ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCES

SCHOOL OF ALLIED HEALTH SCIENCES

DEPARTEMENT OF MEDICAL LABORATORY SCIENCES

ASSESSMENT OF LABORATORY INVENTORY MANAGEMENT PRACTICE AT TIKUR ANBESSA SPECIALIZED HOSPITAL LABORATORY AND MEDICAL STORE, ADDIS ABABA, ETHIOPIA

BY

SHIMELIS ADMASSU (BSc)

A RESEARCH THESIS SUBMITTED TO ADDIS ABABA UNIVERSITY, COLLEGE OF HEALTH SCIENCES, SCHOOL OF ALLIED HEALTH SCIENCES, DEPARTMENT OF MEDICAL LABORATORY SCIENCES IN PARTIAL FULFILMENT OF MASTERS OF SCIENCE DEGREE IN CLINICAL LABORATRY SCIENCES (LABORATORY MANAGEMENT AND QUALITY ASSURANCE TRACK), ADDIS ABABA, ETHIOPIA

JUNE 2016

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DECLARATION

I, the undersigned, declare that this thesis is my original work, has not been presented for a degree in this or any other university and that all sources of materials used for this thesis has been duly acknowledged.

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Signature: _____

Place: Addis Ababa, Ethiopia

Date of submission: June 2016

This thesis has been submitted for examination with my approval as a university advisor.

Dr Mistire Wolde Signature: _____

Mr Adino Desale Signature: _____

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ACRONYMS

AAU	Addis Ababa University
AIDS	Acquired Immune Deficiency Syndrome
ART	Anti Retro Viral Therapy
ARV	Anti Retro Viral
CMS	Central Medical Store
DRERC	Departmental Research and Ethics Review Committee
EMLA	Ethiopian Medical Laboratory Association
EOP	Emergency order point
EPHI	Ethiopia Public Health Institute
EPHLA	Ethiopian Public Health Laboratory Association
FEFO	First Expiry First Out
FIFO	First In First Out
HIV	Human Immune Deficiency Virus
IFRR	Internal Facility Report and Request
IPLS	Integrated pharmaceutical logistic supply
KAP	Knowledge Attitude Practice
LIFO	Last In First Out
LMIS	Logistic Management Information System
MSH	Management Sciences For Health
MSL	Minimum Stock Level

NGO	Non Governmental Organization
NLMS	National Laboratory Management System
OPD	Out Patient Department
PFSA	Pharmaceutical Fund and Supply Agency
QO	Quantity to order
RRF	Report and Requisition Form
SOH	Stock on hand
STGs	Standard Treatment Guideline
TASH	Tikur Anbessa Specialized Hospital
TB	Tuberculosis
WHO	World Health Organization

OPERATIONAL DEFINITIONS

Bin card: is IPLS/LMIS format which records received or issued data

Commodities: are include reagents and test kits, laboratory equipment and supplies

Distribution: Logistics management function that includes inventory control, storage, and transporting products.

Inventory management: Procedures that govern how supplies are received, stored, handled, and issued.

Logistics: the set of activities that control how materials and products move from their initial source to the end user. It is the branch of management that ensures resources needed (or products required) by clients reach their destination in the required amount in the least possible time.

Overstock*:* A supply imbalance that occurs when stocks exceed the established maximum level may result in losses due to expiry.

Routine chemistry: commonly ordered blood chemistry

Stock card: a generic name for an inventory control card

Stock out: Depleted supply of a given product or products; a zero stock balance.

Under stock: A supply imbalance that occurs when stocks fall below the established minimum which may result in underserved customers

Stock out on the day of the visit: was defined as not having any available stock on the day that the data collector arrived

Quantity to Order (QO): The quantity required to be ordered for the next consumption period, e.g. 1 month

The **minimum stock level:** An inventory control method, the minimum quantity of a laboratory commodity that the facility should hold at any given time (sometimes called the **re-order level**) is the stock level that indicates you need to place an order to avoid running short of supplies. The minimum stock level can change over time, so check it regularly and make any necessary adjustments to the stock card and your orders. To calculate the minimum level, use the formula:

Minimum stock level = Reserve stock + Stock used during lead time

In IPLS the minimum stock level designed and holds to facilities is two months of stock.

The **maximum stock level** an inventory control method is the maximum amount of any item that should has in stock at any time. You will usually only have the maximum levels in stock just after receiving a delivery. The maximum level helps to prevent you from over ordering. This

level can change over time, so check it regularly and make any necessary adjustments to the stock card and your orders. To calculate the maximum stock level, use the formula:

Maximum level = Reserve stock level + Order quantity for one supply period

In IPLS the minimum stock level designed and holds to facilities is four months of stock

The lead time: between the placement of an order and delivery is one of factors which influence the customer satisfaction

Cool chain: characterized by moderate temperature weather or climate neither hot nor cold

Cold chain: temperature between 2^0C to 8^0C

Frozen temperature: temperature between -20^0C to -70^0C

ABSTRACT

Background: Robust laboratory commodities inventory management practices provide current information on quantities of laboratory commodities consumed as well as enables to accurately estimate requirements for future use. A poorly functioning laboratory inventory management can lead to frequent stock outs leading to services interruptions or overstock.

Objective: The aim of this study is to assess the status of laboratory inventory management and knowledge, attitude and practices of professionals at Tikur Anbessa specialized hospital (TASH).

Methods: A cross-sectional descriptive study was conducted to assess the practices of laboratory commodities inventory management at TASH from May to June 2016. Both quantitative and qualitative data collection techniques were used.

Results: The overall stock out of laboratory commodities on the day of the study was 44 (37.0%). These stock outs included Serology 27 (84.4%), Clinical Chemistry 13 (28.9%), Hematology 3 (20%), and Urine analysis 1 (33.3%). Moreover, there was no expired laboratory commodity during the study period in the medical store. In addition, there were no stock outs (0.0%) for bacteriology and parasitology reagents on the day of the study and during the past one year period. On the other hand, during the past one year time; the overall stock out was 55 (46.2%). Of these 27 (84.4%) of serology, 24 (53.4%) of chemistry, 3 (20%) of hematology and1 (33.3%) of urinalysis laboratory commodities were stock out during the past one year period. Some of the reasons mentioned by respondents for stock out included weak selection, quantification, procurement and in adequate stock control and management, delay in the purchasing procedure; weak/unknown consumption data; absence in the supply agency PFSA to avail needed laboratory commodities; shortage of budget; unpredicted services demand or increased patient flow; and short expiry. On the assessment of stock management, 81 (97.6%) respondents knew the appropriate storage of at room temperature, cold chain items, and frozen items. Majority 80 (96.39%) of the respondents knew the importance of separation of flammable chemicals, damage or expired products removed from stock records. All (100%) of the respondents have the desired practices as regards to the need for cleaning and de foresting refrigerators and prevent from sunlight and water penetration and more over 97.6% of the respondents have the good practices of separately storing of rapidly deteriorating of laboratory commodities.

Conclusion: Although there were no expired items during the past year; frequent stock outs were reported for different laboratory services and supplies at TASH. Therefore capacity building training of the staff on selection and quantification, inventory management and storage practices of laboratory commodities may be necessary to sustainably overcome the frequent stock out and interruption in service.

Key word: Laboratory inventory management, Tikur Anbessa specialized hospital, laboratory Commodity

1. INTRODUCTION

1.1 Background

Inventory is the commodities, supplies, equipment, and other materials those are available in stock in an institution [1]. Commodity management is the process of getting logistics, controlling, transporting, and storing up and distributing commodities through keeping the commodities financial records. Management of basic health commodities concepts is growing as it is very important in various countries [2]. In the era of globalization and intense competitiveness, the requirement for each organization either private or public services is the need to be effective and efficient in organizing resources and avoiding waste [3]. Clinical laboratory inventory management refers to the processes of ordering, receiving, storage and distribution or issuing of laboratory items. The goal of efficient laboratory inventory management is to ensure that commodities are available and accessible so as to provide uninterrupted services [4]. Hence effective clinical laboratory inventory management provides a potential system to improve performance by matching inventory management practice and competitive advantages in the competitive world by having a good laboratory inventory system enable the hospital to keep track on their inventory level as low as possible at minimum cost [5].

Laboratory logistics systems handle a vast range of testing commodities with varying characteristics which must be delivered to facilities every month because of their short shelf lives, other products may have different physical requirements, such as temperature sensitivity and packaging size, often requiring special storage and distribution handling [6]. This continuous supply of laboratory commodities can be guaranteed only through the selection, design, and proper implementation of an appropriate inventory control system [7]. Efficient laboratory and medical commodities management ensures that hospital have an up to date inventory count at all times, giving good customer service, giving accurate information to customer and improve image of the hospitals (8). Robust inventory management system allows managers to receive real time information on inventory. This will assist management to accurately made informed decisions, anywhere, anytime and save time and cost used for labor and thus working on inventory management properly [7,8].

Having accurate laboratory commodities inventory control is essential to facilitate quantification, to avoid stock-outs, to prevent laboratory commodities from expiring on shelves, and to control possible theft and misuse [9]. Health facilities should develop an internal system for checking stock levels at various issuing points. Such a mechanism assists in detecting fraud and in pinpointing where laboratory commodities may be leaking from the health system [10]. Proper record keeping of bin and stock card is paramount to calculate monthly and average consumptions. Therefore the efficient and effective management of inventories will lead to higher satisfaction level in customers [11].

1.2. Statement Of The Problem

Laboratory services are an integral part of clinical decision-making and contribute to various aspects of health services, including the making of diagnostic and therapeutic decisions for patients, as well as disease monitoring and prevention [13] .Inventory management is one of the core quality management system essentials to avail essential laboratory supplies on a timely manner [14].

Implementation of robust laboratory inventory management system is challenging in resource-limited countries that needs a focused approach to establish solid system. Strong laboratory inventory management system with coordination and harmonization of quantification, procurement, inventory control, distribution and reporting are necessary to ensure continuity of care for the patient and to guarantee efficient use of limited resources [15].

Accurate inventory management system implementation brings a substantial improvement on distribution of laboratory commodities, decrease emergency orders, decreases stock out rates and expired commodities [16].

Different reports and research findings indicate that Ethiopian laboratory services suffered by inattention, chronic under-development and absence of system. Despite efforts are being made by ministry of health and different agencies to provide the country with standardized laboratory

commodities to meet the requirements of clients and provide uninterrupted laboratory services, the problem persists in different magnitude[17] .

Inadequate availability of needed laboratory reagents and supplies, lack of information for procurement and re-supply decision, limited capacity of the laboratory personnel in the implementation of laboratory inventory system that lead to long patient waiting-times for tests and frequent stock outs at health facilities [18].

In Ethiopian, laboratory inventory system was weak, consistently being hampered by several systemic problems that cause frequent stock outs of critical items, thus impeding continuous and quality testing. A study conducted in Addis Ababa in the public health facilities showed that 60.5% and 37.2 % of health facilities were stocked out for at least one ART monitoring and TB laboratory diagnostic reagents within six months of time before the assessment and at the time of visit respectively [19].

In other ways Ethiopian context, laboratory commodity system was not systematically designed, strengthened nor supported. Health service delivery in Ethiopia is characterized by poor quality resulting in very low service utilization. Lack of well-trained health providers, a very limited physical health infrastructure, inadequate space; shortages of equipment and Commodities at health facilities [20].

