EXPLORING STRUCTURAL AND SYSTEMIC IMPROVEMENTS TO PROMOTE EFFECTIVE AND EFFICIENT PHARMACEUTICAL SUPPLY CHAIN MANAGEMENT FOR HIV/AIDS SERVICE DELIVERY IN NIGERIA

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ABSTRACT

Innocent Ndubuisi Ibegbunam: Exploring structural and systemic improvements to promote effective and efficient pharmaceutical supply chain management for HIV/AIDS service delivery in Nigeria
(Under the direction of Pam Silberman)

The uninterrupted availability of health products is essential for the provision of HIV/AIDS services. A 2015 assessment of public health supply chain systems in Nigeria supporting HIV/AIDS services revealed that some vital HIV/AIDS products were unavailable in about 9%–16% of health facilities visited. This implied >10% of the health facilities visited did not have all the life-saving HIV/AIDS commodities needed to provide needed clinical services. Health commodity unavailability interrupts health service delivery, negatively affects the quality of services and adversely affects patient adherence to treatment. This suggests a need for changes in the HIV/AIDS supply chain management (SCM) system.

The aim of this study was to explore structural and systemic improvements needed to promote effective and efficient public-sector pharmaceutical SCM system for HIV/AIDS service delivery in Nigeria through; (I) identification of current gaps in the pharmaceutical SCM system, (II) identification of potential solutions to address the gaps, (III) exploring effective solutions in Nigeria and other places, and (IV) identification of policy improvements for the pharmaceutical SCM system. The study was conducted using sequential mixed-method design of surveys and key informant interviews.

The results identified poor logistics data management and use, poor information dissemination for decision-making, limited leadership and funding, poor performance management and limited human resources capacity to support SCM services that disrupts HIV/AIDS service delivery. Some of the solutions to address these gaps include: use of electronic systems for logistics data management to enhance decision-making, more widespread dissemination of information on changes in clinical guidelines and the SCM system, improvements in government leadership and funding, establishment of an accountability structure, improved performance management of private sector contracted to support the supply chain system, and improved human resource management. In addition, the study identified the need to set policies on minimum remaining shelf-life requirements for donated health products, minimum levels of government funding to support the supply chain system, and an implementation plan for the national supply chain policy.

To my mother, Mrs Josephine Mgborie Adaeze Ibegbunam (*Nne ndi Father, Nne Okwukwe*) who died on September 28, 2017 and my father, Mr. Stephen Okafor Ibegbunam, who died on December 28, 1994; may your souls continue to rest in peace, Amen.

And

To my family and friends who had believed in me and endured my absence during this academic pursuit; thank you for your understanding. To my wife, Joy Chinyere Ibegbunam, children, brothers and sister, thank you for all your prayers, support, and encouragement.

And

To all clients that access their health services through the Nigeria public-health supply chain system, it is my hope this study will improve the quality of health services in the system.

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LIST OF ABBREVIATIONS

3PLs	Third-Party Logistics Providers
AIDS	Acquired Immune Deficiency Syndrome
ART	Antiretroviral Therapy
ARVs	Antiretroviral Drugs
CSCMP	Council for Supply Chain Management Professionals
FMOH	Federal Ministry of Health
FDS	Food and Drug Services
GHSC-PSM	Global Health Supply Chain Program - Procurement and Supply Management
HIV	Human immunodeficiency Virus
ISO	International Organization for Standardization
IRB	Institution Review Board
JSI	John Snow, Incorporated
LGA	Local Government Area
LMCU	Logistics Management Coordinating Unit
MSH	Management Sciences for Health
NACA	National Agency for the Control of AIDS
NAFDAC	National Agency for Food and Drug Administration and Control
NAIIS	National AIDS Indicator and Impact Survey
NGO	Non-Governmental Organizations
NHREC	National Health Research Ethics Committee of Nigeria
NPSCMP	National Product Supply Chain Management Programme
PCN	Pharmacists Council of Nigeria
PEPFAR	U.S. President’s Emergency Plan for AIDS Relief

PPP	Public-Private Partnership
RTKs	Rapid Test Kits
SCM	Supply Chain Management
SCMS	Supply Chain Management System
SMOH	State Ministry of Health
SOP	Standard Operating Procedures
STG	Standard Treatment Guidelines
USG	United States Government
UN	United Nations
UNC	University of North Carolina at Chapel Hill

CHAPTER 1: INTRODUCTION

Background

The 2015 assessment of public health supply chain systems in Nigeria supporting HIV/AIDS service delivery revealed that some vital HIV/AIDS products were unavailable in about 9%–16% of health facilities visited (Ajulo et al., 2015). This implied >10% of the health facilities visited did not have all the life-saving HIV/AIDS commodities needed to provide needed clinical services. With about 748,000 persons on antiretroviral therapy (ART) in Nigeria from 6,500 health facilities (NACA, 2015), the unavailability of these products creates significant access barriers to life-sustaining treatment for many patients with HIV/AIDS. Health commodity unavailability interrupts health service delivery, negatively affects the quality of services, and adversely affects patient adherence to treatment. The inability to provide life-saving medicines can lead to loss of lives, especially in emergency health service delivery situations (MSH, 2012).

There have been several studies on the problem of stock-outs (i.e. unavailability) of health products for HIV/AIDS and for maternal, infant and child health services. For example, in the Kinondoni district of Tanzania, Mori and Amani (2014) conducted a cross-sectional study on antiretroviral drugs (ARVs) availability in 20 health facilities. The study documented lack of some vital ARVs in 16 out of the 20 health facilities. This resulted in change of treatment regimen as a coping strategy (Mori & Amani, 2014). This abrupt change in treatment regimen for no therapeutic or pharmacological reasons but product stock-out negatively affects long-term HIV treatment planning, may affect drug efficacy, and could result in poor treatment outcomes. Conversely, studies have shown that availability of needed health products can improve health outcomes. Orobaton et al. (2015) noted how innovative distribution of Chlorhexidine and

Misoprostol (life-saving medicines) improved maternal, newborn and child health outcomes in Sokoto State, Nigeria. The United Nations' Commission on life-saving commodities for women and children also highlighted the cardinal role health products play in health service delivery (UN, 2012). Without health products, the health workers will not be able to deliver complete package of clinical services to the patients.

Several definitions of Supply Chain Management (SCM) exist in literature. This study adopts the Council for Supply Chain Management Professionals (CSCMP) definition, which is, "the planning and management activities that ensure the availability of needed products from the manufacturers to end users" (CSCMP, 2011). These include coordination and management of human resources and materials from sourcing to last mile delivery (CSCMP, 2011). In the health sector, effective and efficient pharmaceutical SCM ensures that pharmaceutical products are available at the health facilities where and when they are needed at the most efficient cost to the program. Thus, the success of health programs is dependent on optimally functioning supply chain system. (Appendix 1 includes a definition of key terms). Without the products—such as necessary medicines—healthcare workers will not have the right medications to deliver services to the clients resulting in service disruption (USAID | DELIVER PROJECT, 2009).

Over the last ten years, the public-sector pharmaceutical SCM system for HIV/AIDS in Nigeria has made several changes to the structures and processes aimed at improving the efficiency and effectiveness of the system. Some of these modifications are donor-driven and result in the creation of private sector-managed parallel pharmaceutical systems, different from the existing government HIV/AIDS pharmaceutical system (Chima & Homedes, 2015). These parallel systems often develop when there is a breakdown in the public-sector SCM system, leading to an emergency need to provide life-saving medications at clinics (Windisch, Waiswa, Neuhann, Scheibe, & Savigny, 2011). There are no standardized policies to update or modify the SCM system in the public nor private sector-managed parallel systems, leaving the pharmaceutical SCM system open to unplanned modifications in one or both. In both systems,

these modifications are often made without first assessing the capacity of the current system, to support required service delivery. Hence, they often negatively affect system performance. For instance, there is a delay in the time it takes to supply HIV/AIDS products from the warehouses to health facilities as result of SCM modifications. In the past, based on my experience in the SCM system, such requests for supply could be made and within two weeks of the requests, supplies would be completed. However, with recent changes in the supply chain system, it has increased to between three to five weeks. This came about as result of the request by the donors to increase the number of pharmaceutical products supplied to health facilities to include pharmaceuticals for tuberculosis treatment. In addition, the number of health facilities that receive pharmaceutical products from the SCM system increased astronomically from less than 1,000 to over 6,000 health facilities within 2 years. The delay caused by the new requirements and additional clinics results in the lack of essential HIV/AIDS medications at service delivery points when needed. This lack of structural processes to accommodate modifications to the SCM is a major challenge. While expansion of clinics improves access to health services, when not well planned, the scale-up often disrupts SCM system.

Currently, discussions are ongoing to modify the inventory management protocols by revising the distribution frequency of supplies to health facilities from bi-monthly (every 2 months) to quarterly (every 3 months). This will require health facilities to increase the stockholding capacity from four months of stock to five or six months of stock (i.e. how long products supplied to the clinics will last at the current rate of utilization). This modification was proposed to address recommended changes in the HIV/AIDS treatment protocol from the 2016 World Health Organization Consolidated Guidelines for HIV/AIDS service delivery that was adapted by the Government of Nigeria (FMOH, 2016). While these discussions are intended to support service delivery, there are no procedures that specify how to implement the changes. In addition, Nigeria does not have specific implementation procedures to avert service disruptions that were noted in other countries that implemented HIV/AIDS services scale-up (Schouten et

al., 2011; Windisch et al., 2011). With the lack of documented procedures for pharmaceutical SCM modifications, new organizations that come into the system do not have guidelines to follow. In addition to lack of processes to follow when making system modifications, several other factors affect product availability in health facilities. These include inaccurate data needed for decision-making (Hasselback et al., 2014), inadequate skilled human resources (Brown & Gilbert, 2014), and poor warehousing and distribution infrastructures (Daff, Seck, Belkhayat, & Sutton, 2014; Yadav, 2015). The study will explore these in the Nigeria context for effective and efficient pharmaceutical SCM for HIV/AIDS.

An effective and efficient pharmaceutical SCM ensures that the "six rights" of the SCM are always maintained to promote uninterrupted health product availability (USAID I DELIVER, 2011). These "six rights" are the hallmark of a well-designed, effective, and efficient SCM system within a health program. These include the right products (based on policy specification), that need to be available in the right quantities (based on guidelines on inventory holding capacity of the service delivery point), at the right time (considering the patients' clinical appointments), in the right place (the selected location for service delivery), at the right condition (not expired or damaged) and at the right cost for the patients (for efficient management of resources both for the SCM and the patients). These "rights" denote the primary purpose of pharmaceutical SCM system to provide health services to the clients (USAID│DELIVER PROJECT, 2011). The "six rights" are essential in quality monitoring of SCM to identify inadequacies in the systems and/or processes that support uninterrupted supply of health products.

The Nigerian public-sector pharmaceutical SCM system has been subject of at least three studies in the last five years. A study of the HIV/AIDS pharmaceutical system identified challenges on lack of standardized logistics data collection system and management within the program as major bottleneck to SCM system harmonization (Agudelo et al., 2012). The authors highlighted how the use of different logistics data collection tools and different channels for

transmission of the data from the clinics to the federal level had made long-term planning for commodity needs difficult. Another study, the Nigeria National Supply Chain Assessment highlighted the weaknesses of the fragmented pharmaceutical SCM systems (Ajulo et al., 2015). The authors noted that Nigeria has parallel public-sector pharmaceutical SCM systems that are operated independently by each health programs (e.g. HIV/AIDS, Malaria, Family Planning, Tuberculosis, and Vaccine). Some of the problems noted for the HIV/AIDS pharmaceutical SCM included a lack of standardized logistics data and data collection tools across the programs, unreliable data to guide decision-making on pharmaceutical product needs, and the lack of standardized inventory management practices. The authors also noted inadequate funding to procure needed pharmaceutical products, and a lack of leadership at the governmental level needed to coordinate procurement across programs (Ajulo et al., 2015). Earlier assessments of the pharmaceutical SCM for HIV/AIDS and the Family Planning program SCM also noted similar findings on fragmented pharmaceutical SCM systems (Agudelo et al., 2012; Bock, Tien, Igharo, Adedeji, & Agudelo, 2011).

The 2015 assessment recommended development of a coordination framework for the pharmaceutical SCM processes that will leverage on the strengths of the various systems. Specific recommendations include the establishment of a robust system for procurement order tracking at the national level, the need for capacity-building of government institutions on quantification, and harmonization of the inventory control parameters and reporting systems (Ajulo et al., 2015). This was similar to the recommendations of the 2012 assessment of the HIV/AIDS program but with emphasis on logistics data management systems (Agudelo et al., 2012).

The government has taken some steps to implement the 2015 recommendations; for example, the Government had set up a coordination framework for the HIV/AIDS commodities procurement (across the multiple donors). This coordination framework helped to minimize duplication of procurements for products that are already available in the country. However,

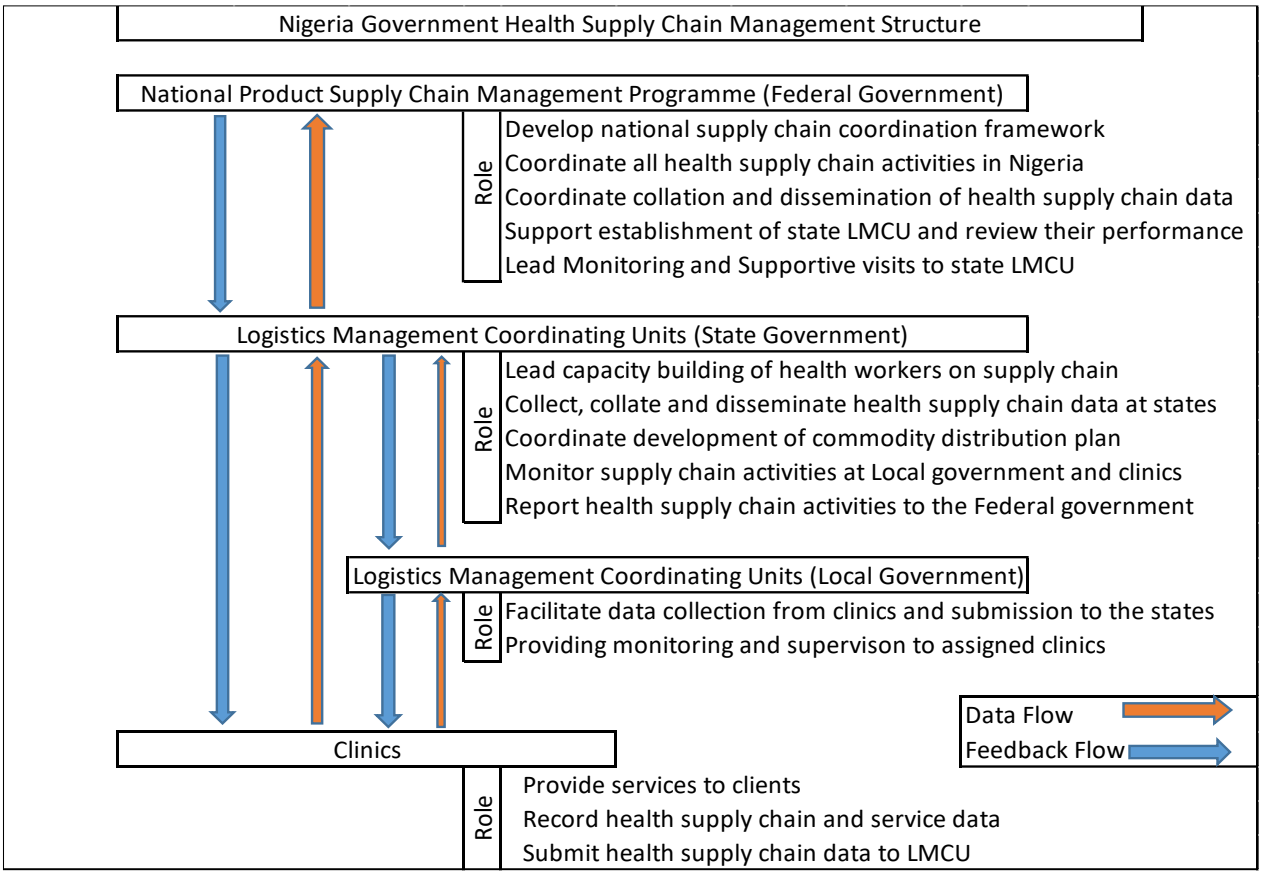
there is not a robust procurement tracking system that provides real-time status of all procurements and resources expended. This is due to the sensitive (and often confidential) nature of procurement information within the government systems, especially as related to costs. Government has also taken steps to build capacity of staff, through the support of donors, on quantification of HIV/AIDS products. However, the increase in the attrition of trained staff had limited the impact of these capacity-building efforts. Furthermore, Government is leading an ongoing discussion on changing the inventory control system for HIV/AIDS program to maintain a harmonized SCM system across the country. A decision has not been made because of the various programmatic considerations (e.g. clinical adherence of patients on medications, warehouse capacity in the clinics to accommodate large supplies, shelf life of the drugs etc.). This decision will impact on whether HIV positive patients on antiretroviral drugs will continue to receive two months of antiretroviral drugs prescription during each clinic visit, as is the current practice, or will receive medications that will last up to six months. The harmonization of the inventory control system, as part of the ongoing discussion, will be used to address the lack of standardization in logistics data collection tools and systems within the HIV/AIDS program.

Finally, the recommendations from the 2012 HIV/AIDS SCM study partly informed the creation of an electronic data management system that would have supported the HIV/AIDS program. Unfortunately, the support for this system was aborted in 2014 with the withdrawal of funding by the donor supporting the program as result of change in priorities. A new discussion across multiple donors is currently at the initial stages due to the ongoing problems in managing logistics data across 5,000 clinics offering HIV/AIDS services in Nigeria. These discussions will inform the development of a strategy for an electronic logistic data collection and management system in 2018 or 2019.

Public health sector leaders and managers must understand the structural and systemic gaps that impede the “six rights” in pharmaceutical SCM. This will enable them develop strategies to address these gaps, including clear roles and responsibilities for the different

stakeholders. They also need this knowledge to ensure system improvement and performance management, and to develop proper accountability mechanisms. Currently, State governments in Nigeria are setting up logistics management coordinating unit (LMCU) to oversee the pharmaceutical supply chain at the health facilities. In some states, efforts are ongoing within the last 12 months to establish the LMCU structures at the local government areas (i.e. districts/counties). These units will need skilled human resources. A national coordinating body, the National Product Supply Chain Management Program (NPSCMP) will supervise activities of the LMCU. Figure (1) provides a summary of the structures and their roles. These accountability structures established by the Government are responsible for coordinating and monitoring HIV/AIDS pharmaceutical SCM. However, the role of these institutions in various states are still evolving while their ability to coordinate pharmaceutical SCM systems is limited by lack of human and financial resources. Understanding role of LMCU and NPSCMP in giving support to the pharmaceutical SCM system will aid in the development of effective and efficient solutions to identified gaps. Nigeria started a National AIDS Indicator and Impact Survey (NAIIS) in June 2018. This study uses a population-based survey that will provide insight on the estimated number of persons living with HIV and their geographic location. The survey findings are expected to guide HIV/AIDS service delivery and resource deployment plan, including SCM services, based on disease burden from 2019. It is my hope that findings from this study will inform policy development and implementation plans that aligns with results of NAIIS to create an effective and efficient HIV/AIDS pharmaceutical SCM system in Nigeria.

Figure 1: Nigeria Government Health Supply Chain Management Structure



Research Question and Aims

The aim of this research will be to make policy recommendations and develop a plan to inform changes in management structures, systems and processes needed to promote effective and efficient pharmaceutical supply chain management for HIV/AIDS service delivery in Nigeria.

To achieve the aim of the research, I will explore this research question:

What structural and systemic improvements are required to promote effective and efficient public-sector pharmaceutical supply chain management for HIV/AIDS service delivery in Nigeria?

Additional sub-questions will be:

- **Aim 1**: What are the gaps in the current pharmaceutical SCM system for HIV/AIDS service delivery that have created barriers to achieving the six "rights" of pharmaceutical SCM?

  Method: Surveys of health workers, program managers, and donors in the SCM.

- **Aim 2**: What are potential solutions to address these gaps in the current pharmaceutical SCM system for HIV service delivery and promote long-term effectiveness and efficiency?

  Method: Surveys and Key Informant Interviews

- **Aim 3:** Are there other models of effective SCM systems that could be adopted for an effective and efficient pharmaceutical SCM system for HIV/AIDS? (In Nigeria, elsewhere?)

  Method: Literature Review and Key Informant Interviews

- **Aim 4:** What policy change(s) will promote an effective and efficient pharmaceutical SCM system for HIV/AIDS service delivery in Nigeria?

  Method: Key Informant Interviews.

Benefits and Significance of the Study

This study will identify improvements in structures and systems needed to create effective and efficient pharmaceutical SCM system for HIV/AIDS that meets public health goals of the country. The study will be used to make specific policy recommendations to improve the pharmaceutical SCM system. Further, as the final product, the study will be used to develop a plan for change that highlights some of the actions that can aid to solve some of the structural and systemic barriers identified.

Over the last decade, I have been working with Non-Governmental Organizations (NGOs) in helping to lead the national HIV/AIDS pharmaceutical SCM system. Under the Supply Chain Management System (SCMS) Project, I supported the government in estimating national HIV/AIDS product requirement, and in designing, implementing, and assessing the pharmaceutical SCM system. These are based on the United States Government (USG) guidance for the U.S. President's Emergency Plan for AIDS Relief (PEFPAR) program. I am also involved in developing pharmaceutical SCM standard operating procedures for HIV/AIDS program, capacity development for Government counterparts, and formulation of national pharmaceutical SCM policy for Nigeria. These experiences had given me insight into the different components of the system. My knowledge of the system informed my research method. It will also guide how I will channel the findings from the research to make desired system changes. I will have the opportunity to promote the implementation of some of these systemic changes. This I hope will happen as I am still involved in SCM leadership role through the USAID Global Health Supply Chain program - Procurement and Supply Management (GHSC-PSM) project in Nigeria. However, for the purpose of the research, I tried to ensure that my personal bias did not influence the data collection, analysis, and interpretation. I did this by limiting eye contact during the interview and following a rigorous codebook development using the conceptual framework. A second coder for consistency further reviewed this codebook and analysis.

CHAPTER 2: LITERATURE REVIEW

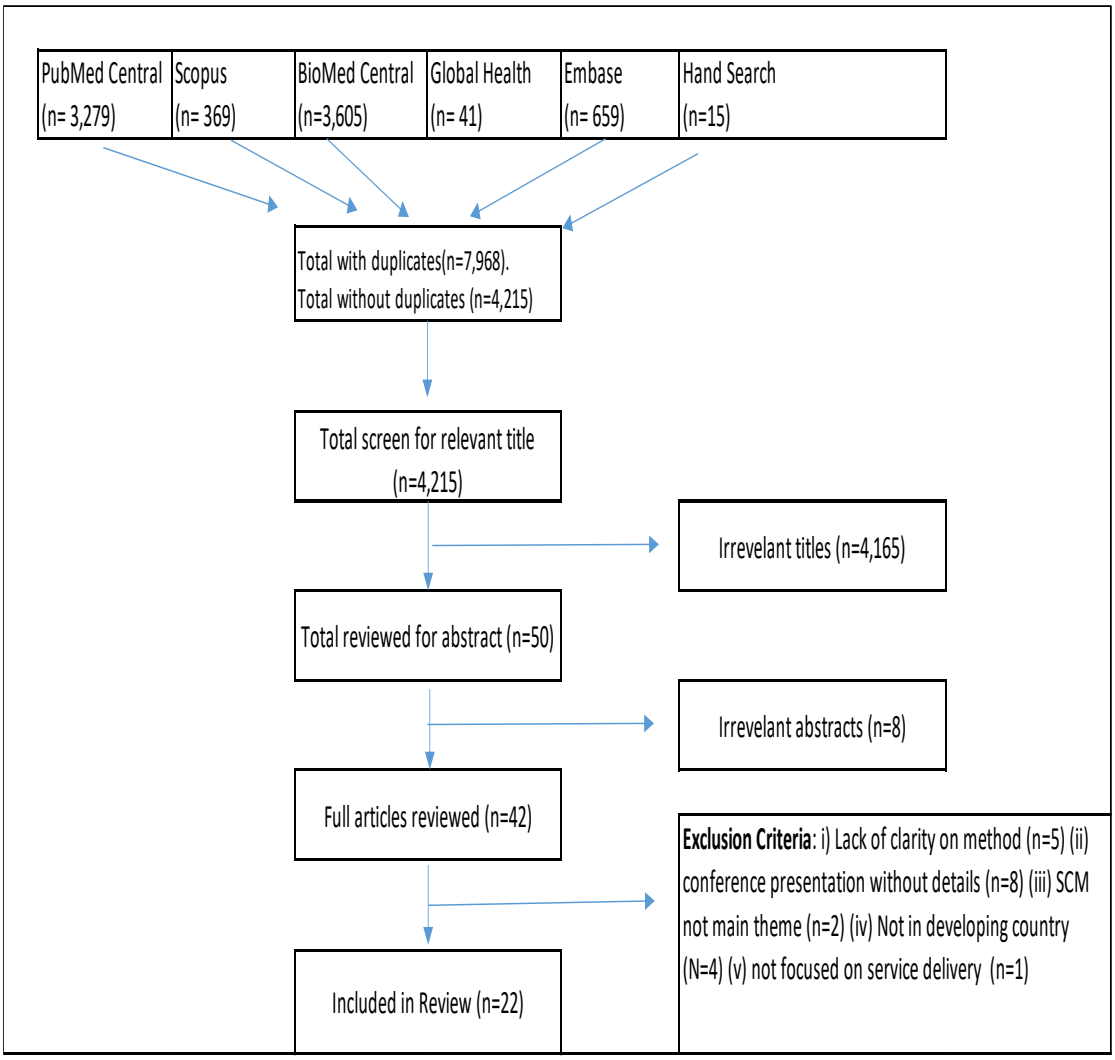
Pharmaceutical SCM is often discussed in fields outside of public health, including business management and engineering. I searched several databases to find pharmaceutical SCM published works in the mainstream journals for public health audience: PubMed Central, Scopus, Global Health, and Embase. I also searched BioMed Central because articles in PubMed Central linked to this database. Based on knowledge of the study area, I also conducted hand searches in grey literatures in the John Snow, Inc. (JSI) USAID│DELIVER PROJECT, Management Sciences for Health (MSH) websites and Google Scholar and regular Google search engines. Finally, I searched available Nigeria policy documents on HIV/AIDS service delivery and pharmaceutical SCM for relevance to the research question.

Search Strategy

The search used the following key terms; “procurement and supply management”, “pharmaceutical supply chain management”, “supply chain”, “leadership”, “health commodities”, “governance”, “HIV service delivery”, “sustainability”, “effectiveness” and “Nigeria”. These concepts and terms were used in different combinations in the search engines to assist in filtering. The search focused only on English language articles from 2005 as this was period of significant changes in the Nigeria pharmaceutical supply chain space. In PubMed Central, I used relevance to arrange citations. The search covered both titles and content of the key words or their synonyms in the abstract. In Scopus, I filtered the search by articles and medicines to limit the number of citation hits reviewed as this database covered articles in business management, agriculture, and other non-health-related fields. In Embase, I used

Antiretroviral drug as sub-filter to bring out citations that were relevant. In BioMed Central, there was no filtering strategy; hence, I used the search terms to pick published articles some of which were also in PubMed Central. Furthermore, I searched grey literature on the USAID | DELIVER PROJECT and MSH websites that are known to be involved in pharmaceutical SCM with focus on human resources management in health and leadership. This aided in generating reports, studies, and practical field lessons on implementation of pharmaceutical SCM. Adapting from Liberati et al. (2009) below is the PRISMA diagram on the literature review process and outcome (Figure 2).

Figure 2: Systematic Literature Review Strategy



Inclusions and Exclusion Criteria

I limited my search to publications that had any of the key search terms in title or abstract. I excluded articles that were not directly related to SCM of health products and health services delivery. Also, I excluded articles discussing general health interventions without identification of pharmaceutical SCM interventions to improve health service delivery. In addition, I also excluded articles that did not have a focus in developing countries. Finally, I removed articles that focused on pharmaceutical SCM for the manufacturing sector only.

Results

Findings from the literature review included 22 papers with varying themes related to structural, leadership and systemic gaps affecting pharmaceutical supply chain management system (SCM) in developing countries. The results include five qualitative cross-sectional and observational studies, five quantitative studies, and four mixed methods studies. The other eight papers include editorials on pharmaceutical SCM, commentaries, literature reviews and a book chapter. Based on the focus of the systematic review, the findings were divided into six major themes focusing on (a) leadership and governance, (b) sustainability, (c) data management, (d) human resource management, (e) health service delivery, and (f) integration of SCM systems.

a) **Leadership and Governance**: The context of weak leadership and governance structures in pharmaceutical SCM within developing countries was noted as a major challenge that needs attention (Chima & Homedes, 2015; Windisch, et al., 2011). The authors identified the lack of clear governance framework in pharmaceutical SCM within the different government institutions involved in antiretroviral therapy service delivery. These institutions are often not working together to coordinate pharmaceutical SCM activities (Windisch et al., 2011). Often, institutions duplicate roles that other institutions perform to enhance their visibility and make themselves more relevant in the public

health environment (Chima & Homedes, 2015). Furthermore, the multiplicity of roles and duplication of efforts leads to inefficiencies, waste, and pharmaceutical system failures (Hasselback et al., 2014). Duplicity of efforts across agencies can also result in bureaucratic delays in obtaining approvals for SCM activities, with different government institutions having overlapping roles in providing strategic direction (Chima & Homedes, 2015). In addition, the pharmaceutical SCM is often designed for convenience in management in governmental administrative structures. This design is inefficient, especially when technical and/or operational optimizations are not considered in the final implementation plan for SCM (Yadav, 2015). Furthermore, lack of a clear accountability structure in the governance system as result of role duplications creates room for poor resource management and product unavailability at the health facilities (Kohler, Mackey, & Ovtcharenko, 2014; Windisch et al., 2011).

Garuba, Kohler, and Huisman (2009) to move the pharmaceutical system forward proposed the development and maintenance of institutional capacity along with governance structures and quality monitoring systems. Government should provide the vision, guidance and oversight for program implementation (Bornbusch, Dickens, Hart, & Wright, 2014). These are critical recommendations as system issues rooted in weak governance structures are often difficult to remedy except through a complete overhaul of the system or significant change in governance structures (Windisch et al., 2011). Problems related to the governance of pharmaceutical systems need to be acknowledged and addressed with participation of all stakeholders (Kohler et al., 2014). This is vital to generate the required consensus of stakeholders through a transparent decision-making process.

b) Sustainability: Brown and Gilbert (2014); Chima and Homedes (2015), and Windisch et al. (2011), noted that public sector pharmaceutical service delivery in developing

countries are donor-dependent, largely because of government inaction in addressing the needs of their population in these countries. Hence, the activities of the pharmaceutical SCM system follows the donor-driven agenda. These agendas are often targeted specifically at particular component of the health sector and short-term goals. As Windisch et al. (2011) noted, the dependence not only promotes fragmentation of the service delivery but also takes attention away from some critical health services like maternal and childhood illnesses that has higher morbidity and mortality but may not be part of the donor priority intervention in the supported health facilities. Poor accountability of donor funds by government had encouraged further bypassing of the existing government pharmaceutical SCM systems for direct interventions that will yield immediate results. This results in further system fragmentation and makes the interventions unsustainable (Chima & Homedes, 2015; Windisch et al., 2011). Further, dwindling donors' support for public health service delivery, due to donor-fatigue, is a concern that needs to be addressed in-county (Grepin, 2012).

c) **Data Management, Data Demand, and Information Use**: Authors identified the need for reliable data to guide decision-making. Data are needed to ensure that decisions on SCM are based on evidence that will support uninterrupted service delivery (Brown & Gilbert, 2014). Poor recordkeeping practices often hampers the ability of the pharmaceutical SCM to calculate the period of product unavailability (stock out duration) for proper replenishment in subsequent supplies (Hasselback et al., 2014). This calculation is important to enable the service providers to receive a full complement of products needed to meet client demand. Findings from Hasselback et al. (2014) in Mozambique indicates an average of 78% missed product utilization opportunities as result of product unavailability. These missed opportunities (referred to as lost consumption) are calculated based on client demand for malaria rapid diagnostics test

kits that were not met due to pharmaceutical product unavailability in clinics. The poor use of available data to guide product resupplies results in less timely access to health services for clients, and can also lead to greater travel costs, as some people must drive to other clinics or return multiple times to obtain needed services (Magadzire, Budden, Ward, Jeffery, & Sanders, 2014). This highlights the importance of evidence-based decision-making using available data to ensure that products are available in clinics based on client demand.

