ADDIS ABABA UNIVERSITY SCHOOL OF COMMERCE, LOGISTICS AND SUPPLY CHAIN MANAGEMENT UNIT



An Assessment on Logistics Practice of Laboratory Commodities: The Case of St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia

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Thesis Submitted to Addis Ababa University School of Commerce in partial fulfillment of the requirements for the Degree of Master of Art in Logistics and Supply Chain Management.

Addis Ababa, Ethiopia

June, 2019

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Approved by Board of Adviser and Examiners

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External Examiner

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DECLARATION

I, Fasil Bekele, declared that this paper is a result of my independent research work on the topic entitled ***"An Assessment on Logistics Practice of Laboratory Commodities: The Case of St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia"*** in partial fulfillment of the requirements for the Degree of Masters of Art in Logistics and Supply Chain Management in Addis Ababa University.

This work has not been submitted for a degree to any other university.

All the references are also duly acknowledged.

Signature: _____

Date: _____

CERTIFICATION

It is to certify that Fasil Bekele has carried out this research work on the topic entitled “An Assessment on Logistics Practice of Laboratory Commodities: The Case of St. Paul’s Hospital Millennium Medical College, Addis Ababa, Ethiopia” under my supervision.

This work is original and has not been presented for a degree in any University, and it can be submitted for the partial fulfillment of the requirements for the award of the degree of Masters of Art in Logistics and Supply Chain Management.

Tariku Jebena, Ph.D.

Signature: _____

Date: _____

LIST OF ACRONYMS

AIDS: Acquired Immune Deficiency Syndrome

EPSA: Ethiopia Pharmaceutical Supply Agency

HIV: Human Immunodeficiency Virus

IPLS: Integrated Pharmaceutical Logistics System

LC: Laboratory Commodities

LCLS: Laboratory Commodities Logistics System

LIAT: Logistics Indicator Assessment Tool

LSAT: Logistics System Assessment Tool

LMIS: Logistics Management Information System

PFSA: Pharmaceutical Fund and Supply Agency

QA: Quality Assurance

QC: Quality Control

SPHMMC: St. Paul Hospital Millennium Medicine Collage

ACKNOWLEDGMENT

I want to thank my Advisor Dr. Tariku Jebena for his valuable advice, constant support, commitment, encouragement, dedication, guidance and comments, and for his being everlasting enthusiastic from the beginning to the end of the project. I would also extend my respect to my instructors to discharge their skills and knowledge unreservedly.

My acknowledgment goes to St. Paul Hospital Millennium College of Medicine, Ethical Committee for review and complement. Laboratory and Pharmacy department, and all study participants for reviewing my study, cooperation in filling out the questionnaire, willingness for an interview, and providing valuable information about Laboratory commodities logistics system (LCLS). I want to extend my special acknowledgment to Hirut Tadesse, Mintesinot, Gutema Misgana, and Tesfaye Kassa for their facilitating and welcoming throughout my study work at St. Paul's Hospital Millennium College of Medicine.

This journey would not have been possible without the support of my family. Thank you, for your support, love, encouragement, patience, care, and support throughout this study period and in my lifetime.

I THANK YOU!

