Logistics Management Performance for Program Commodities at the Upstream Pharmaceutical Supply Chain System of Ethiopia: The Case of Central Pharmaceutical Supply Agency and Ministry of Health

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Abstract

Background: In the supply chain management system, building a resilient and sustainable health services system depend on the achievement of logistics management. In Ethiopia the launching of the free program treatment initiative was characterized by a large infusion of commodities which require strong logistics management capacity.

Objective*:* To assess logistics management performance for program commodities at central pharmaceutical supply agency and Ministry of health.

M**ethod*:*** A descriptive cross-sectional study design complemented with qualitative data collection techniques was conducted from February 21-April 20/2019. One hundred ten professionals involved in study from central pharmaceutical supply agency and Ministry of health. Seventy program commodities with its logistics management documents included in the study. The data were collected through document review, self-administered questioner, observational checklist and in-depth interview. Quantitative data were entered and analyzed using the Statistical Package for the Social Sciences version 23. Results obtained from 25 face to face in-depth interviews were analyzed using thematic analysis techniques.

Result: A total of 70 program commodities included in this study from Human immunodeficiency virus and acquired immune deficiency syndrome, maternal and child health, Malaria, and Tuberculosis programs. All commodities were from the national essential medicine list, and the mean percentage of the international price paid was 99.48%. Forecasts mean absolute percentage deviations were 29.08%. Average of suppliers' lead time 137.33 days and wastage rate of program commodities was 2.1%. The central pharmaceutical supply agency, mean order fill rate 52.9% and, the average stock out days was 8.5. The poor data quality from pharmaceutical supply agency hubs and health facilities was the major challenge for central pharmaceutical supply agency which led to unacceptable forecasting error which intern caused wastage and stock out of essential medicines.

Conclusion: The study showed a weak logistics management performance at the upper stream supply chain system of the country, which was evidenced by inaccurate forecasting, long stock out duration, high wastage rate, and distribution malpractice. Poor data quality from the downstream supply chain was one of the major challenges affecting the logistics practice.

Key words: program commodities, EPSA, logistics management, MOH

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Acronomy and abbreviations

ACT-Artemisinin-based combination therapies

AIDS- Acquired immune deficiency syndrome

ART- Antiretroviral treatment

CMS- Central medical stores

EML-Essential medicine list

EPSA-Ethiopian Pharmaceuticals Supply Agency

HCMIS- Health commodity management information system

IPLS-Integrated pharmaceuticals logistics system

LMIS-logistics management information system

MCH-Maternal and child health

MSD-Medical stores department

MOH- Ministry of Health

NEMLIT - National essential medicines list for Tanzania

RRF- Reporting and resupply form

SCM- Supply chain management

SIAPS- Systems for improved Access to Pharmaceuticals and Services

SMS-State medical stores

STG-Standard treatment guidelines

SOP- Standard operating procedure

SPSS- Statistical Package for Social Sciences

TB-Tuberculosis

WHO-world health organizations

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1. Introduction

1.1 Background

Medicines and health commodities make the backbone of health systems, and health is the main indicator of the level of development of the country. There is all time the necessity to guarantee quality and consistent availability of right quantities of health commodities at affordable prices. Despite this fact, the world community as a whole faced an excess of health problems such as deprived and scarce health facilities, shortage of virtuous logistics management for effective and competent health service delivery, lack of strong health service suppliers and availability of quality data for management. These factors lead to a high rate of mortality and poor service delivery of health services. To endorse consistent availability of health commodities, it is important to assimilate the entire supply chain component together to confirm effective and well-organized health commodity logistics management performances(1,2).

The global supply chain forum describes supply chain management as the integration of key business processes and resources from end-user through original suppliers that provide products, services, and information to add value for the customer and stakeholders. The main goal of having supply chain management is to provide good service to the final customer while keeping costs low. Logistics is a branch of supply chain management and it is the particular tasks that need to be performed by each of the supply chain stockholders such as selecting medicine, forecasting requirements, ordering and purchasing, warehousing and storing, monitoring and evaluating inventory, moving products from one level to the next until it reach the customers and management of data in the process(3,4). In the supply chain, the attainment of logistics activities such as selection, quantification, procurement, inventory management, distributions, and information are a core component, which support building of resilient and sustainable systems for health services (5).

Selection is a process that directly associated to serving customers by determining what products are procured and used in the health system and the range of products a customer can receive. Once products are selected, appropriate quantification will be done. Quantification is the process of approximating the quantities and costs of products required for a specific health program and determining when the products should be delivered to ensure a continuous supply of products.

It is a critical supply chain activity that links information on services and commodities from the facility level with program policies and plans at the national level. Estimating the quantity of products accurately helps program managers to plan budget and procurement (6). After a supply plan has been settled as part of the quantification process, quantities of products must be procured. Procurement is an important activity in ensuring that correct products are available in-country and ready for distribution when required. In any case, procurement should follow specific procedures and national procurement regulations that ensure an open and transparent process (7). Logistics management information system (LMIS) is a system of records and reports, whether paper-based or electronic used to record, aggregate, analyze, validate and display data from all points of the logistics system. This can be used to make logistics decisions and manage the supply chain systems. Information is the heart of the logistics system that runs the whole logistics cycle. Without information, the logistics system would not affect (8). Distribution of pharmaceuticals is the process products are physically conveyed from their point of production or upstream warehouse to the point at which they are available to the final customer(9). The main purposes of a logistics management system are to obtain and move goods, supplies and equipment in a timely approach to the places where they are needed, at a reasonable cost. The problems are intricate by the fact that equipment and supplies usually cannot go directly from their source to the end-user and they must be held as inventory at one or more intermediate points along the way. There are four reasons for holding inventory: transportation efficiency, safety stocks, storage capacity and expectation of a program that is growing or changing (10).

In Ethiopian, the pharmaceuticals supply agency is responsible for the selections, quantifications, procurement, storage and distribution of pharmaceuticals in the country. FMOH participate in selection, quantification and budget reconciliation for procurements of program commodities. If budget donated from support partners not enough to purchase the required product quantity, MOH has the responsibility of mobilizing resources (11). In the country, recently there are various challenges of logistics management such as an inadequate supply of quality and affordable essential pharmaceuticals, poor storage conditions, lack of accurate recording and reporting information and weak stock management which have resulted in high levels of waste and stock-outs commodities. Low pharmaceuticals order fills rates of central EPSA for hubs and in turn hubs for health facilities are another symptom of an inefficient logistics management

system that further perpetuates the problem(12). Therefore, this study was done to identify gaps and set appropriate recommendation to improve future logistic management performance of program commodities in central EPSA and MOH.

1.2 Statements of problems

According to 2017 global HIV statistics an estimated 36.9 million people were globally living with HIV, including 1.8 million children and most of these children live in sub-Saharan Africa. About 75% of people living with HIV were aware of their HIV status in 2017. But, only 21.7 million people living with HIV (59%) were accessing antiretroviral therapy (ART)(13). HIV treatment access is a key to the global effort to end AIDS as a public health threat. TB is one of the top ten reasons of death globally and the foremost cause of a single infectious agent, ranking above HIV/AIDS. In 2017, 10 million people infected with TB, and 1.6 million died from the disease. Ethiopia is among the 22 high TB burden countries and ending the TB epidemic by 2030 is among the health targets of sustainable development goals (14).

Maternal mortality reports by world health organizations, UNICEF, UNFPA and World Bank group, every day about 800 women die from avertible causes related to pregnancy and childbirth. Although great progress has been made in reducing global child mortality, newborns now account for 44% of all childhood deaths. Ethiopia contributes to more than 4% of all global maternal deaths (15,16). In 2017, an estimated 219 million cases of malaria happened internationally. The most cases were in the African (200 million or 92%) leftovers a very serious health challenge, mainly in sub-Saharan Africa, including Ethiopia; bear most of the global malaria burden, with nearly 90% of total deaths. However, it is possible to warrant the robustness and productivity of HIV infected people and, cure and prevent TB, malaria, maternal &child death through efficient and responsible supply chain management of program commodities at all levels of the supply chain system (17).

From 2016 global fund report, without government expenditures global fund had spent US$32.6 billion to support programs for HIV, TB and malaria at end of, 2016 and health commodities account for approximately 40% of grant expenses. This percentage is significantly higher and needs appropriate logistics management at each level of the supply chain system to reduce the global burden of HIV, TB and malaria in low and middle-income countries (5).

In 2010 findings of UN secretary-general's global strategy for women's and children's health show that the suffering of women and children around the world caused by lack of access to life-saving commodities. Frighteningly, a large proportion of these problems could be avoided if women and children access to adequate health services with the necessary quality medicines, supplies and skilled health care providers. The availability of MCH commodities was subject to following weaknesses; inaccurate quantification of requirements, inappropriate pharmaceutical procurement mechanisms, procurement of products that do not meet the necessary technical specifications, weak distribution systems, inadequate storage facilities, and limited inventory tracking systems (18).

Ensuring an uninterrupted supply of antiretroviral commodities is critical to minimize the emergence of HIV drug resistance, protect the health and wellbeing of patients, and ultimately reach universal access goals. However, according to the WHO progress report of 2010 stock-outs of antiretroviral drugs were documented in 36 out of the 94 reporting countries which indicates poor products management and interruption of supply (19). Another study conducted in three countries in East Africa (Tanzania, Uganda, and Rwanda) revealed that, despite the efforts of a global fund to combat AIDS and the President's emergency plan for AIDS relief to increase the availability and access to ARVs, and the supply chain management of it in these countries was poor. The weakness was underlined by the incapacity to adequately quantify needs, place orders, and effectively keep records (19). Also, from report of global fund grants in the republic of Guinea in 2017, due to poor logistics management an estimated of US$3 million anti-retroviral medicines were expired at the central medical store(20). But, to reach the international 90-90-90 targets by 2020 and ending HIV/AIDS require strong supply chains to ensure uninterrupted access antiretroviral commodities (21). According to audit report of global fund grants in the Republic of Niger, In March 2018, three out of four TB drugs were out of stock at the central level for several months. In 2017, more than US$98,000 worth of TB drugs expired at ONPPC (Office National Des Produits Pharmaceutiques et Chimiques) without being distributed, and more than US$235,000 of expired throughout the country (22).

Termination of TB requires strong supply chains to ensure availability of diagnostics and anti-TB drugs. The stock-outs of anti-TB may prevent countries from ending the TB epidemic by 2030 among the health targets of the sustainable development goa1(14).

As study done in Malawi in 2007, anti-malarial drugs were out of stock for periods ranging from 42 to138 days. On average these drugs were out of stock for three months and the main reasons for shortage of drugs at the health center was insufficient deliveries from the regional medical store, poor quantification and improper ordering (23). Another study conducted in Kenya and Uganda to assess stock-outs of Artemether –lumefantrine combination of anti-malaria in 2008 showed that, despite the fact that the countries were receiving drugs from the global fund to fight AIDS, tuberculosis and malaria, they faced stock-outs of Artemether-lumefantrine combinations. This was due to poor quantification and selection of an unreliable suppliers and lead to an interrupted supply of antimalarial and other essential drugs (24). Correspondingly from report of global fund grants in the republic of Guinea in 2017, due to poor logistics management an estimated of US$0.5million antimalarial medicine were expired at the central and regional warehouses (20).

Report of systems for improved access to pharmaceuticals and Services (SIAPS) in Swaziland in 2018, showed that the ministry of health has used the information coming to the central medical store's through LMIS to made decisions that have resulted in a savings of $6.25 million from unnecessary procurement (25). There is also another study conducted in Kenya in 2007 shows that the inefficiency and incompetence of overall administration and management of procurement function in public institutions contribute to loss of over 50 million Kenyan shillings annually (26). According to Benin national supply chain, assessment order fill rate at the central medicine store and regional level were 73% and 66% respectively. This indicates the supply agency has inefficient demand planning and forecasting, poor inventory management (27). A study done in Nigeria revealed that the distribution of medicines is mainly contracted to private agents and based on a push system with no specific schedule or pre-determined interval but at the requests of the manager of programs. Products are generally not delivered within the deadlines due to lack of vehicles, poor condition of the vehicle as well as the high cost of transport. Furthermore, there is no centralized distribution system for health commodities and transportation is managed by the majority of the state medical store (80%), but the available vehicles are insufficient for effective delivery (28).

In many low and middle income countries, the ability of the pharmaceutical supply management (PSM) system has always been challenging. Poor supply management and inventory control leads to stock out, loss due to unnecessary expiry, theft and the desired pharmaceutical products are unavailable at all times in required quantity (29).

The introduction of the free program treatment initiative in Ethiopia was characterized by a large infusion of commodities which require strong logistics management capability. The success of this expanded program is dependent on the ability to reliably and consistently supply of essential commodities and its proper management (30). Ethiopia has a highly centralized health system where selection, quantifications, and procurement of program commodities are performed centrally at the national level with different disciplines and stakeholders. Requirement determination of country depends on national-level morbidity and consumption data but, in many countries difficult to get quality data. Poor quantification processes and procurement are among the common problems that affect availability and accessibility of essential medicines, in most countries (31,32). So far, majority of the previous studies in Ethiopia were limited to the specific component of logistics management cycles such as inventory management practices, logistics management information system performance, and storage condition practices of the program commodities at public health facilities. That was why the current study focused on program commodities logistics management performance at upstream of the Ethiopian pharmaceutical supply chain system. Therefore, this study attempted to provide a brief current logistics management performance for program commodities and challenges of pharmaceutical supply agency and ministry of health to forward helpful recommendations.

1.3 Research questions

This study attempted towards finding answer to the following questions

1. What are the selection, quantifications and procurement performance for program commodities?
2. On what progress inventory and distribution practices of program commodities were found?
3. What are the challenges of logistics managements of program commodities?

2. Literature Review

2.1 Theoretical Literature Review

2.1.1 Concepts of logistics managements

In pharmaceutical supply chain management bottlenecks can exist in all areas of logistics management component such as: selection, determine requirement, procurement, distribution, storage, information systems, and inventory management(18). For the proper functioning of logistics management systems it is necessary to develop standard operating procedures (SOPs) that describes the roles, responsibilities and a methodical fashion for each of key players involved in logistics activity(33). Availability of skilled and trained work force is an important factor in logistics. It is essential that the existing health workers at all levels are well trained and they are given an adequate mix of skills during training. The logistics skills were increasingly important in forecasting, procurement and inventory management. Career progression mechanisms must be in place with an added focus on in service training which should be standardized and nationally endorsed(34).

Pharmaceutical supply chain systems need to carry out a variety of activities at all levels of the health care system, from the national program level down to facilities where medicines are dispensed to patients. A well-functioning and integrated supply chain management is imperative to guarantee continued availability of health commodities and is characterized by clarity of roles, responsibilities and processes, simplified processes, prominence of information, reliance and collaboration, and alignment of goals. The framework emphasizes the cyclic relationships between selection, quantifications, procurement, distribution, serving customer and logistics management information systems (35).

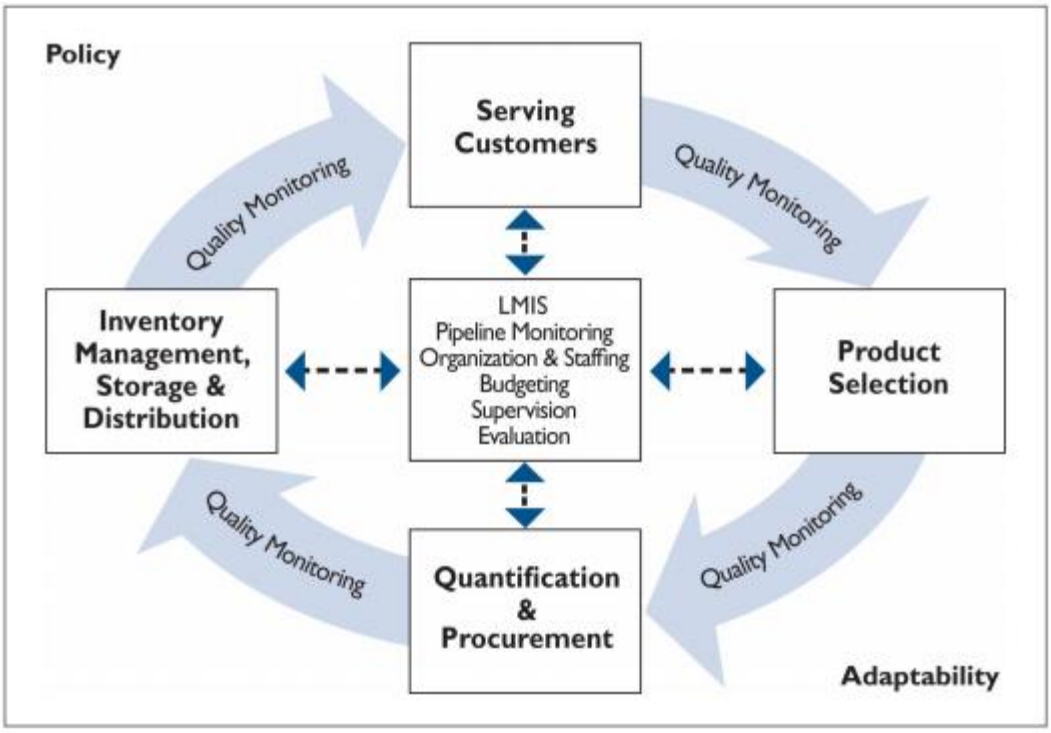

Figure 1: Pharmaceutical logistics management framework.