There is very limited information about laboratory inventory management practice in Ethiopia in general and at TASH in particular. Therefore, this study is designed to assess the status of laboratory inventory management system for laboratory commodities in Tikur Anbessa specialized hospital facilities in Addis Ababa and identify the strengths and weaknesses of the LIMS in order to improve the design and operation of the logistics data collection, analysis and utilization of data for decision of key logistics function.

1.3. Significance of the study

This project is designed to address the factors that lead to poor inventory management practice on Tertiary health care delivery and proper corrective action measures to strengthen laboratory inventory system.

Addressing the laboratory inventory system in TASH will ensures; the right goods in the right condition and right quantity are at the right place, at the right time and for the right cost which will improve the service delivered.

The root cause of poor laboratory inventory management systems at TASH will be known and it can serve as a tool to design intervention measures by the health care staffs and policy makers. This project also served as a base line data for future work in the country.

This finding will also draw the attention of the ministry of health, health service especially the stores, supplies and laboratory management division of the health service and the regional health directorate to the problem in the management of health commodities and region as a whole.

2. LITERATURE REVIEW

A study in Rwanda, most facilities (98%) reported having shelving, 45% of facilities reported using pallets for storage, and 64% reported having Cupboards. Office equipment was available in 82% of the sites; of those facilities some found that many of these storage spaces were not constructed for the storage for laboratory commodities and medical supplies, which could explain their inadequacy in some cases. The survey found that ventilation was not always ensured (70% for main storage, 43% for other rooms). Protection from light was adequate in most of the main storage areas (98%) but insufficient in other rooms (53%) [12].

In 2005, an assessment was conducted in Lesotho to see the status of laboratory capacity to support the scale-up of ART. The result showed that laboratories experience frequent and prolonged stock-outs of key reagents. Hematology reagents were stock out for three months. Thirteen (67%) and 16 (83%) of laboratories didn't set minimum and maximum stock levels respectively. Thirteen (67%) of laboratories had no stock/bin cards to track laboratory commodities. There were no developed LMIS guidelines on how to determine orders and few laboratory staffs were trained in LMIS. Storage spaces were inadequate and poorly ventilated. Thirty three percent of laboratories reported that, reagents were not stored according to the first expiring first out (FEFO) practice. None of the laboratories practiced the separation of damaged/or expired supplies from usable products and storage spaces were small. The author concluded the placing of orders was erratic and inconsistent and data collected in the LMIS wasn't reliable due to poor record keeping [17].

A cross sectional study conducted in Tanah Papua region in Indonesia showed that, supply chains of laboratory commodities were well maintained. However, the author claimed there were challenges such as poor inventory management with stock holdings out of balance, poor logistics data and record keeping, poor management of expiry dates due to the "push" logistics management information system[18].

A study done in Uganda showed that, ARV shortages affected all ART-providing facilities with

considerable fluctuations regarding capacities to take up new patients. ARVs were available at 83%, diagnostic kits at 70% and pediatric ARVs at less than half of the health facilities surveyed. Patients were forced to switch to more complex and different drug regimens. Strategies to cope with stock-outs included lending and borrowing among facilities, late initiation of ART for new patients and treatment interruption. Health workers reported insufficient knowledge regarding safe drug substitution and a general lack of guidance to deal with shortages of ARVs. It also revealed that provision of ARVs suffers from both over and undersupply. According to findings from 2007 only a quarter of facilities receive ARVs on monthly basis. In 2008 the estimated expired value was in the range of USD 1.3 - 2 million More than half (58%) of government facilities reported holding expired ARVs, compared to 29%of NGO facilities. According to a health facility survey in 2005 fewer than 25% of facilities were maintaining adequate stock levels on HIV test kits, and antibiotics. Health facilities on average reported 1 month of stock-outs of testing kits per year in 2005 [19].

Study conducted in unpublished draft national IPLS survey result showed that availability of blank bin cards, IFRR and RRF is high at hospitals (above 90 percent). Higher percentage of hospitals utilized bin cards for the assessed products, the percentage of updated bin cards was found to be similar across all hospitals levels. Close to two-thirds of used bin cards were updated. The data quality of bin card cross checking with the physical count for each of the products on the day of the visit, the comparison is done at two levels of accuracy. A bin card with no discrepancies between the bin card and the physical count are considered accurate 91 percent in hospitals were used IFRR and 86 percent of hospitals have a resupply schedule posted and 83 percent strictly follow the schedule for resupply. The utilization of RRF was high (97 percent), in hospitals. The exact accuracy of RRF data was found to between 40 and 50 percent for most of the products; with the average of 46 percent 87% of pharmacy personnel 84% of hospitals pharmacy personnel received their training through the national IPLS training program. More than 80% of hospitals usually receive products requested within one month or less time. Only four percent of the facilities reported they wait for more than two months to receive products after they placed orders. 37 percent) reported usually receiving the quantity they ordered [20].

Cross s ectional s tudy was c onduct In N igeria poor pl anning a nd f orecasting, i nsufficient information about consumption and current stock levels, funding and capacity constraints and a poor infrastructure are reasons for inappropriate stock levels. Public warehouse infrastructure in Nigeria c onsists of di fferent hos pitals, w hereas c hallenges i ncrease f urther dow n t he s upply chain. In Nigeria there are eight NLMSs, which struggle with moisture, leaking ceilings, roofs, drains or t aps, i nappropriate c old s torage c apacity and non -existent d esignated ar eas f or reception, delivery and quarantined products. However, there are special areas for the storage of dangerous l aboratory chemicals (reagents), pr oducts r equiring cold s torage; pos sibilities t o secure products and stores are shaded from direct sunshine. Stock management is done manually with s tock hol ding c ards a nd f ollows t he f irst-expired-first-out (FE-FO) s trategy. N igeria an d Burkina Faso h ave cr eated s emi-autonomous m edical s tores, w hich pos itively i nfluence a gility and flexibility due to management expertise. NLMSs in Nigeria received several improvements such as the use of Standard Operating Procedures (SOPs) for laboratory inventory management, the in stallation o f a L ogistics M anagement Information S ystem (LMIS) a nd tr aining for employees (Federal Ministry of Health, 2010c). According to the Ministry of Health, Hospitals are usually run with a good infrastructure regarding storage, ventilation and security. Although, stock cards, traceability of batches, defined minimum/maximum stock levels are only common at hospitals. Furthermore, most hospitals don't have temperature charts to control cold chains. 67% of s tock-outs oc cur due to f unding c onstraints or due t o m anagement c onstraints e .g. FE-FO, errors in forecasts or modifications of Standard Treatment Guidelines (STG) [21].

A study done in Malawi showed that, minimum/maximum stock level and EOP weren't set for laboratory commodities, 70% and 40% of hospitals laboratory store and mini store respectively had stock/bin c ards f or laboratory c ommodities i n pha rmacy s tore how ever, m ajority of t hem were not kept up-to-date. No stock/bin cards were used in the laboratory store, all hospitals store and 30% of m ini s tore us ed s tandardized LMIS f ormat. T wenty-eight P ercent a nd 60% o f facilities w ere s tocked o ut f or C D4 an d g lutamate o xaloacetate t ransaminase (GOT) r eagents respectively. Twenty-two percent and 18% of mini store were stock out for determine and uni-gold test kits respectively on the day of visit. Similarly,8% and 25% of facilities were stock out for determine and uni-gold test kits respectively.15%, 8%, 18% and 8% of hospitals and 5% of mini store were stock out for carbon fuchsin, methylene blue, acid alcohol and oil immersion on

the day of visit respectively. Fifty percent of facilities had functioning vehicle, the rest 50% didn't had vehicle for commodity distribution and pick up. Half (50%) of the storage facilities were in compliance with proper storage guide lines, separate storage of hazardous reagents and absence of written storage guide lines were the two weakest storage conditions found [22].

Challenge of the Medical Store during Storage of Medical Supplies

Based on assessment of laboratory commodities management practices in hospital delivery services in Ghana, 98% of respondents agreed to the fact that there were a lot of challenges impairing the proper management of laboratory commodities, some insuperable, even whilst 2% said they did not face any challenges. The challenges brought up by these respondents were many and diverse; some of them were inadequate availability of laboratory commodities, poor procurement practices, counterfeit and substandard commodities, irrational/incorrect use, delays in approving request of laboratory commodities. The study also identified additional challenges like undermined distribution, transportation, unavailability of storage facilities, unavailability of skilled labor, internal bureaucracy, lack of funding, and logistical problems [23].

Training and Education Opportunities

Based on Kenya health system assessment in 2010, two hundred health care professionals, an average of 87% of healthcare professionals had received no training at all in the last three years. Only 2.6% have received some training in the last year. Interviews at facilities revealed that in service training is largely opportunity-driven, rather than based on the skill acquisition needs of the sector or individual providers [24].

Cross sectional Study was conduct, according to an assessment result of the laboratory commodities supply chain in Lesotho, all laboratories reported that they had no written guidelines for storage of laboratory supplies according to their specifications. In most cases, the storage space had poor ventilation and was small, and there were no cupboards for flammable reagents. Thirty three percent of all laboratories reported that reagents were not stored according to the first expiring, first out (FEFO) practice. None of the laboratories practiced the separation of damaged/or expired supplies from usable products. Seventeen percent of the laboratories responded that cold chain items were not stored at appropriate temperatures due to refrigerators being too full and space not being available [25].

Assessment of integrated logistics system performance in Tanzania showed that, 35% of laboratories were stock out. Of these, 10% were stock out for rapid HIV test kits. Order fill rate was accurate in which laboratories receive equal amount of quantities ordered. Thirty seven percent of facilities had stock ledger of which 69% were updated. Fifty-eight percent of facilities had stock ledger forms for rapid test kits of which 91% were updated. 16% of facilities had reported stock outs [26].

A health facility survey conducted in Uganda showed that, many laboratories experienced frequent stock outs and delay of key commodities, such as such electrolyte, chemistry, Serology, Hematology, and Urinalysis reagents. There were no standardized LMIS forms and many staff members hadn't been trained in laboratory commodities management. The author concludes, supply chain deficiencies affected the availability and the quality of laboratory services in the country [28].

Storage practices of the study facilities

According to an assessment result of the laboratory commodities supply chain in Lesotho, all Laboratories reported that they had no written guidelines for storage of laboratory supplies according to their specifications. In most cases, the storage space had poor ventilation and was small, and there were no cupboards for flammable reagents. Thirty three percent of all Laboratories reported that reagents were not stored according to the first expiring, first out (FEFO) practice. None of the laboratories practiced the separation of damaged/or expired Supplies from usable products. Seventeen percent of the laboratories responded that cold chain items were not stored at appropriate temperatures due to refrigerators being too full and space not being available [25].

3. OBJECTIVES

3.1 General Objective

To assess the status of laboratory inventory management and knowledge, attitude and practices of professionals in TASH

3.2 Specific Objectives

- To assess the availability of essential laboratory supplies at their minimum stock level in TASH
- To assess the utilization of logistics data for decision making
- To identify the strengths and weaknesses of laboratory inventory management in TASH
- To determine knowledge, attitude and practice of laboratory professionals for laboratory inventory management system in TASH

4 MATERIALS AND METHODS

4.1 Study Setting

The study was conducted in Tikur Anbessa Specialized Hospital laboratory (TASH) which is located in Lideta sub city. TASH was established in 1965(G.C) to serve the needs of the whole country as specialized referral hospital and as a medical university under Addis Ababa University by drawing its students from across the country as well as foreign nations. TASH is the largest specialized hospital in Ethiopia, with over 600 beds, and serves as the training center for undergraduate and postgraduate medical students, dentists, nurses, midwives, pharmacists, medical laboratory technology, radiology technology, and others who shoulder the health problems of the community and the country at large .

