Texila International Journal of Academic research
ISSN: 2520-3088
DOI: 10.21522/TIJAR.2014.07.02.Art011

Assessment of Knowledge of Essential Supply Chain Functions among HIV/AIDS Supply Chain Workforce in Nigeria

Sunday O Aguora[1]*, Azuka C Oparah[2], Edith C Okechukwu[3]
[1, 3]*School of Public Health, Texila American University, Georgetown, Guyana, South America*
[2]*Department of Pharmacy and Pharmacy Practice, Faculty of Pharmacy, University of Benin, Benin City, Nigeria*
**Corresponding Author: sunnyaguora@yahoo.com[1]*

Abstract

This study on assessment of knowledge of essential supply chain functions among HIV/AIDS supply chain workforce in Nigeria comprised of research objectives, questions and hypothesis. A pre-tested self-completed structured questionnaire (422) was administered to respondents, 396 were completed and returned, with a response rate of (93.8%). The respondents had received previous trainings and knowledge distribution of essential supply chain functions showed good knowledge in serving customers (84.8%), procurement (82.6%), logistics management information system (78.8%), monitoring and evaluation (77.5%) and product selection (71.0%)) and capacity gaps in inventory strategy (48.7%), warehouse and distribution (48.0%), quantification (44.2%) and risk management (33.3%). The study revealed knowledge gaps in essential supply chain functions such as inventory strategy, warehouse and distribution, quantification and risk management among HIV/AIDS supply chain workforce. A reliability analysis was carried out on knowledge level of essential supply chain functions, Cronbach's alpha showed the questionnaire to reach acceptable reliability, $\alpha = 0.925$. Chi-square statistic revealed that knowledge of essential supply chain functions is a significant factor of HIV/AIDS supply chain workforce capacity ($p<0.05$). There is need to strengthen HIV/AIDS workforce capacity in the areas they are deficient to ensure effective provision of service and improved health outcomes.

Keywords: *HIV/AIDS, supply chain workforce, knowledge, supply chain functions.*

Introduction

Human resources have been noted as the most important part of a functional health system (WHO, 2000), and development of skilled workforce contributes to health systems strengthening (Schneider *et al*., 2011). Health systems strengthening (HSS) is vital to achieving health-related Sustainable Development Goals (SDGs) and improved health outcomes (Leatherman *et al*., 2010; Frenk, 2010; Fowkes *et al*., 2016). There is a growing concern that without urgent improvements in the performance of health systems, the health-related Sustainable Development Goals will not be achieved because of lack of skilled human resources for health. It follows therefore that health systems that function well usually are staffed with adequate human resources possessing the right skills and motivation. Thus, the need for a well-trained and competent workforce, knowledgeable on essential supply chain functions to be engaged in HIV/AIDS supply chain management. Human resources are recognized as a key performance driver within supply chains (Brown and Sankaranarayanan, 2014). Therefore, skilled workforce is essential for sustained progress in HIV/AIDS supply chain management in Nigeria. It is important to ensure existing workforce are well trained and given adequate mix of skills. The supply chain workforces are true lifesavers and improving the quality of HIV/AIDS supply chain workforce is vital. To ensure sustainable supply chain, a network of supply chain professionals with broad and vastly specialized expertise needs to be developed (Brown and Sankaranarayanan, 2014). Every cadre of supply chain workforce at every step till the last mile of the supply chain should be adequately trained such that only experts would deliver their task in a professional manner (UNICEF, 2014). Workforce knowledge is key for sustained progress in health supply chains and sustainable development (Brown and Sankaranarayanan, 2014).

Therefore, the present study seeks to assess knowledge of essential supply chain functions among HIV/AIDS supply chain workforce in Nigeria.

Materials and Methods

Selection of the area

The study was carried out in Abuja, the administrative and political centre of Nigeria. Abuja is the centre for policy development, coordination and monitoring of implementation of HIV/AIDS supply chain activities. It has boundary with four states; Kaduna state (north), Niger state (west), Nassarawa state (east) and Kogi state (south) (Ebele *et al*., 2014). Abuja also serves as headquarter of many of the HIV/AIDS organizations from where they carry out their HIV/AIDS supply chain functions around the country.