Source :(*USAID | DELIVER PROJECT, Task Order 1.2011. The Logistics Handbook: A Practical Guide for the Supply Chain Management of Health Commodities. Arlington, Va.: USAID | DELIVER PROJECT, Task Order 1).*

2.1.2 Logistics management in Ethiopia

The Federal Ministry of Health has been ensuring an efficient and high performing healthcare supply chain that will ensure equitable access to affordable medicines for all Ethiopians. In previous years' significant improvement has been made even though various challenges persist; such as an inadequate supply of quality and affordable essential pharmaceuticals, poor storage conditions, weak stock management, and weak distribution system which resulted in expire and stock-outs. To solve these problems, the FMOH started a comprehensive supply chain strategic planning process and pharmaceuticals supply agency (PSA) being established in 2007. EPSA has been established to handle forecasting, procurement, storage, distribution and promote rational use pharmaceuticals to all health facilities. In 2009, as part of a major intervention to improve the supply chain situation in the country, PSA from partnership with support partners, the USAID | DELIVER PROJECT, supply chain management systems (SCMS), and others in the

sector developed and began implementing the Integrated Pharmaceuticals Logistics System (IPLS) (36). IPLS is the term applied to the single pharmaceuticals reporting and distribution system based on the overall mandate and scope of the EPSA. It aims to ensure that patients always get pharmaceuticals they need with affordable price. To be successful, the system must fulfill the six rights of supply chain management by ensuring the right products, in the right quantity, of the right quality, at the right place, at the right time and for the right cost (37).

Ethiopia has a well-designed LMIS used for program commodities and the health commodity management information system (HCMIS) is automated in the EPSA center and covers all branches (11). The central EPSA distributes program commodities to each hub which has submitted a completed and approved the report and requisition format (RRF) on time. Each hub shall prepare and send a requisition of commodities every two months using RRF to central EPSA. Then central EPSA intend to issues stock of the requested commodities after reviewing the quantity and distributes products to the hubs by its own transportations (37). The following figure illustrates the overall flow of program pharmaceuticals and information in the IPLS.

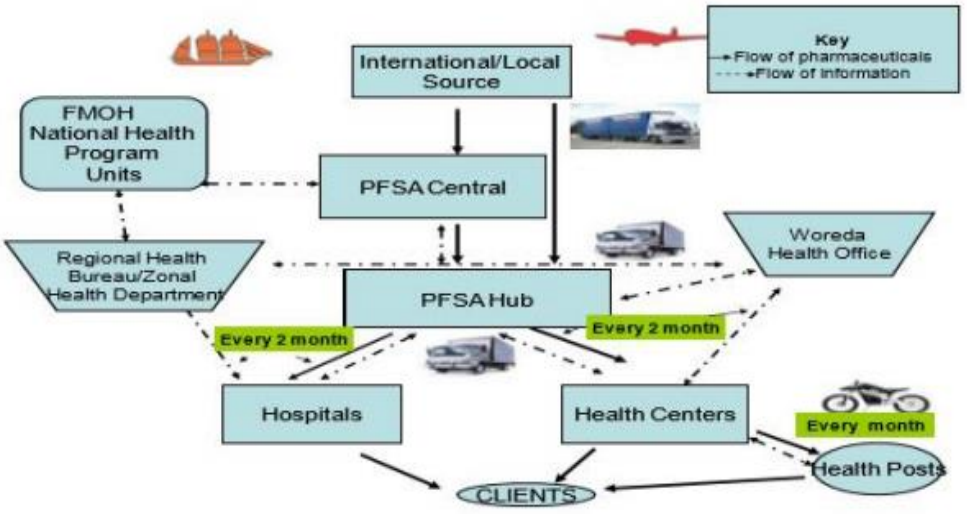

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Figure 2: The flow of program commodities and information between central PSA and other stockholders

Source*: Pharmaceuticals Fund and Supply Agency (PFSA), 2015.Standard operating procedure manual for the integrated pharmaceutical logistics system in health facilities of Ethiopia, 2nd Edition.*

2.1.3 Selection and quantifications

In logistics management system, health programs must select products and it may be the duty of a national formulary and therapeutics committee, pharmaceutical board, board of physicians, or other government-appointed group. Program commodity selected for use will impact the logistics system and logistics requirements must be taken into account during product selection. Limiting the variety of products used and available at public facilities can make the supply chain more manageable. With a designated list of products, the central warehouse can become more familiar with the products, ensure that they meet program needs, monitor and maintain stock levels of all products system wide (7). The WHO recommends the selection of drugs to be based on a list of common conditions and complaints and the treatments of choice for them as defined in standard treatment guidelines. Essential drug list (EDL) simplifies systems of procurement by guiding the procurement and supply of medicines in the public health facilities (38).

After commodities have been selected, the quantity and cost of each product must be determined and quantification results are used to inform higher-level decision making on the financing and procurement of commodities. Forecasting is the process of estimating the quantity of each health commodity that will be dispensed or used during a specified period of time in the future. These quantities then become the basis for calculating the total commodity requirements in the supply planning step. Supply planning starts where forecasting stops. The forecasted quantities to be consumed are adjusted to account for stock on hand, quantities on order, and established minimum and maximum stock levels to determine the quantities of each commodity that should be procured (6).

2.1.4 Procurements

Effective procurement process is an important step in the pharmaceutical logistics system and ensures the availability of the right pharmaceuticals, in the right quantities, at reasonable prices, and accepted standards of quality(28). The goal of pharmaceutical procurement is to ensure the most efficient, transparent and fair manner for the use of public funds and resources. The purpose the governments as the procurer is the provision of goods and services of appropriate quality and at a competitive price. To ensure a good value for money and reduce the risk of corruption and favoritism public procurement procedure should create a fair opportunity for all providers (39).

The effective procurement policy endorses efficiency, i.e. the choice of the supplier with the minimum possible price or generally, the attainment of the best value for money. It is therefore important that the procurement process is not affected by practices such as conspiracy, fraud, and corruption. An anticompetitive conduct affecting the result of the procurement process is a particularly pernicious breach of competition rules. Through bid-rigging practices, the price paid by public administration for products or services is exaggeratedly raised, forcing the public sector to pay supra-competitive prices (40).

2.1.5 Inventory management

An inventory control system informs the storekeeper: when to order or issue, how much to order or issue, how to maintain a proper stock level of all products to avoid shortages and oversupply. The continuous supply of program commodities can be guaranteed only through the selection, design, implementation of an appropriate inventory control system. The best management of storage and inventory involves monitoring expiration dates, inventory levels, unexplained losses and storage conditions, particularly critical for test kits and diagnostic reagents (41). An effective inventory control system provides timely and accurate information to allow for a good balance between inventory carrying costs, procurement costs, and stock-out costs, reduce the incidence of stock-outs and lower procurement workloads(42).

2.1.6 Logistics management information systems

A well-managed and implemented LMIS provides decision makers in a supply chain with accurate, timely, and appropriate data of stock on hand, losses and adjustments, consumption, demand, issues, shipment status, and evidence about the cost of commodities managed in the logistics system. In most systems, data that describe the logistics system and control movement of pharmaceuticals through the system come from periodic reports prepared by the personnel in the facilities who manage the products. A well-functioning LMIS should collect and report key information needed for forecasting commodity needs and making rational decisions on financing, procurement, scheduling of shipments, and routine ordering without burdening service providers (8). Logistics information is the motor that pushes the logistics cycle. The upper-level pharmaceutical supply chain managers can use the LMIS to track trends in overall consumption and adjust national-level procurements as needed. The commodity supply chain managers can also use the data to identify high levels of product expiry and then initiate action to prevent a recurrence(7).

2.1.7 Distributions

The key goal of distributing medicines is to maintain a stable supply of pharmaceuticals to facilities where they are needed, while ensuring that resources are being used in the most effective way. A good distribution system has the following qualities: constant and uninterrupted supplies, maintain commodities in right condition until they are used, minimizes losses due to spoilage and expiry, prevents theft and fraud, maintains accurate stock, efficiently uses transport resources and enables collection of accurate information for forecasting. Transportation should be available when it is needed to fill regular or emergency orders. For some countries and programs, the ministry of health or the central medical stores is responsible for the transportation of commodities and in other countries may be pharmaceutical distribution has been outsourced to private companies. Regardless of the type of distribution system used, procedures should be in place to monitor and document the movement of commodities from the upper levels to the lower levels (9). The guideline for storage of essential medicines and health commodities by delivering project in collaboration with WHO, states maintaining proper storage conditions for health commodities is vital to ensure their quality and product expiration dates and should be based on ideal storage conditions, and protecting product quality until their expiration date is important for serving customers and conserving resources (43).

In most country the distribution from the central medical states (CMS) to the regional or district stores is carried out by a transport that is owned and operated by the CMS. The distribution from CMS to downstream tiers occurs each month in some countries (e.g., Zambia, Tanzania) and every three months in other countries (Kenya, Gambia, Mozambique). Lack of well-functioning transport is a key barrier for the public sector supply chain. The availability of vehicles for distribution of medicines is often limited due to lack of transport planning, poor vehicle maintenance and inappropriate use of vehicles. Instead of trying to own and operate a government fleets, countries such as Kenya have contracted third party transport providers to distribute stock from the CMS to the health facilities (19).

2.2 Empirical Literature Review

According to an in-depth assessment of the medicines supply chain in Tanzania, the country has both STGs and NEML established to guides health workers, what to keep in stock at the various levels within the supply chain management system. However, adherence to these guidelines was only around 52% and most of the facilities felt the guidelines did not address the needs of the

country to treat their patients effectively. It was also indicated the procurement at the medical store department (MSD) was not limited to the NEMLT and tertiary health facilities procured some products that were not listed in the country essential medicine list. This caused the situation where governments of Tanzania wasted allocated budget for non-essential pharmaceutical products and create a shortage of funding for essential medicines (44). Another study conducted by Benin national supply chain in 2016 shows that the selection of program commodities from national essential medicine list was 85%, and the average forecasting accuracy, 71%(27).

The study conducted in Namibia shows that quantification systems are generally weak and procurement quantities for drugs are generally determined by adding 10% to the quantity procured to the previous year. There is also no formal health products management information system is in place and data on the consumption of pharmaceuticals and actual requirements of the regions are not routinely collected and monitored by CMS to determine the quantification of products (42). A study done in Tanzania indicated that by increasing skilled human capacity, use of a standardized methodology, software tools and the availability of quality consumption data of LMIS helped to increased forecast accuracy to 78% for family planning in 2014. Similarly, the ARV forecast accuracy rate increased from 80 percent in 2014 to 94 percent in 2015, and up to 95 percent for anti-malarial in 2015, this was due to continued supply chain management system efforts to promote logistics data availability and quality. The application of an electronic logistics management information system, a web-based application for managing logistics data created a sustainable management information system solution (45). Another study conducted by Benin national supply chain in 2016, shows that LMIS reporting is paper-based and fragmented throughout the supply chain system. This significantly affects the availability of quality data to inform order quantities and national-level forecasting (27).

According to in-depth assessment of procurement and supply management systems for medical products in Nigeria, the programs commodities were procured by different methods such as international bidding, selective bidding, national competitive bidding and direct procurement methods but, they could not indicate the percentage of each category used in the previous year, and also the criteria for choice. It was difficult to determine the type of contracts offered to selected suppliers and average lead time from publication of tenders to contract sign. In addition to these, there are no standard operating procedures (SOP) for tenders, pre-selection of suppliers

and criteria for contract awards during the procurement process. None of the programs gave evidence of a technical committee for the analysis and award of tenders (28).

The audit reports of global fund grant of Republic Niger of 2018 indicate that weak controls of the forecasting and ordering process for drug management, have led to errors and delays that contribute to persistent stock-outs and expiries. For health procurements all health facility in Niger use morbidity data to determine the quantity of medicines needed rather than adjusting it based on consumption and stocks data. Even though data were available it was not collected, organized and used for requirement determination. There is no standard operating procedure to guide supply chain processes, including roles and responsibilities for different stockholders involved in the supply chain management system. These issues have led to irrational and delayed deliveries which have further contributed to stock outs ,expiries and missed opportunities for cost efficiencies(22).

According to the Tanzania medical store department special audit report, December 2011 reported the shortcomings such as procurement plans are not monitored or updated appropriately, some procurement methods used were not appropriately justified, delays were evident between stages in the procurement process, tender opening attendance records were not properly kept, the time between tender closure and opening was long(in cases up to 128 days), the composition of the evaluation team was not appropriate, and the medical stores department awarded tenders beyond their bid validity periods in certain instances (46). Another 2018 global fund grants report in Tanzania for TB commodities, medical store department data show concurrent stock-outs and overstocks of first-line drugs(47).

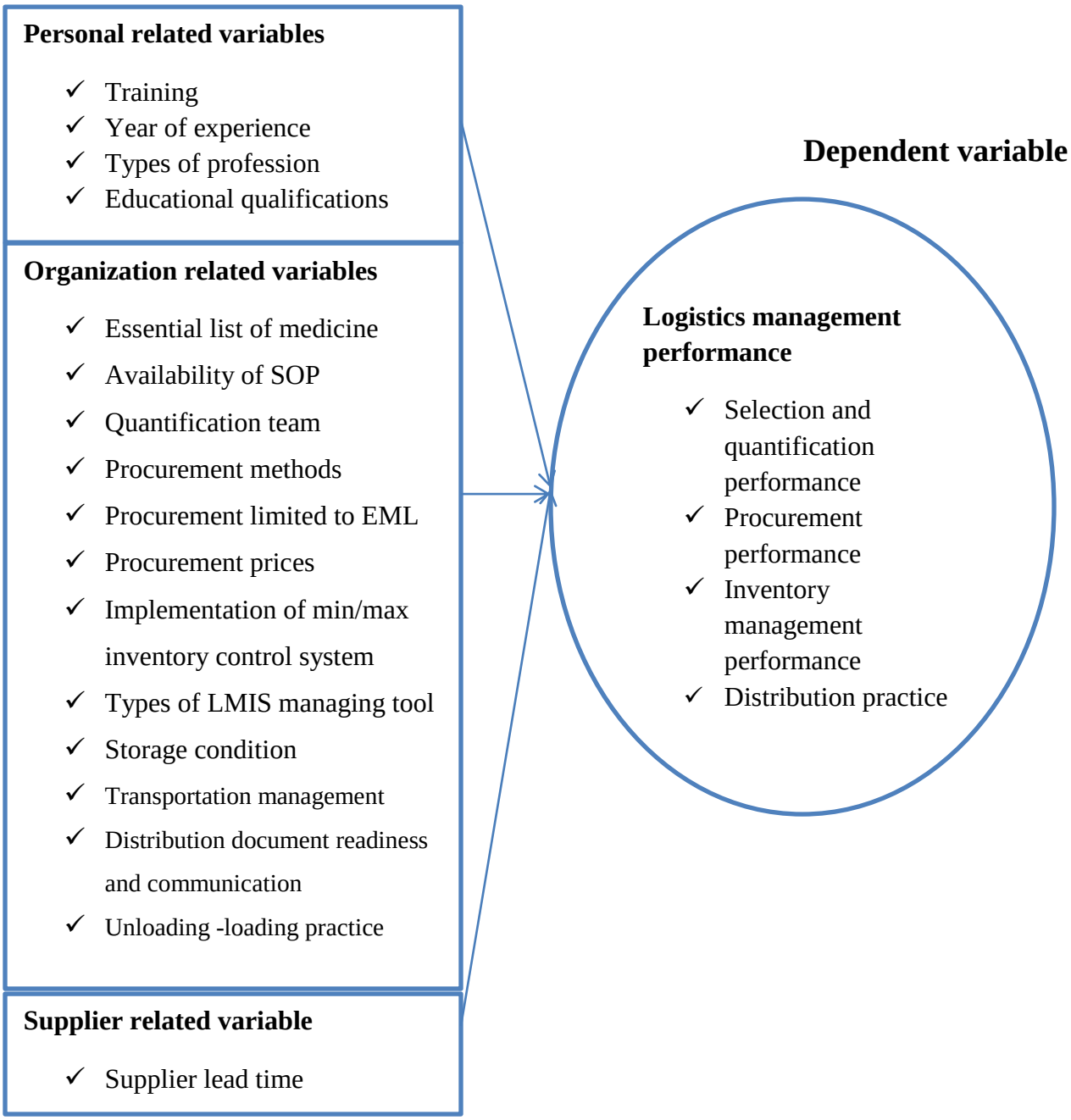
The 2016, Benin national supply chain assessment shows that the percentage of emergency orders placed at central and regional medicine store level was 15% and 35% respectively, which indicates the unavailability of medicine at all times (27). According to a study conducted in Kenya monitoring and distribution of program commodities from national warehouses to service delivery points remains a obstacle, with 40% of the 13 meternal and child health priority products out of stock. This is due to weak and disorganised logistics distribution managemnet in the country for instance, 12 different types of health commodities are supplied by at least 18 donors, purchased by 13 agencies, delivered to five warehouses, and distributed through seven supply chains stackholders (48).