The Hospital has 201 doctors, 627 nurses, 87 laboratory staff, 71 pharmacy staff (of them 12 were working at the medical store), and more than 115 other professionals dedicated to providing the health care services. The hospital Laboratory has 4 sample collection room(3of them in OPD and 1 for pediatrics OPD), 6 rooms for the testing,1 room for sample processing, 1 room for media preparation, 2 rooms for cleaners,1 room for meeting hall, 1 room for quality control office , 1 room for laboratory head and1room for mini store. TASH laboratory undertakes on average 80,000-110,000 tests done per year.

4.2 Study Design

A facility based cross-sectional descriptive study was conducted from May to June 2016 on laboratory inventory management practices at TASH. Both quantitative and Qualitative data collection methods were employed

4.3 Study Period

The study was conducted from May to June, 2016.

4.4 Source Population

Tikur Anbessa Specialized Hospital laboratory staffs and other departments who are responsible in the selection, quantification, procurement, supply, storage, inventory control of laboratory commodities in the hospital laboratory services have been included in this study.

4.5 Study population

Tikur Anbessa Specialized Hospital laboratory staffs and laboratory commodities inventory management were included in this study.

4.6 Study Variables

Dependent variables

- Knowledge, Attitude and practices of laboratory and pharmacy professionals
- Practices of laboratory staffs and store managers toward the appropriate inventory management of clinical laboratories

Independent variable

- Socio-demographics of interviewees, training, presence of guideline,
- Educational background of the interviewee, training on LMIS, temperature condition, presence of inventory management problems, presence of standard storage space etc,.

4.7 Inclusion And Exclusion Criteria

Inclusion criteria

All TASH laboratories staffs and inventory store managers that have direct contact with laboratory services who were volunteers during implementation were included.

Exclusion criteria

Laboratories staffs and inventory store managers that have direct contact with laboratory services who were in annual leave at the time of data collection period.

4.8 Sampling, Sample Size Determination and Sampling Techniques

Laboratory staff and laboratory commodities inventory store managers who were present during the study period were included in the study. Purposive sampling technique was employed to include all laboratory commodities store keepers/managers of the study participants who meet the inclusion criteria. Both quantitative and qualitative data collection techniques were used. This study included all responsible who are involved in laboratories commodities inventory management which fulfilled the inclusion criteria during the study period.

4.9 Data Collection Tools

The data was collected by means of questionnaire and semi structured observations and discussions. The questionnaires were afforded the researcher the opportunity to collect information that would not be readily available, which tended to enrich the answers and enhance the eventual results of the study.

Four different sets of questionnaires and semi-structured observations were used for the study. The first sets of questionnaires were given to store keepers or inventory managers. The second sets of questionnaires also were given for laboratory staffs. The third was semi-structured observation checklist used to assess laboratory commodities store. The fourth tool used was to assess the availability, expiry and stock out of laboratory commodities. This allowed us to get good responses from the different group of respondents. Personal interviews were done for respondents who might not have time to answer the questionnaires.

4.10. Data quality assurance

The data collection tool was pretested prior to the data collection. Quality assurance of the collected data was made by checking completeness and consistency immediately after data collection. The collected data was summarized on the same day of the data collection.

4.11. Data Analysis

The collected data were checked for errors on the spot and then analyzed and descriptive statistics and cross tabulations were computed and results were presented using tables and graphs.

4.12 Ethical Considerations

The study received ethical approval from department of research and ethical review committee (DRERC) of the Department of Medical Laboratory Sciences. After getting ethical clearance, a support letter was written by the school and submitted to TASH hospital to get permission to undergo the study. Questionnaires were administered by the respondents of the study after obtaining the information sheet and consent form, participants have the right not to answer any question if they did not want. The research was anonymous and did not collect data which might identify the identity of individuals to ensure confidentiality and anonymity of the research.

4.13 Dissemination of Results

The final study report will be submitted to the School of Medical Laboratory Sciences, College of Health Sciences, Addis Ababa University and TASH for further dissemination. The study will also be disseminated at different forum and associations like EMLA/EPHLA and others as appropriate. Attempts will also be made to write article for submission to peer review journal for publication.

5. RESULTS

5.1. Socio-Demographic Characteristics of Study Participants

A total of 83 staffs (71 laboratory and 12 store/inventory managers) with a total response of 95.4% were included in this study. As it is indicated in Table 1 below, males accounts 56.6% and females 43.4%; and 63.9% were between ages 21-39 years and 31.1% were from 40 to 59 years of age and with average age of 36.14 years. With regard to the educational background of the respondents 61 (73.5%) were BSc holders and above which were followed by diploma 18 (21.7%). The rest 4(4.18%) were Certificate (Table 1). Moreover, based on the positions 60 (72.2%) were routine laboratory workers, 12(14.5) heads and quality assurance officers, clinical laboratory advisor, 6 (7.3) store keepers/managers and 5 (6.0%) supply officers. As indicated in the table 1; 44 (53.0%) of respondents had less than ten years work of experience, 21 (25.3%) between 10-20 years and 18 (21.7%) were greater than 20 years of experiences, Table 1.

Table 1: Socio-demographics Characteristics of Respondents at TASH May to June 2016

Socio-demographics	Socio-demographics Characteristics	Frequency	%
Sex	M	47	56.6
	F	36	43.4
Age	21-39	53	63.9
	40-59	30	36.1
Education	BSc and above	61	73.5
	Diploma	18	21.7
	Certificate	4	4.8
Work Experiences	<10	44	53.0
	10-20	21	25.3
	20+	18	21.7
Position in organization	Heads, QA officers, advisors	12	14.5
	Laboratory workers	60	72.2
	Sore keepers /managers	6	7.3
	Supply officers	5	6.0
Marital status	Never Married	38	45.8%
	Married	45	54.2%
	Separated	0	0%
	Divorce	0	0%

5.2 Observation of the Storage Practices of Laboratory Commodities in TASH

Laboratory store was assessed based on the standard storage guideline checklist [27]. It was found that 17/20 (85.0%) were according to the expectations of the standard requirements for storage practices such as arrangement of items in the store, protection from humidity, and insects, proper storage room temperature, secured storage practices and use of bin cards. But 3/20 (15.0%) were not stored based on standard i.e., not stored with frozen storage at -20^{0}C or -70^{0}C , hard copies of stock cards were not available, and did not separate flammable and corrosive laboratory commodities from other goods (Table 2).

Table 2: Observation of Storage Practices at TASH Laboratory Commodities May 2016

#	Observation of the storage conditions of laboratory commodities at TASH	Practice obtained through observation	
		YES	NO
1	Products arranged to see labels, expiry date and manufacturing date	YES	
2	Products stored in FEFO manner	YES	
3	Cartons are protected from water and humidity	YES	
4	Storage area is free from harmful insects and rodents	YES	
5	Products are stored at appropriate temperature	Yes	
6	Store room in a good condition (clean, trash removed, shelf organized)	YES	
7	Storage area is secured access is limited to authorized personnel only	YES	
8	Written guidelines for storing laboratory supplies or commodities according to their specification	YES	
9	Monitoring store room temperature	Yes	
10	Bin cards are availability	Yes	
11	Know the stock of the laboratory items	Yes	
12	Bin cards updated	Yes	
13	Laboratory commodities protected from direct sun light	YES	
14	Store use a maximum and minimum stock level for Laboratory commodities	YES	
15	Cold (2 to 8^0 C) storage	Yes	
16	Stock outs	Yes	
17	No expired items	Yes	
18	Stock cards available		No
19	Flammable and corrosive laboratory commodities stored separately from other goods		NO
20	Have frozen (-20^0 to-70^{0}C) storage which requires frozen condition		NO

5.3 Selection, Quantification and Control of Laboratory Commodities Supplies to TASH

The selection laboratory commodities for TASH suggested as the use of standard essential laboratory commodities lists 50(60.2%) and 33(39.8%) based on the types of services to be served, and the policy requirements by respondents.

There were 8 (9.6%) of respondents have got training in the selection, quantification, supply, receiving, storage, controlling and distribution, of laboratory commodities. Respondents were also asked on how they track their laboratory commodities stock levels; they replied that they do it by comparing the physical count with the one on the bin card and separate records for all laboratory commodities whether there are discrepancies and to advice management on stock movement. The respondents recommended that stock tracking have been done 10(12.5%) weekly, 21(25%) monthly, 34(41%) quarterly and 19 (21.5%) annually from bin cards

Majority 60 (72.6%) of the respondents proposed to establish stock levels for their commodities. This implies, majority of the respondents control their stock levels to help reduce or eliminate stock-outs, over-stocking and obsolete stocks. The rests 23 (27.4%) did not establish maximum, minimum and reorder stocks levels.

5.4 Ordering (Requisition), Receipt, Storing and Distribution

The quantity of laboratory commodities needed for TASH were determined based on past consumption as responded by 75 participants (90.3%), 3(3.6%) of them use the requests made by the users, and 5 (6.0%) uses availability of funds for the laboratory commodities, users data and also accommodate seasonal variation by the respondents.

As regards who to determines the quantities of the laboratory commodities that they have replied 61(73.5%) section head, 13 (15.7%) the head of the departments or units, 7 (8.4%) store man 2(2.4%) of the laboratory commodities at TASH. The types of documents to determine quantities of laboratory commodities and for receipt and inspection were credits sales invoices containing specifications along with the costs of the products, stores issue vouchers, and receipts as some of the documents they use as evidence for inspecting commodities when they are receiving laboratory commodities into the medical stores.

The respondents were asked "where laboratory Commodities for TASH was supplied". About 65(78.3%) replied that they got the commodities from the Central Medical Store (CMS) or PFSA, 10 (12%) from the Regional Medical Store (RMS), 8(9.6%) from Private Suppliers, depending on the commodity and its availability at the CMS or RMS.

Majority of the respondents 55 (66.2%) receives commodities between 2 to 4 weeks after an order is placed; 23(27.7%) of respondents receives their commodity in less than a week, while 5 (6%) receives commodities between 5 to 8 weeks after an order has been placed. This implies, proper planning and stock control must be done to avoid stock-outs since the delivery lead-time was long.

Majority 69 (83.2%) of respondents use the first expiry, first out (FEFO) method. This implies, that respective of the arrival of the commodity, majority of the respondents issue out the one that has the date nearer to expiry first .This method help to eliminate or reduce expired commodities in the system, 14(16.8%) of the respondents use the first in, first out (FIFO) method.

The laboratory commodities distributions at TASH are done through approved requisitions form by an authorized person and approved distribution list and through periodic monitoring of inventory management practices are adhered or not.

Majority(66.3%) of respondents did 100% inspection,(33.7%) of respondents did random sampling inspection of laboratory commodities by random sampling inspection of the quality of laboratory commodities when they receive into the stores during unloading from the vehicles and before and immediately after the commodities are stored. In addition, they replied that TASH laboratory have separate quarantine for unfit for use commodities.

The respondents said that to get commodities readily available to the facility as and when they need them without over stocking. There should be a periodic stock monitoring by management to check whether proper inventory management practices are adhered to and correct establishment of consumption levels (maximum, minimum and re-order). An effective schedule delivery system, where the CMS and RMS must collect all requirements of all the TASH and deliver the commodities to them as scheduled. And they thought there must be accurate record keeping by all those who matters in commodity usage.