Sample size determination

Cochran's formula ($n_0 = z^2pq/e^2$) for calculating representative sample size for infinite population was used (Cochran, 1977).

n_0 = sample size

z = 1.96 (selected critical value of desired confidence level)

p = 0.5 (assuming the maximum variability, which is equal to 50%)

q = 1- p

e = 0.05 (±5% desired level of precision at 95% confidence level)

$n_0 = (1.96)^2(0.5)\ (0.5)/\ (0.05)^2$

$n_0 = 384.16$

To ensure minimum response rate, 10% overage was added to the calculated sample size to accommodate possible drop out, non-response, incomplete response and late response.

Sampling technique

Respondents (422) from public sector, private sector, non-governmental organization, faith-based organization and donor agency involved in HIV/AIDS supply chain management without gender discrimination were selected using random sampling technique. The study excluded those who had not spent up to two years in their respective organizations and obtained at least bachelor's degree qualification.

Data collection

Primary and secondary sources of data were used for the study. We used the secondary data for literature review and design of the questionnaire. The secondary data was collected from textbooks, journals and newspapers. The primary sources of data were those collected from the field through a structured self-completed questionnaire. The purpose of the study and questionnaire were explained to the participants and the consent of each participant was obtained before joining the study. Participants were free to withdraw at any point from the study without consequences. The identity of participants was kept anonymous and confidential by excluding their names and organizations in the questionnaire. The questionnaire had twenty-three (23) questions with which relevant information in the area of socio-demographic characteristics, areas of training and knowledge distribution on supply chain functions were obtained. The questionnaire required about 20 minutes to complete. We ensured construct validity by fashioning the questionnaire based on relevant literatures and empirical studies. To ensure content validity, the questionnaire was reviewed by the supervisor and pre-tested and modifications made based on the results of the review and pre-test. The survey was conducted between September and December 2019.

Data analysis

Returned questionnaires were checked for accuracy, completeness and consistency. Usable questionnaires were numbered serially and coded. Each questionnaire was captured on the excel template while ensuring the serial number on the hard copy of the questionnaire ties with the serial number on the excel template. The entries in the excel template were rechecked for accuracy before data analysis. Analysis of data was carried out with Statistical Package for Social Sciences (SPSS Version 20.0) and Chi-square statistic to determine the level of association at 5% level of significance ($p \leq 0.05$).

Results and Discussion

We administered 422 questionnaires, only 396 questionnaires were returned giving a response rate of 93.8%. Table (1) captured socio-demographic characteristics with age of most (96.0%) of the respondents between 30 and 59 years. Most of the respondents (69.4%) were male, with years of experience in HIV/AIDS supply chain between 4 and 15 years and more than half of the respondents had master's degree

as their highest educational qualification. Most of the respondents work at the national and state levels in the NGO and public sector with majority (74.2%) in the rank of manager, supervisor, specialist, advisor and officer. Table (2) captured the areas of previous trainings in supply chain functions, table (3) percentage frequency of knowledge level of supply chain functions, table (4) perception towards supply chain workforce capacity, table (5) Cronbach's alpha test scores and table (6) Chi square test.

The socio-demographic characteristics of the respondents (Table 1) showed that the respondents were drawn from all levels of the health sector with predominant respondents from national and state levels that drive supply chain policy development and implementation. It also entails stakeholders that have played key roles at the different levels and acknowledged supply chain as a key driver for successful HIV/AIDS program implementation. This is essential for development of competent and knowledgeable workforce needed for health supply chain success. The various stakeholders denote diverse perspectives, expertise and capacity to enable consensus, promoting national and local ownership for a sustainable strategy to improve HIV/AIDS supply chain performance. The respondents have substantial experience with good understanding of the supply chain management needs of the HIV/AIDS program, and can be trusted for reliable and valid results, thus guaranteeing credence and quality of the research outcomes. With more than half of the respondents with master's degree as their highest educational qualification it shows that the respondents have attained some level of skill which can be enhanced to promote effective and efficient supply chain functions. They have workable knowledge of good supply chain management. In the present study, the respondents had received training in the key supply chain functions (Table 2). This means that the respondents used in this study have basic background and knowledge required for their position.