2.3 Significance of the study

This study was conducted to assess the logistics management of program commodities at central EPSA and MOH to identify the possible gaps that exist in the logistics management of HIV/AIDS, TB, ant-malaria and MCH commodities. The study finding will help decision-makers and others to have an insight into the logistics management of program commodities in EPSA and MOH. The study will also serve as supplement evidence data for future work in the country. Therefore, the assessment helps to know how well the logistics management of program commodities mainly in central EPSA and identify the strengths and weaknesses of the existing system. The result of the study is believed to have significance in the reduction of resource wastage and the emergence of drug resistance.

2.4 Conceptual frame work

Independent variables



3. Objectives

3.1 General objective

To evaluate the logistics management performance for program commodities at the upstream pharmaceutical supply chain system of Ethiopia**.**

3.2 Specific objectives

- ✓ To assess the selection and quantification of program commodities
- ✓ To evaluate the procurement performance of program commodities
- ✓ To assess inventory management performances
- ✓ To evaluate distribution practices
- ✓ To identify the challenges on the logistics management of program commodities

4. Materials and Methods

4.1 Study area and period

The study was conducted at the central Ethiopian pharmaceutical supply agency (EPSA) and Ministry of health (MOH). To bring efficiency in the pharmaceuticals supply chain, PHARMID was transformed to pharmaceuticals supply agency (PSA) in 2007 G.C. Currently, the agency is accountable to the ministry of health, which stands for forecasting, procurement, warehousing and distribution of pharmaceuticals throughout the country. The agency has 19 branches which are found in all regions of Ethiopia and nineteen directorates; quantifications and market-shaping, tender management, contract management, inventory and warehouse management, distributions and fleet management, capacity building and operational research, directorates of audit, women and youth affairs, public relations and communications, ethics and anticorruption relations, human resource management, planning, monitoring and evaluations, quality assurance, project/program finance ,RDF finance, legal service, good governance and reforms, general service, management information system. The agency manages both programs (donated and free) and revolving drug fund (purchased) pharmaceuticals. Recently, the central EPSA has 10 warehouses centrally and 31 functional vans and heavy load vehicles to distribute pharmaceuticals(49).

Ethiopian federal ministry of health has 16 directorates and its main objective is to promote health and wellbeing of Ethiopians through improving accessibility and quality of pharmaceutical products and services. As part of these efforts, the Ministry is also exerting concerted efforts to improve supply chain and logistics management, and resource mobilization. Pharmaceutical and medical equipment management directorates work with pharmaceutical supply agency and donors to select and quantification of pharmaceuticals(50). The study was conducted from February 21-April 20/2019.

4.2 Study design

The study employed a descriptive cross-sectional design complemented with a qualitative study to evaluate program commodities logistics management performance.

4.3 Study population

Source population

The source populations were program commodities and its documents used in logistics management in the year 2017/18 (from July 2017-June 2018), professionals working in central EPSA and MOH, and central EPSA warehouses.

Study population

The study populations were all program commodities from 2018 EPSA pharmaceutical procurement list, documents used to manage logistics of program commodities including; model 19 and 22, HCMIS, RRF of hubs, purchase order, contract management and quantification documents. The central EPSA and MOH workers who directly participate in program commodities logistics management and all central EPSA warehouses were included.

4.4 Inclusion and exclusion criteria

Inclusion criteria

The program commodities managed at central EPSA and its document used for logistics management (contract management document, purchase orders, hubs RRF, HCMIS, quantification documents, model 19 and 22) in 2017/2018 were included in the study. The central EPSA and MOH workers who directly involved in program commodities management included. But, for a key guide interview, more than one year of experience was required. The central EPSA warehouses were also involved in the study.

Exclusion criteria

Workers at central EPSA who were not present at the time of data collection were excluded. Unfinished documents of program commodities at the time of data collection excluded from the study.

4.5 Sample size and sampling procedures

Sample size

For quantitative part

Form EPSA 2018 pharmaceutical procurement list all program commodities were included(51).

$Total\ number\ of\ program\ commodities\ =$

$17\ HIV\ commodities + 31\ TB\ commodities + 10\ malaria\ commodities +$

$12\ MCH\ commodities = 70$. All logistics management documents of selected program commodities were included in the study. Accordingly, 2017/18 quantification documents, 14 contract management documents, 39 purchase order documents, 39 receiving and 108 issuing transaction documents. In the case of RRF document, EPSA has 19 hubs that send a report every 2 months so that each hub sends six RRF in a year for resupply. But, one hub did not start program pharmaceutical services yet.

$$one\ year\ RRF = 18hubs * 12months * \frac{1}{2}$$

$$= 108\ \ RRF\ \ \ to\ assess\ resupply\ abiility\ of\ \ central\ EPSA$$

Two hundred and sixty-seven professionals are working in five directorates of central EPSA, where, 27 quantification and market shaping, 21 tender management, 35 contract management, 85 inventory and warehouse management, and 99 distribution and fleet management directorates. Out of this 105 professionals directly participated in program commodities logistics management for self-administered questionnaire, where 40 from tender and contract management, 55 warehouse, distribution and fleet management, 4 inventory management, 6 selection and quantification management. From the Ministry of health 5 focal logistics program commodities management's professionals were included in the study. Totally 110 professionals participated in self-administered questionnaires. Ten central EPSA warehouses were also visited to evaluate storage conditions and these warehouses found in different places in Addis Ababa at, Gulale (3), Lebu (2), Kalitiy (2) and Saris (3). The program commodities in EPSA are stored at any of the warehouses where adequate space available regardless of the type of products.

For qualitative part: Twenty-five key informants were selected from central EPSA (20) and MOH (5) for in-depth interviews.

The sample was based on information saturation and the interviewees were selected based on their service year in logistics management and different positions.

4.6 Data collection procedure and instrument

A structured questionnaire and checklists adapted from USAID delivery guidelines, methodology for assessing procurement system (MAPS) and management science of health (MSH)(52,53) used to collect the necessary data about selection, quantification, procurement, inventory and distribution management. The data were gathered through documentary review, self-administered questioner, and physical observation. Regarding document review, one-year quantification document, purchase orders documents, contract management documents, receiving and issuing transaction documents (model 19 and 22) and HCMIS was evaluated. Two central EPSA workers were recruited for data collection. The principal investigators provided one-day training on how to collect the required data.

For the qualitative part, key informant interview with flexible probing techniques was designed to collect the qualitative data using a semi-structured questionnaire to identify challenges of logistics management of program commodities. The LSAT key guide originally developed by USAID/DELIVER was adapted to the local situations and used as guide for key informant interviews(54). The written informed consent was obtained from the participants to digital voice record in-depth interviews. Then 25 key informants were interviewed face to face and each on average took about 20 minutes. For the purpose of maintaining the consistency of information, the interviews were conducted by the principal investigator. The records were listened several times and transcribed from the voice recorder and data were analyzed using a thematic analysis approach. The findings grouped according to key themes and positions, and finally, presented by narration.

4.7 Data processing and analysis

The data were cleared, coded, and entered into the statistical package for social sciences version 23 (SPSS) for analysis. Descriptive statistics computed and results were presented using tables and charts. Since the data for procurement and distribution practices were collected using Likert scale questions, the neutral response was taken as cut of point to dichotomize the responses as good and poor practice. The average responses of three and above regarded as good practices and below poor.

4.8 Study variables
Dependent variable

Logistics management performance

- ✓ Selection and quantification performance
- ✓ Procurement performance
- ✓ Inventory management performance
- ✓ Distribution practices

4.8.2 Independent variables

Personal related variables

- ✓ Training
- ✓ Year of experience
- ✓ Education qualification
- ✓ Types of profession

Organization related variables

- ✓ Essential list of medicine
- ✓ Availability of SOP
- ✓ National quantification team(NQT)
- ✓ Procurement methods
- ✓ Procurement limited to EML
- ✓ Procurement prices
- ✓ Implementation of min/max inventory control system
- ✓ Types of LMIS managing tool
- ✓ Storage condition
- ✓ Transportation management
- ✓ Distribution documents readiness and communication
- ✓ Load-unloading practices

Supplier related variable

- ✓ Supplier lead time

4.9 Key logistics management performance indicators

1. Selection and quantifications were measured by the following indicators

a) Percentage of product procured (donated plus purchased) form essential medicine list
b) Forecast accuracy

2. Procurement performances of program commodities were measured

a) Supplier lead time
b) Supplier lead time variability
c) Percentage of average international price paid
d) Transparency
e) Competitiveness of suppliers
f) Efficiency (value for money)
g) Accountability

3. Inventory management were measured by the following indicators

a) order fill rate
b) average stock out days
c) Percentage value of stock wastage due to expiration or damage (wastage rate)
d) Value of unusable stock
e) Percentage of warehouse maintain acceptable storage conditions

4.10 Data quality assurance

The data collection tools were pre-tested on 2 quantification and market shaping officers, 2 procurement officers, 3 inventory management officers and 2 distribution officers of Jimma EPSA hub to check the clarity, ambiguity, and readability of the statements and questions. This was used the researcher to get feedback on leading and biased questions and complete the questionnaire. Tools were modified accordingly after the pre-test.

4.11 Ethical considerations

Ethical clearance obtained from the ethical review board of Jimma University (ref. IHRPGC192/2019 on 05 February 2019). Then a letter of cooperation and support from MOH & central EPSA and their respective directorates obtained. The data collection started after the EPSA and MOH approval of the official letter and the participants of the study asked for written consent before participating in the study. With regard to the qualitative study part, interviews recorded on digital voice recorder after interviewees gave oral informed consent and summary results of the in-depth interview reported by narration.

4.12 Plans for Dissemination of Findings

The final paper will be submitted to Jimma University Institute of health department of pharmacy graduate study. The result of this study will be submitted to EPSA, MOH, and for other concerned bodies through presenting the findings at the appropriate meetings, workshops, seminars and publishing in a journal. Those stakeholders in program commodity supply chain can use the finding and the recommendation of this study for the system strength.

4.13 Operational and standard definitions of terms

Program commodities: -It includes HIV/AIDS, TB, MCH and anti-malaria commodities

HIV/AIDS commodities: - Are medicine used to treat and care HIV infected people.

Antiretroviral therapy: - Refers to the use of a combination of three or more ARV drugs for treating HIV infection.

Supply chain management: - Management of products and information flow in a supply chain to provide the highest degree of customer satisfaction at the lowest possible cost

Logistics management documents: - It includes quantification, HCMIS, RRF, contract management, Model 19 and 22, purchase order documents

Damage: - Unusable products due to physical damage before expire date

Wastage: - Unusable items due to expired and damage

Dashboard: -The systems allow the spectrum of stakeholders from program managers to Ministry of health officials to donor agencies to monitor commodity stock status, anticipate

future funding gaps, respond to projected medicine shortages and expiries, and make decisions based on accurate information.

Pharmaceutical: -Means any substance or mixture of substances used in the diagnosis, treatment, mitigation or prevention of a disease, and include medical instruments and medical supplies.

Upstream: -Is the central point of the country where pharmaceutical product is selected, procured and distributed to lower level.

90-90-90 strategy: - That means 90% of people living with HIV know their status, 90% of diagnosed people living with HIV are on treatment and 90% of people living with HIV on treatment achieve an undetectable viral load, by 2020(21).

Transparency: Refers to the ability of all interested parties to know and understand the actual methods and processes by which contracts are awarded and managed.

Accountability: An ethical code of conduct, administered by the professional body for staff serving in procurement and property management units.

5. Result of the study

5.1. Study participant's characteristics

From 110 professionals participated in the study, 105(95.45%) were central EPSA workers and the remaining from the Ministry of health. The majority of the staff, 94 (85.45%) were pharmacy professionals and regarding, services year, 84 (76.4%) had less than 5. Seventy-five (68.2%) staff was degree, 19(17.3%) diploma and the left master's holders. More than half, 74(67.3%) of the staff were officers and 18(16.4%) were serving as storekeepers (Table1).

Table 1: Professionals' characteristics of selected for study in central EPSA and MOH, November 2019

Professional background variables		Central EPSA (%)	MOH (%)	Total (%)
Type of profession	Pharmacy	89(80.91%)	5(4.5%)	94 (85.45%)
	Medical laboratory	9(8.18%)		9(8.18%)
	Biomedical engineering	7(6.36%)		7(6.36%)
Qualifications	Diploma	19(17.3%)		19(17.3%)
	Degree	75(68.2%)		75(68.2%)
	Master	11(10%)	5(4.5%)	16(14.5%)
Year of experience	Below five	80(72.7%)	4(3.6%)	84(76.4%)
	Above five	25(22.7%)	1(0.9%)	26(23.6%)
Position	Officers	74(67.3%)	-	74(67.3%)
	Program managers	8(7.3%)	5(4.5%)	13(11.8%)
	Directorate managers	5(4.5%)		5(4.5%)
	Storekeepers	18(16.4%)		18(16.4%)
Total				110(100%)

Thirty (27.73%) study participants of EPSA staffs received only IPLS training, 31 (28.18%) received both IPLS and OSCM, 26(23.63%) trained warehouse management and 6(5.45%) pharmacy professionals received none of the trainings. Nonetheless, all of the participants 5(100%) from MOH received both IPLS and overview of supply chain management (Table 2).

Table 2: Study participants training status of central EPSA and MOH, November 2019

Professional Category	Health professionals IPLS, OSCM and other training profile	Central EPSA	MOH	Total
Pharmacy	IPLS only	20(18.2%)		20(18.2%)
	IPLS &OSCM	20(18.18%)	5(4.5%)	25(22.73%)
	Warehouse Management only	26(23.63%)		26(23.63%)
	Other	17(15.45%)		17(15.45%)
	Not trained	6(5.5%)		6(5.5%)
Biomedical engineering	IPLS only	4(3.63%)		4(3.63%)
	IPLS &OSCM	3(2.73%)		3(2.73%)
Medical laboratory	IPLS only	6(5.45%)		6(5.45%)
	IPLS &OSCM	3(2.73%)		3(2.73%)
Total		105(95.5%)	5(4.5%)	110(100%)

Other: Warehouse management and IPLS, OSCM: Overview of supply chain management, IPLS: Integrated pharmaceutical logistics system

5.2. Selection and quantification of program commodities

MOH and EPSA had a national drug policy document that guide country medicines management. The central EPSA has standard operating procedure (SOP) for all directorate activity. EPSA has developed its own pharmaceutical procurement list based on national essential medicine list and accordingly, 70(100%) program commodities selected for the study were in a national essential list. In developing an essential list of program commodities, patterns of prevalent disease, efficacy and safety, and costs were criteria in the agency.

Selection and quantification of program commodities was performed by the national quantification team. Team composed of central EPSA program coordinators and officers, MOH program commodities logistics managers and support partners with different professional backgrounds such as pharmacy, biomedical engineering, and medical laboratory technologists. The national quantification team exercises mixed quantification methods of consumption and morbidity methods. EPSA collects consumption data through its hubs and health facility reports and MOH collects morbidity data. The mean of percentage absolute deviation forecasts of program commodities was 29.08%. The average of percentage absolute deviation for HIV/AIDS, MCH, Malaria and TB commodities were 31.71%, 22.92%, 37.25%, and 24.42% respectively (Table 3 and Annex one).

Table 3: Percentage of forecasted absolute deviation of program commodities in central EPSA, November 2019

	% of forecasted absolute deviation HIV/AIDS commodities	% of forecasted absolute deviation MCH commodities	% of forecasted absolute deviation Malaria commodities	% of forecasted absolute deviation TB commodities
Mean	31.71	22.92	37.25	24.42
Standard deviation	17.23	16.63	31.73	15.98
Maximum	67.44	66.59	85.1	62.18
Minimum	0.59	3.26	2.85	0.31

5.3. Procurement performance of program commodities

EPSA purchased program commodities from international and national suppliers by open bidding method except for small quantity product and emergency purchase. Out of 70 program commodities selected for the study, 52 (74.3%) commodities had a median price less than international price paid and a mean 99.48%. The maximum percentage of the average international price paid was 487.76 for Artemether + Lumefanthrine - (20mg+120mg) Tablet (6x1). Considering suppliers lead time, in the past one year, central EPSA placed 36 orders of program commodities and all arrived with different time to warehouses and ready for use. The mean suppliers lead time was 137.33 days and 24 (66.67%) orders did not arrive within 90 days. Mean of percentage supplier lead time variability was 33.27% (Table 4 and Annex I&II).