Manual recordkeeping increases the burden on the health service providers to accurately document, store and retrieve available logistics data for decision-making (Silumbe & Kamuhabwa, 2015). Automating these data collections and use processes is beneficial, as timely logistics report submission will strengthen the overall pharmaceutical SCM with accurate data for resupply decisions (Hasselback et al., 2014; Jatau et al., 2015). However, any system that relies on electronic data collection must also include proper back up, as data loss can create a major challenge (Brown & Gilbert, 2012). As noted by Chima and Homedes (2015) and Windisch et al. (2011), donor resources have assisted in the generation of logistics data to inform decision-making. Some of this is through electronic data automation processes. However, the vertical nature of these data collection mechanisms (i.e. multiple and independent channels of data collection from the same health facility) has made it more expensive and difficult to replicate in resource limited settings. Despite the cost implication, the availability and use of reliable data in pharmaceutical SCM improves the quality of public health practice. The continuous use of reliable data promotes the practice of evidence-based decision-making throughout the system (Daff et al., 2014).

d) **Human Resource Management:** Authors noted that there were inadequate human resources for pharmaceutical SCM in developing countries (Brown & Gilbert, 2014;

Silumbe & Kamuhabwa, 2015). Limited supervision and training of staff further complicate inadequate human resources availability to provide services (Brown & Gilbert, 2014). Furthermore, there is poor retention of the staff who work in the SCM system. This is due to lack of performance incentives and poor remuneration within governmental institutions (Chima & Homedes, 2015). In addition, knowledge acquired from capacity-building exercises may not be used because staff are often redeployed to other positions where the new skills are no longer needed (Brown & Gilbert, 2012). This makes donors question resources committed to capacity building. For example, if on completion of a warehouse management training, the trainee is redeployed to an administrative office; the skill acquired from the warehouse management training becomes redundant. In addition, health managers are often limited in their ability to utilize available human resources within the public health system due to limited capacity and bureaucratic rules in meting out sanctions to underperforming staff (O'Neil, 2008; Yadav, 2015). The paucity of staff also adversely impacts on record keeping practices at the clinics to generate data needed to guide pharmaceutical product replenishment.

Oqua et al. (2013) proposed developing a structured system of volunteers to fill staffing gaps in pharmaceutical SCM. The volunteers, with the right capacity building, can serve as local resources for service provision. In addition, these volunteers that are trusted within the communities can be used as a resource for storage, distribution and dispensing of the pharmaceutical products especially in emergency obstetrics care, as noted by Orobaton et al. (2015), in the use of Misoprostol (to prevent postpartum hemorrhage) and Chlorhexidine (cleaning of baby's cord) as demonstrated in Sokoto State, Nigeria.

e) Service Delivery: the availability of health products to support health service delivery is the primary purpose of pharmaceutical SCM (Daff et al., 2014; Hasselback et al., 2014;

Magadzire et al., 2014; Oqua et al., 2013, Orobaton et al., 2015; Silumbe & Kamuhabwa, 2015). Health service delivery is often hinged on the right product being available in the right quantity at the right time, in the place and under the right condition and at the right cost of the clients (USAID|DELIVER PROJECT, 2011). The health workers serve as advocates between the clients and the health system by working to ensure uninterrupted pharmaceutical product availability (Magadzire et al., 2014). The availability of health products was found to motivate health workers as they have the resources needed to provide quality services to their clients (Adzimah, Awauag-Gyawu, Aikins & Duah, 2014).

In pharmaceutical SCM managed by the government, emphasis is often placed on the procurement and warehouse infrastructure components with little attention to the operating costs (data management, distribution, maintenance etc.) of system that supports service delivery. This is often because the capital-intensive cost of purchasing warehousing equipment attracts political attention while the invisible costs that enable the system to function does not (Yadav, 2015).

In addition, the distribution systems to move the pharmaceutical products to the clinics are sometimes not functional. This creates an inefficient system where health workers are compelled to travel to the warehouses to pick up pharmaceutical products (Yadav, 2015). Poor roads also create access barriers that prevent the transportation of products to health clinics. Private sector transporters that are contracted to provide distribution services may choose to avoid areas that can only be accessed through poor roads, thereby denying clients access to pharmaceutical products. Relying on the limited available public-sector transportation often increases the duration from when pharmaceutical products are needed to when they are available to the patients. Furthermore, erratic supply of pharmaceutical products makes clients lose confidence in

the health system. This sometimes encourages them to seek alternative sources of healthcare that may not be of acceptable quality standards (Magadzire et al., 2014). The private sector distribution agents could address this problem through properly structured incentives (Palafox et al., 2014). However, this may increase the cost of service delivery in those rural locations thereby denying patients access to affordable healthcare. Access to health products can also be improved by referring patients to health centers closest to their residence with the required products (Magadzire et al., 2014). However, the client may not want to access services from nearby clinics where they are known due to stigma (especially for HIV/AIDS).

In addition, the use of local networks of individuals (i.e. community health extension workers, retired nurses and lay health advisors in rural communities) that the clients can visit to access products have been noted to improve access to pharmaceutical product in Nigeria (Orobaton et al., 2015). The residence of these individuals has served as distribution points for emergency supplies in obstetrics care. This was documented in the use of Chlorhexidine and Misoprostol in rural communities in Sokoto State, Nigeria (Orobaton et al., 2015). Also, the use of vendor-managed mobile warehouse to increase access to pharmaceutical products have been documented in Senegal to increase access to pharmaceutical products (Daff et al., 2014). These mobile warehouses visit clinics on a defined schedule to assess their requirements and replenish their pharmaceutical product need immediately. Authors noted that inappropriate management of available infrastructure and resources can result in dilapidated warehouses, expiration of products, and in some cases misuse of the product. This denies patients access to quality medicines needed for treatments.

f) **Integration**: With the dwindling funds from the global community to support increased access to HIV/AIDS services, optimizing service delivery is vital to strengthen and

sustain quality service delivery (Amole et al., 2011; Grepin, 2012). Promoting efficiency in pharmaceutical SCM requires coordinating the use of all available resources through a planned integration process for the HIV/AIDS products SCM system among different public and private HIV/AIDS funding institutions (e.g. Government of Nigeria, PEPFAR, and The Global Fund). The benefits of integration may include increased economies of scale, increased flexibility and adaptability, improved efficiency and performance (Optimize, 2013). This is where the role of pharmaceutical SCM managers in shaping the system is crucial. The pharmaceutical SCM managers understand both patient needs and system gaps to meet the needs—hence their role is vital. Through an integrated pharmaceutical SCM system, people, processes, functions, and structure are linked and managed as an interconnected system (Bornbusch et al., 2014).

System failure often occurs because of the institution of disease-specific interventions that are short term (Windisch et al., 2011). These short-term interventions in the procurement of pharmaceutical services are often not be applicable to other health programs. Mtonya and Chizimbi (2006) noted this in the use of World Bank guidelines for procurements of health products in Malawi despite perception by stakeholders that it was ‘cumbersome’. These short-term measures do not address program-wide bottlenecks for the public health program that will promote quality service deliveries (Windisch et al., 2011). Disease-specific interventions may include creating a warehousing system that is only used for antiretroviral drugs or distributions vehicle for drugs needed for malaria treatment. Efficiencies that would have been enjoyed through multiple uses of the same resource like a single warehouse or distribution infrastructure is lost to the system. Integration should include synchronizing or merging the processes within different components of SCM, such as data management. However, deciding which components of the system to integrate and the kind of integration that should

happen (product or processes, full or segmented) is not an easy question to address (Optimize, 2013). This is where the contextual knowledge of the environment, technical understanding of the program and insight on available resources to support the integration process is paramount. Benefits of the integration process needs to be balanced with the goal of the program to ensure that the needs of the clients are always met (Optimize, 2013).

Integration is not the panacea for all pharmaceutical SCM challenges as thought by some people (Optimize, 2013). There may still be benefit in SCM multiplicity to build in redundancies and agility as a risk management strategy (Bornbusch & Bates, 2013). The question though is at what cost and who will pay for the extra redundancies that may never be utilized? It is also important to note that poorly designed pharmaceutical SCM cannot be improved through integration. This will further complicate the system and clog the wheel of progress in making health products available in clinics. An effective supply chain should be able to respond to changes in health priorities of the environment, demographics, manufacturing, technology, and financing (Bornbusch et al., 2014).

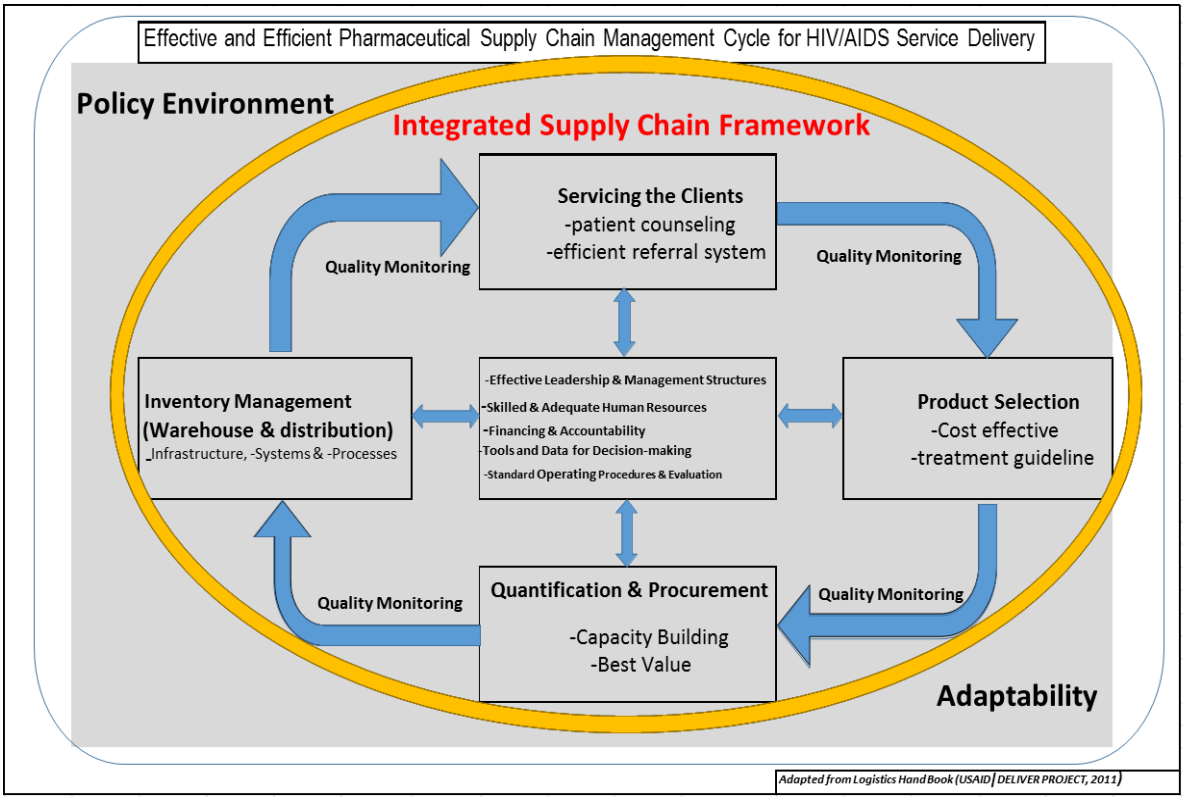
In conclusion, the reviewed studies identified some of the bottlenecks in pharmaceutical SCM. However, none of the studies discussed comprehensive challenges and priority interventions to address all the components of pharmaceutical SCM as seen in the Nigerian context. These include policy formulation and implementation plan, product selection, availability and use at the clinics to support service delivery. Other gaps in effective pharmaceutical SCM in developing countries include human resource management and leadership. This is where further studies will be useful to close gaps in the pharmaceutical SCM system. Gaps to be addressed may include leadership and management, finance, human resources, procedures and process required in each aspect of the pharmaceutical SCM for efficient service delivery.

The results will inform discussions on long-term financing, human resources management for pharmaceutical SCM in Nigeria. Also, leadership and management strategies in pharmaceutical SCM within the government system beyond donor's support will be reviewed as part of this research.

Conceptual Framework

To maintain effective pharmaceutical SCM system that will meet the purpose of the system, all the components of the system must work optimally as seen in the conceptual model (Figure 3). The model was adapted from the "Logistic Cycle" developed by John Snow, Incorporated on public health supply chain systems (USAID|DELIVER PROJECT, 2011). The model was further adapted based on the findings from the literature about needed components to ensure effective and efficient pharmaceutical SCM systems.

Figure 3: Conceptual Model on Effective and Efficient Pharmaceutical SCM System



Adapted from The Logistics Hand Book **USAID|DELIVER PROJECT (2011)**

Five major components of the pharmaceutical SCM cycle (Figure 3) work together in a synchronized and ordered fashion to achieve the purpose of the system. These components form the basis for the conceptual model for an efficient and effective pharmaceutical SCM system. The components include:

(a) **Product Selection**: An integrated supply chain management system starts by selecting the right products needed to deliver services to the patients**.** This technical process involves clinicians, program managers, donors, and technical experts under government leadership. This process includes evaluations of new information on health products that may be introduced into the national formulary to optimize service delivery (Amole et al., 2011). The efficacy and cost-effectiveness of such new products must be considered to ensure the patient received the best possible health services at an affordable price to the system. The output of such exercise is the standard treatment guideline (STG) for service delivery. Sometimes the committee responsible for selection is inactive, making this process cumbersome (Brown & Gilbert, 2012).

(b) **Quantification and Procurement**: An integrated SCM system needs to estimate the quantity of the products needed over a period in the future to provide services and procure the products at the best possible value. This step also requires funding needed to obtain the required products when they are needed. This phase also includes a competitive process of acquiring the products to ensure the best value for the program and clients.

(c) **Inventory Management (Warehousing and Distribution**): The integrated SCM system must have right processes to manage the products using standardized warehousing and distribution protocols. This helps to ensure that the products are not damaged and get to clinics where health workers can distribute them to appropriate clients in a timely and cost-efficient manner prior to expiration.

(d) **Serving the Clients**: The last step in an integrated SCM system includes providing the appropriate services to the clients. This last step could also include counseling and referring clients for other services, and/or recommending new products or services to clients when appropriate. This frontline activity ensure the clients benefit from the pharmaceutical SCM whenever they need services.

These four components work together in a cyclic process. Quality monitoring is critical for all the components. On the arrows that connect the different components is embedded quality monitoring. This is to ensure that each component is performing optimally to feed into the next component. Quality monitoring also provides the information needed to make needed changes or adjustments to continue quality service delivery. Quality monitoring is crucial as poor performance in any step of the SCM model affects the functioning of the other steps involved in making health products available to the clients.

At the heart of the cyclic components is the fifth component that is the main engine that drives the other parts of the SCM system. The fifth component works with all the other components through a two-way feedback mechanism for continued monitoring and direction. Elements of the fifth component include **effective leadership and management structure** with clear vision, mission, and benchmarks to enable each SCM component performs optimally. In addition, the structure is driven by adequate (in number) and skilled (through capacity-building) **human resources** for day-to-day performance. The pharmaceutical SCM system also requires **finances**. The available finances need to be **accounted** for properly, with systems to minimize waste and improve performance. All the components should operate within established **standard operating procedures** (SOPs) that should be **evaluated** periodically to determine whether changes are needed. To implement the SOPs requires the availability of **tools** to gather data on the use of the products, when replenishment products are needed, and to monitor system performance. The data are then used to inform leadership and management

decisions on financing, quality improvements, and evaluation of the pharmaceutical SCM. SOP provides timelines that are synchronized across functions within an integrated pharmaceutical SCM framework. The SOP also include use of standardized tools and protocols for data management, which will help synchronize performance and monitor requirements. Further, the SOP should include periodic performance evaluations. All these are needed to ensure that system performance is optimal using available resources within the system. The integration further involves the use a collaborative leadership and management structures with shared goals that will ensure that all components are functioning optimally.

An effective and efficient pharmaceutical SCM system functions in an **integrated framework** (represented by the yellow circle surrounding the other components). The integrated framework should operate to coordinate and use all available resources within the system, both public and private. Using all resources can help improve efficiency in management of the pharmaceutical supply chain and enable the system be more adaptable to changes. For example, an integrated SCM system should use, when appropriate, private sector infrastructure (e.g. private for-profit entities that can lease their resources at cheaper rate to pharmaceutical SCM activities compared to commercial rates), public infrastructure (e.g. government resources that can be used for pharmaceutical SCM at minimal cost to the program), human resources, and financing. The integration process also includes maximizing available capacity in distribution of products from the manufacturer to the clients at the clinics to minimize waste. For example, maximizing the use of available distribution capacity could involve the utilization of available distribution spaces within a vehicle already scheduled to visit a health facility for another purpose. This will ensure the spaces in the vehicles are used in line with effective and efficient distribution protocol and that the pharmaceutical products get to the clients on time. It may also include optimizing distribution routes to ensure prompt and cost-effective delivery of products to the clinics. The optimization process includes assessing the use of all possible

avenues of getting the pharmaceutical products to clinics on time and in good condition. These may include air transportation, road networks, and distribution by waterways. The review process should also examine the physical condition of the roads, accessibility during different weather conditions (especially during rainy season), and security to maximize the use of available resources. The cost and timeliness of air transportation is also considered especially in emergencies.

Furthermore, the SCM system operates within the context of an existing **policy environment**. The policy structure guides development of SOPs. This is to ensure that the SCM system operations are in line with set objectives of ensuring uninterrupted availability of the pharmaceutical products for specific health intervention. This policy structure determines the type of pharmaceutical products that will be supplied for use at specified health facility. The cadre of health workers often informs the decision on the type of product in the facility. For instance, the primary health centers that do not have access to pharmacists are not allowed to keep narcotic medicines for pain management.

To meet these set objectives in line with the policy environment, the ‘six rights’ of pharmaceutical SCM system need to be met. In addition, an effective supply chain management system is designed to be agile to enable it respond quickly to changes in the environment by being easily **adaptable**. Some of the changes could include changes to patient demand (leading to changes in the amount of supplies needed); changes in treatment protocol leading to changes in demand or types of products, natural disasters and/or outbreak of diseases.

CHAPTER 3: METHODOLOGY

Study Design: This study used an explanatory sequential mixed-method design (quantitative and qualitative) as described by Creswell (2013). The sequential mixed-method approach was necessary to explore the views of a wide variety of stakeholders at the national, state and health facility levels through surveys (quantitative). The survey result was used to guide detailed key informant interviews (qualitative) to further understand the survey findings and make proper qualitative recommendations for system improvements. The sequential mixed-method approach gave me an opportunity to seek the opinions of relevant stakeholders on implementable interventions to address identified challenges.

Survey

Survey Instrument: The survey (Appendices 2 and 3) included questions on the gaps to achieving the six rights of the pharmaceutical SCM system in the HIV/AIDS program. Based on the conceptual model (Figure 3) and literature review, I investigated the system elements of product selection, quantification and procurement, inventory management, serving client, logistic management information system, leadership and systems support (leadership, human resources management and accountability). I used the conceptual model to decide which components of the system to study (e.g. product selection) and literature review to decide which specific barriers and potential solutions to examine for each component, developing separate barrier and solution items as appropriate for ARVs and RTKs. These were used to develop the survey instrument, taking note of issues that applicable in the SCM system for ARVs and RTKs in the Nigeria. The survey focused on identification of barriers in different components of the

Conceptual model to support uninterrupted product supplies and improvements needed in the system.

The survey asked respondents a series of questions about the functioning of the current SCM system (using scoring scale—5-point Likert scale; 5 = Very Important; 4 = Important; 3 = Moderately Important; 2 = Slightly Important; 1 = Not Important; 0 = Don't Know), along with open-ended questions about other disruptions and/or proposed solutions in the supply chain system (Cummings & Hulley, 2007). The survey instrument was in two versions. I shared one version with potential respondents managing the supply chain system for antiretroviral drugs (ARVs) and another version with those managing HIV rapid test kits (RTKs). I developed two versions of the survey to address the unique characteristics of each product type (e.g. quality testing challenges for RTKs and adverse drug reaction for ARVs). In addition, the use of two versions enable me to reach out to respondents that work with each product type in the supply chain system.

I pre-tested the survey instrument on five potential respondents to receive inputs on clarity of the questions and how long it took to complete. Based on their feedback, I further revised the survey content for clarity (Hulley and Cummings, 2001). I submitted the final version of the survey instrument (Appendices 2 and 3) along with other documentation and obtained ethical approvals from the University of North Carolina at Chapel Hill, Institution Review Board (IRB)-17-2071 and National Health Research Ethics Committee, Nigeria (NHREC)-NHREC/01/01/2007-26/10/2017.

Sampling Method: I used stratified purposive sampling in conducting the survey to obtain a representative sample. I stratified the sample by product type (ARVs and RTKs), geographic locations (Northern Nigeria, Southern Nigeria, and Federal Capital Territory), and type of organization (Government, NGOs, and private sector).

Sampling Frame: The sampling frame included persons that work within the pharmaceutical SCM system for the HIV/AIDS program in Nigeria at three different levels (i.e. health facility, states, and federal levels). To obtain a representative sample, I purposively sent the survey to respondents in four states - two states each in the North of Nigeria and two in the South - as well as in the Federal Capital Territory, Abuja. These included personnel in government health systems, donor agencies, local and international non-governmental organizations (NGOs) and private sector organizations supporting the pharmaceutical SCM system for the HIV/AIDS program in Nigeria. The HIV/AIDS pharmaceutical SCM systems within states in Northern and Southern zones in Nigeria share similar characteristics based on the nationally designed system. However, there are marked geographical differences in the pharmaceutical SCM system across the two zones. Hence, selecting representative samples of two states within each zone gave the needed representation to identify gaps and propose solutions. For example, in the Northern states, HIV/AIDS product distribution timeline is longer because of larger landmass and distances between the warehouses and the health facilities. In Southern Nigeria, the distribution timeline is shorter because of smaller landmass and closeness of the health facilities to warehouses. However, in Southern Nigeria, during the rainy season, it is more difficult to deliver health products because of flooding of the roads compared to Northern with better access road network.

To find a representative sample, I obtained the meeting attendance lists from national and state-level pharmaceutical SCM coordination meetings for the HIV/AIDS program in the last 12 months. These meetings are held every quarter at the federal and state levels. At the end of these meetings, participants receive the attendance lists from these meetings along with the meeting minutes that are publicly available. Representatives of the various stakeholders involved in HIV/AIDS pharmaceutical SCM were usually in attendance at these meetings. I also sought out names and emails of prospective participants in health facilities through

recommendations of my colleagues in the states working directly with these health facilities. I used this larger list of potential respondents to identify people to contact in health facilities.

Sample Size: I planned to obtain feedback from 40 to 60 respondents. I assumed a 50% response rate and sampled twice the number of respondents I was targeting for study. Table 1 below had my sampling framework.

Table 1: Number of Surveys Sent and Received

Geography	State	Local areas	Type of organization	Number of respondents who were sent survey	Number of people who received the survey*
North	Benue	Makurdi	Clinics, NGOs, SMOH	21	21
		Gboko	Clinics, NGOs, SMOH	6	6
North	Kaduna	Kaduna	Clinics, NGOs, SMOH	40	28
		Kafanchan	Clinics	17	12
All Northern participants				**84**	**67**
South	Lagos	Ikeja	Clinics, NGOs, SMOH, Private Sector	18	16
		Mushin	Clinics,	9	9
South	Cross River	Calabar	Clinics, NGOs, NGO, Private sector	10	10
		Obudu/Ogoja	Clinics	7	5
All Southern participants				**44**	**40**
Federal	FCT	AMAC	Clinics, FMOH, NGO, Private sector, Donors	98	88
		Gwagwalada	Clinics	10	10
All Federal participants				**108**	**98**
All Participants Combined				236	205

NGOs – non-governmental organization; SMOH – state ministry of health; FMOH – federal ministry of health.

**This column excludes respondents who had bounced surveys (i.e., surveys were not able to be delivered.)*

Data Collection: I contacted respondents via e-mails. First, I asked for an introductory communication via email from the supply chain leaders in the states to all potential respondents letting them know they would be receiving a survey from me. The introductory communication stated that participation was confidential and voluntary while encouraging them to participate. Second, I used e-mail outreach to contact potential respondents on the sampling frame. From

the e-mail outreach, I gave options for the potential respondents to complete the instrument online in Qualtrics or return the attached Microsoft Word document to me via the provided e-mail address. I also gave them the option of filling out a hard copy that would be couriered to them at no cost. I issued the survey instrument through Qualtrics e-mail and attached the Microsoft Word version on the e-mail. I also followed up with periodic e-mail reminders to encourage participation and increase response rate (Dillman, Symth, & Christian, 2014). I also informed the potential respondents that they had different options of returning the completed survey as suggested by Dillman et al. (2014). Respondents that had sent their responses via Qualtrics received an acknowledgement and appreciation e-mail. I conducted the survey over a 6-weeks period. I received all completed instruments via electronic submissions only (e-mail, and Qualtrics). Summary of respondents that received the survey and those that completed it is on Table 2.

Table 2: Number of Surveys Received and Completed by Geography and Setting

	Number who received surveys	Number who completed survey	Response rate (%)
Geography			
North	67	21	31
South	40	11	28
Federal	98	43	44
	205	**75**	**37**
Respondent Work Setting			
Clinics	126	32	25
NGOs	45	27	60
SMOH	14	7	50
FMOH	7	3	43
Private sector	6	3	50
Donors	7	3	43
Total	**205**	**75**	**37**

NGOs – non-governmental organization; SMOH – state ministry of health; FMOH – federal ministry of health.

The survey response rate was 32% for antiretroviral drugs and 33% for HIV rapid test kits giving a cumulative average of 32% overall responses for those that received the survey as contained in Table 3.

Table 3: Survey Response Rates by Type of HIV/AIDS Products (ARVs or RTKs)

Description	ARVs	RTKs	Summary
Potential respondents	159	77	236
Bounced e-mails	18	13	31
Survey transmitted	141	64	205
Finished survey	45	21	66
Completion % for transmitted survey	32%	33%	32%

More than four-fifths of respondents (85%) have more than 3 years experience in HIV/AIDS supply chain in Nigeria. In addition, 30% of the respondents work at the health facilities, 24% at the states, 32% at the federal level while other work across multiple levels of the system. Also, 33% work in Northern Nigeria, 20% in Southern Nigeria, and 47% work in the FCT. On the types of organizations, 32% work with the government, 41% with NGOs, 10% with donor agencies, 14% work in the private sector while 3% work in other organizations.

Data Analysis: I analyzed the results using Qualtrics analytical functions and Microsoft Excel (McFedries, 2013). I summarized and displayed the survey results in tables and bar charts (for multiple variables). I received very few qualitative responses. For the qualitative responses in the survey instrument, I read the feedback to extract emerging themes. These themes I grouped under the theoretical supply chain component (e.g. product selection) where they were reported to provide appropriate context. I used the quantitative data and qualitative results from the survey to form the key informant interview guide.

Key Informant Interviews

Key Informant Interview Guide: I used a semi-structured interview guide (Appendix 4) to gain insight on the barriers and potential solutions found in the quantitative analysis (Gill, Stewart, Treasurer, & Chadwick, 2008). The guide further gave prompts for the respondents to validate barriers and solutions collated from the survey while proposing further barriers and solutions to the Nigeria HIV/AIDS supply chain system from their perspective. In addition, I inquired on

challenges that had hindered the implementation of recommendations from earlier studies. I used this approach to develop pragmatic recommendations and the plan for change. I divided the KII guide into eleven parts with sub-sections to review major components of the supply chain system and the needed enabling environment for supply chain performance.

The guide aligned with the research theoretical framework but also allowed respondents to identify other issues that impacted on the current state of the Nigeria HIV/AIDS supply chain system. The guide was approved by both UNC (17-2071) and Nigeria IRB (NHREC/01/01/2007-09/03/2018B).

Sample Recruitment: I sent the first personalized e-mail to all potential respondents to indicate their willingness and availability to participate. The initial e-mail included the informed consent form that detailed the KII protocol. I gave options to potential respondents to either be interviewed in-person or over the phone at a convenient time and venue to give. My intent was to give them the required flexibility to encourage their participation in the study. I followed up the first e-mail with further e-mail reminders. The reminders were followed up with a phone call to those that indicated they should be called to set up the interview.

Sample Frame, Sampling Method, and Sample Size: Respondents included health supply chain managers within the government institutions, donor communities, local and international organizations working in HIV/AIDS supply chain based on sampling frame I used for the survey. I used purposive sampling method for respondents' recruitment. For the key informant interviews, I planned to recruit between 16 and 24 respondents. The plan was to target about 70% of the respondents from the Federal Capital Territory (FCT) while 15% each will come from the Northern and Southern States. This was because the federal level personnel in the FCT make most of the national policy decisions for the HIV/AIDS pharmaceutical SCM. However, I also wanted to explore the views of the people at the states. This is vital, as State governments

in Nigeria are independent of the federal government on health matters. I conducted the interviews over 5 weeks to accommodate the schedule of respondents. Based on purposive sampling, I reached out to 26 potential respondents from the federal and state levels via e-mails (Table 4).

Table 4: Number of Key Informant Interview Respondents

	Number of respondents reached	Coverage (%)	Number of respondents who participated in interview	Coverage (%)
Geography				
North	3	11	2	10
South	8	31	7	33
Federal	15	58	12	57
	26	**100**	**21**	**100**
Respondent's Work Setting				
NGOs	14	53	11	52
SMOH	5	19	4	19
FMOH	3	12	2	10
Private sector	1	4	1	5
Donors	3	12	3	14
Total	**26**	**100**	**21**	**100**

In total, 24 of the 26 potential respondents responded to the second follow-up e-mail while two respondents did not respond. I did not follow up further after a second reminder e-mail. Of the 24 that responded to the follow up e-mails, I interviewed 21 respondents while three were not available within the timeframe. I sent participants a summary of the survey findings and the KII guide at least 48 hours before the interview.

In total, I interviewed 21 respondents. Nine were from the state level (43%) and twelve were from the national level (57%). This gave a proper representation of the federal and state level responses in the results. In addition, six respondents worked for the government (29%), three respondents worked for donor organizations (14%), eleven respondents worked with non-governmental organizations (52%) implementing health service delivery and one work with private organization (5%) implementing supply chain programs in Nigeria. The respondents' years of experiences ranged from 2.5 to 13 years in the Nigeria health supply chain. The

respondents had a cumulative of 164 years of experience in the public health supply chain space in Nigeria. The respondents' experiences cut across all aspect of the Nigeria HIV/AIDS supply chain from the clinics to the state and federal levels. They also had a blend of experiences working with governments, donors, and Non-Government Organizations (NGOs) supporting HIV/AIDS supply chain and service delivery in Nigeria.

Data Collection: I conducted one-on-one in-depth interviews, in-person and by telephone (Gill *et al.*, 2008). All of the respondents consented to the interview. Most of the interviews took between 30 - 45 minutes. I labelled voice recordings "respondent 1" to "respondent 21" and stored the files in a computer with strong password. I transcribed recordings verbatim in Microsoft Word documents for analysis.

Data Analysis: I used content analysis to analyze the data. First, I moved the transcript from MS Word to MS Excel following the structure of the KII guide. This enabled me to easily navigate through the patterns using MS Excel functionality to highlight common themes within MS Excel rows and columns. I read the transcripts in MS Excel to review emerging themes that I highlighted with different colors of text for easy identification of patterns for the first three transcripts. This guided the development of a codebook based on emerging themes from the responses that was linked to the conceptual framework. The codebook enabled me to display the 21 transcripts in Microsoft Excel to easily see patterns and themes and cluster them together for analysis. I also analyzed differences, similarities, or outliers in the opinions of the respondents, or among types of respondents.

To validate the codebook used in the analysis, I recruited a second coder from UNC DrPH Cohort 12, to review the analysis. The second coder studied three transcripts using the codebook and themes that emerged from the data. For example, an emerging theme on barriers under product selection include poor communication between federal and state governments on

revision of treatment guidelines and reporting. The emerging sub-themes included poor dissemination of the treatment guidelines to the clinics by the federal government and poor reporting of adverse drug reactions from the clinics to the national regulatory authority. The second coder reviewed the themes and sub-themes, and further confirmed if findings from the transcripts aligns with the codebook and analysis already developed. For the three transcripts reviewed by the second coder, a *Cohen's Kappa coefficient* of 0.9 was achieved with 99% agreement using the Cohen Kappa online free calculator.