The study revealed good knowledge in some supply chain functions (serving customers, product selection, procurement, logistics management information system and monitoring and evaluation) and capacity gaps in risk management, quantification, inventory strategy and warehousing and distribution (Table 3) and use of quantification results to inform procurement of HIV/AIDS products within government system at the national and state levels (Table 4). This finding supports existing body of knowledge; Matowe *et al.* (2008) reported limited skills on quantification, inventory strategy, ordering, receiving, storing and distribution, and TGF (2017) reported that supply chain management remains a significant challenge and interventions by donors (The Global Fund, PEPFAR, USAID, United Nations Agencies etc.) only resulted to improvement in procurement and getting the products into the country but do not address the challenges of quantification and getting the products to the intended beneficiaries. Itiola and Agu (2018) reported that requisite supply chain management skills and competencies are inadequate in the Nigeria public sector, whereas Matowe *et al*. (2008) observed that the weakness of health supply chains has remained a consistent barrier across a range of low- and middle- income countries. Therefore, effective supply chains are vital to deliver essential health commodities (Cometto *et al*., 2014) and weakness of supply chain functions increases the potential for the entry of counterfeit and substandard products (WHO Bulletin, 2010). On the other hand, Dowling (2011) reported that stock outs of essential commodities are common in many low- and middle-income countries, with a mean availability of core medicines in the public sector estimated between 38.2% in sub-Saharan Africa and 57.7 % in Latin America and the Caribbean. As a result of inadequate forecasting and information flow among stakeholder's stock outs of ARV drugs are common among health facilities in west and central Africa (UNICEF *et al*., 2008). A similar situation has been noted in east and southern Africa, where stock outs of ARVs and other life-saving drugs have also been a problem (Thom and Langa, 2010).

Notwithstanding past huge investment over the past decades, national supply chains are often unable to respond effectively to existing demands, putting health outcomes at risk (Brown *et al*., 2014). In a previous study, Waako *et al*. (2009) reported inadequate human resources capacity to select, quantify and distribute ARVs and related commodities as some of the problems in East African countries. Despite PEPFAR efforts to improve the capacity of partner country governments to quantify, forecast, procure,

warehouse, distribute, and track commodities, challenges to assuring consistent and reliable supply chain functioning remain in many countries (IOM, 2013). Reliable supply chain is critical for sustainable and cost-efficient HIV/AIDS responses as well as to avoid disruptions to the care and treatment of people living with HIV/AIDS (IOM, 2013).

Furthermore, this study (Table 4) revealed that skilled workforce is an important part of functional HIV/AIDS system, contributes to health systems strengthening and vital for improving health outcomes and achieving health-related Sustainable Development Goals. The result of this study is consistent with reports of previous studies (WHO, 2000; Leatherman *et al*., 2010; Frenk, 2010; Schneider *et al.*, 2011). It follows that supply chain workforce capacity should be developed to ensure availability of skills to provide quality health services (Matovu *et al*., 2013). Furthermore, for supply chains to run effectively, it requires dynamic workforce (which is the most important resource) at all levels who are motivated and possess the competencies required to fulfill essential supply chain functions.

Similarly, the study showed that there is shortage of manpower at the sub-national level and the country's current poor economic situation may not allow for personnel recruitment in the immediate future (Table 4). Supply chain workforce capacity gaps have been reported in low- and middle-income countries with some having vacancy rates of about 71% for public sector posts that would require accredited pharmaceutical training (WHO, 2011), often due to a combination of insufficient training as well as 100-150% higher wages in the private sector as compared to the public sector (Cometto *et al*., 2014). There is a rising need to address human resources capacity requirements for supply chain systems (Cometto *et al*., 2014) and investments in the health supply chain personnel will be worthwhile and effective strategy to improve the overall efficiency of health systems (Soucat and Scheffler, 2013). More so, workforce crisis due to brain drain poses enormous challenge in meeting the manpower capacity needs in the healthcare sector (Ike, 2007) and may hinder progress towards country ownership and sustainability. While there may be adequate capacity in the private sector, available human resource in the Nigerian public sector is inadequate and do not have requisite supply chain skills and competencies (Itiola and Agu, 2018). It is well-known that the global problem of insufficient and adequately trained human resources for health is most critical in sub-Saharan Africa with alarming health workforce crisis (Anywangwe and Mtonga, 2007). In a previous work, Frenk (2010) reported workforce shortage as the most complex challenges of health systems strengthening. Matovu *et al*. (2011) recognized workforce shortage as significant constraint in achieving the SDGs. Inadequate human resource for health is an important global problem in Sub-Saharan Africa (Anywangwe and Mtonga, 2007). In another study, Adekola and Adelanwa (2014) reported human resource crisis in all areas of the health system and cadres including the HIV/AIDS supply chain workforce in Nigeria.