Table 4: Percentages of average international price paid and suppliers lead of program commodities central EPSA, November 2019

Percent of IPP	Total number Of products	Mean	Standard deviation	Minimum	Maximum	Median	% of average IPP below 100%	% of average IPP above 100%
	70	99.48	92.43	3.97	487.76	69.45	52(74.35)	18(25.7)
Suppliers lead time	Number of orders	Mean Days	Standard deviation	Minimum days	Maximum days	Median	% of LT in acceptable range	% of LT not in acceptable range
	36	137.3	70.92	52	294	116	12 (33.33)	24 (66.67)

IPP: International price paid LT: supplier lead time

Source: Management Sciences for Health. International Medical Products Price Guide, 2016 (55)**.**

About, transparency, the competitiveness of suppliers, accountability and efficiency level of procurement practices of central EPSA collected by self-administered questioners from 40 professional working in tender and contract management directorates and they responded as follows:

Regarding, transparency in procurement management at central EPSA, 14 (35%) participants agreed that the agency had written procedure for all procurement process, 13 (32.5%) agreed information on tender process and results are open to the public to the maximum extent, 13 (32.5%) strongly agreed that none of the staff had a separate deal with non-contracted suppliers in the agency, 15 (37.5) strongly agreed that committees established for all different purchasing process in the procurement unit of the agency. The average responses of respondents were, 3.65 which indicate good level of transparency in procurement practice of agency (Table 5).

Table 5: The level of transparency in procurement practice at central EPSA, November 2019

	Transparency	Strongly Disagree frq (%)	Disagree frq (%)	Neutral frq (%)	Agree frq (%)	Strongly agree frq (%)	Average response
1	Develop and follow written procedures for all procurement actions	7(17.5)	3(7.5)	5(12.5)	14(35)	11(27.5)	3.48
2	Make information on the tender process and results public to the maximum extent possible	4(10)	2(5)	11(27.5)	13(32.5)	10(25)	3.58
3	There are no separate deals with non- contracted suppliers	2(5)	4(10)	10(25)	11(27.5)	13(32.5)	3.73
4	Different committees included in selection, approval of suppliers, and award of contracts.	1(2.5)	3(7.5)	4(10)	17(42.5)	15(37.5)	4.05
5	Use a formal monitoring system to ensure continued supplier qualification	4(10)	7(17.5)	6(15)	15(37.5)	8(20)	3.40
	Average response						3.65

Concerning, competitiveness of suppliers at central EPSA, 14(35%) individual agreed that agency use open bidding to purchase pharmaceuticals except, for emergency and small orders, 11(27.5%) agreed only prequalified suppliers to participate in restrictive tenders, 11(27.5%) agreed, agency evaluate suppliers after submission of bids in open tenders, 15(37.5%) strongly agreed that suppliers qualified based on pharmaceutical quality, service reliability, and financial viability, 15(37.5%) strongly agreed that generic names used for fair competition, 12(30%) agreed that agency measure suppliers performance before and after tendering. The average responses of respondents were, 3.40 which indicate good level of supplier's competition in procurement practice of agency (Table 6).

Table 6: **The level of competitions in procurement practice at central EPSA, November 2019**

Competitions	Strongly disagree frq (%)	Disagree frq (%)	Neutral frq (%)	Agree frq (%)	Strongly agree frq (%)	Average response
Use competitive bidding on all but very small or emergency purchases to obtain the best prices	7(17.5)	8(20)	5(12.5)	14(35)	6(15)	3.10
Allow only prequalified suppliers to compete in restrictive tenders	5(12.5)	5(12.5)	8(20)	11(27.5)	11(27.5)	3.45
Evaluate suppliers after submission of bids in open tenders.	6(15)	2(5)	11(27.7)	10(25)	11(27.5)	3.45
supplier qualification based on product quality, reliability, and financial viability	5(12.5)	4(10)	7(17.5)	9(22.5)	15(37.5)	3.63
Use generic names for fair competition.	2(5)	5(12.5)	11(27.5)	7(17.5)	15(37.5)	3.7
Approve suppliers performance before and after tendering	9(22.5)	8(20)	3(7.5)	12(30)	8(20)	3.05
Average response						3.40

When asked about accountability of procurement in central EPSA, 13(32.5%) respondents disagreed that the agency avails all procurement results to the appropriate public supervising body, 11(27.5%) disagreed, the agency develops consumption records and morbidity data, 9(22.5%) disagreed that the agency adjusts for past surpluses, shortages, stock-outs of pharmaceuticals, 14(35%) disagreed, the agency use key indicators to measure procurement performance, 15(37.5%) disagreed that the agency compares key procurement performance

indicators against targets at least annually in agency. The average responses of respondents were, 2.95 which indicate poor level of accountability in procurement practice of agency (Table 7).

Table 7: The level of accountability in procurement practice at central EPSA, November 2019

Accountability	Strongly lisagree frq (%)	Disagree frq (%)	Neutral frq (%)	Agree frq (%)	Strongly agree frq (%)	Average responses
Present results to the appropriate public supervising body	8(20)	13(32.5)	6(15)	6(15)	7(17.5)	2.78
Develop reliable consumption records and morbidity data.	4(10)	11(27.5)	8(20)	12(30)	5(12.5)	3.08
Adjust systematically for past surpluses, shortages, stock outs.	4(10)	9(22.5)	11(27.5)	7(17.5)	9(22.5)	3.2
Use key indicators such as IPR, LT, and Planned versus actual purchases.	5(12.5)	14(35)	7(17.5)	8(20)	6(15)	2.9
Report key procurement performance indicators against targets at least annually.	6(15)	15(37.5)	5(12.5)	9(22.5)	5(12.5)	2.8
Average response						2.95

Regarding, efficiency of procurement in central EPSA, 15(37.5%) participants agreed that agency select safe and cost-effective medicines for procurement, 13(32.5%) strongly agreed that agency concentrate purchases on limited list medicine, 14(35%) agreed agency develop mechanisms for reliable payment and bring down pharmaceutical prices more than bulk discounts, 13(32.5%) agreed that agency conducts an annual financial audit, 13(32.5) strongly agreed that central EPSA use specify divided deliveries to reduce inventory costs. The average responses of respondents were, 3.44 which indicate good level of procurement efficiency practice in the agency (Table 8).

Table 8: The level of efficiency in procurement practice at central EPSA, November 2019

Efficiency	Strongly disagree frq (%)	Disagree frq (%)	Neutral frq (%)	Agree frq (%)	Strongly agree frq (%)	Average responses
Select safe, effective, cost-effective medicines	5(12.5)	5(12.5)	8(20)	15(37.5)	7(17.5)	3.35
Concentrate purchases on limited list to increase quantities, reduce price	6(15)	2(5)	8(20)	11(27.5)	13(32.5)	3.58
Develop mechanisms for reliable payment, which might bring down pharmaceutical prices more than bulk discounts.	4(10)	8(20)	6(15)	14(35)	8(20)	3.35
Conduct an annual financial audit to assess compliance with procurement procedures	6(15)	4(10)	10(25)	13(32.5)	7(17.5)	3.28
Specify divided deliveries	3(7.5)	5(12.5)	8(20)	11(27.5)	13(32.5)	3.65
Average response						3.44

5.4. Inventory management of program commodities

EPSA established maximum/minimum and reorder levels for program commodities. In the agency also standard ordering schedules and procedures were developed. Concerning the frequency of placing orders, there were defined schedules and program commodities purchased twice a year. But, EPSA didn't follow the schedule strictly and purchase a maximum of four times per year. With regard to emergency orders, the agency has established procedures for placing emergency orders. Out of seventy program commodities selected for study, seventeen (24.29%) were purchased by emergency orders in the past year at least once. The central EPSA purchased program commodities fourteen times in the past year, out of that three were emergency purchase and in percentage 21.43% (III).

The central EPSA used a health commodity management information system (HCMIS) and hubs send their orders by email every two months. If the requested products not adequate in central warehouses they contact the program focal person through phone call and make adjustments.

5.4.1. Wastage and stock outs of program commodities

Out of the 70 program items selected for the study, 35 (49.3%) expired and 29 (40.8%) damaged and in value 77,759,124.75(98.93%) and 841,494(1.07%) ETB respectively in the past year.

From 3,821,397,092 ETB total inventory value for program commodities, 78,600,618.75 ETB was lost as a result of wastage of the products, making a wastage rate of 2.1 %. Average stock-out duration of central EPSA was 8.5 days (Figure 3 and annex III-VI).

Wastage and stock-outs of HIV/AIDS commodities

From 78,600,618.75 ETB program commodities wasted due to expiration and damage, HIV/AIDS commodities accounted for 7,252,652 ETB (9.22%). The wastage rate of HIV/AIDS commodities was 0.52% and the most wasted product was NVP 10mg/ml, oral suspension, 31.35% out of its total inventory value. Out of 17 HIV/AIDS commodities selected for study, 15 (88.23%) experienced stock-outs in the past year at least once. The most frequently stocked out product was Abacavir 300mg tablet two times in the past year. The maximum stock out durations in the past year was 35 and 33 days for 3TC + AZT (30 +60) mg tab and NVP 10mg/ml oral suspension, respectively. The minimum was for 3TC + TDF (300mg+300mg) tablet and LPV + RTV (200 + 50) mg tab, stocked out for 4 and 3 days, respectively. The average stock-outs of HIV commodities were 12.17 days (Figure 3 and annex III).

Wastage of MCH commodities and stock outs

From 78,600,618.75 ETB program commodities wasted due to expiration and damage, MCH commodities accounted 19,693,544ETB (25%). Wastage rate of MCH commodities was 1.09% and the most lost product was Misoprostol 200mcg tablet, 10.66% of its total inventory value. Five (41.67%) MCH commodities experienced stock-outs in the past year. The most frequently stocked out product was Levonorgestrel - 0.75mg tablet, two times in the past year. The maximum days out of stock in the past year were 12 and 36 days for Levonorgestrel - 0.75mg tablet and IUCD (Intrauterine Contraceptive Device), respectively.

The minimum was for Levonorgestrel+ Ethinylestradiol + Ferrous Fumerate - (0.15mg+0.03mg +75 mg) tablet and Levonorgestrel 0.03mg tablet for 5 and 7 days, respectively. The average stock-outs of MCH commodities were 5.83 days (Figure 3 and annex IV).

Wastage and stock outs of malaria commodities

From 78,600,618.75 ETB program commodities wasted due to expiration and damage malaria commodities accounted for 38,536,491ETB (49%). Wastage rate of malaria commodities was 13.18% and the most wasted product was Artemether+ Lumefantrine (20mg+120mg) tablet (6x3), 29.91% out of its total inventory value. Out of ten malaria commodities, 6 (60%) experienced stock-outs in the past year at least once. The two most malaria commodities stocked-out for longer periods were Artemether+ Lumefantrine (20mg+120mg) tab(6x2) and Artemether +Lumefantrine-(20mg+120mg) tablet (6x1), for 10 and 26 days, respectively in the past year. The average stock-out was 5.8 days (Figure 3 and annex V).

Wastage and sock outs of TB commodities

From 78,600,618.75 ETB program commodities wasted due to expiration and damage TB commodities accounted 13,117,931.08ETB (16.9%). Wastage rate of TB commodities was 4.1% and the most wasted product was Cycloserine-250mg-capsule, 45.98% of its total inventory value. Out of thirty-one TB products, 11 (35.48%) experienced stock-outs in the past year at least once. Bedaquiline100mg-tablet and Moxifloxacin-400mg-tablet were the two most stocked-out TB commodities for maximum days, for 46 and 47 days, respectively. The average days out of stock were 8.39 days. (Figure three and annex VI).

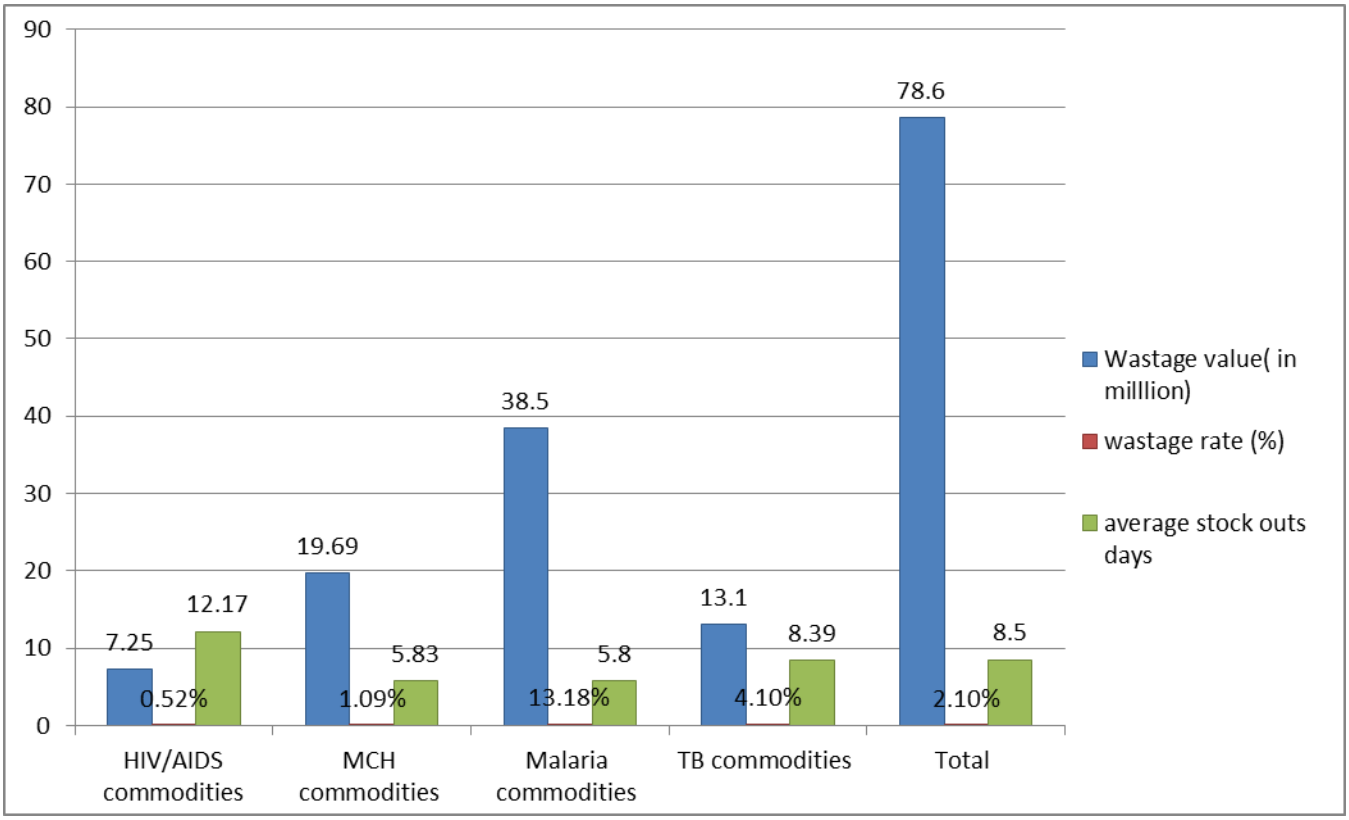


Figure 3: wastage and stock outs of program commodities in central EPSA, November 2019

5.4.2. Program commodities order resupply ability of central EPSA

From 108 orders of program commodities placed by EPSA hubs in 2017/18 year, 92(85.19%) fulfilled below 80% by central EPSA and only 16 (14.81%) orders were above 80 % fulfilled. Mean of orders fill rate was 52.9% (Table 10).

Table 9: Central EPSA orders fulfillment of program commodities, November 2019

	No of orders evaluated	Mean	Standard deviation	Minimum	Maximum	Acceptable order fill rate (>80%)
Order fill rate of central EPSA	108	52.9	22.74	9	91	16(15.38%)

5.4.3. Storage conditions of central EPSA warehouses

Out of 10, only 6 (60%) warehouses met acceptable storage conditions (fulfilled 80 % of the criteria or more). The average storage condition criteria fulfilled per warehouse was 77% (Figure 4).