5.5 Availability and utilization of logistics records and Reports

Availability, consistent and accurate use of updated bin cards, IFRRs, RRFs, recording and reporting formats are high at TASH (above 95 percent). And it was found that all of the bin cards that were reviewed were updated at TASH. However, there are no stock cards at TASH. The availability of bin card was the fundamental logistics records that captures essential laboratory supply data. Clearly, more must be done to improve the availability of all forms

TASH with Complete and Accurate RRF Reports

Overall, response rate was impressive: reports were completed for all format in at least 88 percent of the TASH.. The level of completeness was high for all laboratory commodities at TASH level.

The data quality of RRF reports was also checked by comparing the balance of stock on hand reported in the RRF with the balance on the bin card on the date that the RRF report was completed. For some products, all the information needed to calculate this indicator were not available or not recorded properly and updated bin card and/or completed RRF.

5.6. Stock availability and stock out of laboratory Commodities

5.6.1. Stock availability of laboratory commodities by type of services

As reported by the staff of TASH; there were no expired laboratory commodities during the past one year period. As can be seen from Table 3 and Figure 1, stock out of laboratory commodities were assessed on two approaches. One was stock out of laboratory commodities on the day of the study and the other was stock out during the past one year period. The overall stock out of laboratory commodities on the day of the study was 44 (37.0%) And the overall stock out during the past one year period was 55 (46.2%). There was no stock outs (0.0% stock out) were for bacteriology and parasitology for both stock out on the day of the study and during the past one year time (Table 3). Respondents were also asked on how to deal with when stock out is encountered and they replied that and an emergency order for the laboratory commodities are placed, borrow from other facilities, and forward requisitions to central medical stores (CMS).

Table 3: Summary of stock out of laboratory commodities by type of services assessed in two approaches in TASH, 2016

Type of Lab services	Number of Lab commodities reviewed	Lab commodities stock outs during the study day		Lab commodities stock outs during the past one year	
		Frequency	Percent	Frequency	Percent
Chemistry	45	13	28.9	24	53.4
Hematology	15	3	20.0	3	20.0
Serology	32	27	84.4	27	84.4
Urine analysis	3	1	33.3	1	33.3
Bacteriology	19	0	0.0	0.0	0.0
Parasitology	5	0	0.0	0.0	0.0
Total (average %)	119	44	37.0	55	46.2

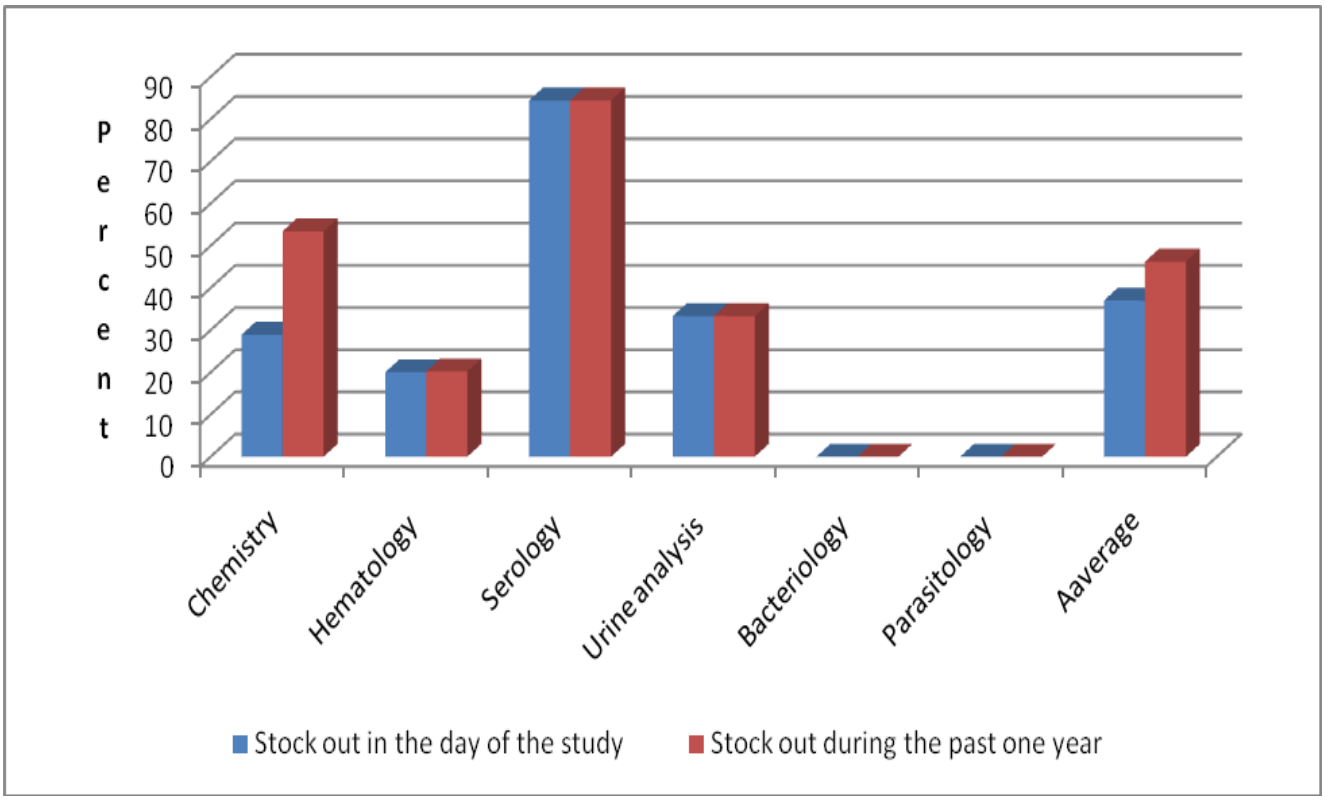

Figure 1: Stock out of laboratory commodities by type of lab services assessed in two approaches

5.6.2 Stock out of Laboratory Commodities on the day of the study at TASH

The type of laboratory services and specific laboratory commodities (reagents, Kits) stock out on the day of the study were assessed. The stock outs of laboratory commodities on the day of the study classified by the type of services included Serology 27 (84.4%), Chemistry (these are Hormone 3(16.7%), Tumor marker 2(66.7%), Routine chemistry 3(15.8%), and electrolytes5 (100%)), Hematology 3 (20%), and Urine analysis 1 (33.3%). The stock outs findings are shown in Table 4 below.

Table 4: Stock out of Lab commodities on the day of the study at TASH May 2016

Type of Lab service	**Reagents, Kits**	**Stock out on the day of the study (Yes)**
Chemistry (Hormone, Tumor marker, Routine chemistry)		
Hormone	GGT (Gamma Glutamyl Transferase	Yes
	LDH (Lactate Dehydrogenase)	Yes
	Adrenocorticotropic hormone(ACTH)	Yes
Tumor marker	Cancer Antigen 19-9(CA-19)	Yes
	Cancer Antigen 125- (CA-125)	Yes
Routine chemistry	Folate	Yes
	Globulin	Yes
	Protein Electrophoresis	Yes
Electrolytes	Sodium(Na)	Yes
	Potassium(K)	Yes
	Chloride(Cl)	Yes
	Magnesium(Mg)	Yes
	Calcium(Ca)	Yes
Hematology	Prothrombin time (PT)	Yes
	Activated partial thrombop lastin time (PTT)	Yes
	Hemoglobin A1C	yes
Serology	TPHA	Yes
	Rapid plasma regain (syphilis)	Yes
	Myoglobulin	Yes

Type of Lab service	Reagents, Kits	Stock out on the day of the study (Yes)
	Cryptococcus antibody	Yes
	C-reactive protein (CRP)	Yes
	Anti-striptolysen O(ASO)	Yes
	Alph Feto Protien(AFP)	Yes
	Prostate specific Antigen (PSA)	Yes
	Hepatitis C virus(HCV test)	Yes
	ToxoIGg	Yes
	ToxoIG M	Yes
	Troponin	Yes
	Coombs Test direct	Yes
	Coombs test indirect	Yes
	Hepatitis B surface Ag (HBSAg)	Yes
	Hepatitis A(HEP A)	Yes
	HepatitisE (HEP E)	Yes
	Anti-Nuclear Antibodies (ANA)	Yes
	Brucell	Yes
	Cytomegalo virus	Yes
	Infectious mononucleosis	Yes
	Mumps	Yes
	Brucella	Yes
	Rubella	Yes
	Welflex-ox19	Yes
	Toxoplasma	Yes
	Varicella	Yes
Urine analysis	Urine 24 hours protein	Yes

5.6.3. Stock Out Of Laboratory Commodities during the Past One Year Period Of The Study At TASH

The type of laboratory services and specific laboratory commodities (reagents, Kits) stock out during the past one year period were also assessed. These stock outs of laboratory commodities during the past one year period of the study classified by the type of services included Chemistry (Hormone, Tumor marker, Routine chemistry, and electrolytes), Hematology, and Serology and Urine analysis. For example the overall stock out was 55 (46.2%) laboratory commodities were stock outs during the past one year period. Of these 27 (84.4%) of serology, (100%) of Tumor marker, 5 (100%) of electrolytes, 4 (2 1%), of routine chemistry, 12 (66.7%)) of hormone, 3 (20%) hematology and 1(33.3%) of urinalysis laboratory commodities were stock out during the past one year period. But laboratory commodities for Bacteriology and Parasitology were not stock out throughout the year and the findings are shown in Figure 2 and Table 5 below.

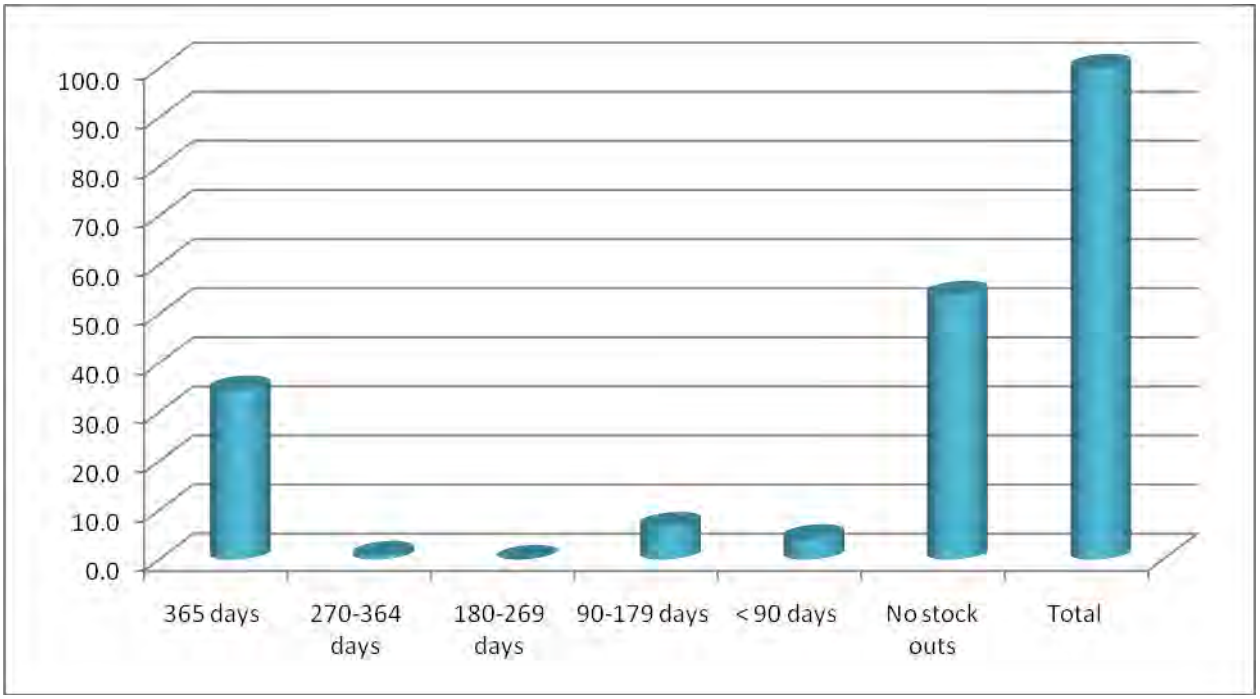

Figure 2: Stock outs of laboratory Commodities by duration of stock out the past one year (=119)