A number of reasons have been provided for the human resource shortage; chronic underinvestment in human resources (IOM, 2011), frozen recruitment and salaries (IOM, 2011), restricted public budgets (IOM, 2011), higher turnover of health workforce (IOM, 2011), insufficient compensation (Oleribe *et al*., 2016), harsh working conditions (Oleribe *et al*., 2016), high burden of HIV and AIDS (Mazibuko *et al*., 2014), increased numbers of patients needing antiretroviral (ARV) services (Mazibuko *et al*., 2014), migration to developed countries in search of greener pastures (Waako *et al*., 2009; Itiola and Agu, 2018), higher salaries within externally funded projects, sometimes more than twice as obtained in the public sector (Windisch *et al*., 2011), motivation (Akinyemi and Atilola, 2013) and uneven distribution of health workers (Bangdiwala *et al*., 2010; Adeloye *et al*., 2017).

The problem of human resources skills weakness in supply chain management in Nigeria needs to be addressed to ensure country's progress towards sustainability. This is even more imperative now with the declining donor funding. PEPFAR's contribution to health workforces in partner countries has been directed to more pre-service production. However, partner countries continue to have huge need for health workforce development and retention (IOM, 2013). Therefore, adherence by partner countries to the Global Code of Practice on the International Recruitment of Health Personnel and follow through on commitments to the Abuja Declaration could support both sustainability of

their own health workforces and country ownership (OAU, 2001; IOM, 2013).

A reliability analysis (Table 5) was carried out on the knowledge level of essential supply chain functions scale comprising 9 items. Cronbach's alpha showed the questionnaire is reliable, $\alpha = 0.925$. Chi-square (χ^2) test (Table 6) revealed a relationship between knowledge of essential supply chain functions and HIV/AIDS supply chain workforce capacity ($p<0.05$). We accepted the alternative hypothesis (Ha), therefore knowledge of essential supply chain functions is a significant factor of HIV/AIDS supply chain workforce capacity.

Table 1. Socio-demographic Characteristics of Respondents

Socio-demographic Characteristics	**Categorization**	**Number (%)**
Age (Years)	20-29	0 (0.0)
	30-39	121 (30.6)
	40-49	207 (52.3)
	50-59	52 (13.1)
	≥60	16 (4.0)
	Total	396 (100.0)
Gender	Female	121 (30.6)
	Male	275 (69.4)
	Total	396 (100.0)
Years of Experience (years)	0-3	34 (8.6)
	4-7	104 (26.3)
	8-11	138 (34.8)
	12-15	103 (26.0)
	≥16	17 (4.3)
	Total	396 (100.0)
Sector of Engagement	Public	103 (26.0)
	Private	52 (13.1)
	Faith-based organization	17 (4.3)
	NGO	207 (52.3)
	Donor Agency	17 (4.3)
	Total	396 (100.0)
Job Title	Director	68 (17.2)
	Associate/Assistant Director	34 (8.6)
	Manager/Supervisor	156 (39.4)
	Specialist/Advisor/Officer	138 (34.8)
	Total	396 (100.0)
Level of Supply Chain Work	Health Facility	20 (5.1)
	LGA	52 (13.1)
	State	138 (34.8)
	National	175 (44.2)
	International	11 (2.8)
	Total	396 (100.0)
Educational Qualification	Bachelor's Degree	119 (30.1)
	Postgraduate Diploma	14 (3.5)
	Fellowship	35 (8.8)
	Master's Degree	221 (55.8)
	Doctorate	7 (1.8)
	Total	396 (100.0)