CHAPTER 4: RESULTS

Survey Results

Findings from the surveys are contained in the bar charts below for each product type. The charts highlight the barriers and solutions identified by the respondents. The findings were arranged by each of the six components of the supply chain management system and by product type. The results focus on the barriers and solutions that were identified by respondents as very important or important. For the purpose of further analysis of the findings, I identified the priority barriers and solutions using 85% as the threshold (i.e. 85% of respondents needed to have identified a specific barrier or solution as very important or important). While this number was somewhat arbitrary, I used it to identify the top barriers and/or solutions. Also, I included some of the additional comments provided by respondents in the open-ended section of the surveys for barriers or solutions. These were comments noted by respondents that also came up in the key informant interview and/or that were raised by multiple respondents in the survey.

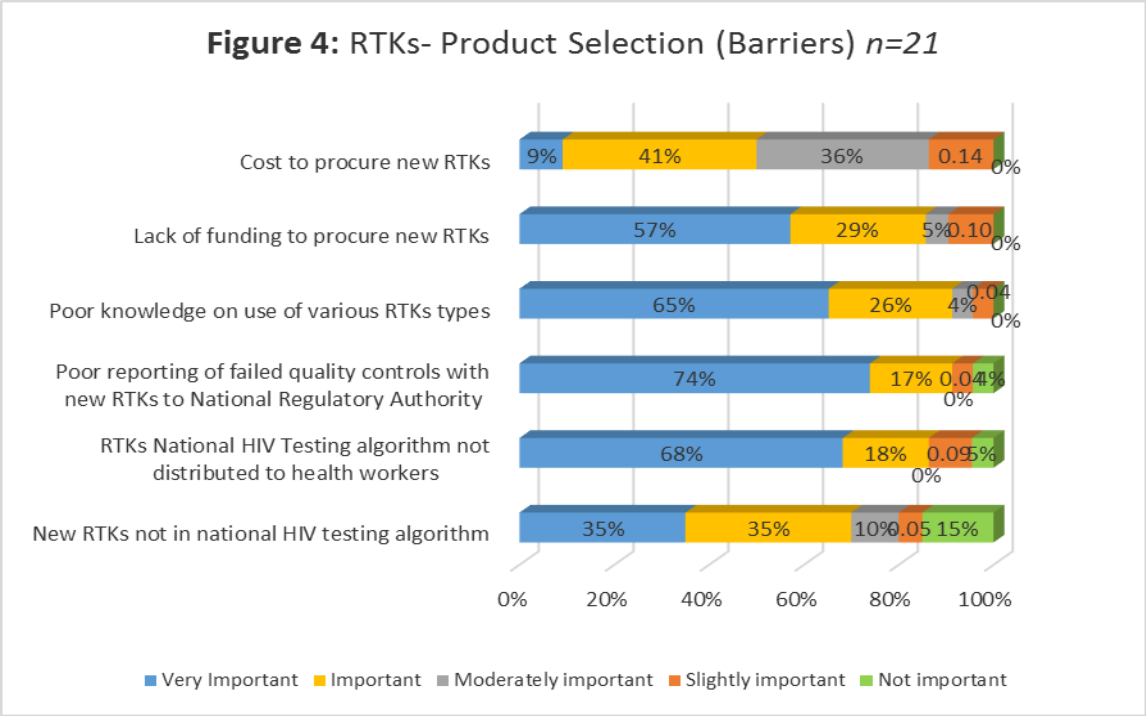
Product Selection

Barriers

The RTKs respondents were asked about major barriers to product selection (Figure 4). More than 85% of respondents identified four barriers as “important” or “very important”: poor reporting of failed quality controls with new RTKS to the National Regulatory Authority (90%),

poor knowledge and use of various RTKS types (91%), failure to distribute national testing algorithms to health workers (86%), and lack of funding to procure new RTKS (86%).

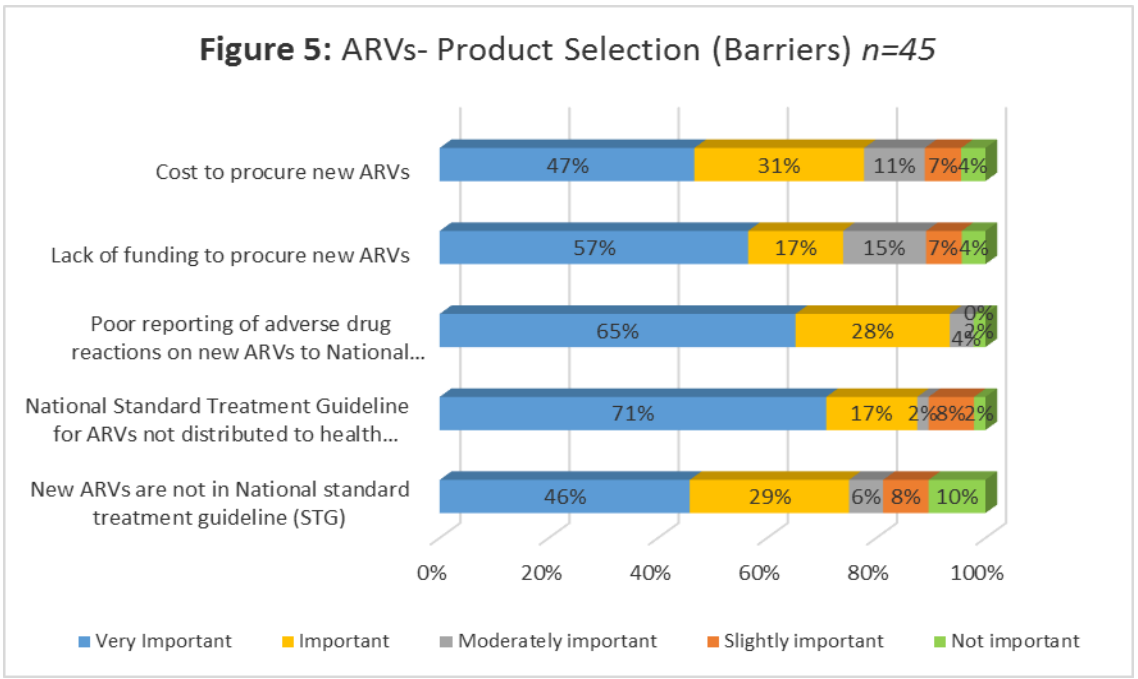
Figure 4: RTKs – Product Selection (Barriers)



These corresponds with qualitative feedback from respondents. For example, one person highlighted that poor engagement with clinic health workers when new products were being introduced made it difficult for the workers to understand the protocol for use of the new product and report on their quality performance in line with established standards. One respondent noted that pressure from manufacturers to include their products into the national testing algorithm resulted in limited stakeholder engagement by the Government leadership in selection of RTKs.

Similarly, the ARVs respondents were asked about major barriers to product selection (Figure 5). More than 85% of respondents identified two barriers as “important” or “very important”: Poor reporting of adverse drug reactions on new ARVs to National Regulatory Authority (93%), and national standard treatment guidelines for ARVs not distributed to health workers (88%). Like the qualitative feedback from the RTKs respondents, for the ARVs several respondents highlighted limited involvement in the decision-making process by health workers that are using these products daily for service delivery. In addition, two respondents identified lack of clear protocols for inclusion of new ARVs regimen into the national guideline that often results in wastages as legacy products are not completely used up while new ones are being introduced. Also, new treatment guidelines for introduction of new regimens are not disseminated promptly.

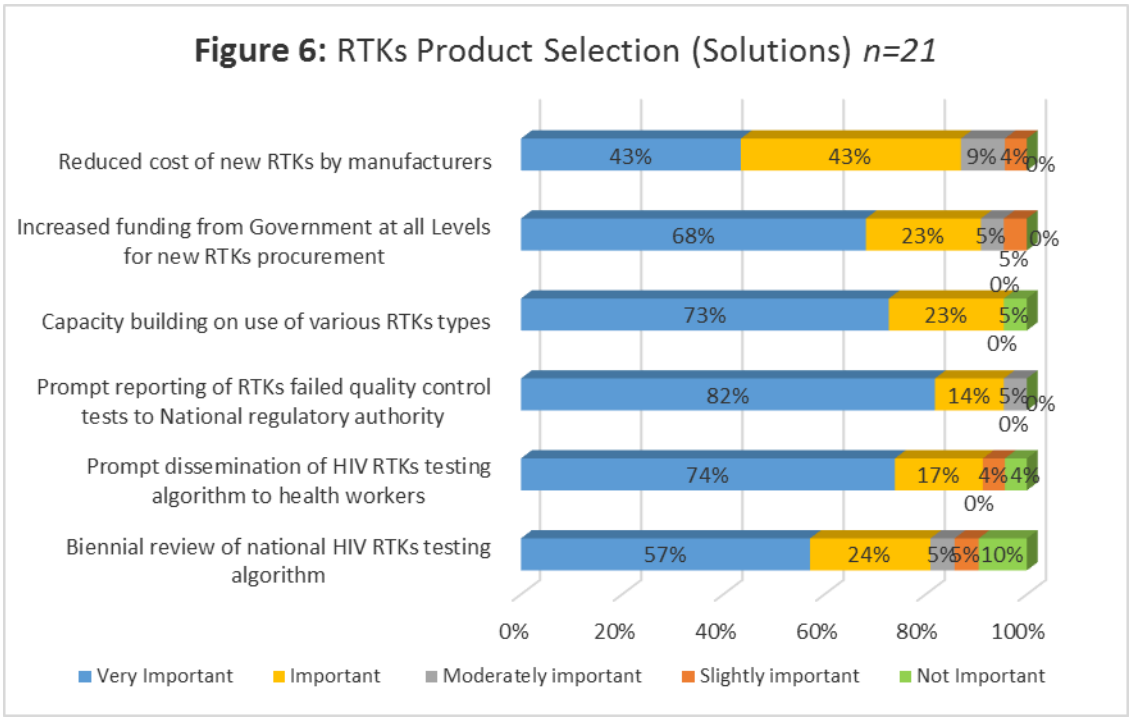
Figure 5: ARVs- Product Selection (Barriers)



Solutions

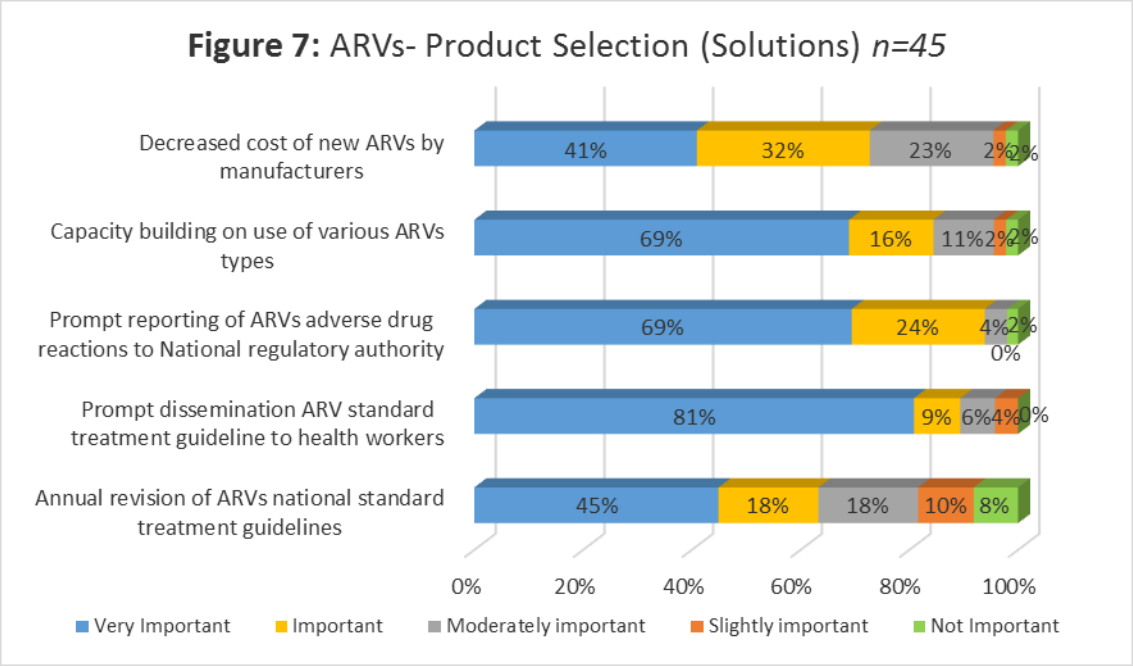
On solutions to the identified barriers on the product selection component, RTKs and ARVs respondents proposed solutions that directly related to the barriers. RTKs respondents were asked about solutions on identified barriers to product selection (Figure 6). More than 85% of respondents identified five solutions as “important” or “very important”: Reduced cost new RTKs by manufacturers (86%), increased funding from Government at all levels for new RTKs procurements (91%), capacity building on use of various RTKs types (96%), prompt reporting of RTKs failed quality control tests to National Regulatory Authority (96%), and prompt dissemination of HIV RTKs testing algorithm to health workers (91%). From the qualitative responses, a respondent identifed capacity-building of local manufacturers to minimize cost of production as a solution.

Figure 6: RTKs Product Selection (Solutions)



Also, ARVs respondents were asked about solutions on identified barriers to product selection (Figure 7). More than 85% of respondents identified three solutions as “important” or “very important”: Capacity-building on use of various ARVs types (85%), prompt reporting of ARVs adverse drug ractions to National Regulatory Authority (93%), and prompt dissemination of ARVs standard treatment guidelines to health workers (90%). From the qualitative feedback, effective stakeholder engagement in product selection and development of local capacity for ARVs production were identified by two respondents as solutions to the identified barriers.

Figure 7: ARVs Product Selection (Solutions)



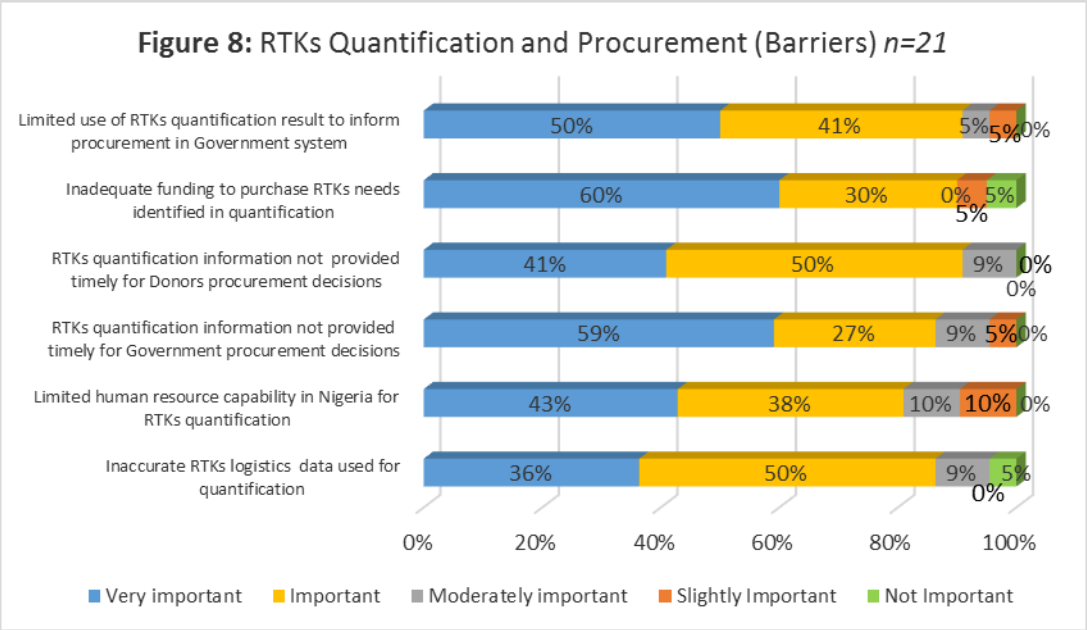
Quantification and Procurement

Barriers

Respondents to the RTKs questions were also asked about major barriers to Quantification and Procurement (Figure 8). As a reminder, quantification is an ongoing process of estimating the HIV/AIDS product quantities and funding needs of a program over an identified

period in the future. The projection is intended to ensure uninterrupted supply of products to the health service providers and clients. More than 85% of respondents identified five barriers as “important” or “very important”: Limited use of RTKs quantificaton results to inform procurement in Government system (91%), inadequate funding to purchase RTKs needs identified in quantification (90%), RTKs quantification information not provided timely for donors procurement decisoion (91%), RTKs quantificatio information not provided timely for Government procurement decisions (86%), and inaccuate logistics data used for quantification (86%).

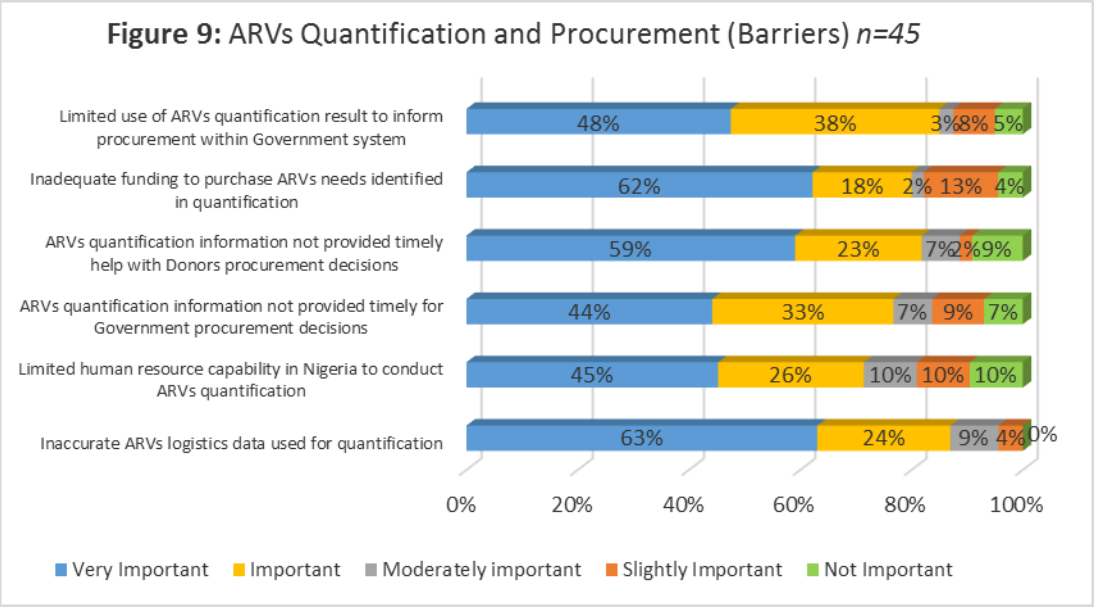
Figure 8: RTKs Quantification and Procurement (Barriers)



Similarly, respondents to the ARVs questions were also asked about major barriers to Quantification and Procurement (Figure 9). More than 85% of respondents identified two barriers as “important” or “very important”: Limited use of ARVs quantification result to inform procurement within Government system (86%) and inaccurate ARVs logistics data used for

quantification (87%). On the qualitative feedback, a respondent noted that the quantification exercises were not properly supervised for prompt completion and timeliness of the results.

Figure 9: ARVs Quantification and Procurement (Barriers)

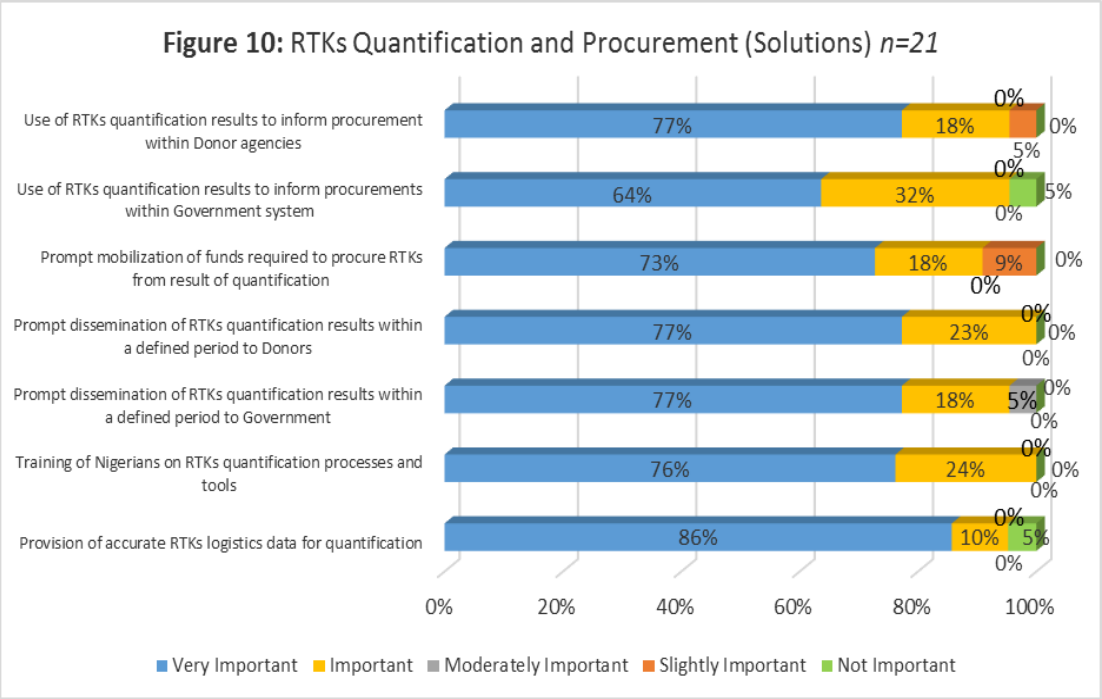


Solutions

Similar to what respondents reported with product selection, the solutions to the barriers identified for quantification and procurement were directly related to the barriers. More than 85% of RTKs respondents identified all seven solutions as “important” or “very important” (Figure 10): Use of RTKs quantification results to inform procurement within donor agencies (95%), use of RTKs quantification results to inform procurements within Government system (96%), prompt mobilization of funds required to procure RTKs from result of quantification (91%), prompt dissemination of RTKs quantification results within a defined period to donors (100%), prompt dissemination of RTKs quantification results within a defined period to Government (95%),

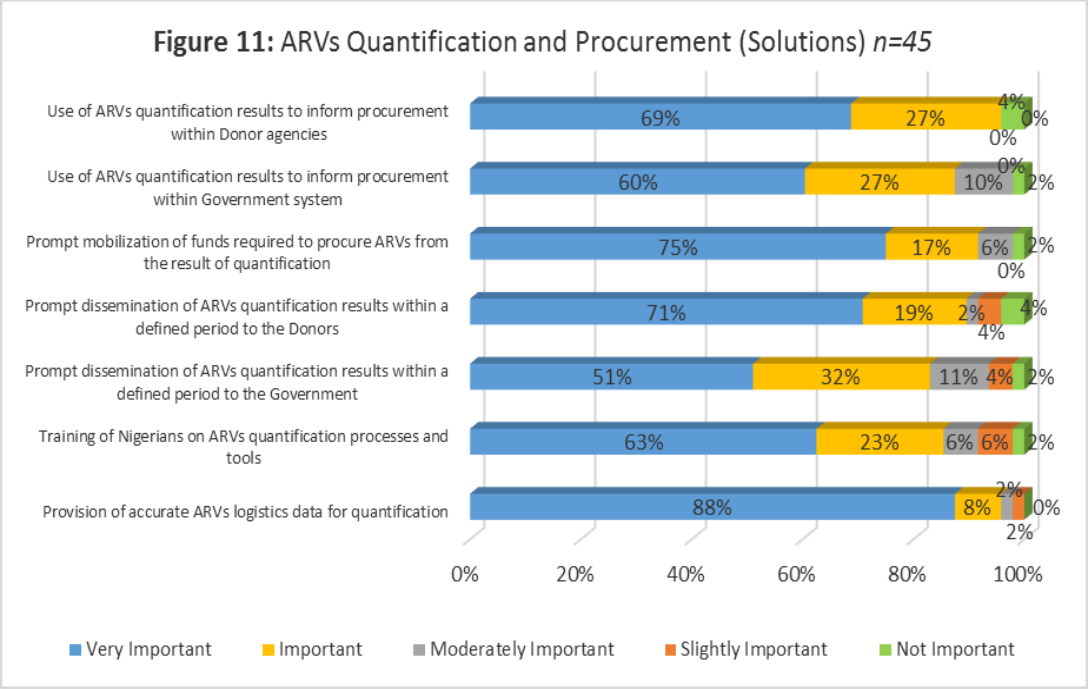
training of Nigerians on RTKs quantification processes and tools (100%), and provision of accurate RTKs logistics data for quantification (96%).

Figure 10: RTKs Quantification and Procurement (Solutions)



On the ARVs quantification and procurement, more than 85% of ARVs respondents identified six solutions as “important” or “very important” (Figure 11): Use of ARVs quantification results to inform procurement within donor agencies (96%), use of ARVs quantification results to inform procurement within Government system (87%), prompt mobilization of funds required to procure ARVs from the result of quantification (92%), prompt mobilization of funds required to procure ARVs from the result of quantification (92%), prompt dissemination of ARVs quantification results within a defined period to donors (90%), training of Nigerians on ARVs quantification processes and tools (86%), and provision of accurate ARVs logistics data for quantification (96%). One respondent proposed a stepwise follow up in all the quantification processes and effective engagement with Government for prompt disbursement of budgetary allocations needed to procure the products required from quantification results.

Figure 11: ARVs Quantification and Procurement (Solutions)

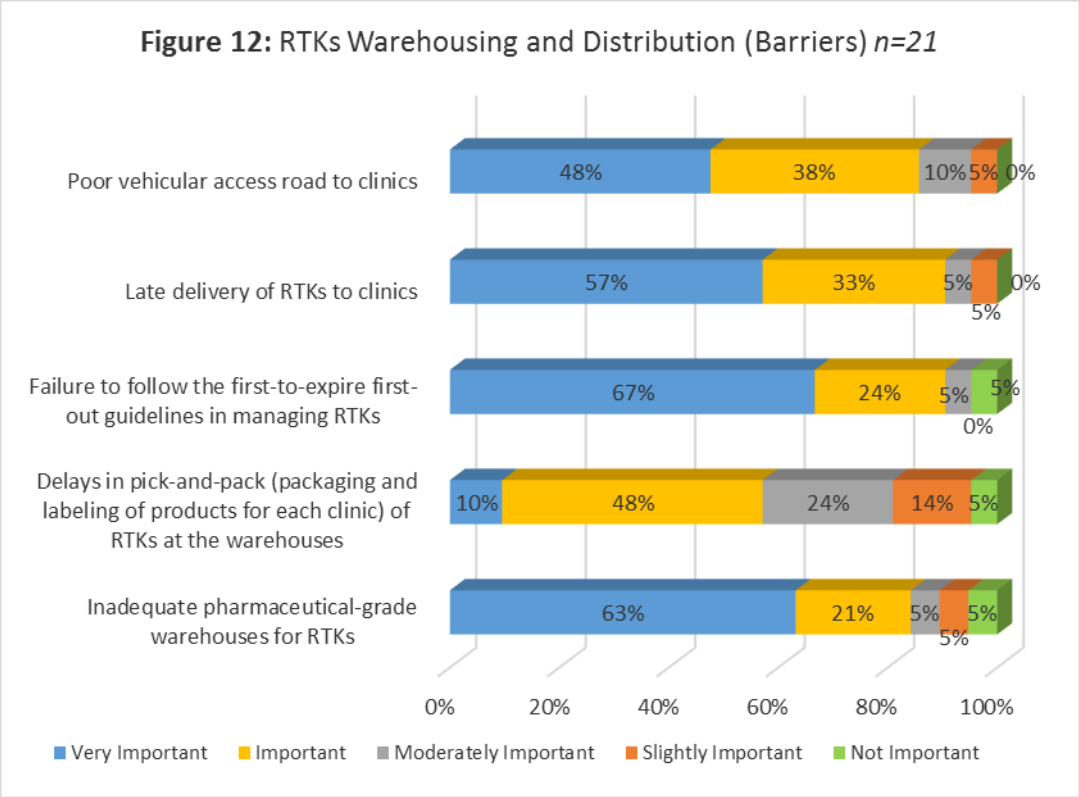


Warehousing and Distribution

Barriers

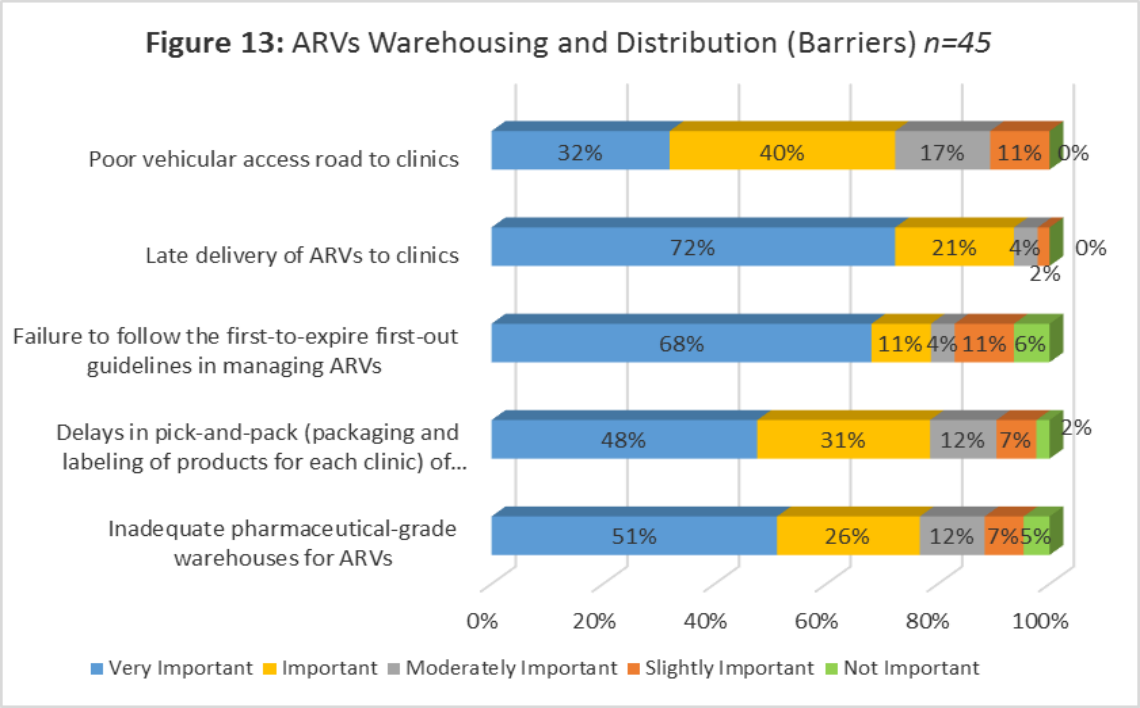
On the Warehousing and Distribution services, more than 85% of RTKs respondents identified three barriers as “important” or “very important” (Figure 12): Poor vehicular access road to clinics (86%), late delivery of RTKs to clinics (90%), and failure to follow the first-to-expire first-out principles in managing RTKs (91%).

Figure 12: RTKs Warehousing and Distribution (Barriers)



On ARVs Warehousing and Distribution barriers, more than 85% of respondents identified one barrier as “important” or “very important” (Figure 13): Late delivery of ARVs to clinics (93%). On the qualitative responses, a respondent identified the distribution agents’ poor communication skills as a barrier while two respondents noted lack of human resource capacity in the use of standard operating procedures for warehouse management as a barrier.