Fasil Bekele

ABSTRACT

The inefficient logistics can cause a stock out of critical and essential products, leaving clients underserved and which adversely affect the patients particularly and widely the health sector. To secure laboratory commodities at health facilities, all elements of the logistics cycle have equal importance. Assessing a part lonely will not address the logistics challenges at all. This study aims to assess the logistics practice of laboratory commodities in the perspective of logistics elements. A descriptive, cross-sectional study design with mixed research approaches, qualitative, and quantitative is employed in data collection and analysis. Nine interviews, twenty-nine questionnaires were responded, and ninety-four LC were assessed at SPHMMC. The finding indicates that good customer service and relation management practiced but above half of the test menu were stock out. No guideline and involvement of laboratory case teams head for product selection and quantification. Almost half, 54 (57.4%), of line of commodities quantified from expected, 20 (37%) commodities were received till 11th month of the budget year, 11(35.5%) received despite not quantified, no involvement of stakeholders during quantification, limited skills, and knowledge in each laboratory commodities logistics cycle. Above 80% of commodities stocked below min or max level, of this 56.8 % (29) were above max. No proper implementation of IPLS, no IFRR and weak stock keeping recording practice, RRF generated for 40 (42.6%) line of commodities, from 54 availed items 40 (74.1%) were set min-max, and 18 (45%) were updated. There was storage space constraint. As a result testing units, mini store, and a main sore stock max level of a week, ½ month, and two months respectively, good storage practice is observed in mini store 11(73%) compared to main store (33%).Quality assurance scheme was not guideline and SOP-based intervention in the logistics cycle. Quality control approach was different when it was received from EPSA and private suppliers. The sample tested when it was received from a private supplier only. Generally, on the grand average mode of all respondents of the questionnaire were almost agreed in each logistics cycle for all issues raised with limited standard deviation. Customer service means 4±0.844, Product selection 3.7±0.99, Quantification 4±0.84, Procurement 3.85±0.90, Inventory management 4±0.91, storage and transportation 4±0.93, and LMIS 4±1.01. In conclusion, poor inventory management practice, weak LMIS implementation, no standardized product selection and quantification, and long procurement, and weak storage practices. It is proposed that professional development on each logistics cycle, the involvement of laboratory professionals and other stakeholders during quantification and product selection, maintaining min-max, proper implementation of LMIS, developing and or adopting guidelines and SOPs related to the logistics cycle and adhering the guidance will improve logistics practices.

Keywords: Health Commodities Logistics, Laboratory Commodities Logistics, Logistics, Customer service, Product selection, Quantification, Procurement, Inventory management, Storage and distribution, Quality Assurance, Logistics Management Information System

CHAPTER ONE

INTRODUCTION

This chapter demonstrates the background and problem statement of the study that aims to address the objectives in the case study area. It also shows the organization of the study in chapters and expresses the scope, limitation, and significance as well. To address clearly and convey proper information terms are operationally defined.

1.1. Background of the Study

The logistics system provides quality customer service by fulfilling six rights: ensuring that the right information on the right laboratory commodity in the right quantities at the right time and the right place for making the right decisions on what, when and how much to order (USAID/DELIVER PROJECT, 2008).

The logistics system in the health sector demand more efforts to attain the six rights due to its varied product characteristics, and as it is public health importance. Likewise, Laboratory logistics systems manage a vast array of testing commodities, with varying features, for a diverse number and type of service delivery points. These commodities used for laboratory testing services which are required for several important public health purposes (Mwencha, Marasi, Sarah Anderson, Naomi Printz, Patrick Msipa, Kelly Hamblin, and Carmit Keddem, 2010).

Apart from its public health purpose, a reliable and efficient logistics system will help to create a successful health program on many levels, improve the availability of affordable health commodities, patients gain confidence in the health facility. The opposite, an inefficient logistic system can cause a stock out of critical and essential products, leaving clients underserved and which adversely affect the patients, or overstocking of facilities leading to waste of scarce resources through expiry (Ughweroghene Kingston Omo-Emmanuel, Ochei Kingsley Chinedum, Obeagu Emmanuel, Odo Michael and Olubunmi Negedu-Momoh, 2017).

To solve such challenges in public health facilities, in Ethiopia, by proclamation number 553/2007, Pharmaceuticals Fund and Supply Agency (PFSA) was

established in 2007 to avail affordable and quality Pharmaceuticals, including laboratory commodities (LC) sustainably to all public health facilities (Federal Negarit Gazeta, 2007). Accordingly, the health facilities are expected for forced ordering to maintain Maximum/Minimum inventory control system (PFSA, 2017).

For unavailable commodities in PFSAs' stock keeping and supplying branches, health facilities have the mandate for selecting, quantifying, and procuring from other suppliers/vendors.

1.2. Statement of the Problem

The importance of laboratory service is indisputable. It plays a significant role in a country's health system and the delivery of quality health services. For efficient and reliable laboratory operations require an uninterrupted availability of reagents, supplies, consumables, and other related services.