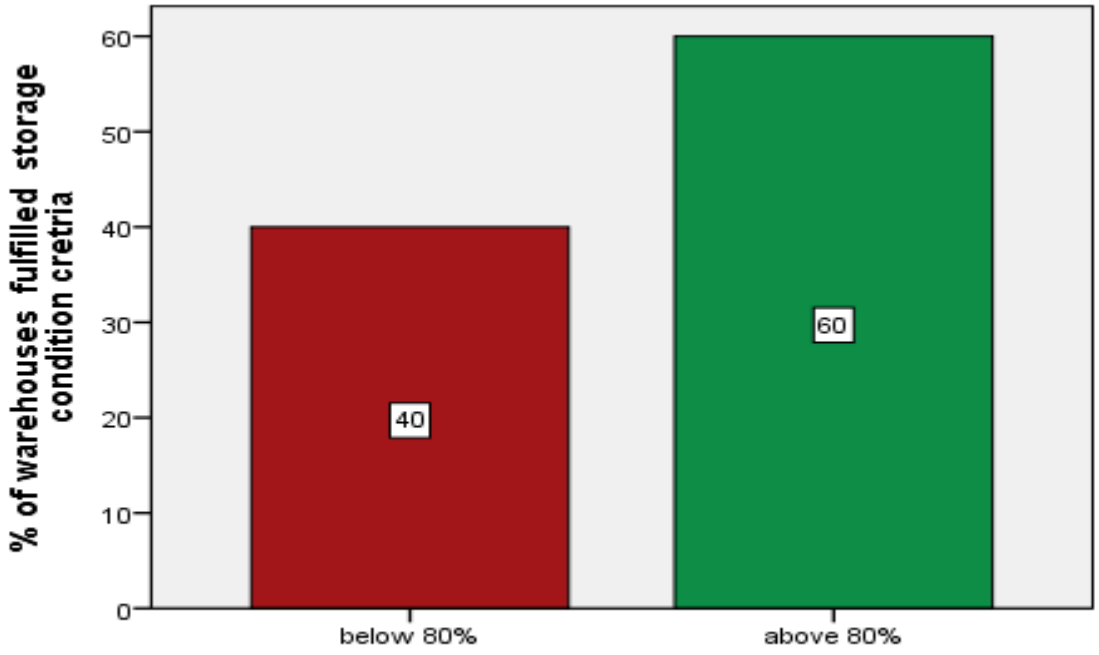


Figure 4 : Percentage of warehouses meeting acceptable storage conditions of EPSA November, 2019

From the warehouses assessed, 90% of it stored products at the appropriate temperature according to product temperature specifications, 100% of them secured storage area with a lock and key but is accessible during normal working hours, access is limited to authorized personnel, 10% of them arranged products on shelves with arrows pointing up, and with identification labels visible, 70% of it stacked products at least 30 cm away from the walls and other rows or stacks of products, 100% of them had fire safety equipment and 70% of its store products according to FEFO procedure. Finally, only 60% of the warehouses assessed had adhered to good storage practice standards according to this study. The table below illustrates the general storage conditions of the warehouses of central EPSA.

Table 10: Storage conditions criteria fulfilled by warehouses of central EPSA, November 2019

S.№	Description	Yes	No	Adherence (n)%
1	Products are arranged on shelves with arrows pointing up, and with identification labels, expiry dates, and manufacturing dates clearly visible.	1	9	1(10)
2	Products are stored and organized to FEFO procedures and are accessible for counting and general stock management.	7	3	7(70)
3	Outer cartons are in good condition (not crushed, perforated, stained, or otherwise visibly damaged).	8	2	8(80)
4	Damaged and expired products are separated from usable products in the storeroom, and procedures exist for removing them from inventory.	6	4	6(60)
5	Products are stored in a dry, well-lit, well-ventilated Store room.	10	0	10(100)
6	Cartons and products are protected from direct sunlight.	10	0	10(100)
7	There is no evidence of rodents or insects in the storage area.	10	0	10(100)
8	Storage area is secured with a lock and key but is accessible during normal working hours; access is limited to authorized personnel.	10	0	10(100)
9	Products are stored at the appropriate temperature according to product temperature specifications (8°–30°C) and including cold chain storage (2°–8°C), as required for certain products.	9	1	9(90)
10	Roof is maintained in good condition to avoid sunlight and water penetration.	9	1	9(90)
11	Storeroom is clean, with all trash removed, no evidence of Food and drinks, products stored on sturdy shelves/bins, and boxes organized neatly.	8	2	8(80)

12	Current storage space is sufficient for existing products and planned program expansion.	2	8	2(20)
13	Products are stored separately from insecticides, flammable products, and chemicals.	9	1	9(90)
14	Food and drinks are not stored together in refrigerator used for storing product that requires cold storage.	10	0	10(100)
15	Fire safety equipment is available and accessible.	10	0	10(100)
16	Products are stacked at least 30 cm away from the Walls and other rows or stacks of products.	7	3	7(70)
17	Products are stacked at least 10 cm off the floor	5	5	5(50)

5.5. Distribution practices of central EPSA

The central EPSA used pull distribution system and each hub sends their orders to central EPSA every two months by determining the type and quantity of program commodities they required. Then it delivers products to each hub with its vehicles and drivers. Regarding, transportation management, distribution documents readiness and communication and load -unloading practices level of distribution of central EPSA collected by self-administered questioners from 55 professional working in warehouses, distribution and fleet management and they responded as follows:

Concerning, fleet management and coordination of distribution in central EPSA ,16(29.1%) respondents disagreed that agency has adequate type and number of vehicles for pharmaceuticals distribution, 11(20%) strongly disagreed that transport and distribution units plan together to assign delivery vehicles, 13(23.6%) disagreed that the information system used to control vehicles, 14(25.5%) disagreed that vehicles assigned as soon as requested from the distribution unit, 15(27.3) disagreed that clear line of communication between distribution and general unit in the agency. When asked about the distribution documents preparation and communications in central EPSA, 16(29.1%) participants disagreed that delivery documents prepared as soon as requests come from hubs, 10(18.2%) strongly disagreed that all products loaded on a specific vehicle can be collected from a single warehouse, 16(29.1%) disagreed that there are strong communication and cooperation between distribution officers and store managers in the agency, 16(29.1%) disagreed that pharmaceuticals are loaded and dispatch as soon as delivery documents arrive at the warehouse**.**

Considering, loading -unloading distribution practices of central EPSA, 19(34.54%) agreed that drivers have some resistance to carry pharmaceuticals as per full capacity of the vehicles, 16(29.1%) disagreed that vehicles are suitable to load pharmaceuticals according to the distance of delivery sites, 12(21.8%) disagreed that agency has a mechanism to load pharmaceuticals for separate branches (Table 13).

Table 11: Distribution practices of central EPSA, November 2019

Distribution practices	Strongly disagree frq (%)	Disagree frq (%)	Neutral frq (%)	Agree frq (%)	Strongly agree frq (%)	Average response
Fleet management and coordination						
Adequate type and number of vehicles available	7(12.7)	16(29.1)	9(16.4)	9(16.4)	11(20)	2.85
Transport and distribution units plan together to assign delivery vehicles	11(20)	10(18.2)	12(28.6)	8(21.8)	9(16.4)	2.62
Vehicles are reserved for emergency orders	3(5.5)	8(14.5)	15(27.3)	14(25.5)	11(20)	3.2
Management information system is used to control vehicles	7(12.7)	13(23.6)	11(20)	14(25.5)	10(18.2)	3.13
Vehicles are assigned as soon as requested from distribution unit	10(18.2)	14(25.5)	11(20)	10(18.2)	10(18.2)	2.93
There is clear line of communication between distribution and general unit	11(20)	15(27.3)	11(20)	11(20)	7(12.7)	2.78
Average response						2.91
Distribution documents preparation and communications						
Delivery documents are prepared as soon as requests come from hubs	8(14.5)	16(29.1)	11(20)	11(20)	9(16.4)	2.95
Delivery documents are prepared and all products loaded on a specific vehicle can be collected from a single warehouse	10(18.2)	16(29.1)	11(20)	12(21.8)	6(10.9)	2.93

There is strong communication and cooperation between distribution officers and store managers	6(10.1)	16(29.1)	9(16.4)	13(23.6)	12(21.8)	3.2
Pharmaceuticals are loaded in the same day that delivery documents arrive at the warehouse	9(16.4)	16(29.1)	9(16.4)	15(27.3)	6(10.9)	2.87
Average response						2.99
Loading Unloading issues						
Drivers have some resistance to carry pharmaceuticals as per full capacity of the vehicles	8(14.5)	18(32.7)	7(12.7)	19(34.5)	3(5.6)	2.76
Vehicles are comfortable to load pharmaceuticals according to the distance of delivery sites	10(18.2)	16(29.1)	11(20)	10(18.2)	8(14.5)	2.81
There is mechanism to load separately pharmaceuticals for separate hubs	11(20)	10(18.2)	12(18.2)	12(21.8)	7(12.7)	2.94
Average response						2.84
Average response for distribution practices						**2.92**

5.6. Challenges for logistics management of program commodities

Face to face in-depth interview was conducted to identify the challenges associated with the selection, quantification, procurement, inventory management, LMIS and distribution practices of program commodities and forwarded important recommendations to improve performance in the system. The key informants identified various types of problems, and the findings thematically analyzed by categorizing based on the feature of the data.

Data quality related challenges

Information is the engine driving the entire logistics management cycle. Most of the interviewees, especially the quantification officers mentioned that, the lack of accurate recorded consumption and morbidity data from service delivery points. Quantifying needs and smoothing logistics management was challenging without quality data and results in stock outs and wastage of essential medicine. One of the MOH logistic focal explained the problem as follows: *"The major problems encountered in the quantification of program commodities were inaccurate, incomplete and not timely report data from service delivery points. This leads to unacceptable forecasting error and mostly depends on assumption. It finally results in increases national stock-outs and wastage of program commodities*". Most key informants recommend: EPSA should have create awareness for the service delivery point professionals about quality data and its importance in logistics.

Human resource and staff's commitment related challenges

Skilled and committed human resource is important in logistics management. Most of the interviewee especially inventory management and warehouse officers mentioned that lack of adequate skilled and committed persons in an agency. The reasons raised by interviewee were professionals earned an inadequate salary, most drivers and loading- unloading workers have no good awareness about pharmaceuticals and they look as other cargo, the junior staffs with fewer years of experience participating in procurement, but EPSA deal with international suppliers, which needs deep knowledge of supply chain. One of the distribution officers explained the problems as follows; *"Most personnel participate in loading-unloading activity has an inadequate understanding and less committed as they are paid inadequate salary and not permanent employees. This leads to poor arrangement and damage of products in most central warehouses. Regarding drivers when they sent to hubs they stayed on the road above given time*

and sometimes transports other non-pharmaceutical products to get their advantages, this might be due to low salary. So, when new orders prepared for dispatch due to lack of enough vehicles and sometimes resistance transporting products to remote hubs, we face the big challenge. Most key informants recommend: The central EPSA should increase skilled staff numbers to agency and give necessary orientation to all individual participated in distribution.

Inter and intra agency communication related challenges

Central EPSA has many directorates and stockholders participate in the country supply chain systems. Without close communication and information share difficult to make appropriate decisions on logistics management. Most key informants mentioned problems in inter directorates communication, especially between store managers and distribution officers, tender and contract management. The reasons behind were less staff commitment, the burden of works, job dissatisfaction, and lack of individual risk reduction in the agency. One of contract management directorate team coordinator elucidates problems as follow, "*In contract management, we deal with many stockholders, EFMHACA, customs, and international and national suppliers. Working in this directorate has many risks at each stage, but EPSA has no risk mitigation mechanisms because of this, many staff shift towards other directorates*". Most key informants recommend: Central EPSA should increase the number of staff to reduce work burden and facilitate staff incentives.

Storage condition related challenges

Maintaining proper storage conditions for health commodities is vital to ensure product quality, reduces damage, maintains expiration dates and simplify locating product in warehouses. However, central EPSA has the following challenges. There are no sufficient storage spaces, products stored in different warehouses were space available, some warehouses are old design and not suitable for storage. Most warehouses have no appropriate dock and some of them didn't have required storage equipment such as racking and shelves so, difficult to follow FEFO inventory management systems.

One of the store managers explained the problems as follows, *"Some warehouses have no racks, zoning, necessary handling equipment and products stored on the ground by the pallet so, difficult to follow FEFO procedure to simply identify damaged products and ease movement in the warehouses. As a result, increase wastage of products due to damage and expire. Even though products available in the warehouse, sometimes it's regarded as stock out products due to difficult physical tracing in the warehouse."* One distribution officers elucidate problems as follows, *"One of the main challenges we faced was the distance between the warehouses of central EPSA and collecting one order from different warehouses which results in wastage of time, resources and increase transportation costs. Regarding, loading-unloading issues, most warehouses have no good dock and impossible to load and unload during rain"*. Most key informants recommend: all warehouses should have a rack, different zone and necessary storage equipment's. The old design should be replaced by a modernized one. Program commodities should store in one warehouse, if not enough in two warehouses near to each other.

Transportation related challenges

The availability of adequate number and types of vehicles for the distribution of medicines is important. Most key informants mentioned that central EPSA has an inadequate type and number of vehicles to distribute pharmaceutical to all hubs. EPSA has many hubs which found at a different distance within different regions of the country. The central EPSA distributes high number and quantities of products to all hubs. One of the distribution officers explained; *"There are great challenges in fleet management that the agency has only 65 functional and four types of vehicles. These are not sufficient to distribute program commodities to18 hubs. Because of these reason hubs, resupply can delay up to one week. Another challenge, GPS not completely implemented and working*". Most key informants recommend: Increase numbers and type of vehicles used for products distributions and GPS should be implemented completely and managed accordingly.

6. Discussion

Selection and quantification of program commodities

The study was aimed to evaluate logistics management performance of program commodities. Limiting the variety of products used and available at public facilities can make the supply chains more manageable. Developing and adhering to the national essential medicine list is important to identify and insuring the availability of essential medicine in the country (7). The present study revealed that all products (100%) selected for the study were from the national essential medicine list. This is better than the 2016 Benin national supply chain assessment(27), and an in-depth assessment of the medicines supply chain in Tanzania (44), where adherence to national essential medicine list were 85% and 52% respectively. The possible reason for difference might be Ethiopian update essential medicine list as needed to include important products and have standard operating producers for EML usage. Non-adherence to the national essential medicine list leads wastage of resources on non-prioritized medicine and stock out essential medicine.

Quantification results are used to inform higher-level decision making on the financing and procurement of commodities to ensure that appropriate products are available constantly to treat, promote and maintain the rational and economic use of it(6). However, in the current study, forecasts mean absolute percentage deviations for program commodities was, 29.06% which is not in the acceptable range. In the Ethiopian context, the forecast error of 25% or less is usually the accepted standard margin(56). The mean absolute percentage deviations forecast for MCH and TB commodities was 22.92% and 24.42% respectively which were in an acceptable range, whereas for HIV/AIDS and malaria commodities 31.71% and 37.25% respectively, which deviate from the normal range. These indicate the weak performance of forecasting program commodities that led to wastage and stock outs of essential medicines in the agency. But the current findings are better than the study done in Namibia, where quantification systems where generally weak and procurement quantities for drugs are determined by adding 10% to the quantity procured to the previous year and consumption data not collected from service delivery points(42). This difference might be due to a functional national quantification team with the different professions of EPSA, MOH, and support partners were participated in quantification and consumption data collected for requirements determination from service delivery point.

However, the present study result is in line with 2016, Benin national supply chain assessment where program commodities forecasting accuracy was, 71%(27), and 2014 a study conducted in Tanzania where forecasting accuracy for MCH and HIV/AIDS commodities, 78% and 80% respectively(45). From key guide interviews, the major problems encountered in the quantification of program commodities were inaccurate, incomplete and late submission of reports data from service delivery points. In addition to this, lack of committed staff in the agency led to unacceptable forecasting error of program commodities.

Procurement of program commodities

The lower the percentage of the average international price paid, the more the cost savings and when greater than 100%, the country is paying a premium on the average international prices(56). In the present study, out of 70 program commodities selected for the study, 52(74.3%) commodities prices were below median international prices paid, and 18(25.7%) were above the median international price. The maximum percentage of the average international price paid was 487.76 for Artemether + Lumefanthrine - (20mg+120mg) Tablet (6x1) which was more than four times of acceptable international price paid. The mean percentage of the average international price paid was 99.48% and in the acceptable range. This result is better than the study conducted in Kenya were inefficiency and incompetence of administration and management of procurement function in many public institutions contribute to loss of over 50 million Kenyan shillings annually(26). The possible reason might be central EPSA use bulk purchase, which reduces the unit price of products and open tender procurement method that increases transparency and efficiency of procurement. In our study, from 36 program commodity order placed by central EPSA, only 12 (33.33%) arrived and ready for use with ninety days (supplier lead time settled by central EPSA). The mean of supplier's leads time were 137.33 days which was more than the settled time and order delayed up to 294 days. This is far below Ethiopia, 2015 health sector development Program (HSDP) four, plan for supplier lead time was 120 days(57). However, the findings is somewhat comparable to 2016, Benin national supply chain assessment where average orders lead time, 192 days and 80% of suppliers' lead time was above 100 days (settled days)(27). From key guide interview, the possible reasons for delayed of supplier lead time were central EPSA not measure and take corrective actions and lack of staff

commitments. Delayed suppliers lead time increases stock out of products, emergency procurement and customer dissatisfaction which affect patient treatment outcome.