Table 5: Stock out in days during the past one year period of Laboratory commodities at TASH May 2016

Type of services	Tracer Reagents, Kits	Stock out duration during the past one year period (in days)
Chemistry (Hormone, Tumor marker, Routine chemistry)		
Hormone	Adrenocorticotropic hormone(ACTH)	365
	Free T4 (thyroxine)	304
	Free T3 (Triiodothyronin)	98
	Thyroid stimulating hormone (TSH)	98
	Total T3 (Triiodothyronin)	98
	Testosterone	98
	Estradiol	98
	LDH (Lactate Dehydrogenase)	62
	Cortisol	45
	Prolactin	45
	FSH (Follicle Stimulating Hormone)	45
	Thyroxin, Total (T4)	45
Tumor marker	Cancer Antigen 19-9(CA-19)	116
	Carbohydrate Antigen (CA-125)	116
	Carcino Embryonic Antigen (CEA)	106
Routine chemistry	Globulin	365
	Protein Electrophoresis	365
	GGT (Gamma Glutamyl Transferase)	365
	Folate	365
Electrolytes	Sodium(Na)	365
	Potassium(K)	365
	Chloride(Cl)	365
	Magnesium(Mg)	365
	Calcium(Ca)	365
Hematology	Prothrombin time (PT)	365

Type of services	Tracer Reagents, Kits	Stock out duration during the past one year period (in days)
	Activated partial thromboplastin time (PTT)	365
	Hemoglobin A1C	365
Serology	TPHA	365
	Rapid plasma regain (syphilis)	365
	Myoglobulin	365
	Cryptococcus antibody	365
	C-reactive protein (CRP)	365
	Anti-striptolysen O (ASO)	365
	Alph Feto Protien(AFP	365
	Prostate specific Antigen (PSA	365
	ToxoIGg	365
	ToxoIG M	365
	Troponin	365
	Coombs Test direct	365
	Coombs test indirect	365
	Hepatitis B surface Ag	365
	Hepatitis C virus	365
	Hepatitis A(HEP A)	365
	Hepatitis E(HEP E)	365
	Anti-Nuclear Antibodies (ANA)	365
	Brucella	365
	Cytomegalo virus	365
	Infectious mononucleosis	365
	Mumps	365
	Brucella	365
	Rubella	365
	Welflex-ox19	365
	Toxoplasma(Qualitative)	365

Type of services	Tracer Reagents, Kits	Stock out duration during the past one year period (in days)
	Varicella	365
Urine analysis	Urine 24 hours protein	365
Bacteriology		0
Parasitology		0

5.7 The Reasons for Stock Outs Of Laboratory Commodities

The reasons for stock outs are weak selection, quantification, procurement and in adequate stock control and management, delaying of purchasing procedure, weak/unknown consumption data, limited capacity of PFSA to avail needed laboratory commodities, shortage of budget, many work load, unpredicted services demand or increased patient flow, transportation challenges, not ordering in time of needed commodities, short expiry, and inadequate supply were the reasons for stock outs.

5.8 Knowledge, Attitude And Practices (KAP) Of Respondents In Inventory Management Of Laboratory Commodities

5.8.1 Knowledge of respondents about inventory management of laboratory commodities

Eight one (97.6%) respondents knew the appropriate storage of cool chain items, and frozen items; 80 (96.4%) of them knew what quality commodity means and 79 (95.2%) of them maintained the quality of medical laboratory commodities using standard guidelines. Majority 80 (96.4%) of the respondents knew the importance of separation of flammable chemicals, damage or expired products removed from stock records. All (100%) of the store managers knew that medical laboratory commodities should be protected from direct sun light and all medical laboratory commodities should be stored at temperatures according to their specifications and 75 (90.4%) of the respondents explained that all responsible personnel had adequate knowledge about how to store medical laboratory commodities (Table 6 and Figure 3).

Table 6: Knowledge of respondents (n=83) about inventory management of laboratory commodities at TASH May 2016

#	Knowledge Related Questions	Inventory Management Knowledge (Yes)	Percent (Yes)
1	Separation of flammable chemicals	80	96.4
2	Separation of damaged or expired products and removal from stock	81	97.6
3	Appropriate storage of cool chain items	81	97.6
4	Appropriate storage of frozen items	81	97.6
5	Protection of laboratory commodities from sun Light	83	100.0
6	Importance of Temperature specification	83	100.0
7	Know what a quality commodities means	81	97.6
8	Know standard guideline for laboratory commodities supplies storage and management	81	97.6
9	Know procedures or guidelines for destroying damaged, expired or unfit for use products	79	95.2
10	Know about the method how to store laboratory commodities	75	90.4

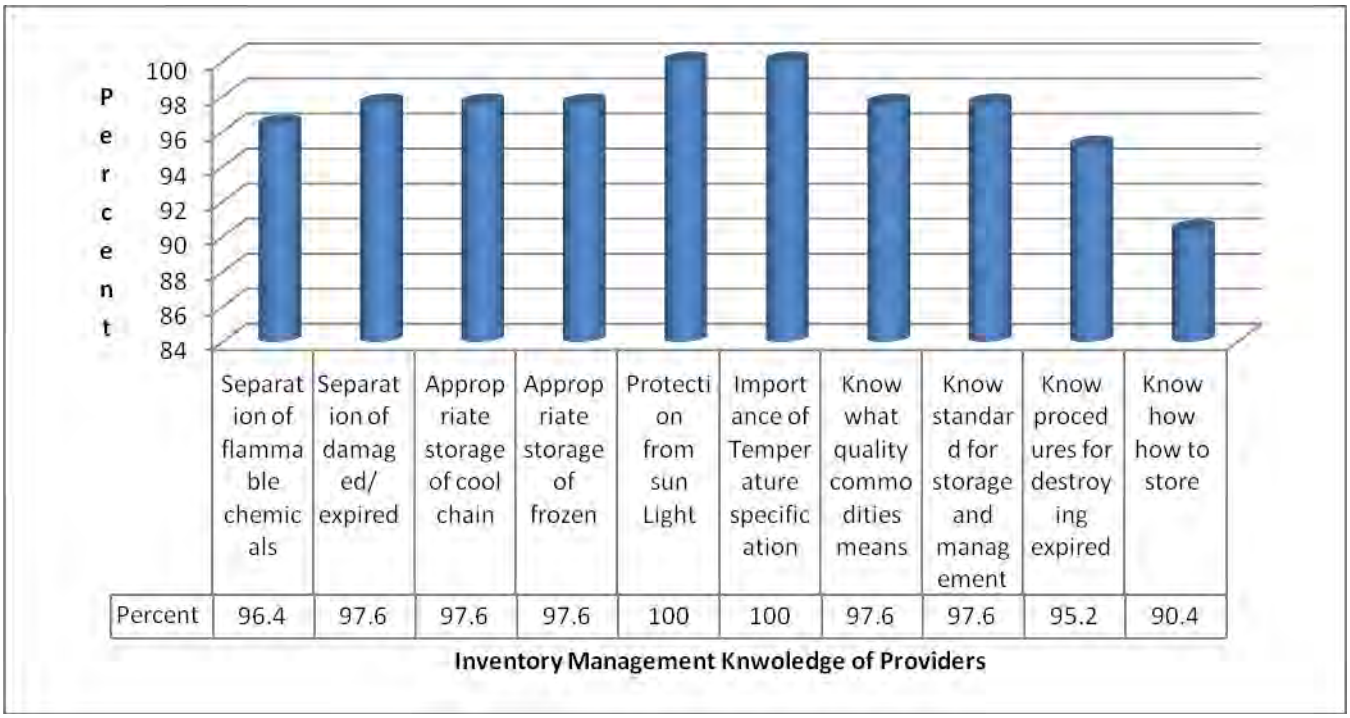

Figure 3: Knowledge of Inventory Management of Providers

5.8.2 Attitude of respondents towards the appropriate inventory management of laboratory commodities

All respondents have the good understanding and attitude for the need to care for cartoons containing laboratory commodities and products; 97.6% of them believe that monitoring store room temperature, 96.4 % of them have the desired attitude for proper storage of laboratory commodities in compliance with the storage standard, and 94.0% of the respondents have thought that the need for standard guideline for laboratory commodities supplies storage and management (Table 7).

Table 7: Attitude of respondents (n=83) towards the appropriate inventory management of laboratory commodities in TASH May 2016

#	Attitude related questions	Responses of Inventory Management Attitudes (Yes)	Percent
1	Standard guideline for medical laboratory commodities supplies storage and management	78	94.0
2	monitoring store room temperature	81	97.6
3	Caring for the cartons containing medical laboratory commodities and products	83	100
4	Laboratory commodities stored in compliance with the storage standard	80	96.4

5.8.3 Practice of respondents on the appropriate inventory management of laboratory commodities

All (100%) of the respondents have the desired practices as regards to the need for cleaning and deforesting refrigerators and prevent from sunlight and water penetration. More over 97.6%of the respondents have the good practices of separately storing of rapidly deteriorating items, and 96.4% on measures taken when temperature is out of range and the need for establishing maximum, minimum and reorder levels for the laboratory commodities (Table 8 and Figure 3).

Table 8: Practices of respondents (n=83) on the appropriate inventory management of laboratory commodities in TASH May 2016

#	Practice related questions	Inventory Management Practices (Yes)	Percent
1	Separate storage of rapidly deteriorating items	81	97.6
2	Measure taken when temperature is out of range	80	96.4
3	Cleaning and deforesting refrigerators	83	100.0
4	Prevent from sunlight and water penetration	83	100.0
5	Establish ma ximum, mi nimum a nd r eorder le vels for the laboratory commodities	80	96.4
6	Established p rocedures f or p lacing em ergency orders	79	95.2

Figure 4: Inventory Management Practices of Providers

5.9. Cross Tabulation of Work Experiences with Knowledge and Practices of Respondents

Cross tabulation of Work Experiences versus knowledge of respondents about inventory management of laboratory commodities are shown in Table 9 below. From the table it can be seen that respondents have adequate knowledge of inventory management and there are important variations by work experiences such as respondents know about the method how to store laboratory commodities and know procedures or guidelines for destroying damaged, expired or unfit for use products.