According to USAID|DELIVER (2009), managing supply chains in support of laboratory services is a formidable challenge, especially in developing countries. Poor supply chain management at all levels of the health system in developing countries is common and is leading to stock-outs of critical reagents, supplies and consumables that are resulting in interruptions of service delivery (Gibson Kagaruki, Mathias Leo Kamugisha, Andrew Kilale, and Erasmus Kamugisha, 2018).

Without adequate laboratory supplies or an effective supply chain to deliver the commodities to facilities continuously, investments in the provision of laboratory services will not be maximized (Diallo, Abdourahmane, Claudia Allers, Yasmin Chandani, Wendy Nicodemus, Colleen McLaughlin, Lea Teclemariam, and Ronald Brown, 2008).

Most studies made in the business context, and in enhancing the logistics operation of the subject institutions for ultimately seek answers in increasing profitability of the institutions. On the other hand, a number of studies on logistics made on health industry or health facilities specifically target on assessing a specific element of the logistic cycle such as Logistics Management Information System (LMIS), Integrated Pharmaceutical Logistics System (IPLS) implementation, and Inventory Management that mainly focus on selective program types and list of LC such as Human Immuno-deficiency Virus (HIV), Tuberculosis (TB), and Malaria management (Azeb, 2017; Taddesse, 2015; Tilahun, 2014), (Mulusew Alemneh Sinishaw, Gebremedhin Berhe Gebregergs, Melashu Balew Shiferaw, 2015), (Adino Desale, Bineyam Taye, Getachew Belay, Alemayehu Nigatu, 2013).

Whereas, this study is made in the health context and to assess challenges related to laboratory commodities logistics practices in each elements of logistics cycle

that may cumulatively contributing for low laboratory test menu (46.5%) presence (Addisu Gize Yeshanew, Rozina Ambachew Geremew, Melkayehu Kassa Temesgen, 2017) in the domains of St. Paul's Hospital Millennium Medical College (SPHMMC)

1.3. The objective of the study

1.3.1. General Objective

The general objective of this study is to assess the logistics practice of laboratory commodities of St. Paul's hospital millennium medical college, Addis Ababa.

1.3.2. Specific Objectives

This study has the following specific objectives.

- To assess SPHMMC's laboratory department customer service and their relationship management practice at the time of visit
- To assess the product selection practice of laboratory commodities of SPHMMC
- To describe quantification and procurement practices for laboratory commodities of SPHMMC
- To identify inventory management challenges of laboratory commodities of SPHMMC
- To assess storage and transportation practices of SPHMMC laboratory commodities against the guideline
- To identify problems related to laboratory commodities logistics management information system of SPHMMC
- To investigate quality assurance challenges of laboratory commodities logistics of SPHMMC

1.4. Research Questions

The fundamental research question: What major laboratory commodities logistics problems exist in the logistics cycle elements of St. Paul's Hospital Millennium Medical College? This research question also implies that the study seeks to provide possible solutions for the problems.

The following research questions triggered the study of laboratory commodities logistics practices of SPHMMC

1. How does the laboratory department serve its customer and maintain its relationship?

2. What issues are considered in the product selection of laboratory commodities?
3. What system and technique applied in laboratory commodity quantification and procurement
4. What inventory management technique used to maintain laboratory commodities with adequate stock?
5. How do laboratory commodities storage practicing in the frame of storage guideline?
6. What logistics management information system are issues contributing to laboratory commodities stock out?
7. What issues in the logistics cycle contributing to compromising quality assurance?

1.5.Significance of the Study

A study conducted in 2016 in the case hospital found that the availability of test menu is below half of the expected provisional laboratory tests. With pre-existed logistic related problems and system on the time of the study, the hospital could provide laboratory services for around 309,964 patients annually. It could be higher if laboratory commodities logistics challenges are identified and resolved in each laboratory logistics cycle.

Furthermore, since the case hospital is selected by government as excellence center, the study result is taken as a good learning source and policy inputs to both the hospital and concerned government bodies in their decisions that will have contributions in realizing the mission of the hospital excellence center.

In a similar vein, the information provided by this study will trigger other health institutions to take measures in reforming their logistic system, which is directly associated with health service quality improvement.

