather waiting and guessing to see if commodities had been delivered. Mislabeling due to transcribing error was eliminated due to the uniformity of data entry procedure. Flagging report from the ERP system tells if the commodity shelf-life has been compromised.

Discussion and recommendations

This study was undertaken to evaluate the cost of logistics management of HIV rapid test kits (Determine, Uni-Gold, and Stat-Pak). It compared the cost of logistics management without an enterprise resource planning (ERP) software and the cost using ERP to manage the commodities. Apart from financial cost, other costs like personnel time, ease of records and information availability. The cost of procuring Determine over 4 years is about $50m, Uni-Gold is about $46m and Stat-Pak gulping $10m. To

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ensure efficient management of the commodities like avoiding overstock and out of stock, a robust ERP is compulsory as it is easy to filtered information that top executives and other management staff require for decision making about quantification, procurement, warehousing, distribution and last mile delivery to the service delivery points.

This agrees with the studies carried out by Ince, Zeki, Imamoglu, Keskin, Akgun, and Efe (2013) in Turkey that ERP system is an important business tool with impact on finance, materials, equipment and labor within the supply chain management practices that ensures mutual advantages proving the hypothesis that using ERP to manage HIV RTKs commodities has advantages over managing these commodities without ERP. The main reason why ERP impact positively on the supply chain management of HIV commodities in Nigeria PEPFAR program is that ERP system is responsible for making available to top management level staff the information that is gathered whenever a situation arises to decide about commodity management. This is in perfect harmony with Uçaktürk and Villard (2013) that examined effects of management information and ERP system on strategic knowledge management and decision-making.

In conclusion, this study showed that there is an advantage in using ERP to the supply chain management of HIV RTKs commodities in Nigeria because it makes available, information required for the SCM of these commodities accessible to the managers when needed. The amount of money involves in the procurement of HIV commodities in Nigeria is huge and whatever system helps in the prudent management of the commodities is a welcomed development. The lessons learned from this study can be replicated in other areas of commodities like ARVs and opportunistic infections drugs being managed by PEPFAR program and other related commodities managed by other agencies even in other countries.

This study is limited to only HIV rapid test kits (Determine, Uni-Gold, and Stat-Pak). Further studies should be expanded to other areas of supply chain management to see if ERP is also relevant in the management of such commodities even though initial cost investment in ERP could be discouraging but on the long-run, the benefits will overshadow the cost.

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Annexes

1. Particulars of procured HIV rapid test kits 2012-2015

Supplier	Funding	Product Code	Product	Receive Date	ID	Quantity	Status	Product Costs	Freight Costs	Total Costs
SCMS	PEPFAR	102169	Determine	8/28/2012	56	11349	Received	1010061	121207.32	1131268.32
SCMS	PEPFAR	102169	Determine	12/4/2012	75	24230	Received	2156470	258776.4	2415246.4
	2012					35579	0	3166531	379983.72	3546514.72
SCMS	PEPFAR	102169	Determine	1/28/2013	102	30584	Received	2721976	326637.12	3048613.12
SCMS	PEPFAR	102169	Determine	2/26/2013	91	9416	Received	838024	100562.88	938586.88
SCMS	PEPFAR	102169	Determine	3/31/2013	76	11238	Received	1000182	120021.84	1120203.84
SCMS	PEPFAR	102169	Determine	9/30/2013	168	21377	Received	1902553	228306.36	2130859.36
SCMS	PEPFAR	102169	Determine	11/8/2013	169	46537	Received	4141793	497015.16	4638808.16
SCMS	PEPFAR	102169	Determine	12/31/2013	287	33968	Received	3023152	362778.23	3385930.23
SCMS	PEPFAR	102169	Determine	12/31/2013	314	9335	Received	830815	99697.8	930512.8
	2013					162455	0	14458495	1735019.39	16193514.39
SCMS	PEPFAR	102169	Determine	2/28/2014	273	47972	Received	4269508	512340.95	4781848.95
SCMS	PEPFAR	102169	Determine	7/10/2014	347	31353	Received	2790417	334850.03	3125267.03
SCMS	PEPFAR	102169	Determine	8/31/2014	447	41266	Received	3672674	440720.87	4113394.87
SCMS	PEPFAR	102169	Determine	9/30/2014	362	15087	Received	1342743	161129.16	1503872.16
	2014					135678	0	12075342	1449041.01	13524383.01
SCMS	PEPFAR	102169	Determine	1/27/2015	427	46302	Received	4120878	494505.35	4615383.35
SCMS	PEPFAR	102169	Determine	4/30/2015	585	12000	Received	1068000	128160	1196160
SCMS	PEPFAR	102169	Determine	5/8/2015	587	5280	Received	469920	56390.4	526310.4
SCMS	PEPFAR	102169	Determine	6/30/2015	484	21385	Received	1903265	228391.79	2131656.79
SCMS	PEPFAR	102169	Determine	7/15/2015	503	9	Received	801	96.12	897.12
SCMS	PEPFAR	102169	Determine	8/31/2015	559	26510	Received	2359390	283126.79	2642516.79
SCMS	PEPFAR	102169	Determine	11/4/2015	589	22642	Received	2015138	241816.55	2256954.55
SCMS	PEPFAR	102169	Determine	12/10/2015	588	33871	Received	3014519	361742.27	3376261.27