Table: 9: Work Experiences Vs Knowledge of Respondents about Inventory Management of Laboratory Commodities (n=83) at TASH May 2016

#	Knowledge about Laboratory commodities Inventory Management	Percent Work experiences (years) of Respondents			Total
		< 10	10-20	20+	
1	Separation of flammable chemicals	95.5	95.2	100.0	80
2	Separation of damaged or expired products and removal from stock	97.7	100.0	94.4	81
3	Appropriate storage of cool chain items	95.5	100.0	100.0	81
4	Appropriate storage of frozen items	97.7	100.0	94.4	81
5	Protection of laboratory commodities from sun Light	100.0	100.0	100.0	83
6	Importance of Temperature specification	100.0	100.0	100.0	83
7	Know what a quality commodities means	97.7	100.0	94.4	81
8	Know standard guideline for laboratory commodities supplies storage and management	97.7	100.0	94.4	81
9	Know procedures or guidelines for destroying damaged, expired or unfit for use products	97.7	95.2	88.9	79
10	Know about the method how to store laboratory commodities	90.9	85.7	94.4	75
	Total	**44**	**21**	**18**	

Cross tabulation of work experiences of respondents with laboratory commodities inventory management practices. From the table it is apparent that have adequate practices about laboratory commodities inventory management but there are some that have differences by work experiences such as the need for separate storage of rapidly deteriorating items, measure taken when temperature is out of range, establish maximum, minimum and reorder levels for the laboratory commodities, and established procedures for placing emergency orders (Table 10).

Table 10: Work Experiences Vs Practices of Respondents about Inventory Management of Laboratory Commodities (n=83) at TASH May 2016

#	Knowledge about Laboratory commodities Inventory Management	Percent Work experiences (years) of Respondents			Total
		<10	10-20	20+	
1	Separate storage of rapidly deteriorating items	100.0	90.5	100.0	81
2	Measure taken when temperature is out of range	93.2	100.0	100.0	80
3	Cleaning and deforesting refrigerators	100.0	100.0	100.0	83
4	Prevent from sunlight and water penetration	95.5	95.2	94.4	83
5	Establish maximum, minimum and reorder levels for the laboratory commodities	93.2	100.0	100.0	80
6	Established procedures for placing emergency orders	93.2	95.2	100.0	79
	Total	44	21	18	

6. DISCUSSION

In this study setting, TASH hospital laboratory commodities stores have a well-ventilated and in proper condition to avoid sunlight and water penetration. It was different from study done in Rwanda where the survey found that ventilation was not always ensured (70% for main storage, 43% for other rooms).Protection from light was adequate in most of the main storage areas (98%) but insufficient in other rooms (53%) This could be due to many of those storage spaces were not constructed for the storage for laboratory commodities and medical supplies [12].

In this study, it was found that the overall stock out during the past one year period was 55 (46.2%) which was different from the study done in Tanzania showed that, 35% of laboratory commodities were stock out. Of these, 10% were stock out for rapid HIV test kits. Order fill rate was accurate in which laboratories receive equal amount of quantities ordered. Thirty seven percent of facilities had stock ledger forms of which 69% were updated. Fifty-eight percent of facilities had stock ledger forms for rapid test kits of which 91% were updated and 16% of facilities had reported stock outs; this could be due to inadequate supply [26].

As observed in our study TASH laboratory commodities stores meet the standard storage criteria, 100% products are stored separately from insecticides and chemicals, nearly 88.3 % of TASH stores practiced first expiry, first out (FEFO) procedures. It was different from the study done in Lesotho Thirty three percent of all laboratories reported that reagents were not stored according to the first expiring, first out (FEFO) practice. Seventeen percent of the laboratories responded that cold chain items were not stored at appropriate temperatures due to refrigerators being too full and space not being available [25].

In a well-designed laboratory logistics system, facilities request laboratory commodities based on the established inventory control procedures and supposed to receive the quantity requested. TASH use an inventory control system with established maximum-minimum stock levels to determine quantity of laboratory commodities they order and receive. In this study it was found that the established inventory control procedures were known and utilized (72.6%) out of respondents. The rest 27.4% of the respondents did not know and utilized the established

maximum-minimum stock levels. This result was in agreement with the study done in Malawi [22].

In this study protection from direct sun light was adequate in all (100%) of the stores in this study which was in line with a study conducted in Rwanda where 98% of medical stores did protect medical laboratory commodities from sun light [12].

In this study, 8 (9.6%) of the respondent answered that they had received training about storage of medical supplies. It was different from a study done in Kenya where 2.6% of health professionals had received some training. It could be due to low attention to inventory management system and did not participate all health professionals [24]. Where few number of laboratory professionals were trained in laboratory inventory management

This study showed that, most frequent stock out reagents were 5 (100%) of electrolyte,3 (100%)of Tumor marker,12 (66.7%)of hormone which was comparable with the study done in Lesotho and the result that laboratories experience frequent and prolonged stock-outs of key reagents. Hematology reagents were stock out for three months. Thirteen (67%) and 16 (83%) of laboratories didn't set minimum and maximum stock levels respectively. Thirteen (67%) of laboratories had no stock/bin cards to track laboratory commodities. There were no developed LMIS guidelines on how to determine orders and few laboratory staffs were trained in LMIS. Storage spaces were inadequate and poorly ventilated. Thirty three percent of laboratories reported that, reagents were not stored according to the first expiring first out (FEFO) practice. None of the laboratories practiced the separation of damaged/or expired supplies from usable products and storage spaces were small. The author concluded the placing of orders was erratic and inconsistent and data collected in the LMIS wasn't reliable due to poor record keeping [17].

Our result showed that the reasons of stock out are poor purchasing management system (quantification problem), inadequate request of stock, delaying of purchasing procedure, unknown (well established consumption data), capacity of PFSA avail to needed lab supply, shortage of budget, not available in the market or PFSA, many work load, increased patient flow,

matter of transportation, not ordering at a time of needed. Unexpected consumption and expiry, inadequate supply, claimed delivery of near expiry laboratory commodities, unable to bring laboratory commodities on time and did not receive enough laboratory commodities were reasons for stock outs which was different from the study done in Tanah Papua region in Indonesia showed that, supply chains of laboratory commodities were well maintained. However, the author claimed there were challenges such as poor inventory management with stock holdings out of balance, poor logistics data and record keeping, poor management of expiry dates due to the "push" logistics management information system [18]. It could be due to inadequate supply.

Our result showed that the TASH storage practices for laboratory commodities, most of times using standard guideline for storage of laboratory commodities. In that hospital observed arranged and labeled expiry and manufacturing date. In Tikur Anbessa specialized hospital medical stores had a roof maintained in proper condition to avoid sunlight and water penetration. But Stores did not have frozen storage of -20C or -70C , did not have thermometer in the rooms and did not have adequate number of refrigerators for storing cold chain items, inadequate space, not available stock cards, stock out of a lot of tests for a year, did not separate flammable and corrosive laboratory commodities, and absence of fire safety equipment were the weakest areas found in TASH mini-laboratory stores, and main medical stores which was comparable with the study done in Rwanda [12] that was Based on assessment of infrastructure by direct observation, 98% of facilities were clean; 95% had walls in good condition. From those sites that reported problems, leakages and roofs seemed to be the main concerns. However, less than half of facilities (47%) reported having a reliable supply of electricity, and 35% of facilities reported experiencing power cuts on a daily basis. Refrigerators were available in 78% of the facilities, but functional in 73% of the sites. With respect to the adequacy of the equipment available, 43% of facilities indicated that equipment in the medical store needed improvement. Most facilities (98%) reported having shelving, 45% of facilities reported using pallets for storage, and 64 % reported having Cupboards. Office equipment was available in 82% of the sites; of those facilities some found that many of these storage spaces were not constructed for the storage for laboratory commodities and medical supplies, which could explain their inadequacy in some cases. The survey found that ventilation was not always ensured (70% for

main storage, 43% for other rooms). Protection from light was adequate in most of the main storage areas (98%) but insufficient in other rooms (53%) [12].

Respondents were also asked on how they track their laboratory commodities stock levels; they replied that they do it by comparing the physical count with the one on the bin card and separate records for all laboratory commodities whether there are discrepancies and to advice management on stock movement adequate stocktaking should be done for all laboratory commodities in their health facilities, establishing maximum, minimum or Reorder levels and EOP(Emergency order point) for the laboratory commodities, and establishing methods for laboratory commodities store practices as FEFO, FIFO and LIFO which was different from the study done in Malawi [22] showed that, minimum/maximum stock level and EOP weren't set for laboratory commodities, 70% and 40% of hospitals laboratory store and mini store, respectively had stock/bin cards for laboratory commodities in pharmacy store however, majority of them were not kept up-to-date. No stock/bin cards were used in the laboratory store [22]. It could be due to absence of written storage guidelines.

Our result showed that there were frequent stock out for longer period of time for different laboratory commodities, mainly Chemistry, serology, Hematology and urinalysis which might have lead to services interruptions which was comparable with the study done in Uganda that showed many laboratories experienced frequent stock out and delay in supply of key commodities, such electrolytes, chemistry, Serology, Hematology, and Urinalysis reagents. There were no standardized LMIS forms and many staff members hadn't been trained in laboratory commodities management. These had supply chain deficiencies which affected the availability and the quality of laboratory services in that country [28].

Our result showed that it is a good laboratory commodities practice at TASH in using the first in, first out (FIFO) method, and the first expiry, first out (FEFO) as described by the respondents. It is also a standard practice that the laboratory commodities distributions at TASH are done through approved requisitions from an authorized person and approved distribution list and through periodic monitoring of inventory management practices. This was different from the study done in Lesotho, all Laboratories reported that they had no written guidelines for storage of

laboratory supplies according to their specifications. In most cases, the storage space had poor ventilation and was small, and there were no cupboards for flammable reagents. Thirty three percent of all Laboratories reported that reagents were not stored according to the first expiry first out (FEFO) practice. None of the laboratories practiced the separation of damaged/or expired supplies from usable products. Seventeen percent of the laboratories responded that cold chain items were not stored at appropriate temperatures [12, 25]. It could be due to absence of written storage guidelines.

Our findings showed that availability, consistent and accurate use of updated bin cards, IFRRs, RRFs, recording and reporting formats are high at TASH (above 95 percent) And it was found that all of the bin cards that were reviewed were updated at TASH. However, there are no stock cards at TASH which was comparable with the Study conducted in unpublished draft national IPLS survey result that showed availability of blank bin cards, IFRR and RRF is high at hospitals (above 90 percent). Higher percentage of hospitals utilized bin cards for the assessed products, the percentage of updated bin cards was found to be similar across all hospitals levels [20].

7. STRENGTHS AND LIMITATIONS OF THE STUDY

7.1Strengths Of The Study

- The study has designed to provide baseline information and to identify the weakness and improve the laboratory commodities management system
- The study has designed to address the factors that lead to poor inventory management practice on Tertiary health care delivery and proper corrective action measures to strengthen laboratory inventory system
- Combination of both qualitative and quantitative method helped to supplement the findings each other

7.2 Limitation Of The Study

- Limited number of laboratory commodities in inventory management in similar study especially in Ethiopia made it difficult for comparing results.
- The sample size was not large enough for some specific indicators
- The assessment was not included PFSA central and AA PFSA hub
- Absence of similar literature, especially in Ethiopia in laboratory inventory management system

8. CONCLUSIONS AND RECOMMEDANTIONS

8.1 Conclusions

TASH laboratory commodities storage practices use the first in, first out (FIFO) or the first expiry, first out (FEFO); and secured storage practices and use of bin cards. TASH laboratory commodities distributions use approved distribution list and requisitions forms by an authorized person and also that there is periodic monitoring of inventory management practices. However, absence of frozen temperature and stock cards, and lack of separation of flammables and corrosives for laboratory commodities were some of the limitations observed. There were stock out for longer period of time for different laboratory commodities, mainly including Chemistry, serology, Hematology and urinalysis which might have lead to services interruptions.