1.6. Scope of the Study

The study investigates the major elements of the logistic cycle that are found in the domains of St. Paul's Hospital Millennium Medical College. The study examines the associated factors for LCLS challenges for predefined hospital's test menu, not

for the whole health commodities logistics system of SPHMMC. The research focuses on 94 lines of laboratory commodities that could be input to assess the hospital's test menu. It has estimated the availability of indicated laboratory Commodities (LC) on the day of visit and in the past six months.

The study focuses on assessing the major elements or issues that are found in and affect the LCLS in the case institution. Moreover, this study does not explicitly evaluate the effect of logistic management/system problems as associated with customer/client dissatisfaction.

1.7. Limitation of the Study

The study assessed major elements or issues found in and affect the LCL in the case hospital, not focus on investigating the appropriateness of the whole LCL process in the logistics cycle. This is because the 'process' aspect will also require a more in-depth qualitative investigation in the premises of the case institution.

The study focuses on one federal hospital located in Addis Ababa. Thus, it could be a limitation in representing all hospitals' LCL; however, it has been providing service for above 3.3 mils (Central Statistical Authority, 2007) of patients located in Addis Ababa and across the nation by referral cases.

In customer service, this study does not explicitly assess the effect of logistic management/system problems associated with customer/client dissatisfaction. Besides, due to the constraint of time, it is not evaluated the environment of LCL cycle elements and some internal issues like policy, adaptability, budgeting, supervision, and evaluation, respectively.

1.8. Operational Definition of Concepts and Terms

The following are the working definitions of the keywords that are used in this proposal.

Program Commodities: Are pharmaceuticals and laboratory commodities that are procured and provided free of charge by EPSA to health facilities for effective implementation of specific health programs such as HIV/AIDS, Malaria, Tuberculosis (TB), etc. (Tadesse D., 2014)

Laboratory Logistics Practice: Practice of laboratory commodities logistics in the perspective of logistics cycle elements from customer service, product selection, quantification, procurement, inventory management, storage and distribution to LMIS and Quality assurance scheme in SPHMMC

Laboratory Commodities: Laboratory reagents, chemicals, kits, and supplies necessary for analyzing laboratory tests menu independently and or as a package commodities (USAID|DELIVER, 2009).

Logistics Management Information System (LMIS): Is the management of laboratory commodities in a systematic and standardized way by collecting, processing and utilizing timely logistics data to inform quantification, procurement, storage and distribution of laboratory commodities (USAID|DELIVER, 2009).

Inventory control system: is to inform personnel when and how much of laboratory reagents and supplies to order and to maintain an appropriate stock level to meet the needs of patients (PFSA, 2017).

1.9. Organization of the Study

This study organized into five chapters. The first one is the introductory chapter that covers the background of the study, statement of the problem, research questions, and objective of the research, the significance of the study, the scope of the study, limitation of the study and definition of terms.

The second chapter, literature review, is sub-categorized into four parts, Theoretical, Empirical literature review, Conceptual framework, and Identified literature gaps. The third one covers the laboratory logistics cycles from serving customer/product selection to Forecasting/Quantification, Purchasing, Inventory Management, Storage, LMIS, Quality monitoring, and Budget

The third chapter explains the research methodology. It is a method of how the study conducted.

The fourth, the Result and Discussion part focuses on research results presented in different views; in the figure, table, and charts and discussing the finding against the guidelines, SOPs, and with other related kinds of literature

The fifth chapter covers a summary of findings, conclusion, and recommendation.

CHAPTER TWO

RELATED LITERATURE REVIEW

This chapter presents a critical review of relevant literature on logistics practice of health commodities particular focus on laboratory commodities. The section has four sub-chapters such as Theoretical, and Empirical reviews, Conceptual Framework, and Identified Literature Gaps.

2.1. Theoretical Review

2.1.1. Definition of Logistics

According to Frazelle (2002), logistics is a branch of management that studies the process of planning, implementing and controlling the efficient, cost-effective flow and storage of goods, services from the point of origin to the end of consumption.