The goal of pharmaceutical procurement is to ensure the most efficient, transparent, provision of goods and services of appropriate quality at a competitive price, good value for money, and a fair manner for the use of public funds and resources (39). Transparency, supplier's competitiveness, efficiency and accountability are indicators of good procurement practices level in agency. The present study revealed that there are transparent procurement practice in the agency wherein, 14 (35%) participants agreed that the agency had written procedure for all procurement procedures, 13 (32.5%) agreed information on tender process and results are open to the public to the maximum extent, 13 (32.5%) strongly agreed that none of the staff had a separate deal with non-contracted suppliers in the agency, 15 (37.5%) strongly agreed that committees established for all different purchasing process in the procurement unit of the agency. The average response was 3.65 which indicate good transparency level in agency. This finding is better than in-depth assessment of procurement and supply management systems for medical products in Nigeria, where programs commodities procured by various methods but, they could not indicate the percentage of each category which was used in the previous year, no criteria for procurement method choice, no determined average lead time from publication of tenders to contract signing, no standard operating procedures for tenders, pre-selection of suppliers and criteria for contract award during the procurement process, and none of the programs gave evidence of a technical committee for the analysis and award of tenders(28). The possible reason for difference might be EPSA have standard operating procedure and committee in procurement management practice.

Anticompetitive conduct affecting the outcome of the procurement process is a particularly pernicious breach for competition rules (40). The present study result showed good competitiveness of suppliers in the agency wherein, 14(35%) individual agreed that agency use open bidding to purchase pharmaceuticals except, for emergency and small orders, 11(27.5%) agreed only prequalified suppliers to participate in restrictive tenders, 11(27.5%) agreed, agency evaluate suppliers after submission of bids in open tenders, 15(37.5%) strongly agreed that suppliers qualified based on pharmaceutical quality, service reliability, and financial viability, 15(37.5%) strongly agreed that generic names used for fair competition. The average response was 3.40 which indicate good supplier's competitiveness level in agency. This finding is better

than Tanzania medical store department, 2011 report where procurement plans not monitored or updated appropriately, some procurement methods used were not properly justified, delays were evident between stages in the procurement process, tender opening attendance records not properly kept, the time lapse between tender closure and opening was reportedly long (in cases up to 128 days), the composition of the evaluation team was not appropriate, and medical stores department awarded tenders beyond their bid validity periods in certain instances (46). The possible reason for difference might be EPSA used open bidding procurement method except for emergency purchase and small quantity and agency have standard operating procedure for procurement practices. The poor procurement practices causes stock outs of essential medicine, mismanagement of scare resource for health, reduce competitiveness and fair participation of suppliers.

Inventory management of program commodities

A well-functioning LMIS should collect and report key information needed for forecasting commodity needs and making rational decisions on financing, procurement, scheduling of shipments, and routine ordering without burdening service providers (8) . In the current study central EPSA used health commodity management information system (HCMIS) in recording, managing and reporting program products in warehouses. This is better than 2016, Benin national supply chain assessment, where LMIS reporting is paper-based and fragmented throughout the supply chain system and this significantly affects the availability of data to inform order quantities and national-level forecasting (27). The difference may be Ethiopia has a well-designed LMIS for program commodities and implement IPLS for it and used automated logistics information management system in EPSA and most health facilities.

Wastage of program commodities

Strong inventory management system results in a well maintained stock levels, smooth consumption patterns, and supplies that always arrive on time. While, poor inventory management leads to waste of financial resources, overstock and shortages of essential medicines(56). The current study showed that a total of 78,600,618.85 ETB lost due to expiry and damage in the past year and making wastage rate 2.1%. This was not in line with 2015 Ethiopian health sector development Program (HSDP) IV plan, which targeted wastage rate

below 2%(57). Among four program commodities, HIV/AIDS (0.52%) and MCH (1.09%) commodities wastage rate within acceptable range but, Malaria (13.18%) and TB (4.1%) were more than a hundred times of acceptable standard. The possible reasons for unacceptable wastage rate might be poor forecasting needs, lack of staff commitment and poor storage conditions. *One of the inventory management officer explained the problem as follows: The major problems encountered in the management of program commodities were inaccurate, incomplete and not timely report data from service delivery points. This led to unacceptable forecasting error and mostly depends on assumption. Finally results in increases national stock-outs and wastage of program commodities*". Wastage of medicines by expiring and damaging poses significant supply chain management problems by increasing stock out of essential medicine, wasting of scarce resources for procurement and removing it after out of use. Finally leads to interruption of supply and patient dissatisfaction.

Stock outs of program commodities

Availability of drugs largely influences the quality of healthcare and patient satisfaction. HIV/AIDS treatment cannot be interrupted without risk for the development of drug resistance and worse survival people on it, and need continuous supply of commodities(35). In the current study an average stock outs days of program commodities of central EPSA was 8.5 days and 5.8 for Malaria commodities. This is better than the study conducted in Malawi in 2007, where stock out of anti-malarial drugs was ranging from 42 to138 days(23). The difference might because of central EPSA is the aggregate supply of the country than zonal and health facility stores. However, the current study finding is in line with a study conducted in Uganda and Kenya in 2008, showed that despite the fact that the countries were receiving drugs from the global fund to fight AIDS, TB and Malaria they faced stock-outs of malaria commodities. Stock out of essential program commodities at upstream supply chain system causes stock out and interruption of service to downstream supply chain system. In the present study, out of 12 MCH products assessed, 5(41.7%) faced stock out and average stock-outs of it was 5.83 days. This is comparable with the study conducted in Kenya, where monitoring and distribution of program commodities from national warehouses to service delivery points remains obstacle and 40% of the 13 MCH priority commodities out of stock(48). Regarding to TB commodities, 11 (35.48%) were experienced stock-outs and on average 8.39 days. This result is better than audit report of

global fund grants in the Republic of Niger in 2018, where 75% TB drugs out of stock at the central level for several months(22). The possible reason for difference might be in Ethiopian program commodities mostly funded by donors and IPLS implemented with automatic LMIS which help actively to tackle problem and redistribution of commodities.

The percentage of all customer orders placed to a distribution source over a period of time that filled correctly (at least 80%) in terms of items and quantities of those items to fit the current context of Ethiopia (56). However, from the current study, out 108 program commodities orders placed by EPSA hubs only, 16 (14.81%) were achieved above 80 % and 92(85.19%) fulfilled below 80% by central EPSA. The mean order fill rate was 52.9% which was far below acceptable Ethiopian standards and leads to stock out of commodities downstream of the pharmaceuticals supply chain of the country. However, the finding is comparable with 2016, Benin national supply chain assessment, ordered fill rate at central medicine store and regional level 73% and 66% respectively(27). This indicates the supply agency has inefficient demand planning and forecasting, poor inventory management and leads stock outs of program commodities downstream supply chain system. In the current study, from assessed program commodities central EPSA purchased 17(24.29%) by emergency orders and making percentage emergence order 21.43%, which is comparable with, 2016 Benin national supply chain assessment where the percentage of emergency orders placed at central and regional medicine store level was 15% and 35%, respectively (27). This indicates an unavailability of medicine at all time and causes interruption of supply and poor patient treatment outcome.

World health organization, state maintaining proper storage conditions for health commodities are vital to ensure their quality, expiration date and accordingly serving customers and conserving resources(43). In the present study, only six (60%) warehouses met acceptable storage conditions criteria (fulfilled 80% of the criteria or more) and the mean storage condition criteria fulfilled per warehouse was 77%. However, in the Ethiopian context, acceptable storage condition criteria is defined as warehouses that fulfilled at least 80% of the storage condition(56). The possible reasons for poor storage conditions are insufficient storage spaces, some warehouses old design and not suitable for storage and does not have required storage equipment such as racking and shelves.

One of the store managers explained the problems as follows, *"Some warehouses have no racks, zoning and necessary handling equipment so, products stored on the ground by the pallet and difficult to follow FEFO procedure, to simply identify damaged products and ease movement in the warehouse was difficult. As a result, increase wastage of products due to damage and expire. Even though products available in the warehouse, sometimes it's regarded as stock out products due to difficult physical tracing in the warehouse."*

Distributions

Regardless of push and pull type of distribution system used, procedures should be in place to monitor and document the movement of commodities from the upper levels to the lower levels (9). The primary distribution management goal is to maintain a steady supply of pharmaceuticals to facilities where they are needed while ensuring that resources are being used in the most effective way(56). In the current study, central EPSA used pull distribution systems where each hub sends their orders to central EPSA every two months by determining the type and quantity of program commodities they required and delivered by central EPSA vehicles and drivers. This is better than the study done in Nigeria revealed that distribution of medicines is mainly contracted to private agents and based on a push system with no specific schedule or pre-determined interval but at the requests of the manager of programs(28). The difference may be due to EPSA has distribution schedule and standard operating procedure.

In the present study poor fleet management and coordination in agency wherein ,16(29.1%) respondents disagreed that agency has adequate type and number of vehicles for pharmaceuticals distribution, 11(20%) strongly disagreed that transport and distribution units plan together to assign delivery vehicles, 13(23.6%) disagreed that the information system used to control vehicles, 14(25.5%) disagreed that vehicles assigned as soon as requested from the distribution unit, 15(27.3%) disagreed that clear line of communication between distribution and general unit in the agency. The average response was 2.91 which indicate poor fleet management level in agency. This is comparable to, 2011 the world medicines situation storage and supply chain management study, where products are generally not delivered within the deadlines due to lack of a vehicle, poor condition of the vehicle as well as available vehicles are insufficient for effective delivery(19). The poor fleet management does not guarantee timely deliveries of pharmaceuticals, safeguard of products and derives, and increase transportation costs and finally

lead to poor product availability and logistics management inefficiency. The current study also showed poor distribution documents preparation and communications and average response of respondents was 2.99 which indicate poor practices in agency and for loading -unloading distribution practices average response was 2.84 and poor practices. The possible reasons for poor distribution practices, mentioned by most key informants were, central EPSA has an inadequate type and a number of vehicles to distribute pharmaceutical to all hubs and it has many hubs which found at a different distance within different regions of the country and distributes high number and quantities of products to all hubs. One of the distribution officers explained; *"There are great challenges in fleet management that the agency has only 65 functional and four types of vehicles. These are not sufficient to distribute program commodities to18 hubs. Because of these reason hubs, resupply can delay up to one week. Another challenge, GPS not completely implemented and working*".

7. Strengths and limitations of the study

Strengths of the study

Combination of both quantitative and qualitative method helps to supplement the findings with each other. The study included selection, quantification and procurement of program commodities which only done at upstream supply chain management of the country.

Limitation of study

The study did not include quantitative data quality of LMIS because physical count of all program commodity included in the study is not feasible. Local and international suppliers at the upper tier of the supply chain system were not included and study variables are not feasible to higher statistics because of the study lack of adequate sample size units.

8. Conclusions and Recommendations

Conclusions

Program commodities quantification performance was below the standard, due to an inaccurate, incomplete and not timely report of data from services delivery points and lack of staff commitment. In the central EPSA there was good procurement practice which implicated by good transparency, the competitiveness of suppliers, efficiency in the agency and mean international price paid of program commodities in an acceptable range. The poor inventory management practice in the agency led to wastage of products through expiring, while stock out of essential medicines and the storage conditions of central EPSA warehouses were below recommended standard. Distribution practices of central EPSA were poor which expressed by poor loading-unloading practices, communication and document preparation and fleet management in the agency. The major challenges that influence distribution practices were lack of skilled and committed staff and lack of enough type and number vehicles. Overall poor logistics management of program commodities.

Recommendations

Based on the finding of this study the following recommendations can be forwarded

To central EPSA

- ✓ Measure suppliers lead time and take corrective action according to contracts.
- ✓ Work to reduce the wastage level of program commodities by improving forecast accuracy, storage conditions and staff communication within the agency.
- ✓ Improve the storage conditions of warehouses by fulfilling important storage equipment, store program commodities in one or two warehouses, and replace old warehouses design by modern.
- ✓ Increase the availability of program commodities and order fill rate of hubs to standard level (above 80 %) and reduce stock-outs downstream of the supply chain.
- ✓ Work to increase the number and the skills of professionals in the agency.
- ✓ Improves distribution practices through increasing number and type of vehicles required and skilled and committed staff.

To MOH and central EPSA

- ✓ Should facilitate report of quality data from service delivery points and create awareness of the importance of quality data for service delivery point professionals to improve forecasting accuracy and reduce wastage and stock-outs.
- ✓ More detailed and large scales studies need to be conducted to see the status of logistics management for program commodities nationally

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Annex I: Forecast error of program commodities central EPSA, November 2019

Lists of Products	Forecasted quantity	Actual consumption	Absolute deviation	Absolute deviation % (% forecasting error)
ABC 300mg tab	41279	33781	7498	22.19
Atazinavir/r300mg +100mg tab	165050	117130	47920	40.91
Efavirenze 200mg capsule	23548	30848	7300	23.66
Efavirence 50mg capsule	84897	59184	25713	43.45
Efavirence 600mg tab	601966	805893	203927	25.3
Lamivudine(3TC) 150mg tab	70239	47093	23146	49.15
3TC +EFV + TDF (300+600+300)mg tab*	3683641	3193578	490063	15.34
3TC + NVP + AZT (150 +200+ 300)mg tab*	794864	1361341	566477	41.61
3TC + NVP + AZT (30 +50+ 60)mg tab*	279603	281272	1669	0.59
3TC + TDF (300mg+300mg) tab	675676	696869	21193	3.04
3TC + AZT (150 +300)mg tab*	677856	854037	176181	20.63
3TC + AZT (30 +60)mg tab	95945	161106	65161	40.45
3TC + ABC (30 +60)mg tab	74324	57175	17149	29.99
LPV + RTV(100 + 25)mg tab	5712	4224	1488	35.23
LPV + RTV(200 + 50)mg tab	28553	59125	30572	51.71
NVP 10mg/ml, 20ml oral suspension*	64746	198880	134134	67.44
NVP 200 mg tab	593323	828962	235639	28.42
Artemether + Lumefanthrine -	6622	34627	-28005	80.87

(20mg+120mg) Tablet (6x1)				
Artemether + lumefantrine (20 +120)mg 6x2 tablet	7510	50403	-42893	85.10
Artemether + Lumefanthrine - (20mg+120mg) Tablet (6x3)	3907	11936	-8029	67.26
Artemether + Lumefanthrine - (20mg+120mg) Tablet (6x4)	75953	55787	20166	36.15
Artesunate - 60mg - Vial – Injection	176289	129076	47213	36.58
chloroquine Phosphate - 50mg – syru	121098	85053	36045	42.38
primaquine 7.5mg tablet	96109	93010	3099	3.33
Chloroquine Phosphate - 150mg – Tablet	68235	70238	2003	2.85
Quinine Sulfate - 300mg – Tablet	29081	31234	2153	6.89
Rapid Diagnostic Test (Malaria AGPF/PV)	229186	257645	28459	11.05
Condom Male Latex - 180mmx53mm	28046947	24305280	3741667	15.39
Condoms (Female)	12754	10854	1900	17.51
Etonogestrel-68mg Capsule	1205457	1022324	183133	17.91
IUCD(Intrauterine Contraceptive Device) - Long acting	495580	380448	115132	30.26
Levonorgestrel - 75 mg/rod of 2rods - implant rods (Sub dermal) with sterile insertion trocar	338980	393384	54404	13.83
Levonorgestrel (D-Norgestrel) - 0.03mg tablet	281912	438792	156880	35.75
Levonorgestrel (D-Norgestrel) - 0.75mg tablet	389420	424122	34702	8.18

Levonorgestrel(D-Norgestrel) + Ethinylestradiol + Ferrous Fumerate - (0.15mg + 0.03mg +75mg) – Tablet	1848974	2171040	-322066	14.83
Medroxyprogesterone Acetate - 150mg/ml in 1ml vial - Injection with 3ml Syringe (Aqueous suspension)	10171390	12960392	2789002	21.52
Mifepristone + Misoprostol - (200mg (1Tablet) + 200mcg (4 Tablets)) – Tablet	4290000	3300000	990000	30
Misoprostol - 200mcg – Tablet	1861776	1117548	744228	66.59
Misoprostol 25mcg Tablet	36864	35700	1164	3.26
Isoniazid -(INH) 300mg –tab	98645	71507	27138	37.95
RHZE(150mg+75mg+ 400mg+275mg) of 6x28 tablets + (150mg+75mg) of 12x28 tablets – Tablet	120677	139203	18526	13.31
Pyridoxine HCL 25 mg – tab	354089	289444	64645	22.33
Ethambutol - 400mg – tab	224	286	62	21.68
Ethambutol - 100mg – tab	29337	33882	4545	13.41
Isoniazid - 100 mg – tab	82645	77488	5157	6.65
RH - (75mg+50mg) – tab	69773	90765	20992	23.13
RHZ - (75mg+50mg+150mg) -tab	34530	34044	486	1.43
Amino salicylic Acid Delayed - Release granules,4gms – Solution	1492	1050	442	42.1
Amoxicillin + Clavulanic Acid -	15606	11528	4078	35.37