On the other hand, on the awareness of TASH store keepers, they had good knowledge about the appropriate storage of cool chain items, frozen items; the importance of separation and removal from stock records of flammable chemicals, damaged or expired products; medical laboratory commodities should be protected from direct sun light; and all medical laboratory commodities should be stored at their specific temperatures. Laboratory personnel have indispensable role in inventory management of laboratory commodities storage, they were in involved in mini-stores only but not in the main hospital medical stores.

8.2 Recommendations

- The actions taken by TASH during stock out were important, however, capacity building training of the staff on selection and quantification, inventory management and storage practices of laboratory commodities may be necessary to sustainably overcome the frequent stock
- Hospitals should have adequate storage space to store separately flammable and corrosive, and damaged/expired laboratory commodities appropriately.
- Regular inspection and control should be focused in store rooms

- Store keepers/managers should know how to appropriately store items, how to take measures to faults and should have positive attitude to proper storage of laboratory commodities.
- Updated stock cards and bin cards should be regularly used for all products to track the level of stock and prevent stock outs to minimize services interruptions.
- Engagement with PFSA and other supplies to work strongly to avail all products required for laboratory commodities and to minimize if possible to avoid stock out.

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10. ANNEXES

Annex I: INTRODUCTION: Information Sheet (English Version).

Addis Ababa University College of health science, school of allied health Science School of Medical Laboratory Sciences

Dear Participants,

My name is --------, Post graduate student of Addis Ababa University, College of health science, school of allied health science, School of Medical Laboratory Sciences; I am going to conduct study and collect data on laboratory inventory management practice and the overall laboratory commodity management practices in Tikur Anbessa specialized hospital Addis Ababa. The objective of the study is to collect current information on laboratory inventory management practices, commodities and associated factors. The information you provide will be used to improve inventory management system in the management of laboratory commodities and better quality service provision to the clients. The study will identify gaps and challenges and provide recommendations for proper interventions of government and logistic interventions for the future. If you decide to participate, we will guarantee that there is no any influence related to study but only request you that to provide all relevant information regarding the study. Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Your name will not be written on the questionnaire or be kept in any other records. Your participation is voluntary and you are free to withdraw your consent and to discontinue participation at any time without consequence. Your participation or not, do not have any influence for your position or responsibilities in your health facility. For the successes of our study, you are kindly requested to respond genuinely and voluntary with patience. Your signature below indicates that you have read the information above and have decided to participate in the study.

You have been identified as someone who can assist by responding to the questionnaire intend for the research. I wish to assure you of most confidentiality of any information you may provide and also that your responses are only for the purpose of this research,

Thank you

Annex II: Consent form in English

I_____ here by giving my consent for giving accurate information about the status of laboratory inventory management practice and medical store. Health facility as recommended by the researcher/data collector and to answer those commodities questions. I understand there is no problem within my position in the health facility by participating in this assessment at the beginning as well as at the end of the study. I understand this study will be used not only for my health facility but also for other health facilities those provide medical laboratory services. I believe that at the end of study the result will not refer individual facilities but rather will describe the overall picture of all facilities.

Participants Name _____ *Signature*_____ *Date*_____

Researcher's Name_____ *Signature* _____*Date*_____

Thank you in helping with this important study

N.B: If you want to request additional information about the study, you will call by those phone numbers contact address of Principal investigator, 0911428198 DRERC: 251-116 755170

Questionnaires

Research title: Assessment on laboratory inventory management practice and medical stores of medical laboratory commodities in Tikur Anbessa specialized hospitals in Addis Ababa, Ethiopia. Please provide your assistance by giving your answers to the following questions.

Annex III: Questionnaire For Inventory Managers (Medical Stores) At TASH

Background Information

1. Sex a) Male☐ b) Female☐

2. Profession: a) Pharmacy ☐ b) Medical lab tech ☐ c) Nurse ☐ d) Other ☐

3. Age:_____

4. Marital Status: a) Never married) Married☐ c) Divorced☐ d) Separated☐ e) Widowed ☐

5. Position in organization …….

6. What is your level of education?

   a) Certificate

   b) Diploma

   c) BA/BSc ☐

   d) MBA/MSc ☐

   e) Others (specify) ……

7. How would you describe your role in the laboratory commodity management?

   a) Selection and Procurement☐

   b) Inventory Management ☐

   c) User☐

   d) Supervisor ☐

8. How many years (months) have you been working in this capacity?----------

9. Have you ever received any training in laboratory commodity management? a) Yes☐ b) No ☐

10 .Do you know what a quality commodities means? a) Yes ☐ b) No☐

11. If yes, how do you maintain the quality of medical laboratory commodities?

   a. By using standard guide line b) By using manufacturers manual or instruction. c)If other Specify

12. Measure taken when temperature is out of range? a) Yes ☐ b) No☐

13. Way of cleaning and deforesting refrigerators? a) using other refrigerators b) I do not know

14. Separation of damaged or expired products and removal from stock? a) Yes☐ b) No☐

15. C aring f or t he c artons c ontaining m edical l aboratory c ommodities a nd pr oducts?

a) Yes ☐ b) No☐

16. Cleaning and deforesting refrigerators? a) Yes ☐ b) No☐

Product Selection, Quantification and Control

17. How is the selection of laboratory commodities done in TASH?

a) Standard essential lab supplies list ☐

b) Nonstandard lab list that varies with time ☐

c) Based on the type of services provided☐

d) Others (specify) ☐……

18. Do you do Stock tracking? a) Yes ☐ b) No☐

19. If yes to question 18, how often do you do it?

a) Weekly ☐b) Monthly☐ c) Quarterly ☐ d) Bi-annually☐

20. Do you maintain separate records for all health commodities? a) Yes ☐ b) No ☐

21. Are there list t of essential laboratory commodities list? Yes ☐ No

Product Ordering and Distribution

22. How do you determine the quantity of laboratory commodities needed?

a) Past Consumption☐

b) Expected number of clients/patients

c) Requests from end-users☐

d) Availability of Fund ☐

e) Others (specific) ……

23. Do you establish Maximum, Minimum, and Re-order levels for the laboratory commodities? a) Yes ☐` b) No ☐

24. If yes to question 23, how often do you update these levels?

a) Weekly ☐b) Monthly ☐c) Quarterly ☐d) Bi-annually ☐

25. If No to question 23, how do you control your stock levels?

.....

26. Are there established procedures for placing emergency orders? Yes ☐ b) No☐

27. Who determines the quantity of commodities to be ordered?

a) Head of the department b) Store manager c) Other ……..

28. How often the quantity of commodities needed is ordered?

a) Monthly☐b) Quarterly ☐c) Bi-annually ☐d) As the need arises e)Weekly f)Daily

29. How long does it take your unit to receive commodities once a request has been placed?

a) Within a day ☐ d) 8 to 14 days

b) 2 to 4 days ☐ e)After14 days

c) 5 to 7 days ☐

30. From where does TASH receive its laboratory commodities?

a) Central Medical Store☐ b) Regional Medical Stores ☐

c) Private Supplies☐d) Hospital Pharmacy ☐

e) Others (specify) ☐…….....

31 Have you ever experienced expire?, a) yes b) No

32. Have you ever experience Stock-Outs? a) Yes☐ b) No ☐

33. If yes t o que stion 32 , how di d you de al w ith t he s ituation? ....

.....……

34 Reason f or S tock out ? .....

35 How commodities get to TASH?

Product Receipt, Storage and Issues

36 What a re s ome of t he doc uments r eceived a long with t he c ommodities?

……

37. How is inspection of commodities done at your facility?

a) 100% inspection☐ b) Random sampling inspection ☐

38. At what stage of commodity arrival is inspection done?

a) Before Unloading ☐ c) Before Storage ☐

b) After Unloading ☐ d) After Storage ☐

39 By which method are commodities stored and issued in your facility?

a) First In, First Out (FIFO) ☐ b) Last In, First Out (LIFO) ☐

c) First Expiry, First Out (FEFO) ☐ (e) Others (specify) ☐……

40**.** Are flammable chemicals stored in a specialized or in separate area? Do you know whether it needs specialized area? a) Yes ☐ b) No ☐

41. Are laboratory commodities are stored at the appropriate temperature according to product temperature specification? a) Yes ☐ b) No☐

42. Do you have standard guide line for medical laboratory commodities supplies storage and management a) Yes ☐ b) No☐

43. Do you have Storage of rapidly deteriorating item? a) Yes ☐ b) No

44. Are cold chain items stored at appropriate temperature? a) Yes ☐ b) No☐

45. Are cool chain items stored at appropriate temperature? a) Yes ☐ b) No☐

46.Do you have frozen storage which requires frozen condition? a) Yes ☐ b) N

47 Does the roof is maintained in a good condition to avoid sunlight and water penetration**?** a) Yes ☐ No ☐

48. Do you have a separate location for quarantine commodities? a) Yes☐ b) No☐

49. Are the following LMIS Formats and Job Aides are available at the TASH?

(Ask for documents to verify)

1. Bin Cards a) Yes ☐` b) No ☐
2. Internal Facility Report and Requisition Voucher (IFRR) a) Yes ☐` b) No ☐
3. Facility Report and Requisition Form (RRF) a) Yes ☐b) No ☐

50. How is the store standard for your laboratory commodities? a). In compliance with the storage standard. b) Not in compliance with the storage standard c) I don't know

51. What do you think should be done to get commodities readily available to your facility as and when they need them without over stocking? ……

……

……

Annex IV: Questionnaire for laboratory staffs at TASH

Research title is assessment on laboratory inventory management practice and medical stores of medical l aboratory commodities i n T ikur A nbessa s pecialized hos pitals i n A ddis A baba, Ethiopia.

Please provide your assistance by giving your answers to the following questions

BACKGROUND INFORMATION

1. Sex: a) Male☐ b) Female☐

2. Age: ----------

3. Marital Status

a) Never married ☐ d) Separated ☐

b) Married ☐ e) Widowed ☐

c) Divorced ☐

4. Position in organization ……..

5. What is your level of education?

a) Certificate ☐ d) MBA/MSc☐

b) Diploma ☐ e) Others (specify)☐……

6. How would you describe your role in the laboratory commodity management?

a) Prescriber ☐

b) User ☐

c) Supervisor

d) Others (specify) ☐ ……

7. How many years have you been working in this capacity? :----------

8. Have you ever received any training in laboratory commodity management? a) Yes☐ b) No ☐

9. Do you know what a quality commodities means? a) Yes ☐ b) No☐

10. If yes, how do you maintain the quality of medical laboratory commodities?

a) By using standard guide line b) By using manufacturers manual or instruction. c) If other Specify

11. Are laboratory commodities are stored at the appropriate temperature according to product temperature specification? a) Yes ☐ b) No☐

12. Measure taken when temperature is out of range? a) Yes ☐ b) No☐

13. Way of cleaning and deforesting refrigerators? a) Using other refrigerators b) I do not know

14. Separation of damaged or expired products and removal from stock? a) Yes ☐ b) No

15. Caring for the cartons containing medical laboratory commodities and products? a) Yes ☐ b) No ☐

16. Cleaning and deforesting refrigerators? a) Yes ☐ b) No☐

17. Are flammable chemicals stored in a specialized or in separate area? Do you know whether it needs specialized area? a) Yes ☐ b) No☐

18 Are cold chain items stored at appropriate temperature? a) Yes ☐ b) No☐

19. Are cool chain items stored at appropriate temperature? a) Yes ☐ No ☐ b

20. Do you have frozen storage which requires frozen condition? a) Yes ☐ b) N

21. Does the roof is maintained in a good condition to avoid sunlight and water penetration**?** a) Yes ☐ b) No☐

22. Do you have standard guide line for medical laboratory commodities supplies storage and management a) Yes ☐b) No☐

23. Do you have Storage of rapidly deteriorating item? a) Yes ☐ b) No☐

24. How is the store standard for your laboratory commodities? a). In compliance with the storage standard. b) Not in compliance with the storage standard c) I don't know

PRODUCT SELECTION, QUANTIFICATION AND CONTROL

25. How is the selection of laboratory commodities done in your facility?

a) Standard essential lab supplies list ☐

b) Nonstandard lab list that varies with time ☐

c) Based on the type of services provided☐

d) Others (specify) ☐……

26. Do you maintain separate records for all laboratory commodities? a) Yes ☐ b) No☐

27. Are there list of essential laboratory commodities? Yes ☐ No

PRODUCT REQUISITIONING AND ISSUING

28. How do you determine the quantity of laboratory commodities needed?

a) Past Consumption ☐ b) Requests from Users

c) Availability of Funds ☐ d) Others (specify) …☐……

29. Do you establish Maximum, Minimum, and Re-order levels for the laboratory commodities? a) Yes ☐` b) No ☐

30. If yes to question 29, how often do you update these levels?

a) Weekly ☐b) Monthly ☐c) Quarterly ☐d) Bi-annually ☐

31. If No to question 29, how do you control your stock levels?

.....