A successful logistics system provides excellent customer service by fulfilling the six rights: procuring the right goods, in the right quantity, in the proper condition, delivered to the right place, at the right time, for the right cost (Raja and Mohammad, 2004).

2.1.2. Laboratory Commodities Logistics

In the health sector logistics, healthcare supplies delivery on time to fulfill the needs of healthcare providers to save a life. Similarly, in the case of laboratory, many tests require the simultaneous availability of multiple commodities. Depending on the levels of the logistics system, laboratory services will need between 350 and 3,000 different commodities to perform testing services. It can be classified as reagents, consumables, and durables; whether they are slow-moving or fast-moving, according to the length of their shelf life, (USAID|DELIVER, 2008) or whether they are storing in different temperature requirements: Deep-freeze (below -15°C); Refrigerator (2°C to 8°C); Cool (8°C to 15°C); or Room temperature (15°C to 25°C) (JSI/DELIVER, 2003).

The specific characteristics and the quantities of LC to be handled pose particular challenges for managing the supply chain (Diallo et al., 2008). Several peculiar features of LC affect the design and management of the logistics system.

2.1.3. Logistics Cycle Elements Related to Laboratory Commodities

Apart from the above peculiar characteristics of products, the efficient and effective logistics practice at each element of the logistics cycle has a pivotal role in optimum availability of laboratory commodities.

2.1.3.1. Customer Service of Laboratory in Logistics Perspective

The ultimate goal of any logistics cycle is to serve customers. "Customer service" has traditionally been a term used in the business world, but over the past few years it has crept into the health care vocabulary (Victoria L. Anderson, 2008). Businesses around the world have shown that a customer-driven supply chain not only benefits the consumer but also increases the profitability for all organizations involved in delivering the product to the consumer (Raja and Mohammad, 2004).

In laboratory logistics, the type of customers and disease typically have a high tendency to determine the kind of products the laboratory to hold commodities. Therefore, according to USAID|DELIVER (2009), there are many customers with varying expectations and needs. These are patients who rely on laboratory results for an accurate diagnosis of their health condition. Clinicians who are dependent on laboratory test results for the diagnosis and clinical management of patients. Other health care providers, including voluntary counseling and testing providers and blood bank professionals, who rely on lab results to effectively perform their duties. Epidemiologists who use lab results to determine the source case in an outbreak or to conduct contact studies. Policymakers who use lab data to monitor the overall functioning of the laboratories in the health system, and Laboratory staffs

2.1.3.2. Product Selection for Laboratory Commodities

The purpose of product selection is to select the most effective and cost-efficient commodities to support the goals of the program. Selecting a limited range and diagnostic commodities can lead to better availability, better staff knowledge, more appropriate use, and lower costs (MSH, 2012). Product selection is appropriate based on the testing protocols, cost, training of personnel, and infrastructure for storage and transportation (USAID|DELIVER, 2008).

Recognized the importance of standardization and defined tests for each tiered network level (Maputo Declaration, 2008) improve the efficiency of procurement, quantification, supply chain management across laboratory networks, and help ensure that the correct testing supplies are available whenever needed (Trevor F. Peter, Yoko Shimada, Richard R. Freeman, Bekezela N. Ncube, Aye-Aye Khine, and Maurine M. Murtagh, 2009)

2.1.3.3. Quantification and Procurement for Laboratory Commodities

According to WHO, quantification is a fundamental process that can help calculate how much required of any particular item for a given period, and it is an essential part of a successful inventory management program (USAID|DELIVER PROJECT, 2011). Both stock outs and expired items occur because of poor monitoring and quantification nationally and at facility level (MSH, 2012).

A critical prerequisite for conducting a quantification for health commodities are definite, well-defined standard treatment guidelines (STGs), standard laboratory testing menus and/or testing protocols, and a standard equipment list (USAID|DELIVER PROJECT, 2011). To quantify how much to order, MSH (2012), recommends consumption, adjusted consumption, and morbidity data.

According to MSH (2012), efficient quantification helps to avoid stock outs and ensure continuous availability of essential supplies, avoid wastage caused by over stocking, make the best use of scarce resources and budget for the laboratory's means, facilitate central bulk purchasing, prepare and justify a budget, plan for new or expanding programs and policies, calculate emergency needs, resupply an existing supply network that has become depleted of supplies, and estimating how much space, including refrigerated space, might be needed in the future.