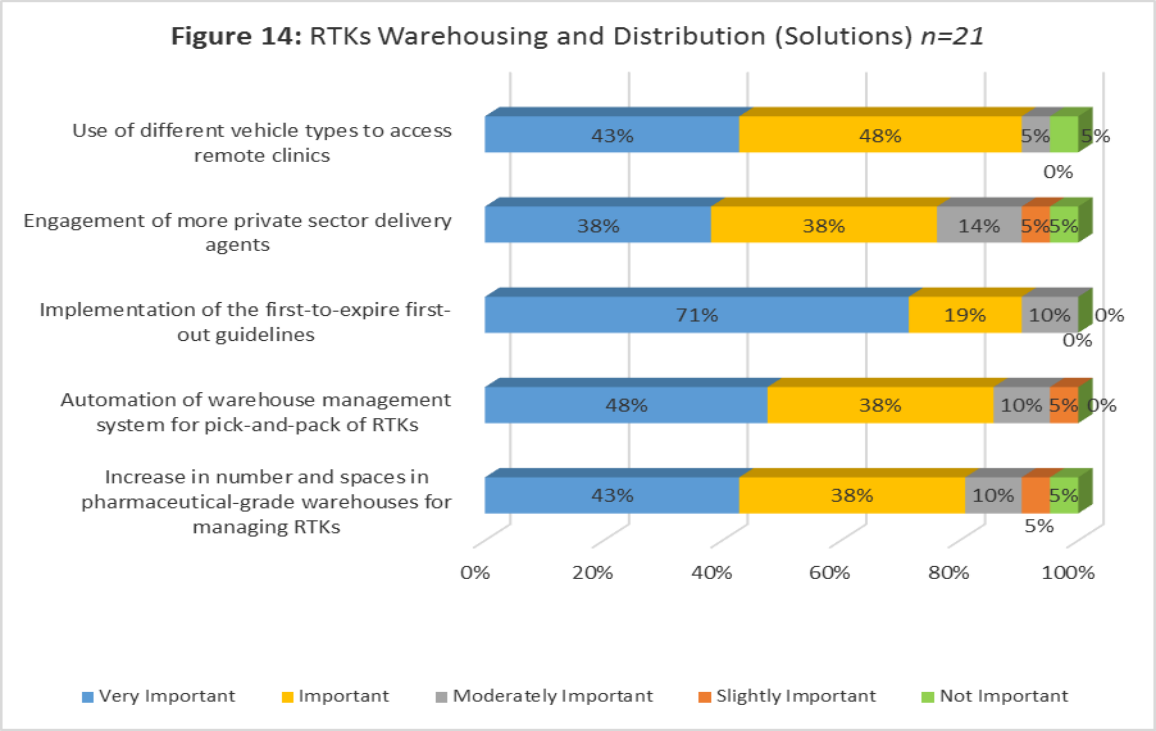
Figure 13: ARVs Warehousing and Distribution (Barriers)



Solutions

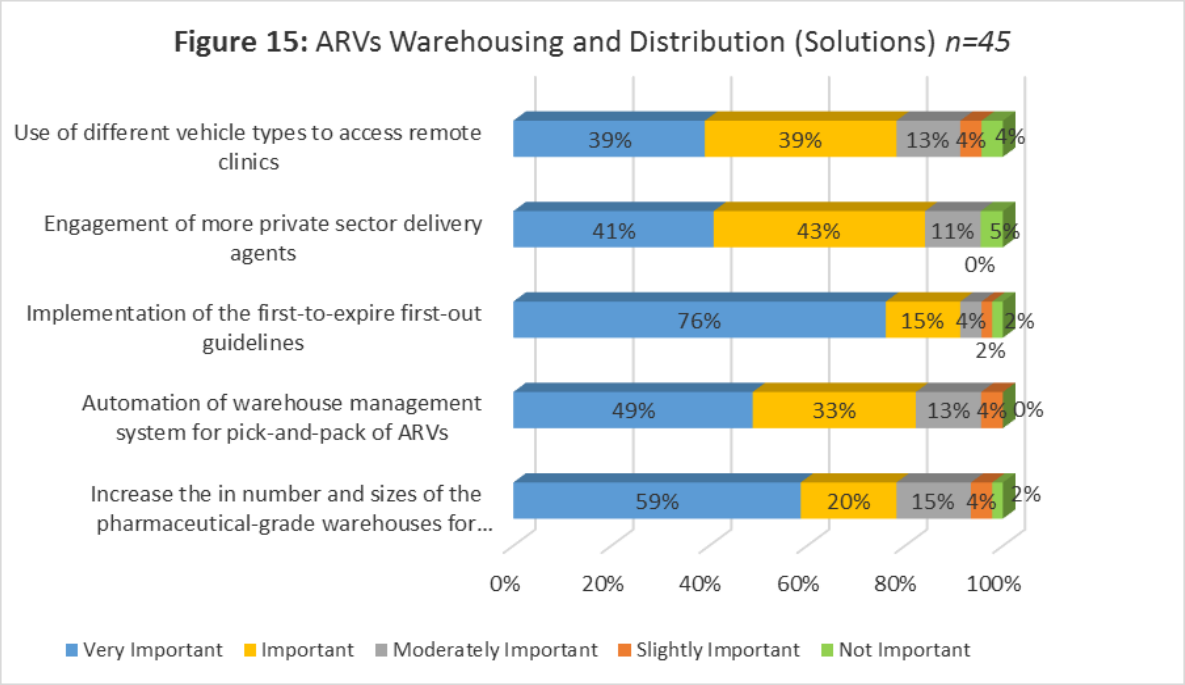
On solutions to the identified Warehousing and Distribution barriers, more than 85% of RTKs respondents identified three solutions as “important” or “very important” (Figure 14): Use of different vehicle types to access remote clinics (91%), implementation of the first-to-expire first-out guidelines (90%), and automation of warehousing management system for pick-and-pack of RTKs (86%).

Figure 14: Warehousing and Distribution (Solutions)



Similarly more than 85% of ARVs respondents identified one solution as “important” or “very important” (Figure 15): Implementation of the first-to-expire first-out guidelines (91%). On the qualitative responses, near real-time monitoring of the distribution agents to ensure compliance with established distribution protocols was identified as a solution along with capacity-building of distribution agents on standard operating procedures and communication skills.

Figure 15: ARVs Warehousing and Distribution (Solutions)

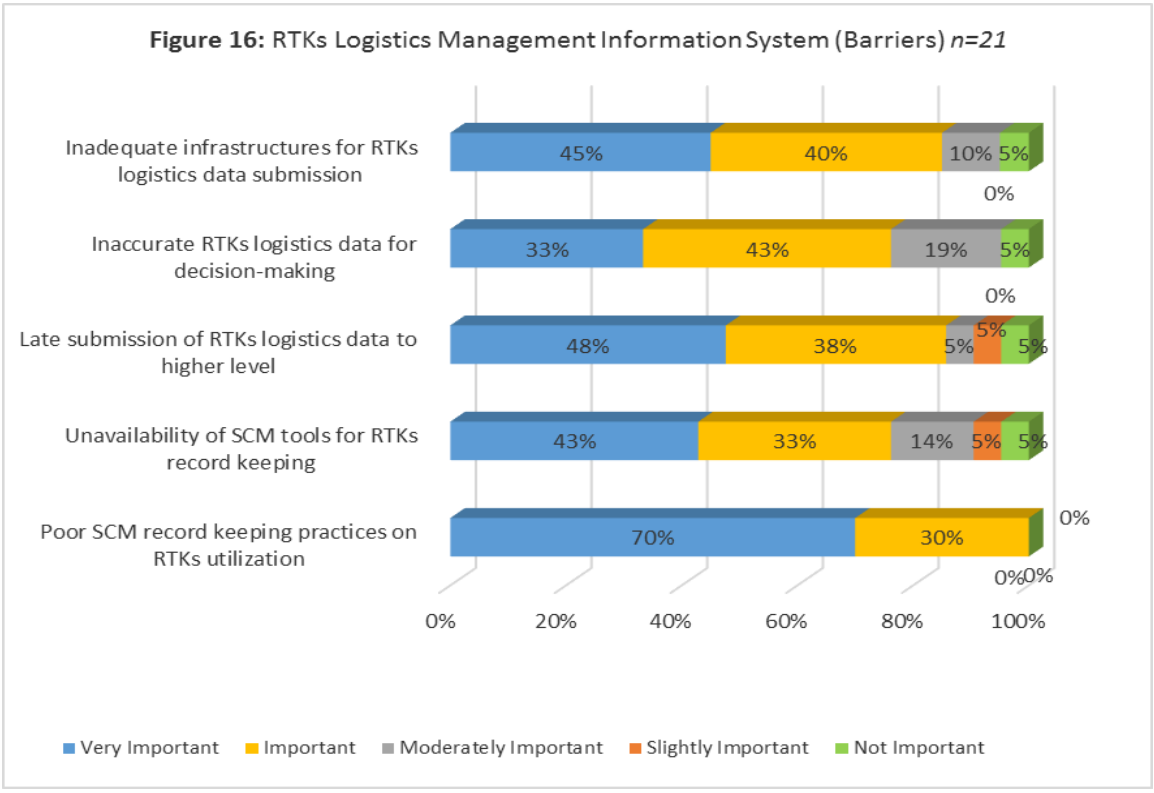


Logistics Management Information System

Barriers

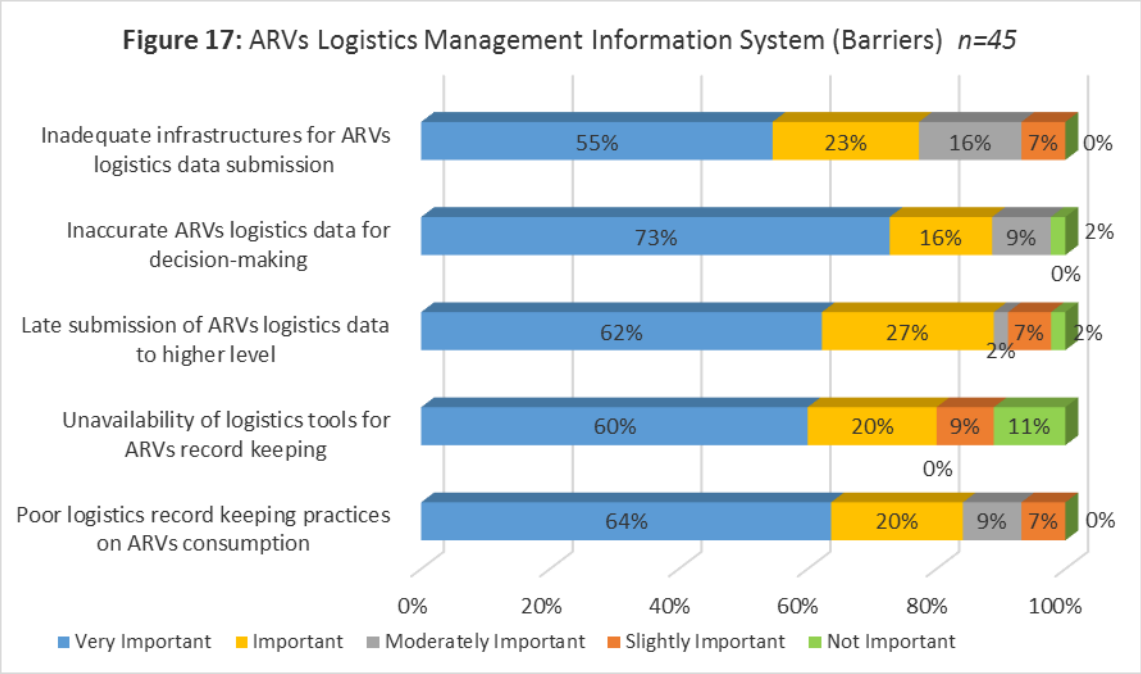
Respondents to the RTKs questions were asked about major barriers to logistics management information system. About 85% or more of respondents identified three barriers as “important” or “very important” (Figure 16): Inadequate infrastructures for RTKs logistics data submission (85%), late submission of RTKs logistics data to higher level (86%), and poor SCM record keeping practices on RTKs utilization (100%).

Figure 16: RTKs Logistics Management Information System (Barriers)



Respondents to the ARVs questions were also asked about major barriers to logistics management information system. More than 85% of respondents identified two barriers as “important” or “very important” (Figure 17): Inaccurate ARVs logistics data for decision-making (89%), and late submission of ARVs logistics data to higher level (89%).

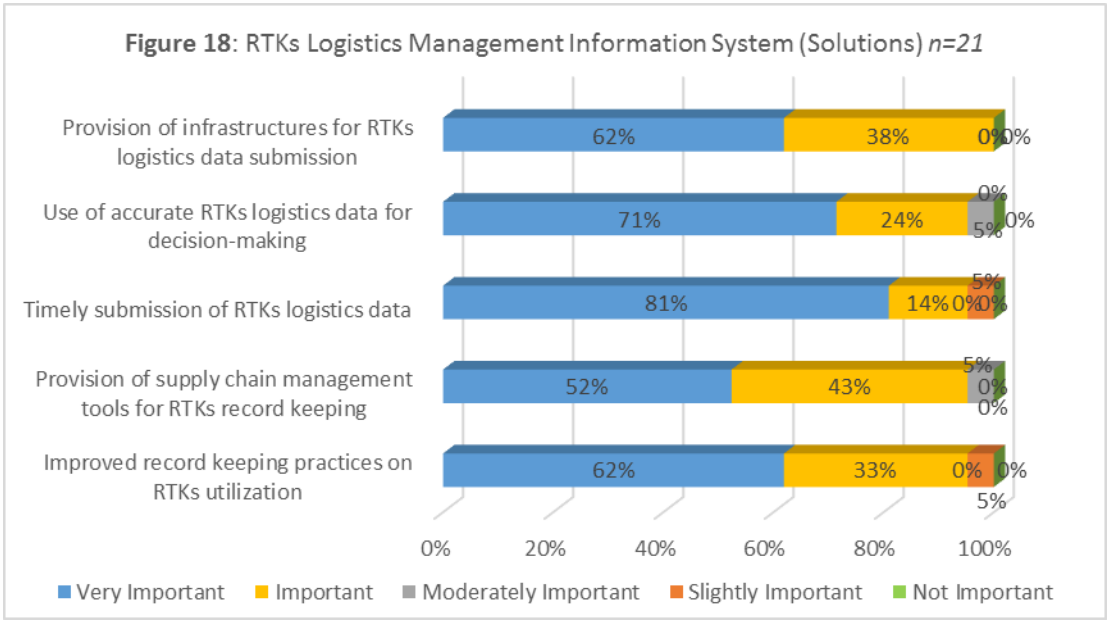
Figure 17: ARVs Logistics Management Information System (Barriers)



Solutions

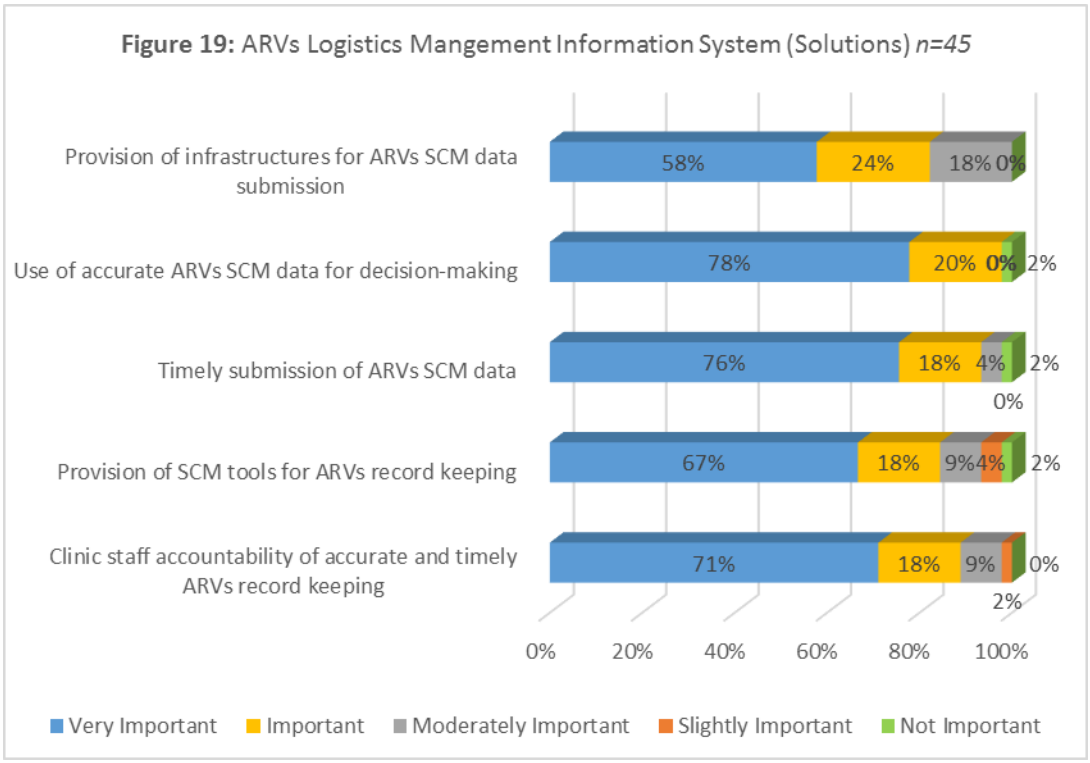
On solutions to the identified barriers on logistics management information system more than 85% of RTKs respondents identified five solutions as “important” or “very important” (Figure 18): Provision of infrastructures for RTKs logistics data submission (100%), use of accurate RTKs logistics data for decision-making (95%), timely submission of RTKs logistics data (95%), provision of supply chain management tools for RTKs record keeping (95%), and improved record keeping practices on RTKs utilization (95%).

Figure 18: RTKs Logistics Management Information System (Solutions)



Similarly, about 85% or more of the ARVs respondents identified four solutions as "important" or "very important" (Figure 19): Use of accurate ARVs SCM data for decision-making (98%), timely submission of ARVs SCM data (94%), provision of SCM tools for ARVs record keeping (85%), and clinic staff accountability of accurate and timely ARVs record keeping (89%).

Figure 19: ARVs Logistics Management Information System (Solutions)

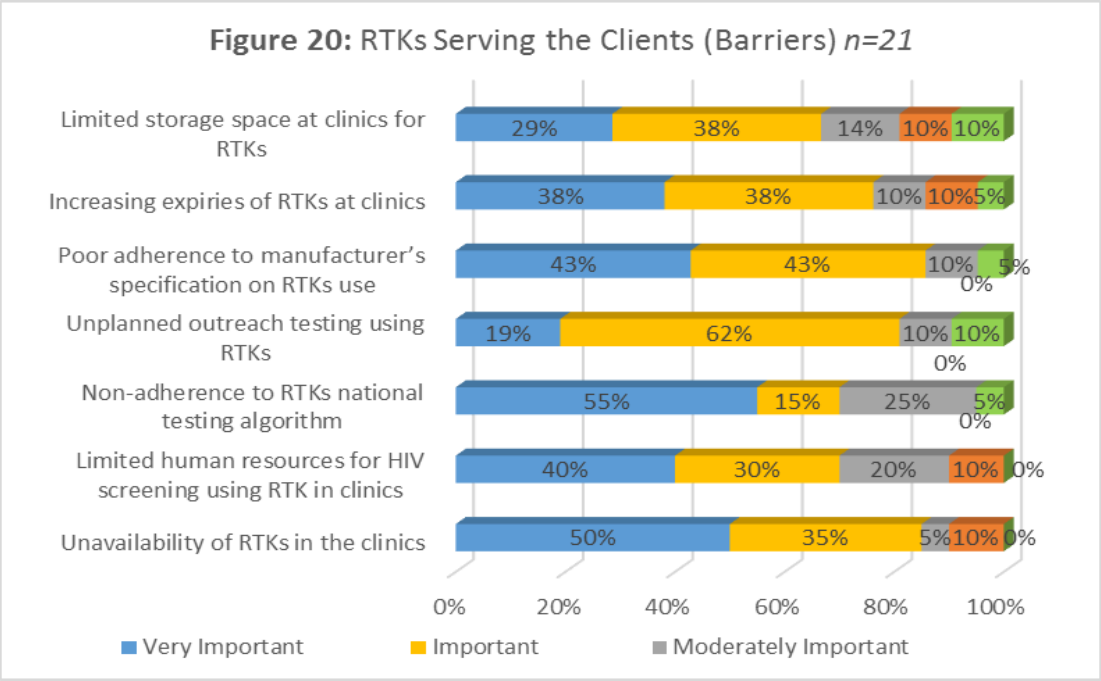


Serving the Clients

Barriers

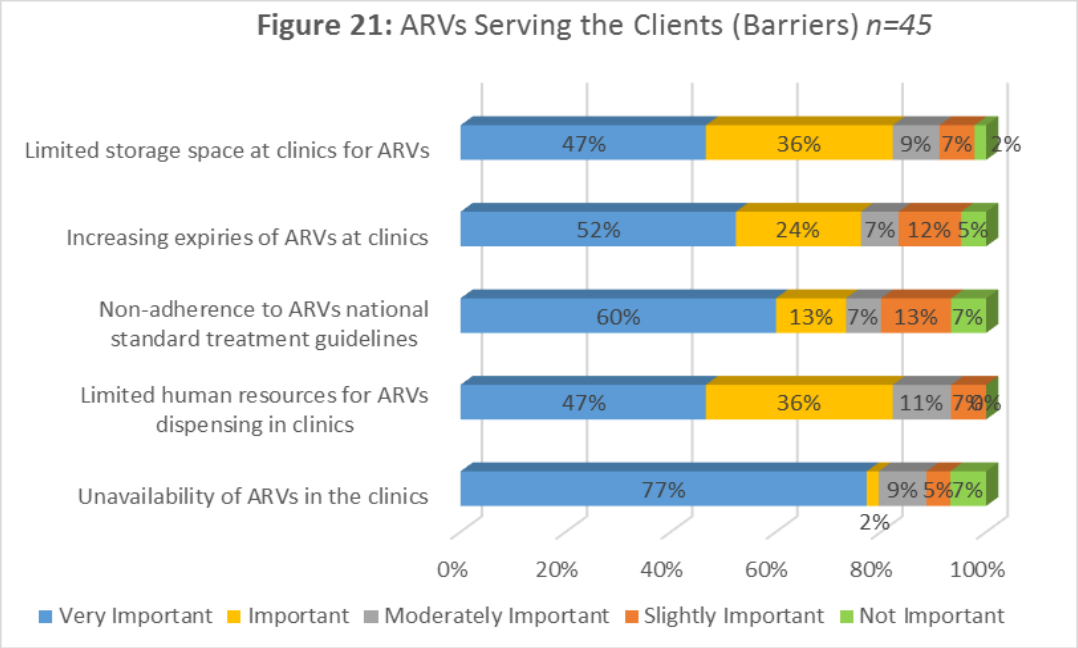
Respondents to the RTKs questions were asked about major barriers to serving the clients. About 85% or more of respondents identified two barriers as “important” or “very important” (Figure 20): Poor adherence to manufacturer’s specification on RTKs use (86%), and unavailability of RTKs in the clinics (85%).

Figure 20: RTKs Serving the Clients (Barriers)



However, none of the barriers in serving the clients from ARVs respondents reached the 85% threshold of importance (Figure 21). From the qualitative feedback, poor staff pay was identified as a barrier to serving clients. Also, limited knowledge of the staff on antiretroviral therapy and the inability of manufacturers to meet global demands with constant changes in treatment regimen was identified as barriers to the system.

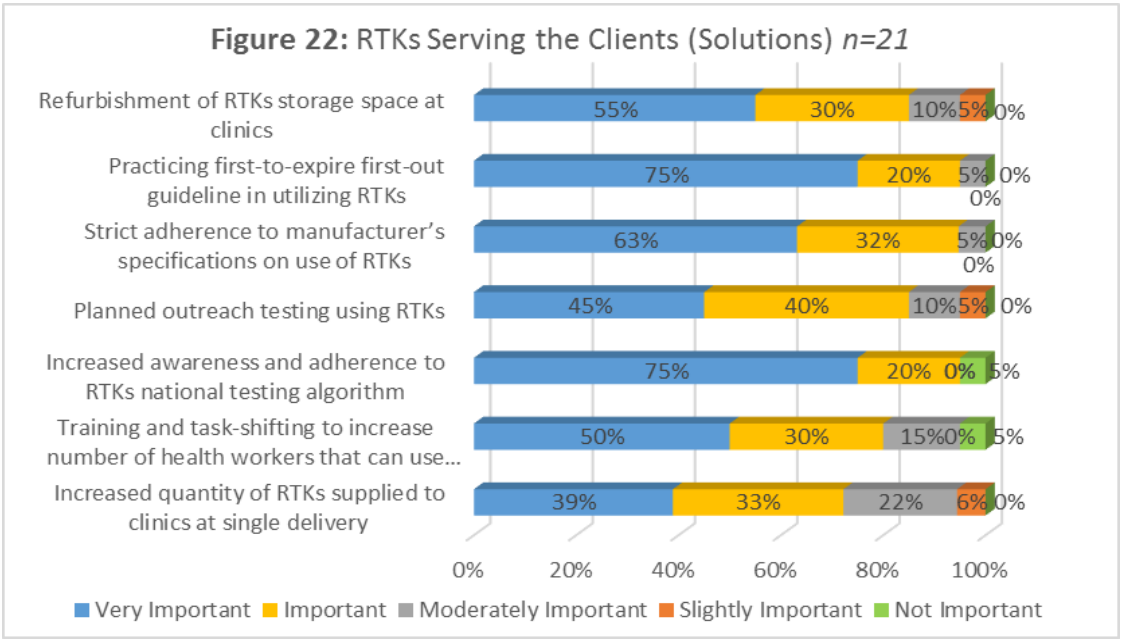
Figure 21: RTKs Serving the Clients (Barriers)



Solutions

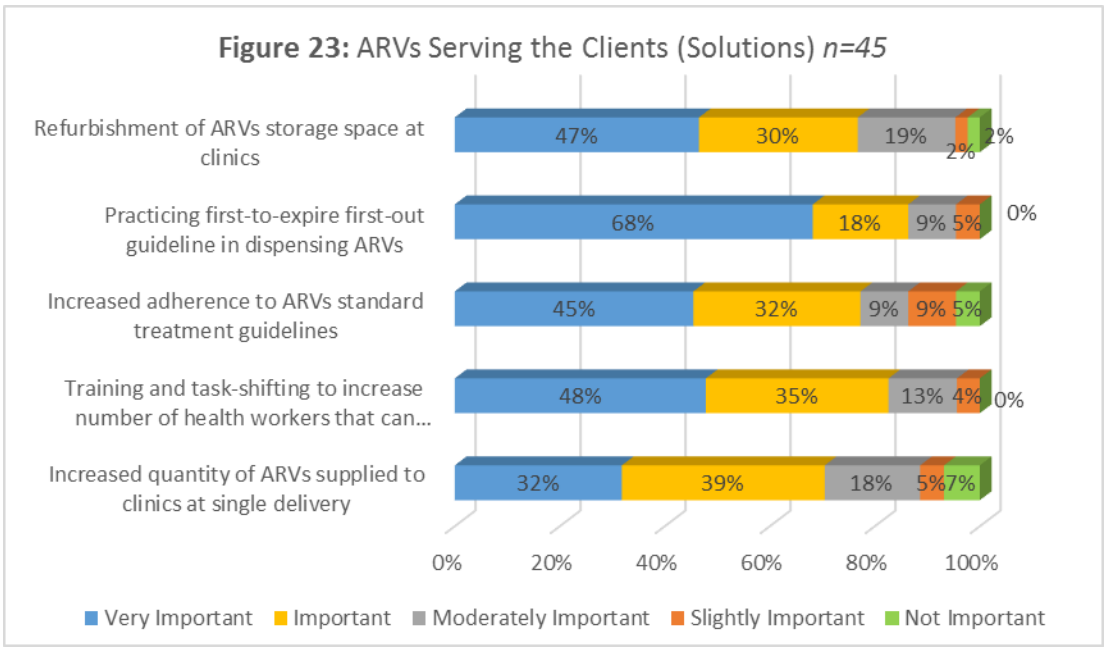
On solutions to the identified barriers to serving the clients about 85% or more of RTKs respondents identified five solutions as “important” or “very important” (Figure 22): Refurbishment of RTKs storage space at clinics (85%), practicing first-to-expire first-out guideline in utilizing RTKs (95%), strict adherence to manufacturer’s specification on use of RTKs (95%), planned outreach testing using RTKs (85%), and increased awareness and adherence to RTKs national testing algorithm (95%).

Figure 22: RTKs Serving the Clients (Solutions)



On solutions to the identified barriers to serving the clients more 85% of ARVs respondents identified one solution as “important” or “very important” (Figure 23): Practicing first-to-expire first-out guideline dispensing ARVs (86%). From the qualitative feedback, increased compensation package for the health workers and increased storage space at the clinics were identified as solutions to improve service delivery.

Figure 23: ARVs Serving the Clients (Solutions)

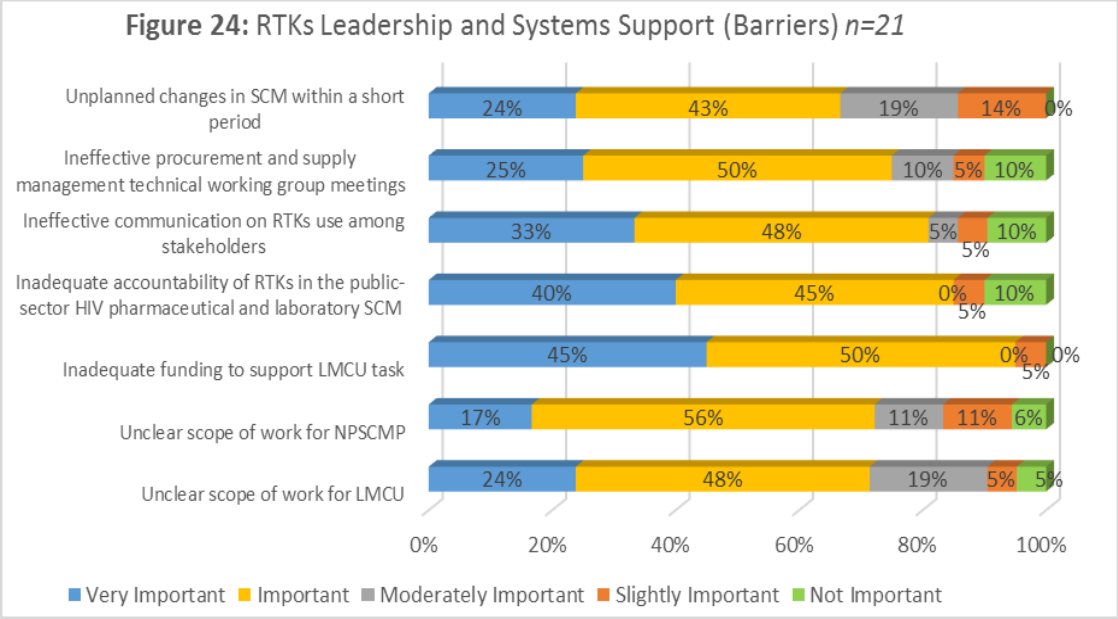


Leadership and Systems Support

Barriers

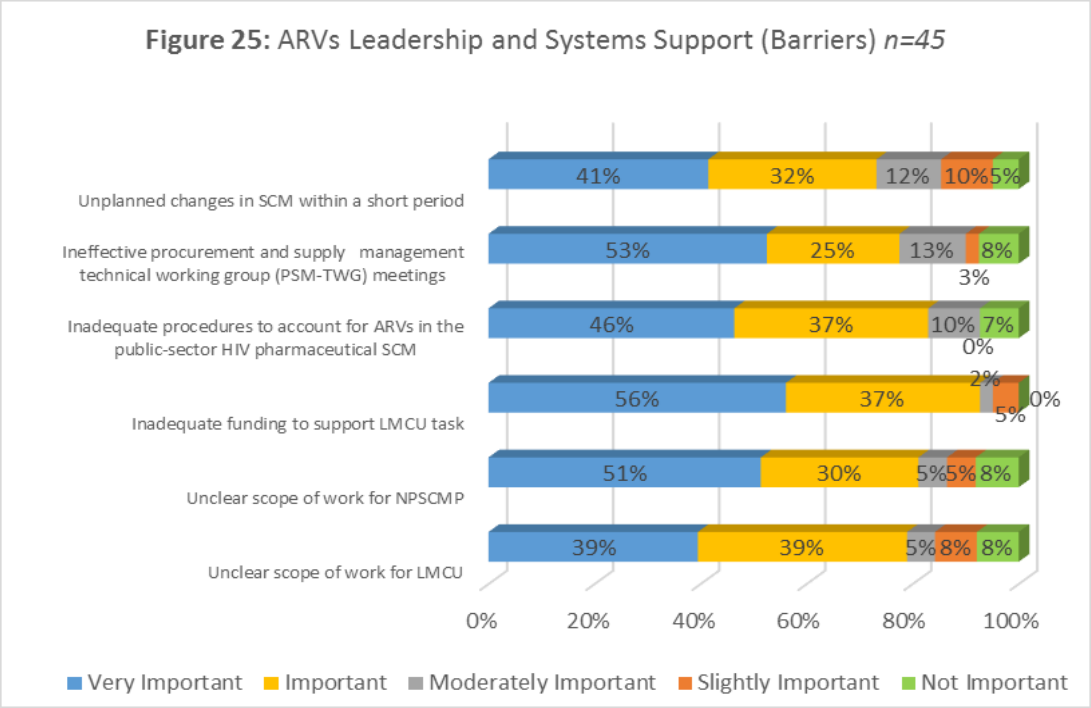
On leadership and systems support, respondents to the RTKs questions were asked about major barriers. About 85% or more of respondents identified two barriers as “important” or “very important” (Figure 24): Inadequate accountability of RTKs in the public-sector HIV pharmaceutical and laboratory supply chain management system (85%), and inadequate funding to support LMCU task (95%).