Table 2. Respondents Areas of Training and Experience in Supply Chain Management

Variables	Yes (%)	No (%)
Serving Customers	207 (52.3)	189 (47.7)
Product Selection	207 (52.3)	189 (47.7)
Quantification	207 (52.3)	189 (47.7)
Procurement	258 (65.2)	138 (34.8)
Inventory Strategy	258 (65.2)	138 (34.8)
Warehousing and Distribution	241 (60.9)	155 (39.1)
Logistics Management Information System (LMIS)	258 (65.2)	138 (34.8)
Monitoring and Evaluation	207 (52.3)	189 (47.7)
Risk Management	155 (39.1)	241 (60.9)

Table 3. Percentage Frequency of Knowledge Level of Supply Chain Functions

Items	Positive Responses Frequency N (%)
Nigeria HIV/AIDS supply chain workforce has demonstrated capacity in the key supply chain functions	
Serving Customers	336 (84.8)
Product Selection	281 (71.0)
Quantification	175 (44.2)
Procurement	327 (82.6)
Inventory Strategy	193 (48.7)
Warehousing and Distribution	190 (48.0)
Logistics Management Information System (LMIS)	312 (78.8)
Monitoring and Evaluation	307 (77.5)
Risk Management	132 (33.3)

Positive responses = Agree/ Strongly Agree

Table 4. Percentage Frequency of Respondents Perception towards Supply Chain Workforce Capacity

Items	Positive Responses Frequency N (%)
Development of skilled workforce contributes to health systems strengthening	396 (100)
Supply chain workforce is an important part of functional HIV/AIDS system	396 (100)
Skilled supply chain workforce is vital for improving health outcomes and achieving health-related Millennium Development Goals	396 (100)
There is shortage of manpower at the sub-national level and the country's current poor economic situation may not allow for personnel recruitment in the immediate future	344 (86.9)
There are still capacity gaps at the national and state levels especially for quantification and use of quantification results to inform procurement of HIV/AIDS products within Government system	379 (95.7)
Inadequate workforce is the most important problem of Nigeria HIV/AIDS supply chain	241 (60.9)

Positive responses = Agree/ Strongly Agree

Table 5. Cronbach's Alpha Test on Knowledge Level of Supply Chain Functions

Items	Mean	SD	Factor Loading	Cronbach's Alpha
Nigeria HIV/AIDS supply chain workforce has demonstrated capacity in the key supply chain functions				**0.925**
Serving Customers	3.876	0.8493	0.891	
Product Selection	3.576	1.1722	0.846	

Quantification	3.005	1.0626	0.759	
Procurement	3.745	0.7912	0.786	
Inventory Strategy	2.965	1.1600	0.777	
Warehousing and Distribution	3.104	1.2855	0.802	
Logistics Management Information System (LMIS)	3.662	0.9608	0.869	
Monitoring and Evaluation	3.699	0.7484	0.671	
Risk Management	2.914	1.0226	0.775	
Mean of mean± SD	3.394	1.006		

Table 6. Relationship between Knowledge of Supply Chain Functions and Supply Chain Workforce Capacity

Knowledge of Supply Chain Functions	**Factors of Supply Chain Workforce Capacity**		**Total**	χ^2	**p-value**
	High Level Factors (%)	**Low Level Factors (%)**			
High Knowledge	281 (93.1)	21 (6.9)	302 (100.0%)	207	0.001
Low Knowledge	19 (20.2)	75 (79.8)	94 (100.0%)		

Null Hypothesis (Ho): Knowledge level of supply chain functions is not a significant factor of supply chain workforce capacity.

Alternative Hypothesis (H_a): Knowledge level of supply chain functions is a significant factor of supply chain workforce capacity.

Conclusion

The study revealed lack of capacity in essential supply chain functions (e.g. warehouse and distribution, inventory strategy, quantification, and risk management) among HIV/AIDS supply chain workforce in Nigeria to provide quality HIV/AIDS prevention, care and treatment services. This may posse threat to effectively plan for HIV/AIDS service delivery and sustainability of the national HIV/AIDS response.

Recommendations

Federal and State Ministries of Health should adopt a mix of effective human resources capacity building approaches to proactively increase knowledge and skills of the supply chain workforce particularly in the observed areas of deficiency e.g. warehouse and distribution, inventory strategy, quantification and risk management to ensure availability of well-prepared, skilled and knowledgeable workforce vital for well-functioning HIV/AIDS supply chain and quality services.