Procurement of laboratory supplies is not different from other types of commodities. The efficient and effective procurement of laboratory items critically impacts the quality of all laboratory services (WHO, 2008). Before procuring medical and laboratory supplies and equipment, specifications should be defined in close collaboration with technical staff. Moreover, a good procurement practices depend on reliable and accurate quantification of needs, transparency in selection

of suppliers, quality assurance of commodities, and in management of bids or contracting (MSH, 2012).

Framework agreements appear to be seldom used in procurement of health commodities in countries of sub-Saharan Africa. Likewise in Ethiopia, despite there is framework agreement directive on the Federal Public Procurement Directive of Ministry of Finance & Economic Development (2010), under the methods of open bidding, restricted bidding, request for quotations, single source/ direct procurement, request for proposal, and two stage bidding, recently, clinical chemistry and hematology testing commodities were awarded for three years.

Framework agreements are long-term contracts that provide the terms and conditions under which smaller repeat purchasing orders may be issued for a defined period of time, whereas, the practice of floating tenders multiple times a year contributes to long lead times and stock-outs, and it hampers the manufacturer's or supplier's ability to plan and respond to the government's needs (Leslie Arney, Prashant Yadav, Roger Miller, Taylor Wilkerson, 2014).

2.1.3.4. Inventory Management for Laboratory Commodities

An inventory control system informs the storekeeper when to order or issue utilized, how much to order or issue, how to maintain an appropriate stock level of all products to avoid shortages and oversupply (USAID/Deliver, 2009). Good management of storage and inventory involves monitoring expiration date, inventory level, unexplained losses (leakage), and storage condition such as light, temperature, and sanitation, which are particularly critical for test kits and reagents. (MSH, 2012)

The continuous supply of LC can be guaranteed only through the selection, design, and proper implementation of an appropriate inventory control system.

Many strategies or inventory control systems can be adapted to manage commodities of any kind. For sufficient commodity are ensured, a max-min inventory control system is recommended (USAID|Deliver, 2009). According to USIAD/Deliver (2011), forced-ordering, continuous review, and standard max-min

inventory control system are applicable to health commodity logistics systems. In a forced-ordering system, the trigger for ordering is the end of the review period. In a continuous review system, the trigger for ordering is when the facility reaches the minimum level. In a standard system, the trigger for ordering is the end of the review period for the commodities that are at the minimum level.

2.1.3.5. Storage and Distribution for Laboratory Commodities

In many supply chains, warehousing/storage costs can sometimes account for the largest percentage of overall logistics costs. It is vital that this function is managed effectively and efficiently (Raja and Mohammad, 2004).

The purpose of a storage and distribution system is to ensure the physical integrity and safety of commodities and their packaging as they move from the central storage facility to peripheral laboratories. A sound storage and distribution system will help ensure that commodities reach the laboratory in usable condition (USAID|DELIVER, 2008). The shelf- life of the products is dependent on good storage practices (Raja and Mohammad, 2004)

2.1.3.6. Logistics Management Information System (LMIS) for Laboratory Commodities

A logistics management information system uses standard types of forms for recording essential data items. These are: Stock keeping records (bin cards), Transaction records (requisition and issue vouchers), and Consumption records (daily activity record) (Raja and Mohammad, 2004) for tracking stock on hand, consumption, and losses and adjustments to stock for purposes other than use (expiry, damage, wastage, theft, etc.)(USAID|DELIVER, 2008).

2.1.3.7. Quality Assurance (QA) and Quality Control (QC) for Laboratory Commodities Logistics

Quality of the products need to be maintained throughout the supply chain, starting from the manufacturer, all the way through the distribution network until the patient consumes it. (Raja and Mohammad, 2004).