Figure 24: RTKs Leadership and Systems Support (Barriers)



Similarly, respondents to the ARVs questions were asked about major barriers. More than 85% of the respondents identified one barrier as “important” or “very important” (Figure 25): In adequate funding to support LMCU task (93%). From the qualitative feedback, lack of full time staff to support the work of the LMCU in some states was identified as a barrier.

Figure 25: ARVs Leadership and System Support (Barriers)

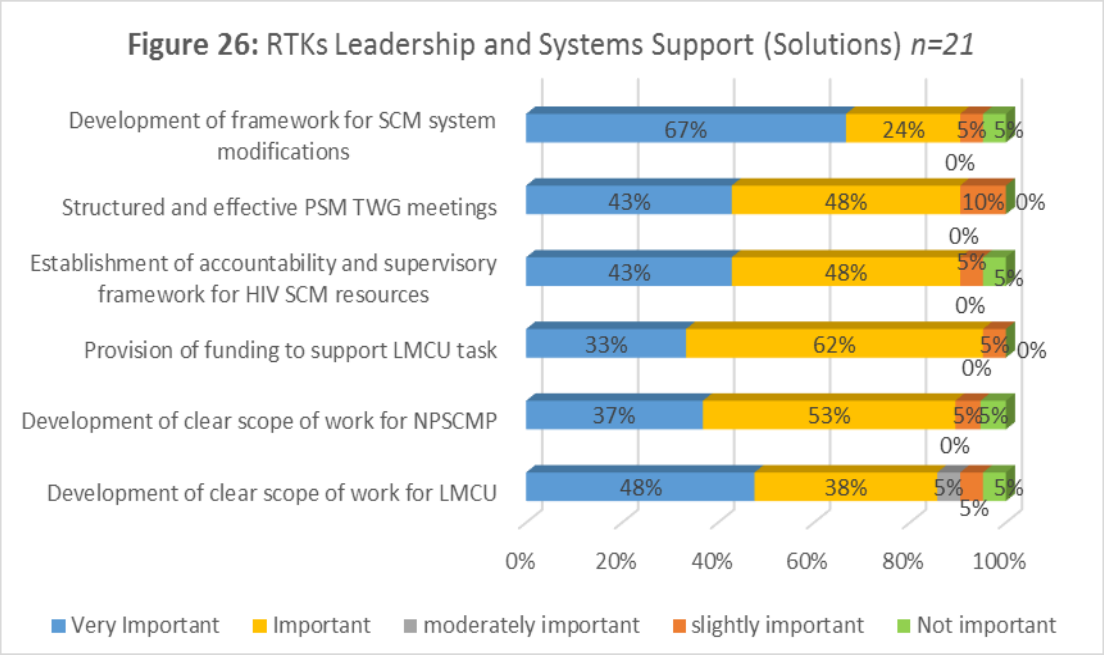


Solutions

On solutions to identified barriers on leadership and systems support, about 85% or more of the RTKs respondents identified six solutions as “important” or “very important” (Figure 26):

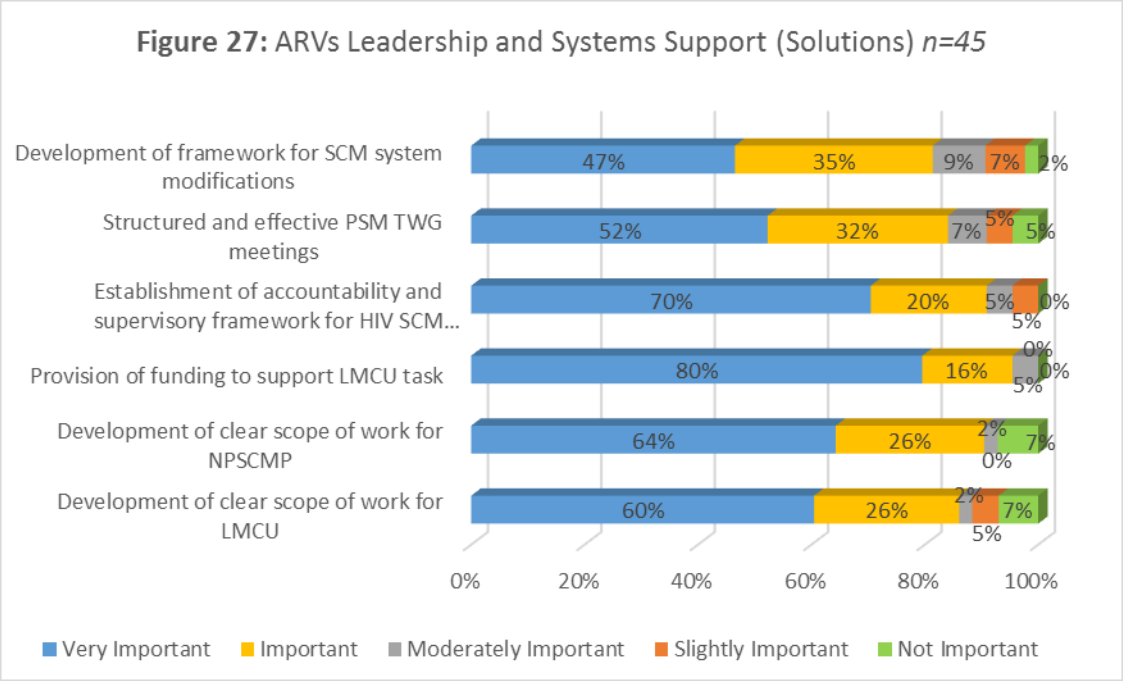
Development of framework for supply chain management system modifications (90%), structured and effective procurement and supply management technical working group meetings (91%), establishment of accountability and supervisory framework for HIV SCM system resources (91%), provision of funding to support LMCU task (95%), development of clear scope of work for NPSCMP (90%), and development of clear scope of work for LMCU (86%).

Figure 26: RTKs Leadership and Systems Support (Solutions)



Similarly, about 85% or more of the RTKs respondents identified four solutions as "important" or "very important" (Figure 27): Establishment of accountability and supervisory framework for HIV supply chain management resources (90%), provision of funding to support LMCU task (96%), development of clear scope of work for NPSCMP (90%), and development of clear scope of work for LMCU (86%).

Figure 27: ARVs Leadership and Systems Support (Solutions)



Summary

Table 5 summarizes the barriers and solutions that the respondents reported as very important or important on both the ARVs and RTKs surveys that attained the 85% threshold. The summary of these major respondents' feedback on barriers and solutions revolves around four themes: data management and use, leadership and funding, stakeholders' coordination, and service delivery.

The major barriers and solutions that attained the 85% threshold are grouped under these themes to highlight their similarities and relationships in the survey. In addition, the themes highlighted in the survey were the basis of the key informant interview guide. Thus, these themes are linked in both the survey and key informant interviews.

These themes are interconnected and linked to several aspects of the SCM system as contained in the Conceptual Model for an Effective and Efficient Pharmaceutical Supply Chain Management Cycle (Figure 3). For example, data management and use challenges were linked to unavailability of tools to collect logistics data (Tools and Data for Decision-making) and limited human resource capacity (Skilled & Adequate Human Resources). This impact directly on ability to make the right decision on quantities of the health products needed for service delivery (Quantification and Procurement). This poor documentation further results in service disruption due to health product unavailability at the clinics (Serving the Clients). Also, limited leadership (Effective Leadership) and funding support from the government impedes stakeholders' coordination and accountability (Finance & Accountability). The consequence was the reported gap in information sharing among the different levels in the system (i.e. federal, state and clinics), which in turn leads to problems in giving quality services to the clients (Serving the Clients).

Similarly, the solutions to address the data management challenges are linked directly to provision of infrastructure in terms of logistics tools (Tools and Data for Decision-making) and capacity building (Skilled and Adequate Human Resources). Furthermore, prompt sharing of national guidelines (Product Selection) and quantification results with relevant stakeholders is essential for decision-making on health product needs (Quantification and Procurement). These will empower the stakeholders with relevant information to ensure continuous availability of health products at the clinics (Warehousing and Distribution). Also, the need for Government leadership and funding is crucial through clear accountability structures (Effective Leadership & Management Structures). This will ensure that resources invested in capacity building leads to meaningful impact through improved service delivery (Serving the Clients).

To address specific major themes from the survey, respondents identified more top barriers on the RTKs survey compared to the ARVs survey. This very notable on inaccurate

data reporting and inadequate funding to procure HIV/AIDS products. Based on the views of the respondents, the barriers around government funding, significant reliance on donors, inaccurate data and reporting problems, and poor information dissemination were consistency identified both in the RTKs and ARVs survey responses and in written feedback provided by the respondents. Many respondents noted delay in the supply of needed health commodities to the clinics to support service delivery. The delay results in service disruption especially in the use of RTKs. Other themes that were highlighted as underlying reasons for the inability of the supply chain system to meet clients' health needs was the rapid changes in antiretroviral drugs regimens with introduction of new medications coupled with the inability of the manufacturers to produce the quantity of new drugs needed to meet the need. This creates program disruptions because the delayed procurement cascades into late deliveries resulting in the unavailability of antiretroviral drugs at the clinics.

The solutions to the identified barriers closely followed the barriers. Capacity-building and increased government funding to procure health products and support the supply chain system were prominent themes. In addition, respondents suggested greater capacity building of health workers on supply chain practices at the clinics and warehouses, and enhanced data visibility for decision-making (e.g., timely availability and use of data). Proactive engagement of more stakeholders in the selection of new products along with government support for local production of required health products were solutions identified to address some of these barriers.

Table 5: Summary of Survey Top Barriers and Solutions

	Top Priority Barriers (>85% rated as Very Important or Important)	Rapid Test Kits (% of respondents rating the barrier as very important or important)	Antiretroviral Drugs (% of respondents rating the barrier as very important or important)
Data Management and Use	Inaccurate data	Inaccurate RTKs SCM data used for quantification (86%)	Inaccurate ARVs logistics data used for quantification (87%)
		Poor SCM record keeping practices on RTKs utilization (100%)	Inaccurate ARV logistics data for decision-making (89%)
	Poor reporting	Poor reporting of failed quality controls with new RTKs to National Regulatory Authority (91%)	Poor reporting of adverse drug reactions on new ARVs to National Regulatory Authority (93%)
		Late submission of RTKs logistics data to higher level (86%)	Late submission of ARVs logistics data to higher level (89%)
	Poor data use	Limited use of RTKs quantification results to inform procurement in Government system (91%)	Limited use of ARVs quantification results to inform procurement within Government system (86%)
Leadership and Funding	Inadequate government funding	Lack of funding to procure new RTKs (86%)	Inadequate funding to support LMCU task (93%)
		Inadequate funding to purchase RTKs needs identified in quantification (90%)	
		Inadequate funding to support LMCU task (95%)	
	Inadequate infrastructure	Poor vehicular access road to clinics (86%)	
		Inadequate infrastructure for RTKs logistics data submission (85%)	
	Poor performance management	Late delivery of RTKs (90%)	Late delivery of ARVs to clinics (93%)
	Inadequate accountability	Inadequate accountability of RTKs in the public sector HIV pharmaceutical and laboratory SCM (85%)	
Human Resources Management	Limited human resources capacity	Poor knowledge on the use of various RTKs type (91%)	
		Failure to follow the first-to-expire first-out guideline in managing RTKs (91%)	
		Poor adherence to manufacturer's specification on RTKs use (86%)	
Stakeholders Coordination	Poor information dissemination	RTKs National HIV Testing algorithm not disseminated to health workers (86%)	National Standard Treatment Guideline for ARVs not distributed to health workers (88%)
		RTKs quantification information not provided timely for Government procurement decisions (86%)	

		RTKs quantification information not provided timely for Donor's procurement decisions (91%)	
Service delivery	Service disruption	Unavailability of RTKs in the clinics (85%)	
	Top Priority Solutions (>85% rated as Very Important or Important)	**Rapid Test Kits (% of respondents rating the solution as very important or important)**	**Antiretroviral drugs (% of respondents rating the solutions as very important or important)**
Data Management and Use	Submission and use of accurate data	Provision of accurate RTKs logistics data for quantification (96%)	Provision of accurate ARVs logistics data for quantification (96%)
		Provision of accurate ARVs logistics data for quantification (96%)	Timely submission of ARVs SCM data (94%)
		Use of accurate RTKs logistics data for decision-making (95%)	Use of accurate ARVs SCM data for decision-making (98%)
		Timely submission of RTKs logistics data (95%)	Clinic staff accountability of accurate and timely ARV record keeping (89%)
	Data use for decision making	Use of RTKs quantification result to inform procurement within Government systems (96%)	Use of ARVs quantification results to inform procurement within Government system (87%)
		Use of RTKs quantification results to inform procurement within Donor agencies (95%)	Use of ARVs quantification results to inform procurement within Donor agencies (96%)
		Improved record keeping practices on RTKs utilization (95%)	
Leadership and Funding	Increase Government funding	Increased funding from Government at all levels for new RTKs (91%)	Prompt mobilization of funds required to procure ARVs from the result of quantification (92%)
		Prompt mobilization of funds required to procure RTKs from result of quantification (91%)	Provision of funding to support LMCU task (96%)
		Provision of funding to support LMCU task (95%)	
	Reduced cost of new products	Reduced cost of new RTKs by manufacturers (86%)	
	Provision of infrastructure	Use of different vehicle type to access remote clinics (91%)	Provision of SCM tools for ARVs record keeping (85%)
		Provision of infrastructure for RTKs logistics data submission (100%)	
		Provision of supply chain management tools for RTKs record keeping (95%)	
		Refurbishment of RTKs storage space at clinics (85%)	
		Automation of warehouse management system for pick and pack of RTKs (86%)	

Human Resources Management	Capacity-building of health workers	Capacity building on use of various RTKs types (96%)	Capacity building on use of various ARVs types (85%)
		Training of Nigerians on RTKs quantification process (100%)	Training of Nigerians on ARVs quantification processes and tools (86%)
		Strick adherence to manufacturer's specification on use of RTKs (95%)	
		Increased awareness and adherence to RTKs national testing algorithm (95%)	
	Appropriate inventory management	Implementation of first-to-expire first-out guidelines (90%)	Implementation of first-to-expire first-out guidelines (91%)
		Practicing of first-to-expire first out guideline in utilizing RTKs (95%)	Practicing first-to-expire first out guideline in dispensing ARVs (86%)
		Planned outreach testing using RTKs (85%)	
Stakeholders Coordination	Prompt dissemination of guidelines	Prompt dissemination of HIV RTKs testing algorithm to health workers (91%)	Prompt dissemination of ARVs standard treatment guidelines to health workers (90%)
	Prompt information dissemination	Prompt dissemination of RTKs quantification results within a defined period to Government (95%)	Dissemination of ARVs quantification results within a defined period to the Donors (90%)
		Prompt dissemination of RTKs quantification results within a defined period to Donors (100%)	
	Development of coordination structure	Establishment of an accountability and supervisory framework for HIV SCM resources (91%)	Establishment of an accountability and supervisory framework for HIV SCM resources (90%)
		Development of a framework for SCM system modifications (91%)	Development of clear scope of work for NPSCMP (90%)
		Structured and effective PSM TWG meetings (91%)	Development of clear scope of work for LMCU (86%)
		Development of clear scope of work for NPSCMP (90%)	
		Development of clear scope of work for LMCU (86%)	
Service Delivery	Reporting of failed quality control tests	Prompt reporting of RTKs failed quality control tests to National Regulatory Authority (96%)	
	Prompt reporting of adverse drug reaction		Prompt reporting of ARVs adverse drug reactions to National Regulatory Authority (93%)

Key Informant Interview Results

First, I asked the respondents questions about the overall functioning of the supply chain system (Appendix 4). In addition, I explored their views on barriers and facilitators for each of the major components of the supply chain system. Like the survey, the interview guide aligned with the research theoretical framework. Furthermore, the interview guide explored respondents' opinions of the current state of the Nigeria HIV/AIDS supply chain system. I asked respondents to give insight on reasons for poor implementation of past recommendations to improve the supply chain system from prior studies.

In general, the views of the respondents did not differ significantly by their geographic location or place of work in identifying the barriers and solutions to the address them. There were a few instances for stakeholder's coordination in planning, quantification, and procurement, where federal and state level respondents identified unique perspectives on solutions to the identified challenges. Below are the results from the key informant interview under the major components identified for the research.

Overall Assessment

On the overall assessment of the Nigeria HIV/AIDS supply chain system, most of the respondents indicated that the system had evolved over time and had made significant improvements in the last decade. However, most of the respondents also noted that the system needed more improvements to enhance its efficiency. One respondent described the system thus:

> *I think the pharmaceutical and laboratory supply chain for the HIV program in Nigeria has improved significantly over the last decade but I still believe that there is still a very large room for improvement especially in some components of the supply chain because I believe that currently the optimal benefit that can be derived from the supply chain system is not being achieved.*

This theme was consistent across most of the respondents. Furthermore, one respondent noted that the system as a whole was effective, but added a cautionary note, that the existing system may not be sustainable: "*This is my overall assessment, it is an organized system, effective in doing what it is supposed to do, but it cannot be sustained by the recipient, the government of Nigeria."*

Product Selection

Barriers

On product selection, many respondents, both federal and state level, identified poor dissemination of national HIV/AIDS treatment guidelines to the clinics as a major barrier to the program. As a result, the health workers had limited knowledge and poorly implemented the guidelines. This had adversely affected the quality of services provided to patients accessing services at these clinics:

> *In talking about challenges, I know in the past when there have been treatment guidelines being brought out. It usually ends of at the central level with big meetings and the guidelines are launched. Nobody has really asked how these are cascaded further down to service delivery points or any efforts made to see if those things are there or being used at the service delivery points.*

In addition, many federal level respondents noted poor documentation of adverse drug reactions and the failure of clinics to report incidents of adverse reactions to the authorities as another barrier:

> *For example, I could remember when during the streamlining [i.e. new guideline revision] of the ARVs happened in 2012. Some people will say that they have not gotten the information on what is happening, hence we have such constraints. So, there is need to improve information dissemination system. Also, from the bottom up, the people working in the clinics [need] to report adverse drug reactions, because we cannot continue to rely on foreign literatures on what is happening, we need to know what is happening locally.*

We have so many patients having adverse drug reaction for example with Efavirenz. People often say it, but the question is whether it has been documented.

Respondents also noted the problem of depending on donors for product selection, rather than basing product procurement on local preferences. This often happens because the donors fund the procurement of these products and hence guide product selection to align with the products they will finance. For example, one respondent noted:

So, because the government funds are limited, they tend to lean more towards the donors for procurement and the donors usually have other interests that guides their product selection. So, you have a situation where the country basically is controlled by what the donors are bringing in. There is a standard product selection, most of what is done in the country relies more on what is in the World Health Organization guideline but to filter it down to actual products depends more on the preference of the donors than of the country.

Solutions

Many respondents suggested prompt information dissemination of new HIV/AIDS treatment guidelines to the health workers at the clinics. Some state level respondents suggested electronic dissemination of the guidelines via e-mails to many of the health workers that now have access to smartphones and internet connection:

In the area of effective communication of the guideline for me, [I] am looking at a situation where at the national level there is a database of the e-mail contacts of every stakeholder that is involved in HIV program in Nigeria so that when we have revisions, whether it is the algorithm or treatment guideline, this can be promptly circulated.

[Regarding] our guideline dissemination. We could make e-copy of it. As long as it has been finalized, everyone should have a copy. We could ask government to make e-copies and protect them so that nobody can change anything. Disseminate them widely. We are in an e-age. We do hard copies it is important, and they are sent, but that one or two copies might just be in one office, but with e-copy, many people have phones now, they have phones that are PDF enabled and they can read on the go.

In addition, respondents suggested that government should create mechanisms to monitor and support reporting of adverse drug reactions and to use local data to inform product selection. Respondents further proposed building the capacity of health workers to use the new guidelines and to create systems to actively monitor the use of the guidelines. Excerpts from some of the respondents include:

> *We need to implement the active search for patients with side effects. There was a form that was developed recently to have every ART client to report on any adverse effect at all that they are experiencing during every clinic visit. That has not been operationalized and it needs to be operationalized, so we can generate more local evidence…These will guide product selection.*
>
> *"Number one is to improve [increase] the human resource capacity at that level and if human resource capacity is improved [increased in number], then they will be better informed via training and retraining, the importance of data, logistics data, and clinical data will be used to take these decisions.*

Quantification and Procurement

Barriers

On quantification and procurement, many respondents noted that inaccurate data are used to guide procurement decisions. This leads to both under- and over-supply of different products. Inadequate quantities of certain types of products are purchased, leading to product unavailability at the clinics due to inaccurate data. On the other hand, excess supplies of other products are being purchased, leading to expiries. One respondent stated thus: "*Data is key in quantification; it is one of the most important requirements in quantification. Getting the wrong data, you either quantify to overstock [via procurement above requirement] or procure commodities that would not serve the populace."*

In addition, the respondents identified poor coordination of procurement plans and product requirements among the stakeholders (federal government, state governments, and donors) as a barrier. This happens because of poor visibility of procurement plans initiated by

these stakeholders. This is notable in coordination of the procurement plans between the federal and state governments. This is often the case as the State governments are independent of federal government, on health matters, and may decide not to take directive or collaborate with the federal government. Some respondents noted that sometimes the state governments' commodity procurements are based on political reasons for popularity rather than technical product needs for service delivery. Some of the state level respondents identified the poor involvement of state governments in national quantification activities (organized by federal government and donors) as the cause of this poor coordination as noted by a respondent thus: "*...most of the time, our quantification happens only at the national level without resource to the needs at the state level.*" The poor involvement of the state governments results in duplication of efforts. This is because the State governments may decide to procure products not required, as the federal government and/or donors already procure the products, while needed products are not procured. The consequence is limitation on the number of patients that can benefit from available resources:

> *Government does not share data with other stakeholders. Coordination is also an issue. If donor A is buying the same commodity that donor B is buying, they are likely going to buy the same quantity. So, coordination, inaccurate data and lack of government transparency are the issues in quantification where it affects procurement decisions. Donors may not know what to buy, they may over procure which will lead to expires at the end. That way, if you are supposed to use the funding to treat, say 500 patients, you may end up treating 300 patients because you don't have resources to put more patients on treatment.*

Solutions

To address the barriers, many respondents highlighted the need to collect and validate data from all the healthcare levels in the system. This is to ensure accurate data is used to inform quantification and procurement decisions:

> *"So, I feel we need to exhaust and explore the opportunities of getting data from all the levels of government and all the levels of [health] care and making sure that such data are verified and validated before they are used for any decision making.*

Other respondents spoke about the need to build the capacity of the health workers to ensure accurate and timely data generation:

> *The system to [be] put in place is one [thing], the ability to be able to build the capacity of staff to be able to report quality data [is another thing]. I think that over time and with experience, on the job training remains the best to be able to do that.*

In addition, many respondents recommended coordination of procurement plans among the various actors involved in the quantification and procurement processes (federal and state governments, and donors). They suggested that this could be achieved through transparent and prompt information sharing among the various stakeholders. Furthermore, state level respondents proposed that the involvement of the state governments in the national quantification activities would help ensure the state governments were aware of federal procurement decisions to minimize duplication of efforts in procurement:

> *Government needs to come out and be transparent in their procurement process. Coordinate with donors, let the donors know what government is procuring. Donors needs to be transparent as well so we are not blaming only government. I know the system used to be [in] silos with everyone buying on their own but it has now improved [amongst donors] with pooled procurement…which has helped in reducing expiries we noticed in the past. So, coordination, transparency, motivation of people that generate this data that we use to quantify for procurement [is very vital].*

> *I also think that it is also very important that state governments are involved when national quantification is being done even though they may not play a major role in the supply of data or in the actual process but we can also have opportunities for dissemination of these quantification output in a timely manner so that whenever any state decides to buy, whatever [they] buy [can be] virtually incorporated into the national pool and they will not be able to go outside what has been agreed at the national level. I think more involvement of the state actors will help to eliminate this challenge.*

Warehousing and Distribution

Barriers

Many respondents noted that there was a lack of both the warehousing infrastructure, and trained workers with the capacity to manage the existing warehouses. A respondent reported this challenge thus: *"…the main constraint to warehousing in Nigeria [availability of] quality pharma-grade warehousing. A lot of the state warehouses are basically just storage facilities. So, that is a major constraint, [poor] infrastructure.*" This resulted in product expiration at the warehouses as good warehousing standard operating procedures were not followed in managing health products. Some noted these barriers as follows:

> *[Poor capacity of the personnel] that is the bane of the warehousing system. What amount of training do we put into the personnel that manage our warehouses? You cannot run away from the quality of the personnel [as] that determines the quality of the work. We have people who often are not trained in the act of warehousing and commodity storage and when it comes to that a lot of issues [it goes] to back to training.*

> *[During visit to a warehouse] the stock was not arranged, and they were not even observing the principles of first-to-expire, first-out. In trying to help them rearrange the store, you find out a lot of commodities have expired, and they are not aware the commodities are there. Inadequate storage practices in the health system is also a concern for warehousing and distribution.*

Furthermore, many state level respondents identified the late delivery of health products, delivery to the wrong locations and inappropriate distribution practices through untrained proxies (i.e. persons not part of the supply system), and delivery at odd hours to the clinics by the third-party logistics service providers (3PLs), as barriers. Many of state level respondents noted that these inappropriate distribution practices had continued despite complaints raised previously by the health workers to implementing partners managing the 3PLs. This they opined was as result of poor monitoring and implementation of contractual terms, (especially concerning penalty payments and/or termination of contracts) signed by the 3PLs:

I think the problem has to do with distribution because the courier agents (3PL) that are used to deliver this product end up not delivering this product to the service deliver point. We have heard stories where some of the courier agents hand over the products to third party or fourth party agents [intermediaries] for onward delivery.

On the distribution side, poor monitoring of courier services [is a barrier]; have we punished courier service providers for late deliveries? What did we put in our contract while having these services with these providers? What are the penalties for late deliveries? If there are penalties for every late delivery by deducting certain percentage of money during payment, they will sit up.

Solutions

To address the identified barriers on warehousing system, some respondents recommended that government upgrade available warehouses to pharmaceutical-grade standards and engaging the private sector to manage these warehouses as noted by a respondent: *if the government can, working with donors, provide [more] pharmaceutical grade warehouses and even if they can't, they may consider engaging private pharmaceutical warehouses for storage of these commodities".* In addition, government should establish and maintain minimum standards for warehousing operations. This should include capacity building of personnel that operate the warehouses. Also, respondents recommended funding to maintain the infrastructure and support needed upgrades:

In terms of warehouse, the minimum criteria for a warehouse should be met. Now for the warehouse personnel…[they] should be trained on minimum criteria for a pharma-grade warehouse. Two, monitoring; monitoring to ensure compliance with minimum requirements. Three, funding; meeting minimum requirements will also require funding. Funding in term[s] of maintenance of infrastructure. It may not be so much but if the funding is being budgeted for and is ensured that it is being used for such purposes too, that will bring about an improvement.

On distribution of commodities, some of the respondents recommended strict enforcement of the distribution contract agreements as a strategy to close the performance gaps of the third-party logistics providers (3PLs). This can be achieved through real-time monitoring of the 3PLs to ascertain their performances and building capacity of staff

responsibility for monitoring. The state level respondents proposed the engagement of the state officials, who are closer to the clinics, in monitoring the activities of the 3PLs to address the problem of inappropriate deliveries. Other respondents recommended creating opportunities for competition among the private distribution agents as a performance management strategy that will continue to spur the third parties to meet their contractual agreements:

> *Most organizations that are responsible for distribution go into partnership with their distribution vendors. There are contracts with stipulations at what time commodities should be distributed. I think those organizations should go back and see how they can enforce the stipulations of those contracts so that incidents of late deliveries can be brought down to the minimum.*
>
> *It is the engagement of a third-party logistics agent; the agreement needs to be reviewed to ensure that they are able to deliver these product[s] to the service delivery point directly by themselves without using any middle agent that can delay the process of delivery. Also, the items should be delivered directly to the contact person.*

In addition, one of the respondents noted the importance of collecting real-time data about when the deliveries are made to the facility:

> *In the area of late deliveries, I think we need to put in place opportunities for real-time reporting of date and time when deliveries are made to the facilities. This will ensure that when facilities receive their commodities, they can quickly put in SMS [short message service] or something that will quickly inform people at the federal level that are monitoring this distribution. Another thing that can also help is to see how the state level actors can also be involved in the monitoring of the distribution of commodities…I also think that the national program needs to create competition among these distribution agents that are currently being used.*

Logistics Management Information System

Barriers

Many respondents highlighted poor record keeping practices in the clinics as problems for the logistics management information system (LMIS). This occurs because record keeping tools (i.e. forms for data collection) are not available in the clinics. Also, the manual process of

data collection, which is the current practice, is very laborious. Furthermore, when the tools are available, they are not user-friendly (i.e. bulky). This makes it difficult for the health worker to accurately complete them on time. The consequence of this is the poor quality of data submitted for decision-making, which disrupts health services delivery:

> *Yes, I agree that unavailability of tools and poor recording-keeping are major barriers in the supply chain and I think that this is because most of the tools that are currently being used in these facilities are outdated…. Also, these facilities also lack the infrastructural support to have electronic management system. I think these are some of the issues we have at these facilities.*
>
> *I will say the manual system is a problem. We do a lot of manual system [processes], from drug dispensing to inputting the data at the end of the day. These are manual system and then the transmission of the report, you still have to look for [computer] system to type it in, then send it to the state LMCU…Even at the national level there are still errors that come up, transcription errors. Manual process is a problem.*

In addition, many respondents noted the limited human capacity (both in numbers and skills) to keep records of supply chain transactions in the clinics as another barrier. The attrition of skilled manpower from government services worsens the situation. The attrition is as result of poor remuneration and unconducive work environment that is a systemic issue for the entire health system beyond health supply chain. As noted by a respondent "*…we are living in a country where people work for months without being paid…So, poor motivation of our government staff is a key challenge.". This will require an overall health system intervention beyond supply chain management system.*

Other feedback from a respondent on cause of the human resource gap in the system include:

> *Also, we have also observed that there [are] frequent changes in the responsible personnel at facilities. So even after we have worked with implementing partners to train the service providers who are managing the [product] supplies at the facilities, we usually have frequent redeployment of personnel and so this creates capacity gaps in the personnel at the facilities and some of them when they join the program they are not able to fill the form.*

Solutions

For the barriers identified, many of the respondents proposed the use of technology in the management of supply chain data. This will alleviate the burden of data management for the health workers at the clinics and minimize errors in data transmission. Furthermore, many respondents proposed investment by government in the infrastructure (computers, internet connection) for data management and transmission, and use of mobile technology as strategies to implement this recommendation. Examples of the recommendations from respondents include:

> *We [the government] need to invest in some of these infrastructure[s], internet, computers and train people to use those things because those system seems to be faster because you will be able to transmit reports faster and ultimately you have less people and less paper work to do. Also, if we don't have computers, can we look at the popular handsets [mobile phone], the androids, [and] the popular phones that everybody is using for now, [that] can we consider that as a means of generating report.*
>
> *For the issue of the poor recording-keeping and use of tools, I think we should start thinking about developing and supporting them with electronic system. I believe this would minimize the burden of filling many of these forms and worksheets especially during dispensing and preparation of LMIS reports. We should also be looking at a mobile-based LMIS system which is based on something like SMS rather than internet-based [system] because I know that a number of health facilities even in Lagos where you think is far more developed than others, you still have challenge of internet access.*

In addition, many respondents identified cost-effective and targeted capacity building of health workers via training on required skills, followed with mentoring and supportive supervision on supply chain data management and use, as strategies to address challenges of LMIS. Respondents further recommended behavioral change management via education and performance-based incentives. These they noted will enable the health workers to imbibe the culture of documentation. In addition, performance-based incentives will motivate the health workers take ownership data management processes and data use for decision-making. Examples of comments from respondents include:

I think we should start developing training curriculum that target the essential needs of the facilities in keeping records and generating reports. This will help us minimize the time required for some of these capacity building and the cost which has always been the limitation around continuous capacity building.