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	2015					167999	0	14951911	1794229.27	16746140.27
Total						**50,171,100**	**-**	**44,652,279.00**	**5,358,273.39**	**50,010,552.39**
SCMS	PEPFAR	102170	Stat-Pak	8/31/2012	90	20020	Received	1781780	213813.6	1995593.6
SCMS	PEPFAR	102170	Stat-Pak	9/30/2012	106	68020	Received	6053780	726453.6	6780233.6
	2012					88040	0	7835560	940267.2	8775827.2
SCMS	PEPFAR	102170	Stat-Pak	4/26/2013	107	3401	Received	302689	36322.68	339011.68
SCMS	PEPFAR	102170	Stat-Pak	5/6/2013	94	1447	Received	128783	15453.96	144236.96
SCMS	PEPFAR	102170	Stat-Pak	9/27/2013	174	202	Received	17978	2157.36	20135.36
SCMS	PEPFAR	102170	Stat-Pak	11/30/2013	175	5439	Received	484071	58088.52	542159.52
	2013					10489	0	933521	112022.52	1045543.52
SCMS	PEPFAR	102170	Stat-Pak	1/3/2014	252	3337	Received	106784	12814.08	119598.08
SCMS	PEPFAR	102170	Stat-Pak	2/16/2014	270	3487	Received	111584	13390.08	124974.08
	2014					6824	0	218368	26204.16	244572.16
SCMS	PEPFAR	102170	Stat-Pak	5/5/2015	483	1620	Received	51840	6220.8	58060.8
SCMS	PEPFAR	102170	Stat-Pak	8/31/2015	567	1564	Received	50048	6005.76	56053.76
SCMS	PEPFAR	102170	Stat-Pak	10/27/2015	596	1391	Received	44512	5341.44	49853.44
SCMS	PEPFAR	102170	Stat-Pak	10/27/2015	597	562	Received	17984	2158.08	20142.08
	2015					5137	0	164384	19726.08	184110.08
Total						**2,209,800.00**	**-**	**9,151,833.00**	**1,098,219.96**	**10,250,052.96**
SCMS	PEPFAR	102165	Uni-Gold	9/12/2012	57	160360	Received	14272040	1712644.8	15984684.8
SCMS	PEPFAR	102165	Uni-Gold	12/12/2012	104	241680	Received	21509520	2581142.4	24090662.4
	2012					402040	0	35781560	4293787.2	40075347.2
SCMS	PEPFAR	102165	Uni-Gold	2/1/2013	97	24510	Received	2181390	261766.8	2443156.8
SCMS	PEPFAR	102165	Uni-Gold	11/8/2013	176	6355	Received	565595	67871.4	633466.4
	2013					30865	0	2746985	329638.2	3076623.2
SCMS	PEPFAR	102165	Uni-Gold	1/31/2014	250	31842	Received	1018944	122273.28	1141217.28
SCMS	PEPFAR	102165	Uni-Gold	3/31/2014	279	24250	Received	776000	93120	869120

	2014					56092	0	1794944	215393.28	2010337.28
SCMS	PEPFAR	102165	Uni-Gold	4/30/2015	482	13409	Received	429088	51490.56	480578.56
SCMS	PEPFAR	102165	Uni-Gold	6/15/2015	576	6768	Received	216576	25989.12	242565.12
SCMS	PEPFAR	102165	Uni-Gold	6/15/2015	577	5717	Received	182944	21953.28	204897.28
SCMS	PEPFAR	102165	Uni-Gold	11/2/2015	604	5948	Received	190336	22840.32	213176.32
SCMS	PEPFAR	102165	Uni-Gold	11/17/2015	605	2399	Received	76768	9212.16	85980.16
	2015					34241	0	1095712	131485.44	1227197.44
Total						**10,464,760.00**	**-**	**41,419,201.00**	**4,970,304.12**	**46,389,505.12**
	Grand Total 2012-2015				**All Kits**		**-**	**95,223,313.00**	**11,426,797.47**	**106,650,110.47**

Annex 1. List of procured kits 2012-2015.