32. Are there established procedures for placing emergency orders? Yes ☐ b) No☐

33. Do you have Storage of rapidly deteriorating item? a) Yes ☐ b) No

34. How often is the quantity of laboratory commodities needed requested?

a) A Monthly☐b) Quarterly ☐c) Bi-annually ☐d) As the need arises e)Weekly f)Daily

35. From where does your Unit receive its Laboratory commodities?

a) Central Medical Store☐ b) Regional Medical Stores☐

c) Hospital pharmacy ☐ e) Others (specify)☐…….....

36. How long does it take your unit to receive commodities once a request has been placed

a) Within a day☐

b) 2 to 4 days☐

c) 5 to 7 days☐

d) 8 to 14 days

e) After 14 days☐

37. Have you ever experienced expire?, a) yes b) No

38. Have you ever experience Stock Outs? a)Yes ☐ b) No ☐

39. If yes to question 38, how did you deal with the situation? ..... .

.....……

40 Reason for Stock out?.....

41. How do the commodities get to the unit …….....

……

42 Who de termines the qua ntity of c ommodities t o be r equested? ..... ……

……

43. By which method are commodities stored and issued in your facility?

a) First In, First Out (FIFO) ☐ b) Last In, First Out (LIFO) ☐

c) First Expiry, First Out (FEFO) ☐ d) Others (specify) ☐……

44. Do you do Stock tracking? a) Yes ☐ b) No☐

45. If yes to question 18, how often do you do it?

a) Weekly ☐ b) Monthly☐ c) Quarterly ☐ d) Annually☐

46. Are the following LMIS Formats and Job Aides are available at the TASH?

(Ask for documents to verify)

1. Bin Cards a) Yes ☐` b) No ☐

2. Internal Facility Report and Requisition Voucher (IFRR) a) Yes ☐` b) No ☐

3. Facility Report and Requisition Form (RRF) a) Yes ☐ b) No ☐

47. W hat do you think should be done to get c ommodities readily available to your c lients as and w hen t hey ne ed t hem w ithout ove r s tocking t he c ommodities?

……

Annex V: Observation of TASH laboratory commodities store condition

Description Yes/No Comments

1. Products that are ready for distribution are arranged so that identification of labels and expiry dates and/or manufacturing dates are visible. a) Yes☐ b) No☐

2. Products are stored and organized in a manner accessible for first-to-expire, first-out (FIFO) counting and general management. a) Yes☐ b) No☐

3. Cartons and products are in good condition a) Yes☐ b) No☐

4. The facility makes it a practice to separate damaged and/or expired products from usable products and removes them from inventory. a) Yes☐ b) No☐

5. Products are protected from direct sunlight. a) Yes☐ b) No☐

6. Cartons and products are protected from water and humidity. a) Yes☐b) No☐

7. Storage area is visually free from harmful insects and rodents. a) Yes☐b) No☐

8. Storage area is secured with a lock and key, but is accessible during normal working hours; access is limited to authorized personnel. a) Yes☐ b) No☐

9. Products are stored at the appropriate temperature according to product temperature specifications. a) Yes☐ b) No☐

9. Knowledge of responsible personnel about the method how to store laboratory commodities. a) Yes ☐ b) No ☐

10. Roof is maintained in good condition to avoid sunlight and water penetration a) Yes☐ b) No☐

11. Store room is maintained in good condition (clean, all trash removed, sturdy shelves, organized boxes). a) Yes☐ b) No☐

12. The current space and organization is sufficient for existing products and reasonable expansion a) Yes☐ b) No☐

13. Bin cards are Availability? a) Yes☐ b) No☐

14. If no, how do you know the stock of the lab items? a) Yes☐ b) No☐

15. Are bin cards updated a) Yes☐ b) No☐

16. Are there overstocks a) Yes☐ b) No☐

17. Are there stock outs a) Yes☐ b) No☐?

18 Are there expired items a) Yes☐ b) No☐

19 When was last inventory made? a) before 3 months b) within 3 months c) before 6 months within 6 months

20 How are laboratory items stored? a) FIFO ☐ b) LIFO ☐

21 How well are stored? …….

22 Are stock cards available? a) Yes☐ b) No☐

22 Is the stock card match with the bin card? a) Yes☐ b) No☐

23 Who controls the stock cards?

a) Store man b) head of Lab c) person other than store man,

d) Others (specify) ,,

24. Are there written guideline for storing laboratory supplies or commodities according to their specification. a) Yes ☐ b) No ☐ c) I don't know ☐

25. Do you monitor your store room temperature?

a)Yes☐ b).No☐ c) If others specify☐

26. D o you s tore f lammable a nd c orrosive l aboratory commodities separately from other goods? a)Yes ☐ b) No ☐ c) I don't know ☐

27. Do you have frozen storage which requires frozen condition?

a) Yes☐ b)No☐c)I don't know☐

28. If yes, what is the temperature it requires?

a)2 to 8^0c ☐ b) below -20^0c ☐

29. Does laboratory commodities are protected from direct sun light?

a) Yes☐ b) No☐ c) I don't know

30. Does this facility use a maximum stock level for Laboratory commodities? a) Yes ☐ b) No☐

31 Does this facility use a minimum stock level for Laboratory commodities) Yes ☐ b) No☐

32 Do you have thermometer? a) Yes ☐ b) No☐

33Do you have frozen storage condition of -20c to -70c? a) Yes ☐ b) No☐

Annex VI. Availability of essential laboratory supply test list and stock out of laboratory supplies

Type of Lab service	Tracer Reagents, Kits	Expire of Laboratory Commodities Over 1 year	Stock out on the day of the study Y/N	Stock out duration (days) over the last one year
Chemistry	Fast blood sugar(FBS)			
	Globulin			
	Total protein			
	Albumin			
	ALP (Alkaline Phosphatase)			
	ALT (Alanine Aminotransferase)			
	AST (Aspartate Aminotransferase)			
	Phosphorus			
	Amylase			
	TIBC(Total iron binding capacity)			
	Carbohydrate Antigen(CA)-125			
	Bilirubin (Total)			
	Bilirubin(Direct)			
	BUN (Urea)			
	Creatinine			
	Uric acid			
	Protein Electrophoresis			
	Random blood sugar(RBS)			
	GGT (Gamma Glutamyl Transferase			
	Lipid A ssessment (HDL, L DL, Triglycerides,Cholesterol)			
	LDH (Lactate Dehydrogenase)			
	Lipase			
	Free T3(Triiodothyronin)			
	Thyroid stimulating hormone (TSH)			
	Total T3((Triiodothyronin)			

Type of Lab service	Tracer Reagents, Kits	Expire of Laboratory Commodities Over 1 year	Stock out on the day of the study Y/N	Stock out duration (days) over the last one year
	Thyroxine, Free (Ft4)			
	Thyroxine, Total (T4)			
	Progesterone (PROG)			
	Luteinizing Hormone (Lh)			
	Creatin Kinase(CK-MB)			
	Testosterone			
	Estradiol			
	Cortisol			
	Prolactin			
	FSH (Follicle Stimulating Hormone)			
	Cancer Antigen 19-9(CA-19)			
	Folate (Folic Acid)			
	Adrenocorticotropic hormone			
	Carcino Embryonic Antigen(CEA			
Electrolytes	Sodium(Na)			
	Potassium(K)			
	Chloride(Cl)			
	Magnesium(Mg)			
	Calcium(Ca)			
Hematology	Blood group and Rh factor			
	Prothrombin time (PT)			
	Activated partial thromboplastin time (PTT)			
	Hemoglobin A1C			
	CD4 Reagent			
	FACS flow			
	Cell Dyne Lyze			
	Cell pack			

Type of Lab service	Tracer Reagents, Kits	Expire of Laboratory Commodities Over 1 year	Stock out on the day of the study Y/N	Stock out duration (days) over the last one year
	Detergent			
	Cell Dyne Diluent			
	FFS(FOR DS)			
	FFD(FOR DL)			
	FB			
	Stromatolyser WH			
	Write /Giemsa stain			
Serology	STAT PAK			
	Viral Load			
	UNIGOLD			
	KHB			
	TPHA			
	Rapid plasma regain (syphilis)			
	Rheumatoid factor (RF)			
	Myoglobulin			
	Cryptococcus antibody			
	C-reactive protein (CRP)			
	Anti-striptolysen O (ASO)			
	Alph Feto Protien(AFP)			
	Prostate specific Antigen (PSA)			
	Hepatitis B surface Ag			
	Hepatitis C virus			
	ToxoIGg			
	ToxoIG M			
	Troponin			
	Widal test			
	Coombs Test direct			

Type of Lab service	**Tracer Reagents, Kits**	**Expire of Laboratory Commodities Over 1 year**	**Stock out on the day of the study Y/N**	**Stock out duration (days) over the last one year**
	Coombs test indirect			
	Hepatitis (HEP A)			
	Hepatitis(HEP E)			
	Helicobacter Pylori Antibody			
	Anti-Nuclear Antibodies (ANA)			
	Brucell			
	Cytomegalo virus			
	Infectious mononucleosis			
	Mumps			
	Brucella			
	Rubella			
	Welflex-ox19			
	Toxoplasma(**Qualitative)**			
	Varicella			
	Cryptococal Ag (for HIV patient CD4 <100)			
Urine analysis	Urine chemical test			
	Urine 24hours protein			
	Urine HCG			
Bacteriology	Blood Agar			
	Chocolate Agar or Heated Blood agar			
	MacConkey Agar			
	Mueller Hinton Agar			
	XLD (Xylose Lysine Deoxychoiate			
	SS (Salmonella-Shigella) Agar			
	DCA (Desoxycholate Citrate Agar			
	MSA(Manitol salt agar)			
	Cled Agar			

Type of Lab service	**Tracer Reagents, Kits**	**Expire of Laboratory Commodities Over 1 year**	**Stock out on the day of the study Y/N**	**Stock out duration (days) over the last one year**
	Nutrient broth			
	Thayer Martin			
	Selenite F Broth			
	Crystalviolet			
	Gram iodine			
	Safranine			
	Phenol			
	Carbon fuchsin			
	Methylene blue			
	Acid alcohol			
Parasitology	Occult Blood			
	Microscope slide			
	Cover slide			
	Wooden applicator			
	H.Pylori Antigen			