(500mg +125mg) - Tablet (Film Coated)				
Capreomycin - 1g in vial - Powder for injection	154710	126107	28603	22.68
Cycloserine-250mg-capsule	14180	25178	10998	43.68
Kanamycin Sulfate - 1gm/4ml – Injec	3361	4634	1273	27.47
Levofloxacin - 250mg – Tablet	15241	13640	1601	11.74
Moxifloxacin-400mg-tablet	1278	788	490	62.18
Prothionamide - 250mg – Tablet	15011	9767	5244	53.69
Pyrazinamide- 400g-Tablet	3167	5766	2599	45.07
Bedaquiline -100mg-Tablet	259	174	85	48.85
Linezolid- 600mg-Tablet	5480	4658	822	17.65
Clofazimine – 100mg-Tablet	4	6	2	33.33
Clofazimine – 50mg-Tablet	819	732	87	11.88
Delamanid – 50mg – Tablet	42	50	8	16.00
Auramine – O 50mg	4222	4209	13	0.31
Auramine – O 1000mg	42	51	9	17.65
Basic fuchsine – crystal 25gm	500	450	50	11.10
Ethanol - 96% RL 1000ml	5257	5809	552	9.5
Hydrochloric Acid - Concentrated 37%	146	199	53	26.63
Immersion oil 100ml	1100	1411	311	22.04
Methylene Blue - powder 25g	194	315	121	38.41
Phenol – Crystal 500mg	1679	2007	328	16.34
Phenol – Crystal 1000mg	180	174	4	3.45
Mean absolute deviation %				**29.08%**

Annex II: International price paid reference of program commodities central EPSA, November 2019

Lists of Products	EPSA Price paid (in $)	International Price of product ($)	% international price reference
ABC 300mg tab	0.134	0.29	46.21
Atazinavir/r300mg +100mg tab	0.468	0.904	51.81
Efavirenze 200mg capsule	0.035	0.0457	76.59
Efavirence 50mg capsule	0.0357	0.0442	80.77
Efavirence 600mg tab	0.0987	0.1333	59.04
Lamivudine(3TC) 150mg tab	0.023	0.0274	83.94
3TC +EFV + TDF (300+600+300)mg tab*	0.201	0.326	61.66
3TC + NVP + AZT (150 +200+ 300)mg tab*	0.1035	0.1442	71.78
3TC + NVP + AZT (30 +50+ 60)mg tab*	0.0597	0.0643	92.85
3TC + TDF (300mg+300mg) tab	0.1047	0.1573	66.56
3TC + AZT (150 +300)mg tab	0.076	0.1208	62.91
3TC + AZT (30 +60)mg tab	0.0243	0.0348	69.83
3TC + ABC (30 +60)mg tab	0.0485	0.0711	68.21
LPV + RTV(100 + 25)mg tab	0.1189	0.073	162.88
LPV + RTV(200 + 50)mg tab	0.1235	0.203	60.84
NVP 10mg/ml oral suspension	0.0132	0.013	101.54
NVP 200 mg tab	0.0268	0.0583	45.97
Artemether + Lumefanthrine – (20mg+120mg) Tablet (6x1)	2.43	0.4982	487.76
Artemether + lumefantrine (20 +120)mg 6x2 tablet	0.602	1.1419	52.72
Artemether + Lumefanthrine – (20mg+120mg) Tablet (6x3)	0.729	1.2303	59.25
Artemether + Lumefanthrine – (20mg+120mg) Tablet (6x4)	1.031	1.4862	69.37
Artesunate – 60mg – Vial – Injection	1.26	1.91	65.97
chloroquine Phosphate – 50mg – syru	0.0162	0.0208	77.88
primaquine 7.5mg tablet	0.0263	0.0228	115.35
Chloroquine Phosphate – 150mg – Tablet	0.00614	0.027	22.74

Quinine Sulfate -300mg – Tablet	0.044	0.0591	74.45
Rapid Diagnostic Test (Malaria AGPF/PV)	0.2932	0.6085	48.18
Condom Male Latex – 180mmx53mm	0.03	0.0335	89.55
Condoms (Female)	0.831	0.8412	98.79
Etonogestrel-68mg Capsule	2.74	9.415	29.1
IUCD(Intrauterine Contraceptive Device) – Long acting	0.29	7.2999	3.97
Levonorgestrel – 75 mg/rod of 2rods – implant rods (Sub dermal) with sterile insertion trocar	7.43	5.55	132.25
Levonorgestrel (D-Norgestrel) – 0.03mg tablet	0.7356	0.5667	129.8
Levonorgestrel (D-Norgestrel) – 0.75m	0.203	0.225	90.22
Levonorgestrel(D-Norgestrel) + Ethinylestradiol + Ferrous Fumerate – (0.15mg + 0.03mg +75mg) – Tablet	0.3	1.198	25.04
Medroxyprogesterone Acetate – 150mg/ml in 1ml vial – Injection with 3ml Syringe (Aqueous suspension)	0.41	0.5824	70.4
Mifepristone + Misoprostol – (200mg (1Tablet) + 200mcg (4 Tablets)) – Tablet	2.862	1.53	187.06
Misoprostol – 200mcg – Tablet	0.0125	0.2	6.25
Misoprostol 25mcg Tablet	0.342	0.325	105.23
Isoniazid –(INH) 300mg –tab	0.0175	0.0429	40.79
RHZE(150mg+75mg+400mg+275mg) of 6x28 tablets + (150mg+75mg) of 12x28 tablets – Tablet	0.031	0.0693	44.73
Pyridoxine HCL 25 mg – tab	0.031	0.0081	382.72
Ethambutol – 400mg – tab	0.1578	0.0402	392.54
Ethambutol – 100mg – tab	0.0293	0.0886	33.07
Isoniazid – 100 mg –tab	0.0084	0.0182	46.15
RH – (75mg+50mg) – tab	0.014	0.0331	42.3
RHZ –(75mg+50mg+150mg)-tab	0.0188	0.0233	80.69
Amino salicylic Acid Delayed – Release granules,4gms – Solution	1.1748	2.5996	45.19
Amoxicillin + Clavulanic Acid – (500mg +125mg) – Tablet (Film Coated)	0.135	0.117	115.38

Capreomycin – 1g in vial – Powder for injection	4.47	5.3293	83.88
Cycloserine-250mg-capsule	0.3742	0.4238	88.3
Kanamycin Sulfate – 1gm/4ml – Injec	2.139	1.0589	202
Levofloxacin – 250mg – Tablet	0.467	0.1395	334.77
Moxifloxacin-400mg-tablet	1.622	1.7562	92.36
Prothionamide – 250mg – Tablet	0.1326	0.1775	74.7
Pyrazinamide- 400g-Tablet	0.0169	0.0251	67.33
Bedaquiline -100mg-Tablet	9.125	15.957	61.49
Linezolid- 600mg- Tablet	6.873	5.48	125.42
Clofazimine – 100mg- Tablet	0.0777	1.2672	6.13
Clofazimine – 50mg- Tablet	0.04329	0.15	28.86
Delamanid – 50mg – Tablet	6.61	0.165	109.22
Auramine – O 50mg	1.99	0.999	199.12
Auramine – O 1000mg	2.03	8.896	22.82
Basic fuchsine – crystal 25gm	1.911	1.94	98.5
Ethanol – 96% RL 1000ml	2.94	0.0022	113.14
Hydrochloric Acid – Concentrated 37%	1.99	8.896	22.37
Immersion oil 100ml	1.1	1.2	91.25
Methylene Blue – powder 25g	1.74	0.558	312.01
Phenol – Crystal 500mg	5.23	2.12	246.56
Phenol – Crystal 1000mg	9.02	16.26	55.47
Mean of % international reference prices			**99.48**

Annex III: Suppliers lead time of central EPSA, November 2019

Lists of orders	Suppliers Lead time(days)	Supplier Lead-time variability (%)	Lists of orders	Suppliers Lead time (days)	Supplier Lead-time variability (%)
1	107	15.89	19	127	29.13
2	125	28	20	131	31.29
3	52	38	21	58	55.17
4	134	32.84	22	294	69.39
5	66	36.36	23	71	26.76
6	69	30.43	24	76	18.42
7	266	66.16	25	105	14.29
8	266	66.16	26	153	41.17
9	78	15.38	27	153	41.17
10	88	2.27	28	88	2.27
11	100	10	29	88	2.27
12	208	56.73	30	256	64.84
13	93	3.22	31	73	23.29
14	284	68.31	32	94	4.25
15	82	9.76	33	150	40
16	191	52.88	34	149	39.6
17	95	5.26	35	208	56.73
18	225	60	36	141	36.17
Average suppliers lead time					137.33 days
Average % suppliers lead time variability					33.27%

Number of emergency order placed	3
Number of product purchased by emergency	17 (24.29%)
Percentage of emergency order	21.43%

Settled supplier lead time by EPSA 90 days

Annex IV: Wastage rate and stock outs days of HIV/AIDS commodities of central EPSA, November 2019

Lists of products	Number of stock out in (2017/8)	Total number of days stocked out(2017/8)	unit value of product	Total value of product managed in 2017/8	total value of damaged plus expired products	% of value expired to total value of wasted due to expiration and damage	% value of product Wasted due to Expiration and Damage to value of total inventory(2017/8)
ABC 300mg tab	2	12	219.68	95885926.40	16476	100	0.017
Atazinavir/r300mg+100mg tab	1	15	382.87	76662442.97	591534.15	100	0.77
Efavirenze 200mg capsule	1	9	85.46	3260811.76	0	-	0
Efavirence 50mg capsule	1	7	32.07	1753780.02	18440.25	100	1.05
Efavirence 600mg tab	1	10	67.27	58115629.32	13723.08	100	0.024
Lamivudine(3TC) 150mg tab	1	6	36.4	2038290.80	324105.6	100	15.9
3TC +EFV + TDF (300+600+300)mg tab	1	14	164.5	605958944.50	169928.5	0	0.028
3TC + NVP + AZT (150 +200+ 300)mg tab	1	20	169.16	143197999.84	0	-	0
3TC + NVP + AZT (30 +50+ 60)mg tab	1	0	70.02	89786856.06	72190.62	9.02	0.08
3TC + TDF (300mg+300mg) tab	1	4	86.03	62531765.80	13764.8	100	0.02
3TC + AZT (150 +300)mg tab	0	0	123.28	142813839.28	348266	100	0.24
3TC + AZT (30 +60)mg tab	1	35	39.62	7531762.00	2694.16	100	0.04
3TC + ABC (30 +60)mg tab	1	8	79.36	3053058.56	0	-	0
LPV + RTV(100 + 25)mg tab	1	21	388.88	1456744.48	0	-	0
LPV + RTV(200 + 50)mg tab	1	3	413.28	37851075.36	2260641.6	100	5.97
NVP 10mg/ml, oral suspension	1	33	35.84	10905251.84	3418992.64	100	31.35
NVP 200 mg tab	1	10	47.37	55060945.83	1894.8	100	0.003
Total		207 days		1397865125 ETB	7252652.2 ETB		Wastage 0.52%

Annex V: Wastage rate and stock outs days of MCH commodities of central EPSA, November 2019

PRODDUCTS	Number of stock out in 2017/8/	Total number of days stocked out(2017/8)	unit value of product	Total value of product managed in 2017/8	total value of damaged plus expired products	%of value expired to total value damaged and expired	% value of product Wasted due to expiration and damage to total inventory value (2017/8)
Condom Male	0	0	0.7	25520544	144.9	0	0.00057
Condoms (Female)	0	0	11.75	138109.5	0	-	0
Etonogestrel-68mg Capsule(Sub-Implant)	1	10	74.59	89915037.63	447.54	66.7	0.00049
IUCD-Long acting	1	36	7.85	3720515.35	0	-	0
Levonorgestrel - 75 mg/rod of 2rods - implant rods with sterile insertion trocar	0	0	20254.6	841214047.2	0	-	0
Levonorgestrel 0.03mg tab	1	7	6.22	2973850.42	11967.28	100	0.4
Levonorgestrel - 0.75mg – tab	2	12	5.535	2331076.32	27.675	0	0.001
Levonorgestrel +Ethinylestradiol + Ferrous Fumerate(0.15 + 0.03 +75)mg - tab	1	5	8.21	20161338.05	4425.19	45.45	0.022
Medroxyprogesterone Acetate - 150mg/ml in 1ml vial - Injection with 3ml Syringe	0	0	11.87	139593680.83	9493827.79	99.98	6.8
Mifepristone + Misoprostol - (200mg (1Tablet) + 200mcg (4 Tablets)) – tab	0	0	1559.79	669461868	9045222.21	99.76	1.35
Misoprostol - 200mcg – Tablet	0	0	9.53	10667481.74	1137481.74	99.80	10.66
Misoprostol 25mcg Tablet	0	0	9.53	5815206	0	-	0
Total		70		1811512755 ETB	1969354.33 ETB		Wastage rate 1.09%

Annex VI: Wastage rate and stock outs days of malaria commodities of central EPSA, November 2019

PRODDUCTS	Number of stock out in 2017/8	Total number of days stocked out(2017/8	unit value of product	Total value of product managed in 2017/8	total value of damaged plus expired	% value of expire to total value of damage and expired	% value of product Wasted due to Expiration and damage to total inventory value(2017/8)
Artemether+ Lumefanthrine (20mg+120mg) tab (6x1)	1	26	1983.46	99123413.5	29014052.88	99.4	29.27
Artemether+ Lumefanthrine (20mg+120mg) tab(6x2)	1	10	492.1	28781452.7	4037188.40	98.54	14.03
Artemether+ Lumefanthrine (20mg+120mg) Tablet (6x3)	1	8	596.1	10150986.9	3035937.30	100	29.91
Artemether + lumefantrine (20 +120)mg 6x4 tablet	0	0	430.88	28126984.64	1420611.36	99.94	5.05
Artesunate - 60mg - Vial – Injection	1	4	34.29	5614267.41	3360.42	0	0.06
chloroquine Phosphate - 50mg – syrup	1	10	7.38	800604.54	47881.44	99.46	5.98
primaquine 7.5mg tablet	0	0	716.74	37612364.98	0	-	0
Chloroquine Phosphate - 150mg – Tablet	0	0	140.13	9970389.63	63899.28	97.81	0.64
Quinine Sulfate -300mg – Tablet	0	0	0	5414400	0	-	0
Rapid Diagnostic Test (Malaria AGPF/PV)	0	0	199.86	66862763.28	913560.06	99.58	1.37
Total		58		292,457,627.6ETB	38536491.14ETB		Wastage rate 13.18%

Annex VII: Wastage rate and stock outs days of TB commodities of central EPSA, November 2019

PRODDUCTS	Number of stock out 2017/8	Total number of days stocked out (2017/8)	unit value of product	Total value of product managed in 2017/8	total value of damaged plus expired products	% value of expired to total value of product wasted due expiration and damage	%value of product wasted due to expiration and damage to total inventory value (2017/8)
INH300mg –Tab	0	0	320.92	22597581.8	641.84	0	0.003
RHZE(150mg+75mg+400mg +275mg) of 6x28 tab + (150mg+75mg)of 12x28 tab – tab	0	0	425.08	70824704.2	115621.76	26.10	0.16
Pyridoxine HCL (Vitamin B6) - 25 mg - Tablet	0	0	293.96	80758161	0	-	0
Ethambutol - 400mg – Tablet	0	0	429.91	246768.34	36112.44	1.19	14.63
Ethambutol - 100mg – Tablet	0	0	79.9	5533234.8	0	-	0
Isoniazid -(INH) 100 mg – Tablet	0	0	22.89	5875359.42	91.56	25	0.002
RH(75mg+50mg) – Tablet	0	0	32	4667936	0	-	0
RHZ(75mg+50mg+150mg) – Tab	0	0	43	1862545	0	-	0
Amino salicylic Acid Delayed release granule, 4gms – Solution	1	45	800.41	2875072.72	1239034.68	96.39	43.1
Amoxicillin + Clavulanic Acid - (500mg+125mg) - tab (Film Coated)	0	0	73.62	393204.42	40491	97.82	10.3
Capreomycin - 1g in vial - Powder for injection	1	14	118.54	75237338	1175561.18	99.89	1.56
Cycloserine-250mg-capsule	1	5	1029.69	19574406.9	9000520.29	98.38	45.98
Kanamycin Sulfate - 1gm/4ml – Injection	1	5	601.63	3257224.82	31886.39	94.34	0.98

Levofloxacin 250mg –tab	0	0	139.24	2928913.4	9746.8	0	0.33
Moxifloxacin-400mg-tablet	1	47	188.43	2220082.26	940265.7	100	42.35
Prothionamide-250mg- tab	1	24	361.3	6846273.7	361.3	0	0.01
Pyrazinamide- 400g-Tablet	1	17	350.1	2621198.7	520948.8	99.93	19.87
Bedaquiline -100mg-Tablet	1	46	19531.5	1562520	0	-	0
Linezolid- 600mg- Tablet	1	4	2378.5	5860624	0	-	0
Clofazimine – 100mg- Tablet	1	8	1058.8	1300206.4	0	-	0
Clofazimine – 50mg- Tablet	0	0	1179.52	75489.28	0	-	0
Delamanid – 50mg – Tablet	1	45	180	10440	0	-	0
Auramine – O 50mg	0	0	54.26	271300	0	-	0
Auramine – O 1000mg	0	0	55.35	14944	0	-	0
Basic fuchsine – crystal 25gm	0	0	26	215878	0	-	0
Ethanol - 96% RL 1000ml	0	0	67.83	707534.73	6647.34	0	0.94
Hydrochloric Acid - Concentrated 37%	0	0	54.26	24199.96	0	-	0
Immersion oil 100ml	0	0	29.84	476664.16	0	-	0
Methylene Blue - powder 25g	0	0	47.4	190074	0	-	0
Phenol – Crystal 500mg	0	0	136.7	411056.90	0	-	0
Phenol – Crystal 1000mg	0	0	142.44	120646.68	0	-	0
Total		260					Wastage rate
Value				319561584.1ETB	13117931ETB		4.1%

Annex VIII: Information sheet

My name is Bekele Boche, a student of pharmaceutical supply chain management MSc program at Jimma University, Institute of Health Sciences, School of pharmacy. I am going to conduct a study on the assessment of logistics management performance for program commodities at your institutions, and collect data on the overall program commodities logistics performance. The objective of the study is to collect current information on program commodities status and its associated challenges. The information you provide will be used to improve the logistics management of program commodities. The study will identify gaps and challenges and provide recommendations for proper interventions of government, and other stakeholders supply chain interventions for the future. If you decide to participate, I will guarantee that no influence related to the study. Any information obtained in connection with this study, and that can be identified with you remain confidential and will be disclosed only with your permission. Your participation is voluntary, and you are free to withdraw your consent and to discontinue participation at any time without consequence. For the successes of my study, you kindly requested to respond genuinely and voluntary with patience.