References

[1] Adekola, A. and Adelanwa, A. (2014). Developing the SCM workforce in Nigeria through contextualised preservice education and continued professional development. *Journal of Pharmaceutical Policy and Practice*, 7(Suppl 1): O22.

[2] Adeloye, D., David, R. A., Olaogun, A. A., Auta, A., Adesokan, A., Gadanya, M., Opele, J. K., Owagbemi, O., and Iseolorunkanmi, A. (2017). Health workforce and governance: the crisis in Nigeria, *Human Resources for Health*, 15:32 DOI 10.1186/s12960-017-0205-4.

[3] Akinyemi, O. and Atilola, O. (2013). Nigerian resident doctors on strike: insights from and policy implications of job satisfaction among resident doctors in a Nigerian teaching hospital. *Int J Health Plann Manage*, 28(1): e46–61.

[4] Anywangwe, S. C. E. and Mtonga, C. (2007). Inequities in the global health workforce: the greatest impediment to health in sub-Saharan Africa. *Int J Environ Res Public Health*, 4:93-100.

[5] Bangdiwala, S. I., Fonn, S., Okoye, O. and Tollman, S. (2010). Workforce resources for health in developing countries. *Public Health Rev*., 32(1):296–318.

[6] Brown, A. and Sankaranarayanan, A. (2014). *Human Resource Development in Supply Chain Management of Health Commodities - A realist review of UN sources*, ISBN: ISBN: 978-1-74088-410-5. 10.13140/RG.2.1.2365.1046.

[7] Brown, A., Atif, M., Hasselberg, E., Steele, P., Wright, C., and Babar, Z. (2014). Human resources health supply chains and access to essential medicines. *Journal of Pharmaceutical Policy and Practice*, 7(Suppl 1):2.

[8] Cochran, W.G. (1977). *Sampling Techniques*. 3rd Edition, John Wiley & Sons, New York.

[9] Cometto, G., Babar, Z., Brown, A., Hedman, L. and Campbell, J. (2014). Health supply chain personnel: an integral part of the health workforce." *Journal of Pharmaceutical Policy and Practice*, 7(Suppl 1): I1.

[10] Dowling P. (2011). *Healthcare Supply Chains in Developing Countries: Situational Analysis*. Arlington, Va.: USAID | DELIVER PROJECT.

[11] Ebele, F.U., Aregbosola, B.G., Hasstrup, D.T. and Adams, E. (2014). The Effect of Climate Change on Agricultural Production among Farmers in Kwali Area Council of Federal Capital Territory of Nigeria. *Advances in Social Sciences Research Journal*, 1(2):13-26.

[12] Fowkes, F. J. I., Draper, B. I., Hellard, M. and Stoové, M. (2016). Achieving development goals for HIV, tuberculosis and malaria in sub-Saharan Africa through integrated antenatal care: barriers and challenges, *BMC Medicine*, 14:202 DOI 10.1186/s12916-016-0753-9.

[13] Frenk, J. (2010). The Global Health System: Strengthening National Health Systems as the Next Step for Global Progress. *PLoS Med*, 7(1): e1000089. doi: 10.1371/journal.pmed.1000089.

[14] Ike, S. O. (2007). The health workforce crisis: the brain drain scourge. *Niger J Med*., 16:204–211.

[15] IOM (Institute of Medicine). (2011). *Preparing for the Future of HIV/ AIDS in Africa: A Shared Responsibility*. Washington, DC: The National Academies Press.

[16] IOM (Institute of Medicine). (2013). *Evaluation of PEPFAR*. Washington, DC: The National Academies Press.

[17] Itiola, A. J., and Agu, K. A. (2018). Country ownership and sustainability of Nigeria's HIV/AIDS Supply Chain System: qualitative perceptions of progress, challenges and prospects. *Journal of Pharmaceutical Policy and Practice*, 11:21 https://doi.org/10.1186/s40545-018-0148-8.