….one way I heard people talk about [this], not in the HIV space, but in other health supply chain space is to build a performance-based incentive system that will motivate proper documentation and proper record keeping and timely transmission of records. Also, the idea of exploring the game theory where something like competition is created among peers as to who are the people that will get the most accurate data in the best possible time.

Serving the Client

Barriers

Many respondents noted that the primary barrier in delivering services to the clients was the unavailability of health products in the clinics. As respondent noted, *"two major issues include [un]availability of products and [poor] remuneration of staff. Unavailability of products affects serving the clients for over 90%. If a client is there and there is no product, then there is no program.*" Respondents suggested that this was primarily due to the inaccurate logistics data management and poor work attitudes. These are often linked to low staff morale as result of poor remuneration, unconducive working environments, and inadequate human resources capacity to provide services. The consequences of these include health services disruption, patient dissatisfaction, and loss to follow up in the chronic treatment of HIV positive clients:

The major constraint is personnel attitude. The personnel or the healthcare worker that attend to the clients, their attitude is key and if their attitude is not welcoming then the client will not feel so free to have an expressive discussion with respect to their health. Another major constraint is inconvenience of the facility. If…there is no secluded comfortable environment to have meaningful patient counseling and discussion. Another constraint, poor logistics [data], stock out will be an issue [with inaccurate logistic data]. And if there is stock out due to poor logistic data, then they will be unable to serve all the clients [at] that service delivery point. Product unavailability? It is a major factor because for client that cannot have access to their ARVs that would also lead to drug resistance.

Solutions

Some of the respondents recommended the deployment of adequate human resources that are well trained and mentored on HIV/AIDS supply chain service delivery. The capacity building, they opined will enable the health workers to understand the impact of HIV/AIDS service disruption. It will also serve as an incentive to motivate performance on positive attitude to the clients and correct supply chain documentation. These the respondents suggested will improve the availability of health products at the clinics for service delivery since these products are available at the central warehouses in Nigeria:

> *For the remuneration of staff, I will want to think that trying to give a small incentive like a little form of training, even if it is onsite training with a certificate that will help the staff so they know they have an added knowledge.*

Leadership and System Support

Barriers

Many respondents identified inadequate government funding, and weak leadership systems as barriers for the HIV/AIDS supply chain system. These result in limited supervisory and accountability monitoring because of poor government commitment to the HIV/AIDS supply chain system. Furthermore, many respondents suggested that limited capacity of the government personnel at the logistics management coordinating units (LMCU) to provide the required leadership had resulted in significant dependence on donor organizations to provide leadership and system support for the system:

> *I think for me, leadership and system support is also one of the weakest link in the HIV program supply chain and it is like a cycle because if don't have adequate funding, then you do not have the required funds for you to be able to provide monitoring and supervision, you do not have the funding to be able to employ more people. I think the LMCU cannot provide the leadership and system support, if there is no opportunity to engage with the health facilities.*

Solutions

Many respondents recommended high-level engagement with senior government officials, with authorities to make decisions, by the donors and private organizations supporting HIV/AIDS supply chain as a solution. Donor organizations can advocate with senior leaders on proper funding allocations and disbursement for supply chain activities. The senior government officials should also be encouraged to demand accountability of the deployed resources from the donors and government technical officers charged with the responsibility of supporting the HIV/AIDS supply chain. Furthermore, some respondents proposed capacity building of the government staff on resources accountability, monitoring of work plan implementation and reporting to the senior leadership as solutions:

> *The advocacy just goes beyond the Minister [for Health]. It needs to go all the way up to the presidency to enable him [to] understand why he needs to invest in health and invest in public health specifically. It is something that needs to go beyond the state government and up to federal government. Until that happens, even if you go to the state, they could create LMCU, [if] there are no funds to support the activities [they cannot make progress]. Right now, most of them are waiting for the donors to support activities that happen at the state level and that is not sustainable.*

Other Environmental Factors

Some respondents highlighted other factors that affect HIV/AIDS supply chain. This includes fear and insecurity in the community that impedes health product distribution. Some respondents also noted the limited involvement of the patients in the HIV/AIDS supply as another factor that impairs the efficacy of HIV/AIDS products. This can be addressed by educating the patients on how to store their medications at home and report on medication concerns to appropriate personnel:

One of the neglected areas of supply chain happens to be involving the patient. Making the patients play an active role on their therapy. Getting feedback from the patients on this drug [they] are taking. That is something that needs to be included in the supply chain going forward.

One other essential factor that I think is the angle of the patients…the patients have a lot of responsibility. For example, a patient comes to a facility, he is given product that we had stored very efficiently. That patient should know that if I take this product home, I should also see that there is an aspect of storage I can do at home [to maintain therapeutic efficacy of the product].

Implementation Challenges

Based on feedback from some respondents, the failure to implement some of earlier recommendations was because the relevant government authorities did not fully understand and accept the initiatives before they were made public by the supporting organizations. This happens because the implementing partners are sometimes eager to release results of their researches to align with mandate given to them by the donors. Unfortunately, government is not in a hurry to make significant changes in the system as result of the long-term impact and financial implications of those decisions. In addition, respondents suggested the involvement of the government in developing the final recommendations and any plan needed to implement the recommendations. Government involvement can help ensure that the proposals are implementable considering local constraints.

In addition to the involvement in drafting recommendations, some respondents thought that government needed to be at the forefront of the implementation efforts. For example, a respondent suggested that procurement across private and governmental funding could be more efficient if the efforts were coordinated (harmonized) under governmental leadership. The respondents also suggested that the internal acceptance of the new ideas would enable the right government authority to issue directives that will support implementation. The issuance of implementation directives by the 'right' government institution is essential because not all the government institutions have the authority to issue directives to make changes in the system.

Respondents thought that part of the reason for the past failure was the lack of an oversight structure to ensure that the recommended changes were implemented. Several respondents proposed putting mechanisms in place for regular review of the agreed implementation plans along with clear key performance measures. Assigning responsible persons within government agencies and holding them accountable through peer review sessions were other strategies to promote implementation of the new ideas.

Other respondents noted the lack of governmental funding at the state and federal levels hampered prior efforts at SCM improvement. Respondents recommended that the donors encourage government investments to implement these recommendations through peer reviews among different state governments and donors. This may be further supported through incentivizing performance through incremental performance-based financing from the donors. The use of performance-based financing (i.e. setting up target(s) that states would need to meet to obtain project funding) will encourage the state governments to meet agreed milestones for program implementation.

In addition, respondents noted lack of trained workers needed to implement prior recommendations. They recommended building the capacity of the workforce on expected level of performance. This is vital, as performance expectation on new recommendations are sometimes not achieved because those saddled with the responsibility may not have the required capacity to implement the new recommendations. For example, recommendations to implement electronic-based data collection system may fail in locations where relevant personnel do not have access to electronic tools or do not have the skill to use available tools:

> *One thing has been the issue of ego. You know HIV/AIDS is such that government cannot do it alone, you need the support of partners. In Nigeria when it is partners that are driving a particular strategy, the government feel reluctant because they are not taking the lead. One thing I advise is that when the improvement idea is coming from the donor, let the government buy-in before it is made public. Right from the planning stage, let them be there and let them take the lead it in…Even when the ideas are not coming*

from them [government], let them [government] be at the forefront in the implementation. When it happens that way, then there will be success.

For these new recommendations to be effectively utilized, there is need to develop a workable work plan…For each activity in the work plan, there is need to have a key person that is responsible for its implementation…I also want to suggest that where possible, we should also be able to commend or motivate those that were able to meet up or has completed their assigned activities within the timeline.

Summary

Table 6 include the summary of the key informant interview responses grouped by the theme based on the theoretical construct of the research. The summary identified barriers and solutions provided by the respondents for an effective and efficient HIV/AIDS pharmaceutical and laboratory supply chain management system in Nigeria. The themes have been grouped under the theoretical construct for the research and they revolve around similar themes as noted in the survey results: data management and use, human resources and performance management.

Table 6: Summary of Key Informant Interview Response

Construct	Barriers	Solutions
Product Selection	Poor dissemination of guidelines	Prompt information dissemination on guidelines
	Limited knowledge on guidelines	Electronic dissemination of guidelines
	Poor implementation of guidelines	Systems to monitor adverse drug reaction
	Poor documentation of adverse drug reactions	Capacity-building of health workers on guidelines
	Donor dependence for product selection	
Quantification and Procurement	Inaccurate data for procurement decisions	Collection and validation of data from clinics
	Over or under supply of product requirements	Capacity-building of health workers
	Poor coordination of procurement requirements	Coordination of procurement plan among stakeholders
	Poor visibility into procurement plans	Involvement of state governments in quantification
	Limited involvement of States in quantification	
Warehousing and Distribution	Inadequate warehousing infrastructure	Government upgrade of warehouse infrastructure
	Inadequate human capacity to manage warehouses	Engagement of private sector in warehouse management
	Expiration of products	Establishment of minimum warehousing standards
	Late delivery of health products	Capacity-building of warehouse operators
	Delivery to inappropriate locations	Funding to maintain warehousing infrastructure
	Poor monitoring of 3PLs contract terms	Enforcement of 3PLs contract terms
		Real-time monitoring of distribution services
		Increase competition among 3PLs
Logistics Management Information System	Poor record keeping practices	Deployment of technology to improve data management
	Unavailability record keeping tools	Government investment in data infrastructure
	Laborious manual data management system	Use of mobile technology for data collection
	Bulky data collection tools	Cost-effective and targeted capacity-building
	Limited human resources capacity	Behavioral change management
	Attrition of skilled staff	Performance-based incentives
Serving the Client	Unavailability of health products at the clinics	Improve availability of health products at clinics
	Inaccurate logistics data	Deployment of adequate skilled human resources
	Poor staff work attitude	Capacity-building of staff
	Poor staff remuneration	
	Unconducive work environment	
	Inadequate human resources capacity	
Leadership and System Support	Inadequate government funding	High-level engagement with senior government officials
	Weak government leadership	Advocacy with senior leaders on adequate funding
	Limited supervisory and accountability system	Demand for accountability of deployed resources
	Limited capacity at LMCU	Capacity-building of LMCU on leadership

Recommended Policy Changes

Many of the respondents noted that the current policy framework was adequate to support implementation of HIV/AIDS supply chain in Nigeria. The major gaps were the lack of political will, limited coordination, and funding for the implementation of the policy provisions. However, a few of the respondents recommended policy changes to improve the likelihood of policy implementation and impact. For example, some respondents recommended active involvement of the private sector in managing the public health supply chain. This was proposed as a strategy to promote efficiency and accountability in use of resources in the system. In addition, some respondents recommended inclusion of a clear policy statement on how much funding the government should contribute to support public health supply chain: "*There is a need to adjust the current the policy and guidelines for HIV supply chain management so that the role of government in spending more of their money is emphasized."* Policy statements do not have the force of law; however, it serves as guiding principles on the activities of government and that of partners working with the government. Furthermore, it forms the foundation for future legislation after several years of policy implementation.

Others suggested that government establish standards on the minimum remaining shelf life of product (i.e. length of time to expiry) before it can be imported into the country. Several respondents further suggested decentralizing the warehousing infrastructure, using more than the single warehouse used in current policy. Also, a few respondents recommended harmonizing the distribution frequencies (across health products). In addition, the respondent noted the need for guidelines for how long it should take to distribute products in each distribution cycle (i.e. all ARVs and RTKs should be distributed within three weeks of report submission from the clinics). Finally, some respondents proposed the development of a policy implementation plan, to ensure that existing or future iteration of the policies are implemented. The implementation plan would include, for example, policies for funding, monitoring, and

reporting on health supply chain activities included in the policy. These are important changes considering the dynamic changes in the HIV/AIDS program implementation with innovations in treatment regimen and need to scale up services. Examples of comments from respondents include:

> *Considering that there a lot of changes that are happening in the HIV world, I think the policy and the guidelines needs to be reviewed, to meet emerging challenges. So, I think we [government] need to spend more resources in terms of funding, in terms of time to monitor the system to improve the coordination and implementation of these policies and guidelines.*
>
> *I think government needs to sit down with all stakeholders and draft clear policies on supply chain management. And government needs to separate the private sector from public sector. The current policy on supply chain management looks at operating mega distribution centers, which for me is for private sectors. We need to have public sector policies that stipulates, what is the shelf life of the pharmaceuticals that are coming into the country, what kind of warehouse do we need to use? What is the distribution cycle for these commodities, what informs reporting? The entire process needs to have clear policies.*

Priority Recommendations

Many respondents identified that increased government leadership and additional funding of the supply chain system as priority recommendations to improve the HIV/AIDS supply chain system. This will require active engagement of senior government leaders and engagement with other stakeholders with resources that can influence government decisions at the highest level. Supporting the management of accurate supply chain data and improving data visibility to inform government decisions and investments were other priority recommendations suggested by other respondents:

> *Top priority should be around funding, governance and support, leadership and support and our LMIS. The reason I say this is because, leadership and support is key in making sure that every other thing works. If we do the LMIS correctly, it will inform every other thing.*
>
> *Ensuring that data generated from health facilities is of good quality and can inform decision making. Not just having good quality data but also ensuring it comes on time to ensure that donors and all stakeholders make appropriate decision.*

CHAPTER 5: DISCUSSIONS AND RECOMMENDATIONS

This chapter reviews the major themes that emerged from the research. In addition, I have included preliminary recommendations that can help improve the HIV/AIDs SCM system. As discussed further in the Plan for Change, I will be working with governmental officials to get buy-in to these preliminary recommendations before widely distributing them to a broader public.

Overview

In general, the study was designed to discover the barriers and solutions to an efficient and effective supply chain management for the HIV/AIDS program in Nigeria. To identify the specific challenges facing each product type (i.e. antiretroviral drugs and HIV rapid test kits), the survey was divided into two parts to address specifics for ARVs and RTKs. It was not surprising that respondents working within the RTKs SCM reported more challenges compared to those working with the ARVs SCM system. This is because the ARVs SCM system had received more attention over the years. This had been the case especially on data accuracy, data submission timeliness, and capacity building for health workers. In addition, laboratory products (RTKs being one of them) are more challenging to manage because of the special handling (i.e. temperature monitoring, different pack sizes and utilization protocols) and reporting requirements (i.e. reported in different units of measure) when compared with ARVs. For example, on RTKs poor record keeping received a 100% score as an “important” or “very important” barrier. This highlights how this barrier had significantly affected the RTKs SCM. Also, poor reporting of failed quality control to the national authority is another unique barrier to

the RTKs supply chain while poor reporting on adverse drug reaction is unique to ARVs supply chain. These further buttresses the inadequate communication channels between the health workers and the national regulatory authorities. The summary of the barriers revolves around poor logistics data management and use, inadequate leadership and funding, limited human resource capacity and performance management, weak stakeholders' coordination and disruption in service delivery.

The solutions proposed by respondents for both RTKs and ARVs were significantly aligned. These common proposed solutions are already reflected in the Government's efforts to integrate the RTKs and ARVs supply chain systems in order to close gaps faced by both systems. Both RTKs and ARVs products are stored in the same warehouses and distributed to the clinics using the same vehicles. The data collection forms for ARVs and RTKs are being harmonized and submitted at the same time to the state government from the health facilities. This mechanism was put in place to improve data accuracy through facility-level peer-review between different health workers generating these reports. In summary the solutions to address identified barriers falls within the themes of strengthening stakeholders' coordination of the supply chain system, improving supply chain data management and use for decision making, improving human resources and performance management, government leadership and funding support, and improvement in quality of service delivery at the clinics.

Below are details of the overall emerging themes for the HIV/AIDS supply chain system and recommendations to improve the system.

1. Stakeholder Coordination and Information Dissemination

The limited coordination and information dissemination among the various stakeholders—especially between the federal and state governments—were significant barriers

for the HIV/AIDS supply chain. The coordination challenges were highlighted in quantification and procurement of HIV/AIDS products. In addition, poor information dissemination to the clinics from the federal and state governments—especially on new service delivery guidelines for ARVs and quality control protocols of RTKs—were other major gaps in the SCM system. Spicer et al. (2010) documented challenges across seven countries with national and subnational government's coordination framework in global health programs. Spicer noted this was a factor that needs to be addressed to improve health program impact. Chima and Homedes (2015) further reiterated the need for robust coordination systems within global health programs in Nigeria to ensure that available resources are optimally used to make desired health impacts.

In Nigeria, the State governments are independent of the Federal government on health-related matters and have the choice of whether to align with the federal government's plans and decisions. This is because of the lack of clarity in the Nigeria policy and legal framework on the tier of government that controls health services. This gives the State governments autonomy on health issues, but it creates room for duplication of efforts if plans are not aligned between the federal and state governments. While there had been good effort in planning and coordination among the stakeholders at the national level (i.e. between donors and federal government), the state officials had not been actively involved in the in planning and coordination for HIV/AIDS commodity procurement and management. For example, some of the state level respondents noted that the state government officials are often not part of the national efforts to quantify needs for HIV/AIDS commodities. The limited involvement of state officials and coordination with the federal government results in duplication of efforts by the various stakeholders (when the state decides to independently procure HIV/AIDS commodities) resulting in suboptimal use of available resources for commodity procurement. This happens because some state governments (not all) are unwilling to coordinate among themselves or request information from the federal government on available commodities in the country. This is often the case when the

federal and state governments are from opposing political parties. The suboptimal utilization of national resources (i.e. pooling federal and state government funds) highlights the need for the federal government to advocate with state governments to invest available resources in filling commodity procurement gaps.

Some of the national respondents stated that there was limited federal engagement with the states because the state governments were not clear on whether they would commit funds for HIV/AIDS commodity procurement. Some thought that some state governments purchase products that generate public attention, for political reasons, rather than bridging the commodity gaps in the system for service delivery. The narrative aligns with the trend for the other health programs as well. This happens as health is seen as a social intervention and used for political campaigns that will endear governments to the people.

Another problem is the slow pace of the government decision-making process at both federal and state governments. This slows information dissemination to the clinics. Hence, information that may be available is not shared with the clinics until it receives official government endorsement, which creates significant gaps in the system over an extended period.

Recommendation #1.1. Donors and private sector organizations should engage directly with federal and state governments to support coordination and collaboration among the different stakeholders in the system to harmonize commodity procurement plans.

The donors and private organizations supporting the HIV/AIDS SCM system should engage directly with both the senior and technical officers within the federal and state governments to facilitate harmonization of HIV/AIDS products procurement plans and funding gaps among stakeholders. While this is not a sustainable strategy for supporting the HIV/AIDS SCM system, it will serve as a catalyst to bring together the federal and state governments to achieve a common goal of health service delivery and promote government ownership of the program (Chima and Homedes, 2015). Donors and private organizations should engage both

the technical officers, at the logistics management coordinating unit (LMCU), and the senior government officials, with decision-making authority, that can make the required changes in the system in funding the system. This is a useful strategy as the donors and private organizations often enjoy the trust of the senior government officials based on their track record of performance in support of the health system. The regular partner's forum established in some state for engagement between donors and senior government officials can be used close the communication gaps. Finally, pooling of resources for commodity procurement will enable government to leverage economies of scale and reduce cost of health product procurement (Larson, Burn, Minnick-Sakal, O'Keefe Douglas, & Kuritsky, 2014).

Recommendation #1.2. Government officials should facilitate prompt dissemination of changes in the national HIV/AIDS treatment guidelines and SCM system using appropriate circulars via electronic systems.

Wide dissemination of information on the new guidelines will be a useful strategy to improve the health supply chain system. Often senior government leaders with authority to act on new recommendations are not aware of the new information or have not received the recommendations in the necessary format needed before they can act. Improving information dissemination through development of a dissemination plan that is followed with short and simple publications for target audiences will be ideal (Schipper, Bakker, De Wit, Ket & Abma, 2016). In addition, sharing the information widely through e-mail listserv and following up with formal communication of these recommendations to senior government leaders by the technical officers will be helpful. For instance, the national HIV/AIDS treatment guidelines should be disseminated electronically via e-mails and be available on official government websites for download as an official government document for referencing. This will also enable health workers and leaders to continue to work with existing information while having channels to receive feedback (via e-mail listserv) on successes and/or challenges of implementation. Similar

approaches should be adopted when there are changes in the HIV/AIDS supply chain system to promote prompt information dissemination and use at the states and health facilities.

2. Leadership, Funding, and Accountability

Inadequate funding provided by the federal and state governments in support of the HIV/AIDS supply chain management system has resulted in significant dependence on donors to meet the needs of the public health system (Chima & Homedes, 2015). The consequence of this limited funding is inadequate leadership at the federal level to drive the process of HIV/AIDS supply chain improvement. While the system had improved significantly in the last decade and is providing HIV/AIDS commodities to the patients consistently, it is largely dependent on the leadership and external resources provided by donors. This may make the system unsustainable in the long-term especially with dwindling donor resources as result of global donor fatigue (Grepin, 2012). For example, one respondent noted that while the supply chain system was currently performing as designed, the federal and state governments due to limited governmental budget allocation to the health sector might not sustain it. Part of the reason for the inadequate governmental funding is competing priorities. The situation arises as the federal and state governments have other priority interventions (e.g. security, agriculture, publicity for public campaigns, etc.) in which they prefer to invest limited government resources. This also happens as government leaders often view the health sector as consumer of funds and do not relate the health of the people to overall productivity of the workforce. The different priorities of the senior government leaders limit the ability of the frontline workers to provide required leadership to the HIV/AIDS SCM system. In addition, senior governmental leaders (especially at the state level) do not give the same level of attention to the HIV/AIDS supply system to ensure proper management of funds as they do to other priority interventions where they have invested significant resources.

Recommendation #2.1. Government should budget adequate funds to provide leadership and implement improvements in the HIV/AIDS SCM system.

The government needs to budget adequate funds during the annual budgeting cycle in order to improve the current HIV/AIDS SCM system. This is needed to enable the frontline workers in government to provide leadership in program implementation. This may include coordination meetings with donors and private sector organizations or monitoring SCM system implementation at the clinics. The federal government and many state governments use an envelope budgeting system. In this system, funds are allocated to different sectors of government with a defined ceiling amount irrespective of their need. For example, in the 2018 federal government budget, the health sector was allocated N340.46 billion (~$945 million) which is about 4% of the federal budget as against national target of 15% (Onigbinde et al., 2018). This figure was artificially determined based on government's projected revenues—not based on actual health needs. The leaders within the thematic areas are expected to work within the budget ceiling. Even after the budget is set, government officials do not always release all the funds. Hence, donor and private sector organizations need to help support government technical officers in advocating for funding with the executive and legislative arms of government.

Recommendation #2.2. Government should disburse budgeted governmental funding for HIV/AIDS SCM program implementation on a timely basis to support service delivery.

Timely disbursement of needed funding that had been approved in the budget may be one of the most challenging problems for the program. Sometimes, the funds are not released for the entire budget cycle. Unavailability of projected state government revenues is often the cause of this delay. If revenues are not sufficient to cover the full budget for all government-funded programs, then the national or state government may allocate limited resources based on its own internal priorities. Health is not always the top priority for governmental agencies. In

addition, if the funds were not released on time, they will be left unspent due to long bureaucratic approval processes. The unspent funds are returned to the government treasury at end of the budget cycle without a guarantee of receiving the funds in the next cycle. Advocacy by donors and private sector organizations is needed to encourage government officials to issue an official circular and timely release funds to support HIV/AIDS SCM system. Also, reporting systems should be put in place that enable the government technical officers to report to the senior government leaders, donors and private organization how disbursed funds had been utilized and the results achieved. The reporting system will encourage private organizations and donors to further lobby senior government leaders and legislators for more resource allocation via the envelope budgeting system.

To mobilize funding from donors and local private organizations in support of the health supply chain system, there should a memorandum of understanding (MoU) between donors, private organizations, and government. The MoU will serve as incentives for state governments to coordinate funds and other resources from external sources and government that are needed for supply chain implementation. Part of the conditions in the MoU will include disbursement of government budgeted funds for program implementation to guarantee continue support from donors. This has been successfully implemented with the immunization and family planning programs in Nigeria--with funding from Nigeria-based foundations, governments, and international partners used to support the supply chain. While the MoU puts leadership and accountability on shoulders of government, it enables the private organizations to monitor the disbursements and utilization of government funds in addition to the funds from these organizations. The use of MoU to encourage government disbursement of appropriated funds is a model the HIV/AIDS program can copy from the other health programs in Nigeria. This may stimulate increased government funding of HIV/AIDS products procurement and SCM system.

Recommendation #2.3. The government should strengthen accountability and management structures for the HIV/AIDS SCM system.

Senior government officials should require progress updates on activities of the NPSCMP and LMCUs based on the approved annual work plan and budgetary disbursements. This is essential to ensure that deployed human and financial resources are effectively utilized for program implementation. The development and monitoring of annual performance metrics will enable senior government official observe progress on program implementation. Constant reporting and oversight, along with consequences for failures, can incentivize positive behaviors. The offices of the Auditor General and Accountant General at both the federal and state governments should be used to monitor financial resource utilization and reporting. Furthermore, training the NPSCMP and LMCU staff on leadership and supervisory techniques can help them provide the requisite support to health workers at the clinics and demand accountability from the private sector and donors providing support to the system.

3. Human Resources and Performance Management

Inadequate human resources and poorly trained staff are also barriers to the system. Government has had problems attracting highly skilled workers, and those who are employed sometimes leave within a short period due to poor working conditions. This staff attrition results in an increased workload for remaining staff without adequate manpower to keep up with the required volume of needed services. This leads to poor customer service to the patients and in the performance of assigned tasks. Inadequate human resource capacity affects different components of the supply chain including data management, warehousing and distribution, service delivery and leadership systems. Furthermore, some of the staff from the implementing partners that provide warehousing and distribution services are also not well trained to manage the warehousing and distribution service contracts with private sector service providers. Another

challenge emanates from the personal relationships between these staff and the service providers. This limits their capability to hold these third-party logistics providers (3PLs) accountable for poor performances in service delivery. Hence, government and public staff who identify poor performance of third party vendors often discuss the problems verbally, rather than monitoring, documenting, and using the data to hold the private sector service providers accountable. The consequence of this is reoccurring problems of suboptimal performance from some of the private sector service providers on warehousing and distribution services.

Recommendation #3.1. Government and private sector organizations should develop a targeted workforce development strategy to improve supply chain performance.

Three mutually reinforcing strategies are needed to ensure an adequate supply of well-trained staff needed for an efficient and effective HIV/AIDS SCM system. First, government must hire sufficient numbers of workers. This necessitates a formal workforce analysis to determine how many workers are needed and in what roles and locations. Second, government must employ new strategies for staff retention through performance-based career promotions, and time provided with encouragement that staff take vacation for rest and recuperation. These are some of the strategies used in the private sector to keep high performing staff even amid poor financial incentives due to budget constraints. Third, staff training should be targeted to the skills needed by each staff to perform assigned tasks. This will involve developing a strategic plan for human resources management for health supply chain management system (Trap, Musoke, Kirunda, Oteba, Embrey & Ross-Degnan, 2018).

Significant resources have been spent in the past training of health workers on skills they did not put to use immediately which are often forgotten after many months of non-use. For example, training a health worker at the clinic who mostly collates logistics data, on management of 3PL contracts is not appropriate deployment of resources. While the contract management skill may be useful in future career direction, it will not be immediately utilized and

may not be useful for the supply chain system at that time. In addition, there is a growing concern around the output of capacity-building interventions—i.e., whether the results in system performance are worth the costs of training and workforce capacity-building efforts. Thus, future efforts should be focused on demonstrating immediate impact of capacity building through visible change in performance improvement. In addition, utilizing strategies that may be less expensive like direct mentoring, on the job training and supportive supervision will be useful. An important skill needed by many health workers is behavior change communication and task management. This skill will enable them to improve their attitude to work and relationship with clients. Building the capacity of staff on contract management and protocols to demand accountability from the private sector are important skills for government staff and implementing partners who are part of the governance structure for the public-private partners and other engagements with 3PLs.

Recommendation #3.2. Government and donors should develop an active performance management strategy to promote effective utilization of deployed resources for supply chain implementation.

The use of active performance management strategy is necessary to support implementation of supply chain management innovations for service delivery. These strategies should be used in the management of both human and materials resources available to the HIV/AIDS supply chain system. On human resources management, this can be achieved through incentivizing performance through rewards and career promotions (Serumaga, Spisak, Rosen, Morgan & Eichler, 2014). In addition, deterrents can put in place through issuance of performance queries both verbal and written to staff members that are performing below expectation. For private sector organizations working in the HIV/AIDS supply chain, as 3PLs, the documentation of performance failures and contract enforcement had been successful strategies for performance management. I had use these strategies in my experience overseeing several 3PL contracts over the years. In addition, increasing competition among the

3PLs through periodic open tendering of the services they provide to attract new 3PL will be a useful strategy to maintain performance standards (Agrawal et al., 2016).

Recommendation #3.3. Government should attract more private sector organizations to manage fixed government assets (i.e. warehouses) through public-private-partnership.

One strategy to consider is greater engagement with the private sector that can be held accountable by government for direct implementation of the major supply chain activities (Agrawal et al., 2016). While there had been complains of poor performance by the private sector, especially in warehousing and distribution of products, they provide a better alternative on resources accountability and efficient delivery of services compared to government institution (Agrawal et al., 2016). This is because as a private institution, they can be called upon by the government at any time to account for resources given to them and their contract can be terminated if they do not demonstrate tangible progress toward performance improvements. In addition, private vendors are likely to have greater performance incentives if Nigeria government enhances its performance management system and opens the private contracts up to competitive bids. The engagement of the private sector for management of government-owned warehouse infrastructure can be through public-private partnership (PPP) as a strategy to promote proper resource utilization and accountability. The Nigeria federal government already has a PPP policy that can be adapted by the state governments to improve supply chain performance (FMOH, 2005). The utilization of PPP has the potential to improve the governance structure within the SCM as both the public and private partners must establish a formal agreement on performance standards over a specified period. The Federal Ministry of Health; Food, and Drug Service Department (FMOH/FDS) through the National Product Supply Chain Management Programme (NPSCMP) should take the lead in the development of the scope of work and implementation the of PPP at the federal level while providing support to states. This should be carried out in consultation with appropriate federal government regulatory agency. At the states, the Directorate of Pharmaceutical Services in the State Ministries of Health through

the Logistics Management Coordinating Units should take the lead on developing state-level scope of work for the PPP.

4. Data Management and Use

The research also identified the use of inaccurate data for quantification and procurement decisions as major barrier to the system. This barrier was due to manual and laborious process of data generation and transmission structures from the clinics to the state and national levels. In addition, poor record keeping practices, inadequate human resources, and the lack of user-friendly standardized data capture forms contributes to this overall lack of actionable data. For example, some of the health workers do not have the proper forms to document product utilization at the clinics. For those that have the forms, completing them is often perceived as more work; hence, they are sometimes unwilling to fill it. Furthermore, frequent staff attrition makes these challenges worse. Despite these challenges, the public health supply chain system in Nigeria is abounding with different types of data to inform strategic decisions on effectiveness and efficiency of the system. Unfortunately, only raw data—rather than aggregated data—are available to the government officials. For example, the LMCU receives the raw data on the quantity of HIV/AIDS products delivered to the clinics from the implementing partners. However, government needs to know the number of patients who have been or could be treated with these products. Also, government officials also need the data to inform them on the level of product availability in the clinics (i.e. stock out rate). The deployment of technology to support this process will be useful. For example, the use of electronic logistics management information system in Tanzania improved data use significantly with increased visibility in the system (Mwencha et al., 2017).

One of the aims of this study was to explore other models of effective supply chain management practices that could be adopted in the HIV/AIDS program in Nigeria. The literature

review identified two other successful efforts, one in Tanzania and the other in Ethiopia that could be helpful to Nigeria. Tanzania invested in an improved logistics system (via the logistics management unit) which resulted in improved data visibility and a decrease in health products stock out and expiries (Mwencha et al., 2017). Ethiopia used data on the number of patients accessing ARVs in addition to logistics data to inform resupply decision, which helped improve HIV/AIDS product availability in the clinics (Berhanemeskel, Beedemariam & Fenta, 2016).