Consent form

I_____here by giving my consent to give accurate information about the status of program commodities logistics performance by institution as recommended by the researcher/data collector and to answer those commodity management's related questions. I understand there is no problem within my position in the institution by participating in this assessment at the beginning as well as at the end of the study.

Participants Name _____ Signature_____ Date_____

Investigators Name_____ Signature _____Date_____

Annex IX: Data collection tool

Part I: General information and demographic background of respondents

Please tick (✓) or provide your own answers where applicable.

1. Type of profession _____
2. Educational qualification of staff

   Certificate ☐ Diploma ☐ Degree ☐ Masters ☐ others (specify) ---

3. Years of experience in the agency----------

4. Received training: IPLS ☐ warehouse management ☐ overview of supply chain ☐

   Other (specify)…….

5. Position in agency/organization ----------

Part II: Questionnaire for selection and quantifications of program commodities

S.N	Question	YES	NO	comment
1	Is there a national drug policy document?			
2	If yes, does it implemented now and contain written guidelines for donation of products			
3	Is there a national essential drug list and followed?			
4	Agency has standard operating procedures?			
5	Selection of program commodities done by? The pharmacy unit only …..... Laboratory unit…..... National quantification team… Other (specify)……			
6	What are the criteria for program commodity selection in the organizations? Pattern of prevalent disease…... Efficacy and safety…..... Cost of the product …..... Preference for well-known products Others (specify) _			
7	Is national quantification team functional?			
8	Which types of quantification method is/are employed for program commodity? Consumption method …..... Morbidity method…..... Proxy consumption method…… Service-level projection of budget requirements……. Other (Please specify)……..			
9	Procurement methods……Open tender ……Restricted tender … Direct Method . ... . Request for Quotations Method ……Other specify……..			

Part III: Procurement form EML and forecasting accuracy of program commodities data

S.N	**Products**	Quantity of product forecasted	Quantity of product consumed	%	Procured from EML		Average unit price (Procurement efficiency)
	HI/AIDS medicine				Yes	No	
1							
2…							
17							
	Malaria commodities						
1							
2…..							
10							
	MCH commodities						
1							
2….							
12							
	TB medicine						
1							
2….							
31							

Suppliers lead time

S.no	Name of suppliers	Date of order placed	Date of product arrived and ready for use	Lead time	Type of commodities
1					
2					
3..					

Part IV: Questionnaire for program commodities inventory management

S.N		YES	NO	Comment
1	Has agency SOP for inventory management			
2	Do you establish maximum, minimum, and reorder levels for program commodities? HIV/AIDS, TB, MCH, Malaria			
3	Is agency developed standard ordering schedules and procedures			
3	Is there emergency order placed in past year?			
4	Frequency of placing orders per year ……			
2	If yes above, are there established procedures for placing emergency orders for program commodities?			
3	Number of emergency order place in last year for HIV/AIDS commodities ---------- TB commodities ---------- MCH commodities---------- Ant- malaria commodities ----------			
4	Is there any documented policy or guideline for managing and using the logistics management information system (LMIS)?			
5	LMIS formats used in agency Computer based------Paper based-------Both------			
6	Is the HCMIS in your store functional?			
7	How do collect report from hubs? By RRF through email…….. By RRF by paper based……			

Part V: Stock Data for program commodities (2017/8)

Instructions: -Please note the following column accordingly

1. Name of each product that will be counted.

2. Unit of count for the product—bottles or tablets or capsules; bottles of oral solution, suspension, or syrup; or sachets of powder for reconstitution

3. Whether or not the product is available, is this agency supposed to manage this product? Answer Y for yes or N for no. If the agency has been stocked out of a particular product for a long time, it may report as "not managing."

4. Total quantity of items managed in 2017/18 from model 19 and HCMIS

5. Total quantity of items issued from storeroom 2017/18 from model 22

6. Total quantity of damaged in 2017/18

7. Record how many times the product stocked out during 2017/18 according to the stock cards/HCMIS.

8. Record the total number of days the product was stocked out during 2017/18 according to the stock cards/HCMIS.

9. Quantity of expired products from 2017/18 HCMIS.

	Products	Units of count	Managed at this facility? (Y/N)	Total quantity of product managed at 2017/18 (purchased and binging balance) from model 19 and HCMIS	Total quantity issued from storeroom 2017/18 from model 22	Total quantity of damaged in 2017/18 from HCMIS	Number of stock out in past year 2017/18	Total number of days stocked out 2017/18	Quantity of expired products 2017/18
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	HIV/AIDS Medicine								
1									
2...									
17									
	Malaria commodities								
1									
2..									
10									
	MCH								
1									
2 ….									
12									
	TB commodities								
1									
2..									
31									

Part VI: Questioner for inventory management to assess resupply ability of central EPSA from RRF

QO= quantity ordered, QR=quantity received, D= QO-QR (product ordered but not resupplied). Name of hub----------

S.N	Products	1st RRF			2nd RRF			3rd RRF			4th RRF			5th RRF			6th RRF		
	HI/AIDS medicine	QO	QR	D	QO	QR	D	QO	QR	D	QO	QR	D	QO	QR	D	QO	QR	D
1																			
2..																			
17																			
	Malaria commodities																		
1																			
2..																			
10																			
	MCH commodities																		
1																			
2..																			
12																			
	TB commodities																		
1																			
2..																			
31																			

Part VII: Procurement Practices

Please rate to what extent you agree on the following procurement practices of the agency. The scale below will be applicable: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree

5 = Strongly Agree

S.N	**Procurement practices**	1	2	3	4	5
1	**Transparency**					
1.1	Develop and follow written procedures for all procurement actions					
1.2	Make information on the tender process and results public to the maximum extent possible					
1.3	There are no separate deals with non- contracted suppliers					
1.4	Different committees, units, or individuals may include selection, quantification, approval of suppliers, and award of contracts.					
1.5	Use a formal monitoring system to ensure continued supplier qualification					
2	**Competitions**					
2.1	Use competitive bidding on all but very small or emergency purchases to obtain the best prices					
2.2	Allow only prequalified suppliers to compete in restrictive tenders					
2.3	Evaluate suppliers after submission of bids in open tenders.					
2.4	Use formal supplier qualification based on pharmaceutical quality, service reliability, and financial viability					
2.5	Use generic names for fair competition.					
2.6	Approve suppliers before tendering (prequalification) or after (post qualification)					

3	**Value for money (efficiency)**					
3.1	Select safe, effective, cost-effective medicines					
3.2	Concentrate purchases on limited list to increase quantities, reduce price					
3.3	Develop mechanisms for prompt, reliable payment, which might bring down pharmaceutical prices more than bulk discounts.					
3.4	Conduct an annual financial audit to assess compliance with procurement procedures, promptness of payment, and related factors.					
3.5	Specify divided deliveries					
4	**Accountability**					
4.1	Present results to the appropriate public supervising body					
4.2	Develop reliable consumption records and morbidity data.					
4.3	Adjust systematically for past surpluses, shortages, stock outs.					
4.4	Use key indicators such as ratio of prices to world market prices, supplier lead times, percentage of purchases made through competitive tendering, and Planned versus actual purchases.					
4.5	Report key procurement performance indicators against targets at least annually.					

Part VIII: Questionnaire to evaluate central EPSA warehouses management

Storage Condition

Ask where the main storage area for program commodity is located: _____

Ask for permission to visit the storage area. Assess storage conditions of main storage area only.

Place a check (tick) mark in the appropriate column based on visual inspection of the storage area; note any relevant observations in the comments column. To qualify for a Yes response, all products must meet the criteria for each item

Description	Yes	No	Comments
Products are arranged on shelves with arrows pointing up, and with identification labels, expiry dates, and manufacturing dates clearly visible.			
Products are stored and organized to FEFO procedures and are accessible for counting and general stock management.			
Outer cartons are in good condition (not crushed, perforated, stained, or otherwise visibly damaged).			
Damaged and expired products are separated from usable products in the storeroom, and procedures exist for removing them from inventory.			
products are stored in a dry, well-lit, well-ventilated Store room. (Visually inspect roof, walls, and floor of storeroom.)			
Cartons and products are protected from direct sunlight.			
There is no evidence of rodents or insects in the storage area. (Visually inspect the storage area for evidence of rodents [droppings] or insects that can damage or contaminate the products.)			
Storage area is secured with a lock and key but is accessible during normal working hours; access is limited to authorized personnel.			
Products are stored at the appropriate temperature according to product temperature specifications (8°–30°C) and including cold chain storage (2°–8°C), as required for certain products.			
Roof is maintained in good condition to avoid sunlight and water penetration.			
Storeroom is clean, with all trash removed, no evidence of Food and drinks, products stored on sturdy shelves/bins, and boxes organized neatly.			
Current storage space is sufficient for existing products and planned program expansion.			
Products are stored separately from insecticides, flammable products, and chemicals.			

Food and drinks are not stored together in refrigerator used for storing product that requires cold storage.			
Fire safety equipment is available and accessible. (Any item identified as being used to promote fire safety should be considered.)			
Products are stacked at least 30 cm away from the walls and other rows or stacks of products (to prevent contact with outer walls and allow access to products).			
Products are stacked at least 10 cm off the floor (on pallets or other materials that elevate the products off the floor).			

Part XV: Distribution Practices

Please rate to what extent you agree on the following Distribution practices of the agency.

The scale below will be applicable: 1 = Strongly Disagree,2 = Disagree, 3 = Neutral, 4 = Agree

5 = Strongly Agree

Distribution practices	1	2	3	4	5
Good Fleet management and coordination					
Adequate type and number of vehicles available					
Transport and distribution units plan together to assign delivery vehicles					
Vehicles are reserved for emergency orders					
Management information system is used to control vehicles					
Vehicles are assigned as soon as requested from distribution unit					
There is clear line of communication between distribution and general service unit					
Pharmaceuticals Distribution documents preparation and communications.					
Delivery documents are prepared as soon as requests come from hubs					

Delivery documents are prepared in such a way that all products to be loaded on a specific vehicle can be collected from a single warehouse					
There is strong communication and cooperation between distribution officers and store managers					
Pharmaceuticals are loaded in the same day that delivery documents arrive at the warehouse					
Loading -Unloading issues					
Drivers have some resistance to carry pharmaceuticals as per full capacity of the vehicles?					
Vehicles are comfortable to load pharmaceuticals according to the distance of delivery sites(for short distance site pharmaceuticals will be load last)					
There is mechanism to load separately pharmaceuticals for separate health facilities					

Part X: **Key informant interview guide for selection and quantification management**

1. How do you assess the current process for selection and quantifications of program commodities in your organizations? Giving emphasis to the strengths and limitations? With respect to

A. Developing and usage of essential list of program commodities
B. Quantification process with team
C. Challenges encountered in selection and quantifications of Program commodities
D. Recommendation for improving the process of selection and quantifications of program commodities further

Key informant interview guide for procurement management

2. How do you assess the current process for procurement of program commodities in your organizations? Giving emphasis to the strengths and limitations?

With respect to:

A. Suppliers selection, procurement method and tender evaluations processes
B. Contract and supplier's management related
C. Communication and skilled human resource
D. Emergency order purchase
E. What is your recommendation for improving procurements for program commodities further?

Key informant interview guide for inventory and warehouse management

3. How do you assess the inventory management, storage and use of program commodities in the organization regarding to the strengths and limitations?

A. Inventory control techniques and procedures

B. Emergency order

C. Storage conditions

D. Expire products and its managements

E. Storage space and location

F. What is your recommendation for improving inventory management for program commodities?

3. How do you express the LMIS in managing program commodities in the EPSA giving emphasis to the strengths and limitations?

With respect to:

A. Using logistics forms (manual or computerized)

B. Using HCMIS and dashboard

C. Availability and update of stock cards /HCMIS in your storage area?

D. What are the challenges encountered for using LMIS in managing program commodities?

E. What is your recommendation for improving the LMIS for program commodities further?
F. What are the challenges encountered in availing program commodities in the needed type and quantity?
G. What is your recommendation for improving the availability of program commodities further?

Key informant interview guide for distributions and fleet management

1. What are the major challenges and opportunities of program commodities distribution in Ethiopia?
2. How central EPSA communicates and coordinate on distribution and fleet management of program commodities, with internal and external organizations like hubs and MOH
3. Would you describe pharmaceuticals supply chain distribution program commodities network of EPSA?
4. What do you think about warehouses and storage condition practices of EPSA?
5. Do you believe that there is delay in distribution pharmaceuticals to your immediate customers? If yes, why this happens? And what efforts your agency made to reduce the delay
6. Which delivery method do you apply? Push or Pull system and why you select push or pull system

Annex X: Key logistics management performance indicators

1. Selections and quantifications will be measured by the following indicators

a. % of product selected form essential lists $= \frac{\text{numbers of product procured from essential lists}}{\text{numbers of product procured in the same year}}$

b. Forecast accuracy $= \frac{\text{forecast consumption} - \text{actual consumption}}{\text{actual consumpition}}$

2. Procurement practices of program commodities will be measured

a. Suppliers lead time

$= Interval\ time\ between\ when\ order\ placed\ and\ when\ order\ reciept$

b. Percentage of average international price paid

$= Average\ Unit\ Cost\ of\ item / average\ international\ Unit\ Cost\ of\ Item * 100$

c. Supplier lead time variability

$= \frac{[\textbf{forecasted lead time} - \textbf{actual lead time}]}{\textbf{actual lead time}} * \mathbf{100}$

3. Inventory management will be measured by the following indicators

a) order fill rate = $\frac{\text{numbers of orders correctly filled}}{\text{total number of order}}$

b) **%** Stock wastage due to expiration or damage= $\frac{\text{unusable stock of item}}{\text{usable} + unusble\ \text{physical}\ stock\ count\ inthe\ same\ period} * 100$

c) % value of unusable stock= $\frac{\text{total value of wasted units}}{\text{Value of total units received of same product}} * 100$

d) % of warehouse maintain acceptable storage conditions

$$\frac{\text{number of warehouse fufiilled 80\% of storage condition}}{\text{total number of warehouse visted}} * 100$$

Research paper final endorsement form to be filled before final submission

To the school of pharmacy

Here with my signature, I declare that this research paper is done under my advisor ship and I have approved that this draft is the final draft thesis for submission to the school of pharmacy, Student Research Project office of Jimma University.

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Here with my signature, I declare that this research paper has been examined by me and I have checked that the student has corrected the comment that I forwarded before final submission.

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