[18] Leatherman, S., Ferris, T. G., Berwick, D., Omaswa, F. and Crisp, N. (2010). The role of quality improvement in strengthening health systems in developing countries. *Int J Qual Health Care*, 22(4): 237–243

[19] Matovu, J. K. B., Rhoda, K., Wanyenze, Susan Mawemuko, Gakenia Wamuyu-Maina, William Bazeyo, Olico-Okui and David Serwadda. (2011). Building capacity for HIV/AIDS program leadership and management in Uganda through mentored Fellowships. *Glob Health Action*, 4:5815. doi:10.3402/gha.v4i0.5815.

[20] Matovu, J. K. B., Rhoda, K., Wanyenze, Susan Mawemuko, Olico Okui, William Bazeyo and David Serwadda (2013). Strengthening health workforce capacity through work-based training; *BMC International Health and Human Rights*, 13:8.

[21] Matowe, L., Waako, P., Odoi-adome, R., Kibwage, I., Minzi, O. and Bienvenu, E. (2008). A strategy to improve skills in pharmaceutical supply management in East Africa: the regional technical resource collaboration for pharmaceutical management. *Human Resources for Health*, 6:30. doi:10.1186/1478-4491-6-30.

[22] Mazibuko, G. N., Sagwa, E., Kagoya, H. R., Kibuule, D., Rennie, T., Mavere, T., Ghoneim, R., Mabirizi, D., Naikaku, E., Niaz, Q. and Lates, J. (2014). Incorporating pharmaceutical supply management modules in the preservice curriculum of the BPharm program, of the University of Namibia, School of Pharmacy, *Journal of Pharmaceutical Policy and Practice*, 7(Suppl 1): P12.

[23] OAU (Organization of African Unity). (2001). Abuja Declaration on HIV/AIDS, tuberculosis and other related infectious diseases. Presented at African Summit on HIV/AIDS, Tuberculosis and Other Related Infectious Diseases, Abuja, Nigeria.

[24] Oleribe, O. O., Ezieme, I. P., Oladipo, O., Akinola, E. P., Udofia, D., Taylor-Robinson, S. D. (2016). Industrial action by healthcare workers in Nigeria in 2013-2015: an inquiry into causes, consequences and control-a cross-sectional descriptive study. *Hum Resour Health*, 14(1):46. doi: 10.1186/s12960-016-0142-7.

[25] Schneider, D., Evering-Watley, M., Walke, H., Bloland, P. B. (2011). Training the Global Public Health Workforce through Applied Epidemiology Training Programs: CDC's Experience, 1951–2011. *Public Health Rev*, 33:190–203.

[26] Soucat A, and Scheffler R. (2013). *The Labor Market for Health Workers in Africa: New Look at the Crisis*. Washington, DC: World Bank.

[27] TGF (The Global Fund). (2017). *Audit Report: The Global Fund's In-country Supply Chain Processes*, GF-OIG-17-008 Geneva, Switzerland.

[28] Thom, A., and Langa, L. (2010). South Africa: Provinces face drug stock outs due to overspending. *The Pharma Letter*, Putney London SW151SP. http://allafrica.com/stories/201004090010.html (accessed October 29, 2019).

[29] UNICEF, WHO, and ESTHER. (2008). *Evaluation of ARV procurement and supply management systems in west and central Africa region*. Dakar, Senegal.

[30] UNICEF. (2014). *Supply Annual Report 2013*. UNICEF Supply Division, Copenhagen, Denmark.

[31] Waako, P., Odoi, R.., Obua, C., Owino, E., Tumwikirize, W., Ogwal-Okeng, J., Anokbonggo, W., Matowe, L., and Aupont, O. (2009). Existing capacity to manage pharmaceuticals and related commodities in East Africa: An assessment with specific reference to antiretroviral therapy, *Human Resources for Health* 7(1):21 DOI: 10.1186/1478-4491-7-21.

[32] WHO. (2000). *World Health Report 2000 Health systems: improving performance.* Geneva, Switzerland.

[33] WHO. (2010). Growing threat from counterfeit medicines. *Bulletin*, 88(4):241-320.

[34] WHO. (2011). *Tackling the crisis of workforce shortages in the pharmaceutical sector*. Geneva, Switzerland.

[35] Windisch, R., Waiswa, P., Neuhann, F., Scheibe, F. and Savigny, D. (2011). Scaling up antiretroviral therapy in Uganda: using supply chain management to appraise health systems strengthening. *Globalization and Health*, 7:25.