Recommendation 4.1. Governments should require the use of electronic data management systems to improve data processing into information for decision-making.

The deployment of technology for electronic management of logistics data will increase data use for decision-making and should lead to overall supply system performance. For example, the use of mobile technology in logistics data management will eliminate the need for paper report transmission to state or national level that improves real-time stock monitoring and product availability (Aranda-Jan, Mohutsiwa-Dibe, & Loukanova, 2014). However, the purchase of new data systems in and of itself will not ensure better data is collected. The knowledge and willingness of the people utilizing the electronic system is essential to achieve desired results. In addition, deployment of electronic systems is capital intensive and requires technological and infrastructure support services for the users. The good news for the Nigeria HIV/AIDS program is that discussions started by the donors in 2017 to deploy electronic system is yielding positive results.

As at May 2018, an electronic logistics data collection platform had been developed under the leadership of the federal and state government, with support of donors. The electronic platform is undergoing pilot testing and deployment in some clinics in Nigeria. This should significantly improve the health supply chain system if the current momentum to roll out the system at the state LMCUs is sustained. Efforts are also ongoing to deploy the system at clinics with existing human and infrastructural capacity by 2019. With the data management software in

place, the government leadership should focus now on national adoption and use of the system. This will include encouraging the staff at the clinics to accurately submit data on time for decision-making via mentoring and feedback system from the state LMCUs.

In addition, simplifying the data collection forms to make them more user-friendly and putting mechanisms in place for data validation, with the aid of technology, will support to improve the quality of data used for decision-making at the national and state levels. Finally, senior government leaders should have access to electronic dashboards that includes supply chain management data and demand interpretation of performance trends from the data. The utility of these electronic dashboards to improve the vaccine supply chain program in Nigeria was noted as a success through improved visibility of product availability at the clinics and prompt decision-making by senior leaders to address identified barriers (Sarley et al., 2016). Access to these electronic dashboards will also provide visibility to the senior government officials when there is a decline in supply chain performance.

5. Infrastructure and System Support

The research highlighted several infrastructure problems that impair the SCM system, including inadequate data management infrastructure (computers, internet access), warehousing services (forklifts, fire-fighting equipment, shelving racks etc.), storage space at clinics, and lack of clinic space for patient counseling and medication dispensing.

Recommendation #5.1. Government should develop and enforce the maintenance of minimum warehousing standards for health products within the supply chain system.

One strategy to address the warehousing infrastructure deficit is the development of minimum warehousing standards. This is different from previous recommendations that proposed global “gold” standards that were often not attainable due to the lack of funding. The

development and enforcement of *minimum* standards will enable government and other private organizations responsible for management of these infrastructures to understand basic requirements and ensure that the SCM system operates within acceptable standards. The development minimum warehousing standards is under the purview of the Pharmacists Council of Nigeria (PCN) that regulates and approves standards for premises used in management of pharmaceutical products in Nigeria. In addition, the National Agency for Food and Drug Administration and Control (NAFDAC) that enforces the national laws on use of medical products and devices should support through regular monitoring to ensure compliance with minimum warehousing standards established by PCN. The establishment of minimum standard will serve as baseline to support pharmaceutical-grade warehouse management. In addition, the public-sector warehouses should continue to aspire towards the International Organization for Standardization (ISO) quality management system (i.e. ISO 9001) certifications on infrastructure and management for pharmaceutical-grade warehouses in the long-term.

Recommendation #5.2. The requirement for data management hardware should be addressed through the use of existing infrastructure rather than investing in a new hardware system.

Delays in timely submission of logistics is often attributed for unavailability of hardware for data submission. This challenge can be addressed through the use of android-based mobile phones to collect data. The good news is that the existing software platform has a mobile-based application. These android devices are readily accessible to most health workers and can address the deficit related to lack of computers for data transmission from the clinics and scale-up in the use of the technology via installation of the software on available android devices (Aranda-Jan, Mohutsiwa-Dibe, & Loukanova, 2014). Furthermore, the challenge of internet connectivity can be addressed through government partnership with major mobile network providers in Nigeria. The partnership will include these mobile network providers offering free online access to users visiting the webpage of the new electronic system. This will minimize

barrier associated with cost of submitting logistics data to the platform by user and others that may want to visit the system to obtain data for decision-making. The donors and private organizations supporting the deployment of the new software should facilitate the discussion between the government and mobile network providers.

6. Quality Service Delivery

The HIV/AIDS program is relatively unique compared to other health care SCM systems. This is because HIV/AIDS program has frequent changes in treatment guidelines as the result of innovations in treatment options. Thus, there needs to be a system to update the HIV/AIDS treatment guidelines when innovations are available. However, new guidelines are not always conveyed down to the level of clinic staff. Further, the poor documentation of the quality problems (e.g. adverse drug reactions for ARVs) and accurate interpretation of these incidents are system problems that need to be addressed (Hui, Vaillancourt, Bair, Wong & King, 2016). Also, Avong et al. (2015) highlighted the importance of prompt reporting of adverse drug reactions in a standardized format for early detection and management of adverse events on clients. Even when these problems are reported, the national government does not provide the feedback needed to help worker manage these incidents. Further, the national antiretroviral therapy task team, constituted to provide national direction on clinical program implementation, does not meet as frequently as expected due to paucity of funds. Similarly, the national laboratory technical working group that provides direction on utilization of RTKs also does not have regular meetings. This lack of regular meetings by these two oversight groups makes it difficult for health workers to provide timely feedback to the national government on health service delivery challenges. Essentially, there is no monitoring and oversight system to ensure that new guidelines are being implemented consistently across clinics. This leads to varying clinical practices across different clinics that should provide the same basic HIV/AIDS services.

Recommendation #6.1. Governments should strengthen electronic dissemination of treatment guidelines and monitoring of compliance with established treatment standards at the clinics.

Improving the quality of HIV/AIDS service delivery through the supply chain system is essential to enhance the patient experience at the clinics. This includes prompt dissemination of national treatment guidelines for RTKs and ARVs management to health workers using innovative means (e.g. electronic dissemination) by the federal government. In addition, the federal and state governments should collate e-mail addresses of the health workers at the clinics to disseminate new decisions on HIV/AIDS product use. The Federal Ministry of Health through the HIV/AIDS Division should be responsible for implementation of this recommendation.

Furthermore, capacity-building sessions for the health workers through a structured and regular meeting of the national antiretroviral task team and national laboratory technical working group is also another intervention that will help to improve quality of HIV/AIDS services. These meetings should include sessions on monitoring implementation of new guidelines and provide feedback to health workers that identified adverse drug reactions or other quality issues with health products used in the clinics (Ehrenkranz et al., 2018). However, the structure of the current national meeting where clinicians, pharmacists, and laboratory scientists travel from many states and clinics to central location is too expensive to finance on regular basis. Hence, the federal and state governments should restructure these meetings using online webinars or other means of electronic collaborative discussions. In addition, proactive efforts at collecting feedback from the patients on product-related challenges in the use antiretroviral medicines will further improve the process of product selection and decisions of the national treatment task team.

7. Policy Improvements

Recommendation #7.1. Government should establish minimum remaining shelf-life policies for donated health products to minimize expiries.

Some of the improvements identified by the research will require structured policy changes before they can be implemented. For example, determining the minimum remaining shelf life of products before they are imported into Nigeria is a policy decision. While most of the donor agencies have their own minimum shelf life requirements (typically, requiring that the product have a minimum of 75% of its remaining shelf life to be shipped into the country), there is no nationally adopted minimum standard in the 2016 national supply chain policy. The national regulatory agency (NAFDAC) stipulates a minimum of six months for commercially imported products but this may not apply to public health programs. Most of the products used in the public health program spend between 8 and 15 months in the country before use. Thus, products that are shipped into the country with a six-month shelf life may not end up not being used before the product shelf-life expires which becomes a waste management challenge for the SCM system. Also, the general health commodities donation guidelines stipulate 50% shelf life for donations in emergency (as there is an expectation that in emergencies, most of the products will be used immediately). However, there is no specification for normal service delivery in the health supply chain policy. Hence, specifying minimum required product shelf life--both in percentage and months—would help ensure that products can be used before expiring.

Recommendation #7.2. The Ministry of Health should ensure that there is specification on the level of Government funding in support of health supply chain system.

Another policy improvement is definition of the role of government in funding the public health supply chain system in Nigeria. Donor organizations have had to step in to support the HIV/AIDS supply chain system because of the limited commitment from the government to provide adequate funding. While the current policy proposes coordinated use of available funds,

it is silent on sources of these funds. Further, current policy does not spell out the level of government funding needed to support different components of the HIV/AIDS supply chain system. This gap will continue to impede sustained system performance and limit the ability of the government team in the HIV/AIDS supply chain system to implement required changes without external funding support.

Recommendation #7.3. Government should ensure that the next revision of the national health supply chain policy include an implementation plan.

The lack of an adequately financed monitoring strategy for policy implementation was another major gap in the current policy framework. While the existing policy framework—the "Nigeria Supply Chain Policy for Pharmaceuticals and Other Healthcare Products" (2016) contains a description of the tactical roles of the various stakeholders (federal and state governments, and clinics) in involved in the SCM system, the lack of a concrete implementation plan made it difficult to ensure proper implementation of the current SCM system.

The Nigeria Federal Ministry of Health, Food and Drug Service Department, should be reviewing the existing supply chain policies in 2019. When revised, the new governmental policy statement should include an accompanying implementation plan with the needed funding to support implementation and monitoring. The revised Supply Chain Policy for Pharmaceuticals and Other Healthcare Products should include an accompanying implementation plan to ensure that the underlying policies are successfully implemented. The implementation plan should identify the governmental agency responsible for implementing different policy provisions, funding sources and levels needed to policy implementation, and a monitoring and reporting structure to oversee policy implementation. Finally, the implementation plan should include issuance of government circulars to all stakeholders to reinforce the policy provision. The circulars will further highlight the policy recommendation and remind all stakeholders on the

need to comply with the government directive on new changes within the public health supply chain.

Prioritization of Recommendations

I am mindful that not all recommendations can be implemented at once, as some of them will require significant changes in the current policies and practices. Hence, I will be sequencing the recommendations into short-term, medium-term, and long-term recommendations. These will enable me focus appropriately on the plan for change and guide prioritization of efforts to support implementation. This is also important as some of the recommendations may be considered as low hanging fruits that will be acceptable to the Government leaders and relevant stakeholders for easy implementation while other will require significant resource investment. More so, some of the recommendations are precursors needed to implement some of the other medium and longer-term recommendations. Thus, these recommendations should be implemented first to build the foundation to implement other recommendations in the future.

Short-term Recommendations: The following recommendations are considered short-term recommendations for implementation in the next 6 to 12 months. In putting together these short-term recommendations, I am mindful of efforts already ongoing in electronic supply chain data management within the national health supply chain system that need to be supported through active government leadership. In addition, these recommendations will require minimal financial resources, and limited changes to existing policy and protocols supporting the HIV/AIDS supply chain system. Finally, these will require limited advocacy to the mid-level managers in the Government for implementation to be successful. These short-term recommendations include:

- Recommendation #6.1. Government should strengthen electronic dissemination of treatment guidelines and monitoring of compliance with established treatment standards at the clinics.
- Recommendation 4.1. Government should require use of electronic data management systems to improve data processing into information for decision-making.
- Recommendation #5.2. The requirement for data management hardware should be addressed through the use of existing infrastructure rather than investing in a new hardware system.

Medium-term Recommendations: The medium-term recommendations will require about 12 to 24 months for implementation. These recommendations will require development and issuance of government circulars from senior government leaders with some level of changes in the current structures and protocols for the public health supply chain program in Nigeria. In addition, it will require significant of level advocacy to senior government leaders to facilitate implementation of these recommendations. These include:

- Recommendation #1.2. Government officials should facilitate prompt dissemination of changes in the national HIV/AIDS treatment guidelines and SCM system using appropriate circulars via electronic systems.
- Recommendation #1.1. Donors and private sector organizations should engage directly with federal and state governments to support coordination and collaboration among the different stakeholders in the system to harmonize commodity procurement plans.
- Recommendation #2.2. Government should disburse budgeted governmental funding for HIV/AIDS SCM program implementation on a timely basis to support service delivery.

- Recommendation #3.2. Government and donors should develop an active performance management strategy to promote effective utilization of deployed resources for supply chain implementation.
- Recommendation #2.3. The government should strengthen accountability and management structures for the HIV/AIDS SCM system.
- Recommendation #5.1. Government should develop and enforce the maintenance of minimum warehousing standards for health products within the supply chain system.
- Recommendation #7.1. Government should establish minimum remaining shelf-life policies for donated health products to minimize expiries.

Long-term Recommendations: These recommendations will require significant changes in government policy and procedures hence will need about 24 to 48 months for implementation. Some of the recommendation will require new legislation; other recommendations will take the involvement of more private sector payers. These recommendations include:

- Recommendation #3.1. Government and private sector organizations should develop a targeted workforce development strategy to improve supply chain performance.
- Recommendation #3.3. Government should attract more private sector organizations to manage fixed government assets (i.e. warehouses) through public-private-partnership.
- Recommendation #7.3. Government should ensure that the next revision of the national health supply chain policy include an implementation plan.
- Recommendation #7.2. The Ministry of Health should ensure that there is specification on the level of Government funding in support of health supply chain system.

- Recommendation #2.1. Government should budget adequate funds to provide leadership and implement improvements in the HIV/AIDS SCM system.

Study Limitations

The survey response rate was 32%, which was lower than the targeted response rate of 50%. While I used gatekeepers to encourage responses from potential respondents and sent periodic reminders, the response rate still fell short of expectations. This may be because the clinic and state level staff were not familiar with the name of researcher and there was no incentive to participate. For the key informant interviews, many of the potential respondents agreed to participate in the interview. My professional networking with most of the respondents may have influenced their acceptance to take part in the interviews. However, I explained that the interview was an academic research, their participation was voluntary, and they were free to decline participation without any consequence. Also, I did not follow up with potential respondents after a second e-mail reminder to minimize undue pressure to take part in the interview. For those that participated in the interview, I did not interject during their explanations and minimized eye contacts to minimize any inadvertent influence on their views via social desirability bias.

Furthermore, my long-term involvement in the Nigeria HIV/AIDS supply chain system for the last ten years guided my interpretation of the research findings. However, I used a second coder in analysis of findings to minimize potential researcher bias. In addition, I tried as much as possible to stay on message in line with what the respondents proposed without allowing by personal bias influence the result analysis and presentation. Furthermore, inputs of the Local Government Area (LGA) officials, that is the third tier of government in Nigeria, were not captured. While their role in the HIV/AIDS SCM system is still evolving--especially in data

collection--their inputs will be useful in future studies. Finally, the study did not cover health supply chain integration with other public health supply chain systems in Nigeria (e.g. malaria and tuberculosis programs) which is currently under implementation.

CHAPTER 6: PLAN FOR CHANGE

Implementation of these recommendations will need strategic collaboration with donors, implementing partners and senior government leaders involved in the public health supply chain system in Nigeria. In my current role as the Deputy Country Director, Supply Chain Operations for the USAID Global Health Supply Chain Program – Procurement and Supply Management project in Nigeria, I can facilitate some of these dialogues to initiate the process of change. I will adopt the Kotter's eight steps model of leading change (Figure 4) in the implementation of the research findings (Kotter, 2007), which I believe will help lead to meaningful improvements. Incidentally, I have been actively involved in some of the major changes that had resulted in the improvements recorded in the HIV/AIDS supply chain system in Nigeria in the last ten years. This will be enable me draw from both my network with relevant stakeholders and knowledge of the system to push these changes forward. Implementing Kotter's eight steps model will involve taking the steps to ensure that these recommendations do not go the way of earlier research in the public health supply chain space in Nigeria.

To ensure successful implementation of the recommendations, I will initially focus on the short-term recommendations as I noted in Chapter 5. These recommendations have higher chances of immediate success with minimal disruption to the existing system. However, if implemented, these recommendations will add significant value to the system. First, I will focus on electronic data management system that will improve prompt generation of information for decision-making via a central data repository. This recommendation leverages the ongoing efforts to implement an electronic logistics data management system but adds a recommendation to present data in different formats that are meaningful to senior and mid-level

government officials. Below is the sequential pathway I intend to follow as recommended by Kotter:

Figure 28: Kotter Change Model

(Kotter, 2007)

1. ***Create Sense of Urgency:*** The first step in the Kotter model is to create a sense of urgency about the need for change. I will achieve this through dissemination of a summarized version of my research findings to some of the research respondents, with focus on government leaders, who had already shown interest in the results. Specifically, I will focus my initial discussion with government officials on the need for timely generation data needed for decision-making. This will form the first part of my plan for change. Sharing the information with government leaders will create the opportunity for internal dialogue. The dialogue will revolve around the kind of information each cadre of government official will want to see, the frequency and format of presentation to guide decision-making. The focus of the dialogue with government officials will be on their thoughts regarding the findings as well as suggestions for how to modify the original recommendations to ensure that they can be implemented. In addition, I also intend to

disseminate the result through a community of practice of public health supply chain experts that I belong to in Nigeria, the International Association of Public Health Logisticians (IAPHL). This community of practice includes senior government officials, donors, private sector players, and implementing partners supporting public health supply chain programs in Nigeria. I will try to create the sense of urgency through emphasizing that improved data via a harmonized in-country SCM data system, would increase the number of patients who could be benefit from the program and clinics that could be provided with necessary HIV/AIDS products, both with the same level of funding in the country. Furthermore, I intend to publish the research finding in reputable public health journals to enable it gain wider visibility and create the required pressure for the government leaders to act. This will include highlighting the gaps in the health supply chain policy document and, after consulting with government officials, proposing revisions to address them.

2. ***Build a Guiding Coalition:*** The IAPHL Nigeria chapter holds its meeting once a month in the country. These meetings have an audience from across the states in Nigeria, many of whom join online. In addition, some government leaders attend in person. Through this forum, I will build a coalition of interested health workers that will be willing to share these ideas at their worksites or other areas of influence. To stimulate this interest, I intend to request time to make presentations at these meetings to identify the gaps in the systems, recommend improvements, and build momentum for change with focus on data for decision-making. The leadership team of the HIV/AIDS public health supply chain in Nigeria takes part in this forum. I intend to use the opportunity of the presentation to stimulate further follow up sessions with the Ministry of Health before the presentation.
3. ***Form a Strategic Vision and Initiative***: Based on the finding from the research, the reason why recommendations from previous researches were not implemented was

because the government was not at the forefront of leading these initiatives. Instead, most of these initiatives were led by donor organizations. Further, some of the prior recommendations did not have accountability structures to monitor implementation. Hence, I intend to hold a strategic brainstorming session internally with the government health supply chain leadership team on how they want health supply chain data to be presented to inform their decisions. This will focus on the use of proper and 'politically acceptable' strategies in increasing the effectiveness and efficiency of the HIV/AIDS supply chain via data visualization techniques with aid of technology. The sessions will also include opportunities for the leadership to help modify the research recommendations based on their knowledge of the system with the aim on developing an implementable strategy on supply chain data management and use for decision-making. The internal dialogue will be an opportunity to communicate the vision in more detail for their buy-in and suggestions. A focal point of discussion will include strategies to obtain government commitment in area of funding allocation and disbursement for implementation of public health supply chain in Nigeria. However, the initial focus will be on how to continuously generate supply chain data that will inform the long-term recommendation on funding. Also, I will try to focus on strategies to improve accountability and feedback, through supply chain data visualization, to the senior leadership about the deliverables achieved through governmental funding.

4. ***Enlist Volunteer Army and Communicate the Vision:*** I will suggest that the government leadership team seek interested volunteers within Government agencies that will lead the implementation process (as champions) in consultation with donors, private sector organizations, and implementing partners. The volunteers will be identified through the IAPHL forum and/or National procurement and supply management technical working group meetings. Representatives of government officials from the states who will champion the implementation of the vision will also be identified through

the logistics management and coordinating unit (LMCU) and/or IAPHL. The volunteers will be individuals who are passionate about meaningful change that will improve the lives of patients accessing HIV/AIDS services. I will communicate the vision to these volunteers with support of the government leadership that are part of the guiding coalition. The communication will be through e-mail listserv set up for that purpose with which I will share relevant new supply chain information and receive feedback on implementation. The volunteers will be encouraged to conduct peer review on progress made at different levels of implementation and seek support from government leaders in the guiding collation when needed.

5. ***Enable Action By Removing Barriers:*** It is important to identify key players who may oppose or impede changes especially on deployment of technology to support supply chain data management. Stakeholder analysis will be used to identify the key stakeholders, their interests, and potential opposition to the proposed public health supply chain improvements. In addition, proper messaging will be crafted to minimize potential opposition to the proposed improvements. This will include the benefits of the improvements to the public health system and to the patients accessing health services from the clinics. I will also advocate for the issuance of government circulars at the state level on the implementation of ideas adopted by the senior leaders. The circulars will give the government the needed credit and show they are in the lead in the implementation of the new recommendations. Scanned copies of the circulars can be disseminated via e-mails to all relevant stakeholders for implementation new changes. This will assist to provide conducive environment for implementation of the new ideas. Table 7 contains stakeholder analysis on electronic management of HIV/AIDS supply chain data in Nigeria.

Government officials at the federal and state ministries of health and local government health departments will be major proponents of the electronic supply chain

data management system. This is because the electronic data management system will provide needed information on the utilization of HIV/AIDS products at the clinics. The improved visibility will promote accountability on the use of government and donor resources to provide HIV/AIDS services. The government officials have the authority to demand clinic workers to submit data electronically and will exercise that power via circulars to promote implementation on the new system. The donors and NGOs working in the HIV/AIDS program are also very likely to be proponents. This will be a strategy to monitor resources deployed and demonstrate accountability to the relevant authorities in their host countries. The donor's involvement may be moderate, as they will expect the NGOs to be at the forefront promoting deployment of the system while bringing the donors into the conversation if there are challenges. The opponents of the electronic data management system will include clinic workers and patients. For the clinic workers, they may feel pressured to use their personal android devices to submit data, which may be at a personal cost on internet connectivity. However, they will be encouraged to submit electronic data explaining how it will reduce their workload. Also, performance-based incentives (annual recognition certificates and performance bonus) on the number of accurate reports submitted on time could be instituted to encourage their participation. In addition, the software provider should centrally cover the cost of internet connectivity to encourage data submission at no cost to the sender. If these fail, the local governments will be requested to deploy staff to manually collect data from the clinics and transmit these data electronically. The patients may be other opponents of the system as result of concerns on breach in patient confidentiality. However, they will be assured the system will only collect data on HIV/AIDS product use and demand pattern without any patient identifier. This will minimize the risk of product unavailability when they come to the clinics for services. Finally, the private sector distribution providers may oppose the electronic data management system, as they will be expected to invest in the

infrastructure for it. However, the will be persuaded with explanation on how the electronic data management system will improve speed of payments for their services.

Table 7: Stakeholders Analysis

Stakeholders	Reason	Power	Resources	Likelihood of involvement	Ways to influence stakeholders position
Proponents of electronic management of HIV/AIDS supply chain data					
Federal Ministry of Health	Increase data visibility will improve accountability on government and donor resources and increase visibility on service delivery	High	Has authority to demand data visibility from clinics under Federal Management and can make policy changes to make electronic data management a requirement	High	
State Ministry of Health	Increase data visibility will improve accountability to Federal Government and Donors to attract more support to the state through increased product supplies	High	Has the authority to demand data from clinics under State management and can make policy changes to demand electronic data management a requirement	High	
Local Government Area officials	Increase data visibility will guide staff deployment for data collection and management	Moderate	Can deploy staff to collect and transmit data at local levels	Moderate	Present benefit of electronic data system and triangulation with service delivery data to improve supply of products
United States President's Emergency Plan for AIDS Relief	Data visibility will aid accountability on funding allocated for service delivery to justify investment to the U.S. Congress	High	Will fund the development of software system and support roll out of the system across clinics and creation of dashboards	Moderate	Demonstrate benefit of the investment to encourage further support
The Global Fund to fight AIDS, Tuberculosis and Malaria	Data visibility will aid accountability on funding allocated for service delivery to justify investment to the Board	Moderate	Will fund the development of software system and support roll out of the system across clinics and creation of dashboards	Moderate	Demonstrate benefit of the investment to encourage further support
Non-Governmental Organizations	Electronic data management will aid commodity supply decisions to minimize waste and justify funding	Moderate	Will support the implementation of new electronic data management system and facilitate government use of the system	High	
Opponents of electronic management of HIV/AIDS supply chain data					
Clinic health workers	Will be pressurized to submit data timely and possibly be required to use their own personal android devices for data submission	High	Staff may decide not to use the electronic system and continue with manual method of data processing claiming lack of capacity	High	Showcase potential reduction in data processing errors and timely resupply of full product requirement
Network of People Living with HIV/AIDS in Nigeria	Concerns on breach in confidentiality of patient identity if electronic system is hacked	Moderate	Can use public media to blackmail the Government that they are planning to breach patient confidentiality via electronic system	Moderate	Clarify that only product information will be collated and not patient information
Private sector distribution service agents	Electronic data management of distribution practices will expose inefficiencies in product delivery	Low	Responsible for the deployment of android devices for parts of supply chain system.	Low	Demonstrate how electronic data management will improve distribution services payment timeline

6. ***Generate Short-term Wins:*** The government-facilitated technical working group meetings and the monthly IAPHL meetings will be platforms to celebrate short-term successes achieved at each milestone. These will include the adoption of new and improved implementation strategies by the government gatekeepers, identification of volunteers, identification of barriers to implementation, issuance of implementation circulars and any success achieved in securing appointments with senior government leaders to present the new ideas. This will sustain the momentum, encourage the volunteers, and provide a platform to monitor implementation progress.
7. ***Sustain Acceleration:*** The opportunities that will be provided by the celebration of short-wins will also be utilized to sustain momentum for volunteers driving implementation of the recommendations. The meetings of the volunteers will be scheduled after the IAPHL meetings and via e-mail communications to minimize cost implication of participation. A nominee, among the volunteers, who will serve as a champion to navigate the government bureaucracies, will lead the volunteer's meetings. However, a volunteer who will be subject matter expert on topic of discussion at each meeting will lead different meetings. In addition, feedback will be sought from other members of the community of practice on how to surmount implementation barriers. This will enable the team to mobilize more volunteers that will sustain the momentum and report on progress. In addition, defining the measure of success and establishing key performance measures will be used to keep the team engaged. This will enable the team to identify small improvements and celebrate successes.
8. ***Institute Change:*** Once breakthroughs are achieved in the government system -- especially in the leadership, allocation, and disbursement of funding to implement public health supply chain activities--the changes will be instituted through continuous accountability of resources released by the government. The team will be encouraged to communicate and be proactive in reporting results rather than waiting to be asked. In

addition, the LMCU will be used as the government institution to coordinate and report on progress by the states. At the national level, FMOH/FDS will be asked to report progress on key milestones during the national procurement and supply management technical working group meetings and publish these achievements in government journals.

Public Health Benefit

HIV/AIDS is a chronic disease that can only be controlled through lifelong antiretroviral drugs treatment; much like hypertension must be controlled with regular and reliable pharmaceutical treatment and behavior change. Thus, this research identified barriers and solutions for an effective and efficient HIV/AIDS supply chain in Nigeria for lifelong treatment of people living with the human immunodeficiency virus. While there are significant strides in the last decade to improve the system, strengthening coordination at the various levels of governments will minimize duplication of efforts in HIV/AIDS commodities procurement and use. This will increase the number of clients that can benefit from HIV services. Increasing the availability of RTK tests will help more people know their HIV status through routine screening tests and expanding access to ARVs will help more people stay in treatment and reduce their viral load. Furthermore, increasing government leadership and accountability through performance management will promote access to quality HIV services at the clinics. Prompt dissemination of HIV/AIDS treatment guidelines that support the appropriate product selection, procurement, and service delivery will ensure that clients benefit from high quality services when they visit the clinics.

Finally, Nigeria is undertaking National AIDS Indicator and Impact Survey that started in June 2018 with planned completed in early 2019. This survey will provide information on population-based prevalence of HIV in Nigeria that will guide further scale-up of HIV/AIDS

services. This scale-up will be dependent on an effective and efficient HIV/AIDS supply chain to ensure that areas with higher prevalence receive needed products for service delivery. The planned review of the national supply chain policy in 2019 further opens the window to advocate for the inclusion of this research findings into the national supply chain policy.

Conclusion

The HIV/AIDS supply chain system in Nigeria has made significant improvements in the last decade. However, there are still opportunities for improvement to make the system more effective and efficient in supporting HIV/AIDS service delivery. These improvements will include strengthening coordination across national and state levels in Nigeria, and across public and private funders to maximize the use of available resources for procurement and supply management. In addition, improving data quality and use for decision-making by the senior government officials is essential to inform budgetary allocations and disbursements for supply chain implementation. Effective government leadership through performance management and greater accountability of the resources deployed in support of HIV/AIDS supply chain is essential to support scale of services in Nigeria. Finally, policy revisions that will define the role of government in funding HIV/AIDS supply chain in Nigeria and stipulations of remaining shelf life of HIV/AIDS products for importation into Nigeria will further strengthen the supply chain system, increase HIV product availability for service delivery and minimize expiries.

APPENDIX 1: DEFINITION OF TERMS

Standard Operating Procedures (SOP): these refer to written documentation on how the SCM system should operate. The documentation details steps for activity performance which align with program goals. In addition, SOPs contains system performance management protocols and quality improvement strategies. It also defines the processes to make needed modifications to the SCM system. These are part of the procedures to maintain optimal performance while using available resources efficiently.

Logistics: The cycle of operational activities and functions in and among organizations, such as procurement, storage and distribution.

Logistics management: The part of supply chain management that plans, implements, and controls the efficient, effective forward and reverses flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirement. Logistics management is an integrating function, which coordinates and optimizes all logistics activities, as well as integrates logistics activities with other functions including marketing, sales manufacturing, finance, and information technology." (CSCMP, 2011)

Supply chain: A network of organizations engaged in a transactional or long-term relationship that as a total output ensures product availability for the end consumer.

Supply chain management (SCM): "planning and management processes and procedures to ensure that products are continuously made available from the manufacturers to the end users that need the products" (CSCMP, 2011).

Pharmaceutical SCM: this is SCM for pharmaceuticals and other health products needed by service providers and clients for health service delivery. The other health products include diagnostic reagents and consumables for health service delivery.

Integrated pharmaceutical SCM: A system that is fully developed with clear linkages among people, processes and systems. The SCM actors also have a common goal of establishing an effective and efficient system through collaborative leadership, management and financing.

Inventory management: appropriate handling of health products that have been procured through standard warehousing and distribution protocols to ensure they get to end users maintaining in a timely manner to ensure their full potency.

Logistics management information system: the processes for data collection, collation, review, storage, retrieval, dissemination and use to inform decisions on pharmaceutical SCM.

APPENDIX 2: SURVEY QUESTIONNAIRES (ANTIRETROVIRAL DRUGS)

Exploring structural and systemic improvements for effective and efficient pharmaceutical supply chain management for HIV/AIDS in Nigeria

Survey Questionnaires

Survey Instrument Number…….

Introduction

Please take 30 minutes to complete this survey

This survey is being conducted as part of the Doctor of Public Health (DrPH) degree dissertation in the University of North Carolina at Chapel Hill, NC USA. The survey is focused on exploring the structural and systemic improvements for an effective and efficient public-sector pharmaceutical supply chain system (SCM) for HIV/AIDS service delivery in Nigeria, with a focus on the 'Six Rights' of a logistics system. These 'Six Rights' refers to the right product being available in the right quantity, and in the right condition, at the right place, in the right time and at the right cost. The HIV/AIDS products referred to in this survey are **antiretroviral drugs (ARVs)**. The survey will seek for your opinion on HIV/AIDS pharmaceutical supply chain management improvements. Improvements may also include adoptions of external models from elsewhere and/or process improvements within the current system to promote effectiveness and efficiency of the pharmaceutical system for HIV/AIDS system in Nigeria. Your opinions are confidential and cannot to be linked to you. All responses are anonymous; hence respondents cannot be identified as the questionnaire will be tagged with serial number in the space provided above. ***You may submit the completed survey electronically via qualtrics or e-mail or return it in hard copy in a sealed envelope for confidentiality***. For questions please contact; Innocent Ibegbunam innoibe@live.unc.edu Phone +234-803-5030-619 or Prof Pam Silberman, pam_silberman@unc.edu

Instructions

i. Please select an option(s) to indicate your opinion to the statement under each section.

ii. Provide text in the box to give other thoughts on barriers to or potential solutions to specific pharmaceutical SCM best practices as noted in the question.

iii. You may also use additional attachments if the provided space is not sufficient to address your point.

iv. Kindly share any available material(s) or references to further support your opinion.