A well-managed laboratory should have a sound QA system that checks and eliminates errors. Quality should be considered in developing the specifications for the procurement of laboratory supplies and reviewed after the product is procured and received in-country, using the civil procedures governing this process. Quality must be monitored for appropriate storage and transportation condition, viable for use upon issuing to the bench, and must be within its shelf life, not have exceeded the recommended excursions from the specified storage temperature, have intact packaging, and be protected from environmental factors such as dust and humidity (USAID|Deliver, 2009)

Make quality a central focus of all activities throughout the product management process by outlining quality assurance measures with all professional groups and in national policies and procedures during product management. Such as; use a pre-qualified suppliers list, implement quality testing practices, ensure proper handling and storage of all commodities, minimize the number of products and brands, have a procedure in place to deal with a product recall, and educate consumers on quality assurance (Raja and Mohammad, 2004).

2.2. Empirical Literature Review

2.2.1. Laboratory Commodities Logistics Cycle Elements Review

Customer Service: For laboratory service improvement, laboratory professionals put in first as the internal customer in advancing the service gearing with technology and ensuring the laboratory logistics system works. According to USAID|DELIVER (2008), laboratory staffs are perhaps the most valuable customers of the laboratory logistics system. They rely on the commodities they receive to perform tests and provide results. The commodities they receive need to be in constant supply and of good quality.

A cross sectional study conducted Addisu Gize Yeshanew, Rozina Ambachew Geremew, Melkayehu Kassa Temesgen (2016) in SPHMMC showed that customer satisfaction on the presence of laboratory test menu was 45.6%.

Product Selection: In Kenya, national standardization reduced the total LC in circulation from over 3,000 varieties to fewer than 300 without sacrificing quality

of care (Peter et al., 2009), whereas most countries like Lesotho (Pharasi, 2007), Ghana (Addo, Nii Akwei, Rowland Adukpo, Veronica Bekoe, Samuel Boateng, Ronald Brown, Egbert Bruce, Aoua Diarra, Parfait Edah, Wendy Nicodemus, and Festus Sroda, 2006), and Angola (Kagoma, C. and W. Goredema, 2011) are not standardized their laboratory.

Similarly, Ethiopia has not yet a standardized list of analyzers, test menu, and test technique nationally. The selection of laboratory commodities and analyzers is the mandate of EPSA and Ethiopian Public Health Institute (EPHI), respectively. As part of its transformation and improving product availability at the health facility level, EPSA has predefined 178 essential LC nationally (PFSA, 2018).

Quantification: An assessment in Angola show that there is no system yet to quantify laboratory supplies based on what consumed in the country, which contributes to recurrent stock-outs of critical reagents and other supplies. Laboratory personnel are not involved in the quantification and other procurement processes and do not have skills to effectively manage laboratory commodities, including being able to quantify current and future laboratory needs to adequately support the country's health care needs (Kagoma, C. and W. Goredema, 2011).

Quantification premises for program items is almost similar across African countries: In Angola and Ethiopia based on disease morbidity and programs expansion targets (PFSA, 2018; Kagoma, C. and W. Goredema, 2011), service data based in Tanzania (USAID|DELIVER, 2016), and Ghana (Addo et. al., 2006). The assumptions to quantify program laboratory commodities based on guidelines and strategic plan are morbidity, laboratory analyzers throughput capacity, analyzer functionality rate, wastage rate and training, and number of working days in the year (Federal Ministry of Health, Pharmaceuticals Fund and Supply Agency, HIV/AIDS Prevention and Control office, Ethiopian Public Health Institute, 2017).

The procurement process begins with selection and forecasting and quantification of product requirements. It includes the development of exacting product specifications, identification of financing, and a budget process to secure funding. (USAID|Deliver, 2006).

In Ethiopia, EPSA is a sole agent in quantifying and procuring program and budget based health commodities, including LC annually and review semi-annually (PFSA, 2018). Most recently, in 2018, a three years contract agreement is done with suppliers for providing closed system hematology and clinical chemistry reagents with service maintenance for quantified commodities

Inventory Control System: Poor inventory control system leads to experience laboratories for frequent and prolonged stock-outs of critical reagents Inventory control level across laboratories. In Lesotho, Tanzania, and Ghana, most of the laboratories did not set minimum and maximum stock levels. Also, most of the laboratories had no stock/bin cards to track LC (Ifeanyi and Abum, 2018; Pharasi, 2007).