A. Background

This section covers background information on your experience, role and organization as part of the pharmaceutical supply chain management for HIV/AIDS program in Nigeria.

1. How long have you worked within the HIV/AIDS pharmaceutical supply chain management (SCM) sector in Nigeria? (Please select what applies).

a. Less than 3 years…….

b. 3-6 years…….

c. 7-10 years…….

d. More than 10 years……

2. At what level(s) of the pharmaceutical SCM space have you worked? (Select all that may apply).

a. Health facility……

b. Local Government Area….

c. State….

d. National….

e. International….

f. Others, please specify…….

3. In which part of Nigeria are you working currently on HIV/AIDS pharmaceutical SCM? (Select)

a. Northern Nigeria

b. Southern Nigeria

c. Federal Capital Territory (FCT)

4. Which of the following type of organization is your main employer currently? (Select the entity).

a. Government…

b. Non-Governmental Organization….

c. Donor agencies…

d. Private sector…

e. Others, please specify……

5. What is your current role in the pharmaceutical supply chain with your organization? (Select all that apply)

a. Serving clients……

b. Product selection……

c. Quantification & Procurement…….

d. Warehousing and Distribution……

e. Logistics Management Information System…….

f. Monitoring and Evaluation…….

g. Others, please specify…….

B. Product Selection

Product selection is the process of choosing the name, strength, formulation, pack size and other characteristics of HIV/AIDS product(s) required for service delivery. The products are used to meet specific health needs of the target population in an identified location.

How important are the following potential barriers to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for **antiretroviral drugs** in Nigeria today on **product selection**?

Please select "Very important = 5" or "Important = 4" or "Moderately Important = 3" or "Slightly Important = 2" or "Not Important = 1" in the Nigeria Pharmaceutical SCM of today. Select "don't know = 0" if you are not sure.

Serial Number	Barriers	1	2	3	4	5	0
1	New ARVs are not included in the national standard treatment guidelines						
2	National standard treatment guidelines for ARVs are not distributed to health workers						
3	Poor reporting of adverse drug reactions to new ARVs to the National Regulatory Authority						
4	Lack of funding to procure new ARVs						
5	Cost to procure new ARVs						
6	Others (please add below)						
7							
8							
9							

How important are the following potential solutions to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for **ARVs** in Nigeria today on **product selection**?

Please select "Very important = 5" or "Important = 4" or "Moderately Important = 3" or "Slightly Important = 2" or "Not Important = 1" in the Nigeria Pharmaceutical SCM of today. Select "don't know = 0" if you are not sure.

Serial Number	Solutions	1	2	3	4	5	0
1	Annual revision of the national standard treatment guidelines (STG) on ARVs						
2	Prompt dissemination of STG on ARVs to health workers across the country						
3	Prompt reporting of adverse drug reaction on ARVs to national regulatory						

	authority						
4	Increased funding from Government at all Levels to support procurement of new ARVs						
5	Decreased cost of new ARVs by manufacturer						
6	Others (please add below)						
7							
8							
9							

C. Quantification and Procurement

Quantification: Is an ongoing process of estimating the HIV/AIDS product quantities and funding needs of a program over an identified period in the future to ensure uninterrupted supply of products to the health service providers and clients.

How important are the following potential barriers to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for **ARVs** in Nigeria today on **quantification**?

Please select "Very important = 5" or "Important = 4" or "Moderately Important = 3" or "Slightly Important = 2" or "Not Important = 1" in the Nigeria Pharmaceutical SCM of today. Select "don't know = 0" if you are not sure.

Serial Number	Barriers	1	2	3	4	5	0
1	Inaccurate ARVs SCM data used for quantification						
2	Limited human resource capability in Nigeria to conduct ARVs quantification exercise						
3	ARVs quantification information not provided in a timely manner to help with **Government** procurement decisions						
4	ARVs quantification information not provided in a timely manner to help with **Donors** procurement decisions						
5	Inadequate funding to purchase ARVs needs identified during quantification						
6	Limited use of ARVs quantification result to inform procurement within Government system						
7	Others (please add below)						
8							
9							

How important are the following potential solutions to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for **ARVs** in Nigeria today on **quantification**?

Please select "Very important = 5" or "Important = 4" or "Moderately Important = 3" or "Slightly Important = 2" or "Not Important = 1" in the Nigeria Pharmaceutical SCM of today. Select "don't know = 0" if you are not sure.

Serial Number	Solutions	1	2	3	4	5	0
1	Provision of accurate ARVs SCM data for quantification exercise						
2	Training of Nigerians on ARVs quantification processes and tools						
3	Prompt dissemination of ARVs quantification results within a defined period to the **Government**						
4	Prompt dissemination of ARVs quantification results within a defined period to **the Donors**						
5	Prompt mobilization of funds required to procure ARVs from the result of quantification exercise						
6	Use of ARVs quantification results to inform procurement within **Government** system						
7	Use of ARVs quantification results to inform procurement within **Donor** agencies						
8	Others (please add below)						
9							

D. Warehousing and distribution

Warehousing & Distribution: the processes of receiving, storing and managing the HIV/AIDS products that have been procured under appropriate conditions and transporting the product, under appropriate conditions, to service delivery points where they are needed to provide health services to the clients.

How important are the following potential barriers to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for ARVs in Nigeria today on **warehousing and distribution**?

Please select "Very important = 5" or "Important = 4" or "Moderately Important = 3" or "Slightly Important = 2" or "Not Important = 1" in the Nigeria Pharmaceutical SCM of today. Select "don't know = 0" if you are not sure.

Serial Number	Barriers	1	2	3	4	5	0
1	Inadequate pharmaceutical-grade warehouses for ARVs						
2	Delays in pick-and-pack (packaging and labeling of products for each clinic) of ARVs at the warehouses						
3	Failure to follow the first-to-expire first-out guidelines in managing ARVs						
4	Late delivery of ARVs to clinics						
5	Poor vehicular access road to clinics						
6	Others (please add below)						
7							
8							
9							

How important are the following potential solutions to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for ARVs in Nigeria on **warehousing and distribution**?

Please select "Very important = 5" or "Important = 4" or "Moderately Important = 3" or "Slightly Important = 2" or "Not Important = 1" in the Nigeria Pharmaceutical SCM of today. Select "don't know = 0" if you are not sure.

Serial Number	Solutions	1	2	3	4	5	0
1	Increase in number and sizes of pharmaceutical-grade warehouses for managing ARVs						
2	Automation of warehouse management system for pick-and-pack of ARVs						
3	Implementation of the first-to-expire first-out guidelines						
4	Engagement of more private sector delivery agents						
5	Use of different vehicle types to access remote clinics						
6	Others (please add below)						

7							
8							
9							

E. Serving clients

Serving clients refers to the processes of health service delivery by the health worker(s) to the clients at the service delivery points using HIV/AIDS products.

How important are the following potential barriers to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for **ARVs** in Nigeria today on **serving clients**?

Please select "Very important = 5" or "Important = 4" or "Moderately Important = 3" or "Slightly Important = 2" or "Not Important = 1" in the Nigeria Pharmaceutical SCM of today. Select "don't know = 0" if you are not sure.

Serial Number	Barriers	1	2	3	4	5	0
1	Unavailability of ARVs in the clinics						
2	Limited human resources for ARVs dispensing in clinics						
3	Non-adherence to ARVs national standard treatment guidelines						
4	Increasing expiries of ARVs at clinics						
5	Limited storage space at clinics for ARVs						
6	Others (please add below)						
7							
8							
9							

How important are the following potential solutions to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for **ARVs** in Nigeria today on serving clients?

Please select "Very important = 5" or "Important = 4" or "Moderately Important = 3" or "Slightly Important = 2" or "Not Important = 1" in the Nigeria Pharmaceutical SCM of today. Select "don't know = 0" if you are not sure.

Serial Number	Solution	1	2	3	4	5	0
1	Increased quantity of ARVs supplied to clinics at single delivery						
2	Training and task-shifting to increase number of health workers that can manage ARVs in clinics						
3	Increased adherence to ARVs standard treatment guidelines						
4	Practicing first-to-expire first-out						

	guideline in dispensing ARVs						
5	Refurbishment of ARVs storage space at clinics						
6	Others (please add below)						
7							
8							
9							

F. Logistics management information system (LMIS)

LMIS refers to systems and process for collecting, collating, submitting and using logistic data from the clinics to a higher level in the system for decision-making.

How important are the following potential barriers to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for ARVs in Nigeria today on **LMIS**?

Please select "Very important = 5" or "Important = 4" or "Moderately Important = 3" or "Slightly Important = 2" or "Not Important = 1" in the Nigeria Pharmaceutical SCM of today. Select "don't know = 0" if you are not sure.

Serial Number	Barriers	1	2	3	4	5	0
1	Poor SCM record keeping practices on ARVs consumption						
2	Unavailability of SCM tools for ARVs record keeping (e.g. daily consumption register, inventory control card)						
3	Late submission of ARVs SCM data to higher level						
4	Inaccurate ARVs SCM data for decision-making						
5	Inadequate infrastructures for ARVs SCM data submission (e.g. computer, internet)						
6	Others (please add below)						
7							
8							
9							

How important are the following potential solutions to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for **ARVs** in Nigeria today on **LMIS**?

Please select “Very important = 5” or “Important = 4” or “Moderately Important = 3” or “Slightly Important = 2” or “Not Important = 1” in the Nigeria Pharmaceutical SCM of today. Select “don’t know = 0” if you are not sure.

Serial Number	Solution	1	2	3	4	5	0
1	Clinic staff accountability on accurate and timely ARVs record keeping						
2	Provision of SCM tools for ARVs record keeping						
3	Timely submission of ARVs SCM data						
4	Use of accurate ARVs SCM data for decision-making						
5	Provision of infrastructures for ARVs SCM data submission (e.g. computer, internet)						
6	Others (please add below)						
7							
8							
9							

G. Leadership and systems support

Leadership and system support refers to the internal and external support required by the public-sector pharmaceutical SCM for from different stakeholders that are working within and outside the system to ensure there are no disruptions in the system for an uninterrupted flow of **antiretroviral drugs** from the manufacturers to the clinics. The logistics management coordinating unit (LMCU) at the state level and National Product Supply Management Program (NPSCMP) at the national level provide governance structures to support public-sector HIV pharmaceutical SCM system. The Procurement and Supply Management Technical Working Group (PSM-TWG) meetings serves as coordination forum for the NPSCMP and LMCU to engage with donors and implementing organizations at the national and state levels respectively on public-sector pharmaceutical SCM.

How important are the following potential barriers to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for **ARVs** in Nigeria today on **leadership and systems support**?

Please select “Very important = 5” or “Important = 4” or “Moderately Important = 3” or “Slightly Important = 2” or “Not Important = 1” in the Nigeria Pharmaceutical SCM of today. Select “don’t know = 0” if you are not sure.

Serial Number	Barriers	1	2	3	4	5	0
1	Unclear scope of work for LMCU						
2	Unclear scope of work for NPSCMP						

3	Inadequate funding to support LMCU task						
4	Inadequate procedures to account for **ARVs** in the public-sector HIV pharmaceutical SCM						
5	Ineffective procurement and supply management technical working group (PSM-TWG) meetings						
6	Unplanned changes in SCM within a short period						
7	Others (please add below)						
8							
9							

How important are the following potential solutions to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for ARVs in Nigeria today on **leadership and systems support**?

Please select "Very important = 5" or "Important = 4" or "Moderately Important = 3" or "Slightly Important = 2" or "Not Important = 1" in the Nigeria Pharmaceutical SCM of today. Select "don't know = 0" if you are not sure.

Serial Number	Solutions	1	2	3	4	5	0
1	Development of clear scope of work for LMCU						
2	Development of clear scope of work for NPSCMP						
3	Provision of funding to support LMCU task						
4	Establishment of accountability and supervisory framework for HIV SCM resources						
5	Structured and effective PSM TWG meetings						
6	Development of framework for SCM system modifications						
7	Others (please add below)						
8							
9							

H. System disruption

Please answer the following questions. If the spaces provided are not sufficient, please add an attachment as needed.

1. Consider one incident of pharmaceutical system disruption for **antiretroviral drugs** supplies within the last 12 months (including stock-out) or any other significant disruption to effectiveness or efficiency of the system. What was/were one or two of the main causes of this disruption, in your opinion? Please describe these causes in some detail

2. What is/are one or two of the most important steps you would recommend to prevent the disruption of pharmaceutical SCM for **antiretroviral drugs** in future? Please describe these steps in some detail.

Thank you so much for your time in completing this survey.

APPENDIX 3: SURVEY QUESTIONNAIRES (HIV RAPID TEST KITS)

Exploring structural and systemic improvements for effective and efficient pharmaceutical supply chain management for HIV/AIDS in Nigeria

Survey Questionnaires

Survey Instrument Number…….

Introduction

Please take 30 minutes to complete this survey

This survey is being conducted as part of the Doctor of Public Health (DrPH) degree dissertation in the University of North Carolina at Chapel Hill, NC USA. The survey is focused on exploring the structural and systemic improvements for an effective and efficient public-sector pharmaceutical supply chain system (SCM) for HIV/AIDS service delivery in Nigeria, with a focus on the 'Six Rights' of a logistics system. These 'Six Rights' refers to the right product being available in the right quantity, and in the right condition, at the right place, in the right time and at the right cost. The HIV/AIDS products referred to in this survey are **HIV Rapid Test kits (RTKs).** The survey will seek for your opinion on HIV/AIDS pharmaceutical supply chain management improvements. Improvements may also include adoptions of external models from elsewhere and/or process improvements within the current system to promote effectiveness and efficiency of the pharmaceutical system for HIV/AIDS system in Nigeria. Your opinions are confidential and cannot to be linked to you. All responses are anonymous; hence respondents cannot be identified as the questionnaire will be tagged with serial number in the space provided above. ***You may submit the completed survey electronically via qualtrics or e-mail or return it in hard copy in a sealed envelope for confidentiality***. For questions please contact; Innocent Ibegbunam innoibe@live.unc.edu Phone +234-803-5030-619 or Prof Pam Silberman, pam_silberman@unc.edu

Instructions

v. Please select an option(s) to indicate your opinion to the statement under each section.

vi. Provide text in the box to give other thoughts on barriers to or potential solutions to specific pharmaceutical SCM best practices as noted in the question.

vii. You may also use additional attachments if the provided space is not sufficient to address your point.

viii. Kindly share any available material(s) or references to further support your opinion.

A. Background

This section covers background information on your experience, role and organization as part of the pharmaceutical supply chain management for HIV/AIDS program in Nigeria.

1. How long have you worked within the HIV/AIDS pharmaceutical supply chain management (SCM) sector in Nigeria? (Please select what applies).

e. Less than 3 years…….

f. 3-6 years…….

g. 7-10 years…….

h. More than 10 years……

2. At what level(s) of the pharmaceutical SCM space have you worked? (Select all that may apply).

g. Health facility……

h. Local Government Area….

i. State….

j. National….

k. International….

l. Others, please specify…….

3. In which part of Nigeria are you working currently on HIV/AIDS pharmaceutical SCM? (Select)

I. Northern Nigeria

J. Southern Nigeria

K. Federal Capital Territory (FCT)

4. Which of the following type of organization is your main employer currently? (Select the entity).

f. Government…

g. Non-Governmental Organization….

h. Donor agencies…

i. Private sector…

j. Others, please specify……

5. What is your current role in the pharmaceutical supply chain with your organization? (Select all that apply)

h. Serving clients……

i. Product selection……

j. Quantification & Procurement…….

k. Warehousing and Distribution……

l. Logistics Management Information System…….

m. Monitoring and Evaluation…….

n. Others, please specify…….

B. Product Selection

Product selection is the process of choosing the name, strength, formulation, pack size and other characteristics of HIV/AIDS product(s) required for service delivery. The products are used to meet specific health needs of the target population in an identified location.

How important are the following potential barriers to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for **HIV Rapid Test kits (RTKs)** in Nigeria today on **product selection**?

Please select "Very important = 5" or "Important = 4" or "Moderately Important = 3" or "Slightly Important = 2" or "Not Important = 1" in the Nigeria Pharmaceutical SCM of today. Select "don't know = 0" if you are not sure.

Serial Number	Barriers	1	2	3	4	5	0
1	New RTKs are not included in the national HIV testing algorithm						
2	National HIV Testing algorithm for RTKs are not distributed to health workers						
3	Poor reporting of failed quality controls with new RTKs to the National Regulatory Authority						
4	Lack of funding to procure new RTKs						
5	Cost to procure new RTKs						
6	Others (please add below)						
7							
8							
9							

How important are the following potential solutions to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for **RTKs** in Nigeria today on **product selection**?

Please select "Very important = 5" or "Important = 4" or "Moderately Important = 3" or "Slightly Important = 2" or "Not Important = 1" in the Nigeria Pharmaceutical SCM of today. Select "don't know = 0" if you are not sure.

Serial Number	Solutions	1	2	3	4	5	0
1	Biennial review of national HIV testing algorithm for RTKs						
2	Prompt dissemination of RTKs testing algorithm to health workers across the country						
3	Prompt reporting failed quality control tests RTKs to national regulatory authority						
4	Increased funding from Government at						

	all Levels to support procurement of new RTKs						
5	Decreased cost of new RTKs by manufacturer						
6	Others (please add below)						
7							
8							
9							

C. Quantification and Procurement

Quantification: Is an ongoing process of estimating the HIV/AIDS product quantities and funding needs of a program over an identified period in the future to ensure uninterrupted supply of products to the health service providers and clients.

How important are the following potential barriers to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for **RTKs** in Nigeria today on **quantification**?

Please select "Very important = 5" or "Important = 4" or "Moderately Important = 3" or "Slightly Important = 2" or "Not Important = 1" in the Nigeria Pharmaceutical SCM of today. Select "don't know = 0" if you are not sure.

Serial Number	Barriers	1	2	3	4	5	0
1	Inaccurate RTKs SCM data used for quantification						
2	Limited human resource capability in Nigeria to conduct RTKs quantification exercise						
3	RTKs quantification information not provided in a timely manner to help with **Government** procurement decisions						
4	RTKs quantification information not provided in a timely manner to help with **Donors** procurement decisions						
5	Inadequate funding to purchase RTKs needs identified during quantification						
6	Limited use of RTKs quantification result to inform procurement within Government system						
7	Others (please add below)						
8							
9							

How important are the following potential solutions to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for **RTKs** in Nigeria today on **quantification**?

Please select "Very important = 5" or "Important = 4" or "Moderately Important = 3" or "Slightly Important = 2" or "Not Important = 1" in the Nigeria Pharmaceutical SCM of today. Select "don't know = 0" if you are not sure.

Serial Number	Solutions	1	2	3	4	5	0
1	Provision of accurate RTKs SCM data for quantification exercise						
2	Training of Nigerians on RTKs quantification processes and tools						
3	Prompt dissemination of RTKs quantification results within a defined period to the **Government**						
4	Prompt dissemination of RTKs quantification results within a defined period to **the Donors**						
5	Prompt mobilization of funds required to procure RTKs from the result of quantification exercise						
6	Use of RTKs quantification results to inform procurement within **Government** system						
7	Use of RTKs quantification results to inform procurement within **Donor** agencies						
8	Others (please add below)						
9							

D. Warehousing and distribution

Warehousing & Distribution: the processes of receiving, storing and managing the HIV/AIDS products that have been procured under appropriate conditions and transporting the product, under appropriate conditions, to service delivery points where they are needed to provide health services to the clients.

How important are the following potential barriers to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for RTKs in Nigeria today on **warehousing and distribution**?

Please select "Very important = 5" or "Important = 4" or "Moderately Important = 3" or "Slightly Important = 2" or "Not Important = 1" in the Nigeria Pharmaceutical SCM of today. Select "don't know = 0" if you are not sure.

Serial	Barriers	1	2	3	4	5	0

Number							
1	Inadequate pharmaceutical-grade warehouses for RTKs						
2	Delays in pick-and-pack (packaging and labeling of products for each clinic) of RTKs at the warehouses						
3	Failure to follow the first-to-expire first-out guidelines in managing RTKs						
4	Late delivery of RTKs to clinics						
5	Poor vehicular access road to clinics						
6	Others (please add below)						
7							
8							
9							

How important are the following potential solutions to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for RTKs in Nigeria on **warehousing and distribution**?

Please select "Very important = 5" or "Important = 4" or "Moderately Important = 3" or "Slightly Important = 2" or "Not Important = 1" in the Nigeria Pharmaceutical SCM of today. Select "don't know = 0" if you are not sure.

Serial Number	Solutions	1	2	3	4	5	0
1	Increase in number and sizes of pharmaceutical-grade warehouses for managing RTKs						
2	Automation of warehouse management system for pick-and-pack of RTKs						
3	Implementation of the first-to-expire first-out guidelines						
4	Engagement of more private sector delivery agents						
5	Use of different vehicle types to access remote clinics						
6	Others (please add below)						
7							
8							
9							

E. Serving clients

Serving clients refers to the processes of health service delivery by the health worker(s) to the clients at the service delivery points using HIV/AIDS products.

How important are the following potential barriers to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for **RTKs** in Nigeria today on **serving clients**?

Please select "Very important = 5" or "Important = 4" or "Moderately Important = 3" or "Slightly Important = 2" or "Not Important = 1" in the Nigeria Pharmaceutical SCM of today. Select "don't know = 0" if you are not sure.

Serial Number	Barriers	1	2	3	4	5	0
1	Unavailability of RTKs in the clinics						
2	Limited human resources for HIV screening using RTK in clinics						
3	Non-adherence to RTKs national testing algorithm						
4	Increasing expiries of RTKs at clinics						
5	Limited storage space at clinics for RTKs						
6	Others (please add below)						
7							
8							
9							

How important are the following potential solutions to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for **RTKs** in Nigeria today on serving clients?

Please select "Very important = 5" or "Important = 4" or "Moderately Important = 3" or "Slightly Important = 2" or "Not Important = 1" in the Nigeria Pharmaceutical SCM of today. Select "don't know = 0" if you are not sure.

Serial Number	Solution	1	2	3	4	5	0
1	Increased quantity of RTKs supplied to clinics at single delivery						
2	Training and task-shifting to increase number of health workers that can manage RTKs in clinics						
3	Increased adherence to RTKs national testing algorithm						
4	Practicing first-to-expire first-out guideline in utilizing RTKs						
5	Refurbishment of RTKs storage space at clinics						
6	Others (please add below)						
7							
8							
9							

F. Logistics Management Information System (LMIS)

LMIS refers to systems and process for collecting, collating, submitting and using logistic data from the clinics to a higher level in the system for decision-making.

How important are the following potential barriers to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for RTKs in Nigeria today on **LMIS**?

Please select "Very important = 5" or "Important = 4" or "Moderately Important = 3" or "Slightly Important = 2" or "Not Important = 1" in the Nigeria Pharmaceutical SCM of today. Select "don't know = 0" if you are not sure.

Serial Number	Barrier	1	2	3	4	5	0
1	Poor SCM record keeping practices on RTKs utilization						
2	Unavailability of SCM tools for RTKs record keeping (e.g. daily utilization register, inventory control card)						
3	Late submission of RTKs SCM data to higher level						
4	Inaccurate RTKs SCM data for decision-making						
5	Inadequate infrastructures for RTKs SCM data submission (e.g. computer, internet)						
6	Others (please add below)						
7							
8							
9							

How important are the following potential solutions to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for **RTKs** in Nigeria today on **LMIS**?

Please select "Very important = 5" or "Important = 4" or "Moderately Important = 3" or "Slightly Important = 2" or "Not Important = 1" in the Nigeria Pharmaceutical SCM of today. Select "don't know = 0" if you are not sure.

Serial Number	Solution	1	2	3	4	5	0
1	Clinic staff accountability on accurate and timely RTKs record keeping						
2	Provision of SCM tools for RTKs record keeping						

3	Timely submission of RTKs SCM data						
4	Use of accurate RTKs SCM data for decision-making						
5	Provision of infrastructures for RTKs SCM data submission (e.g. computer, internet)						
6	Others (please add below)						
7							
8							
9							

G. Leadership and systems support

Leadership and system support refers to the internal and external support required by the public-sector pharmaceutical SCM for from different stakeholders that are working within and outside the system to ensure there are no disruptions in the system for an uninterrupted flow of **HIV rapid test kits** from the manufacturers to the clinics. The logistics management coordinating unit (LMCU) at the state level and National Product Supply Management Program (NPSCMP) at the national level provide governance structures to support public-sector HIV pharmaceutical SCM system. The Procurement and Supply Management Technical Working Group (PSM-TWG) meetings serves as coordination forum for the NPSCMP and LMCU to engage with donors and implementing organizations at the national and state levels respectively on public-sector pharmaceutical SCM.

How important are the following potential barriers to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for **RTKs** in Nigeria today on **leadership and systems support**?

Please select “Very important = 5” or “Important = 4” or “Moderately Important = 3” or “Slightly Important = 2” or “Not Important = 1” in the Nigeria Pharmaceutical SCM of today. Select “don’t know = 0” if you are not sure.

Serial Number	Barrier	1	2	3	4	5	0
1	Unclear scope of work for LMCU						
2	Unclear scope of work for NPSCMP						
3	Inadequate funding to support LMCU task						
4	Inadequate procedures to account for **RTKs** in the public-sector HIV pharmaceutical SCM						
5	Ineffective procurement and supply management technical working group (PSM-TWG) meetings						
6	Unplanned changes in SCM within a short period						
7	Others (please add below)						

8							
9							

How important are the following potential solutions to the effective and efficient operation of the current public-sector HIV pharmaceutical SCM system for RTKs in Nigeria today on **leadership and systems support**?

Please select "Very important = 5" or "Important = 4" or "Moderately Important = 3" or "Slightly Important = 2" or "Not Important = 1" in the Nigeria Pharmaceutical SCM of today. Select "don't know = 0" if you are not sure.

Serial Number	Solution	1	2	3	4	5	0
1	Development of clear scope of work for LMCU						
2	Development of clear scope of work for NPSCMP						
3	Provision of funding to support LMCU task						
4	Establishment of accountability and supervisory framework for HIV SCM resources						
5	Structured and effective PSM TWG meetings						
6	Development of framework for SCM system modifications						
7	Others (please add below)						
8							
9							

H. System disruption

Please answer the following questions. If the spaces provided are not sufficient, please add an attachment as needed.

3. Consider one incident of pharmaceutical system disruption for **HIV rapid test kits** supplies within the last 12 months (including stock-out) or any other significant disruption to effectiveness or efficiency of the system. What was/were one or two of the main causes of this disruption, in your opinion? Please describe these causes in some detail

4. What is/are one or two of the most important steps you would recommend to prevent the disruption of pharmaceutical SCM for **HIV rapid test kits** in future? Please describe these steps in some detail.

Thank you so much for your time in completing this survey.

APPENDIX 4: KEY INFORMANT INTERVIEW GUIDE

Key informant interview Questions

Introduction

The purpose of this interview is to inform policy recommendations for promoting a sustainable pharmaceutical and laboratory supply chain management system for HIV/AIDS service delivery in Nigeria as part of a doctoral dissertation. The interview follows a survey I conducted in November/December 2017 among some key stakeholders in Nigeria supporting HIV/AIDS pharmaceutical and laboratory supply chain management (SCM). In total, I received responses from 45 persons in the ARV supply chain, and 21 persons in the RTKs supply chain system. The survey was to understand the barriers and solutions for an effective and efficient SCM system that covers the six-components of the supply chain system including: product selection, quantification, warehousing and distribution, logistics management information system, client services, and leadership and systems support. The key informant interview is to identify workable solutions to the problems identified by the respondents. I have sent you a summary of their responses in advance and hope you had a chance to look at the document before this interview.

The interviews will take about 45 to 60 minutes. The interviews will be confidential and information collected through this process will only be used for completion of a doctoral dissertation. Your identity will remain completely anonymous and the information you provide will not in any way be associated with you. I request your permission to tape-record this interview to enable be capture your views accurately.

Before we proceed, are there any questions that you have about the study, this interview or any clarifications?

Do I have your permission to start recording the interview?

General overview

First, I will like to get some information about your role in the Nigeria HIV/AIDS supply chain management (SCM) system;

How long have you worked in the HIV/AIDS pharmaceutical and laboratory SCM in Nigeria and what is (was) your role?

What is your overall assessment of the current pharmaceutical and laboratory SCM for HIV/AIDS service delivery in Nigeria?

Product selection: In general, respondents for both the ARVs and RTKs supply chain system thought that the major barriers were the failure to promptly distribute new testing algorithms or treatment guidelines to health workers, and the failure of people at the local level to promptly report quality problems (either failed quality controls for RTKs, or adverse drug reactions) to the National Regulatory Authority.

What do you think are the major constraints to improve product selection in HIV/AIDS SCM? To what extent do you think the identified barriers affect the quality of HIV product selection?

What systems could be put in place to address these problems? (Dissemination of guidelines and reporting of quality problems to the authorities, stakeholder's engagement at the clinics, as well as any new issues the respondent raised).

Quantification and Procurement: In general, respondents identified problems with inaccurate data being used or data not being used to inform procurement within the Government system, and that quantification information is not provided in a timely manner to help donors with their procurement decisions.

In your opinion what do you think are the constraints to improve quantification and procurement in the HIV/AIDS SCM? To what extent do you think the identified barriers affects information for procurement decisions within Government and Donor systems?

What systems could be put in place to address these problems? (Inaccurate data being used for quantification, information not provided timely for decision making, and any new issues the respondent raised).

Warehousing and Distribution: Most of the respondents identified late delivery of ARVs and RTKs to the clinics and expiry of products as major barriers often due to poor vehicular access road along with limited pharmaceutical-grade warehouses to manage the supply chain. Ineffective communication and lack of real-time monitoring of distribution were also identified as barriers.

What do you think are the constraints to improve warehousing and distribution for HIV/AIDS SCM system? To what extent do you think identified barriers affect warehousing and distribution?

What systems could be put in place to address these problems? (Late deliveries, limited pharmaceutical-grade warehouse, ineffective communication and any new issues the respondent raised).

Logistics Management Information System (LMIS): The unavailability of logistics tools and poor record keeping practices were identified by most of the respondents as barriers to the supply chain system. This often results in late submission of reports due to lack infrastructural support.

What do you think are the major constraints to improve logistics management information system for the HIV/AIDS SCM? To what extent do the identified barriers affect LMIS?

What systems could be put in place to address these problems? (Unavailability of logistics tools, poor record keeping practices, late submission of reports due to lack of infrastructural support and any new issues the respondent raised).

Serving the clients: Most of the respondents identified unavailability of both RTKs and ARVs as primary barrier to service delivery to clients. This is often due to lack of storage space to keep more supplies in the clinics and limited human resources to appropriately document utilization.

In your opinion what do you think are constraints to improve serving clients in HIV/AIDS SCM? To what extent do you think product unavailability affects serving clients?

What systems could be put in place these problems? (unavailability of product, limited storage space, limited human resources and any new issues the respondent raised)

Leadership and System Support: Inadequate funding and limited supervisory and accountability framework were identified as barriers under leadership system for the logistics management coordinating unit (LMCU). Also identified is frequent and unplanned changes to the HIV/AIDS SCM.

In your opinion what do you think are constraints to improve leadership and system support for the HIV/AIDS SCM? To what extent do you think inadequate funding, limited supervisory and accountability framework affects leadership and systems support?

What systems could be put in place to address these problems? (inadequate funding and limited supervisory and accountability framework, frequent and unplanned changes to HIV/AIDS SCM and any new issues the respondent raised)

Do you think the current policy and guidelines for HIV/AIDS supply chain management is adequate for an effective and efficient supply chain management? If yes, how so? If No, what policy changes can be made for an effective and efficient SCM?

Conclusion

Considering barriers to the implementation of previous recommendations to improve the HIV/AIDS supply chain system, what do you think should be done differently for a sustainable implementation of the new recommendations in the short-term, medium-term and long-term?

Which recommendation should be top priority to improve the system? Please explain.

What other factor(s) in the environment may be considered essential to improve the overall HIV/AIDS supply chain management to ensure uninterrupted availability of needed products for service delivery?

Is there anything else you want to add about strategies to improve the HIV/AIDS supply chain?

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