Although 70% of hospitals in Malawi had stock/bin cards for LC in the store, the majority of the stock/bin cards were not kept up-to-date. Also, no stock/bin cards were used in the laboratory store (Francis et al., 2006).

Ethiopia is practicing a Forced Ordering Maximum/Minimum inventory control system in the Integrated Pharmaceutical Logistics System (IPLS). Thus all facilities are required to report on a fixed schedule (monthly at health posts, every other month at health centers and hospitals) for all products. Besides, products will be resupplied as soon as possible after the report sent to the respective EPSA hub (PFSA, 2017).

A cross-sectional study conducted in 2011 show that the majority of the facilities (60.5%) were stocked out for at least one ART monitoring, and TB laboratory reagents and the highest stock out rate was for chemistry reagents, bilirubin, and BUN, with mean days of stock out in 6 months is from 15-73 days (Desale et al., 2013).

Other cross-sectional study conducted in Amhara Region, Ethiopia, in 2014 show that thirty-three (40.2%) health centers were under-stocked for at least one of the critical items for tuberculosis diagnosis at the time of visit. Fifteen (18.3%) health centers had no stocks of at least one of the essential items methylene blue (11%),

Carbolfuchsin (11%), acid alcohol (8.5%) and sputum cups (3.7%) (Sinishaw et al., 2015)

Storage and Distribution: In Ghana, despite there is adequate storage space (Ifeanyi and Abum, 2018) at the facility level, storage principles for laboratory supplies are not generally documented, and special considerations, such as separating flammable and caustic materials, were not routinely followed (Addo, Nii Akwei, Rowland Adukpo, Veronica Bekoe, Samuel Boateng, Ronald Brown, Egbert Bruce, Aoua Diarra, Parfait Edah, Wendy Nicodemus, and Festus Sroda, 2006). Similarly, in Lesotho, due to storage space is inadequate and poorly ventilated (Pharasi, 2007), reagents not stored according to the First Expiring First Out (FEFO) practice; also there were no cupboards for flammable reagents.

Expired products management in Ghana were typically separated from unusable supplies but were not removed and disposed. Most facilities had functioning cold chain storage, but the temperature rarely monitored, and the power supply was not reliable to guarantee continuous cold storage (Addo et al., 2006).

The distribution includes storage, inventory management, transport, and re-ordering. These functions are essential in getting the health commodities down to the service delivery points (SDPs) and ultimately to the consumers (Raja and Mohammad, 2004).

LMIS: Laboratory commodities logistics is a severe problem in developing countries. In Lesotho, no logistics management information system (LMIS) in place and a few of the laboratories using stock cards. The placing of orders was found to be erratic and inconsistent, and less than 50% of the laboratories sent stock reports to the district or central levels (Pharasi, 2007). Similarly, the health facility survey for laboratory logistics system conducted in Uganda (Ifeanyi and Abum, 2018) experienced there were no standardized LMIS forms, and many staff members not trained for LMIS.

On the other hand, a national policy for logistics management information systems (LMIS) and inventory management for all essential medicines, including laboratory supplies, defines the maximum and minimum stock levels in Ghana, but this policy

is not followed for laboratory supplies (Addo et al., 2006). After 12 years there in Ghana (Ifeanyi and Abum, 2018), LMIS limited to HIV test kits, and laboratories did not maintain stock cards, and laboratory staff was not regularly aware of the stock status in the stores due to minimal communication between the storekeeper and the laboratory staff.

In 2007, a Logistics Management Information System (LMIS) was introduced by the Ethiopian Federal Ministry of Health to manage the distribution and stock control of laboratory reagents and consumables in the country (Alemayehu Nigatu, Hany Abdallah, Francis Aboagye-Nyame, Tsehaynesh Messele, Tsegaye Kidane-Mariam, Gonfa Ayana, 2009). According to the study, prior to the logistics system design, the Ethiopian laboratory logistics system was weak, consistently being hampered by several systemic challenges that caused frequent stock-outs of critical items, thus impeding continuous and quality testing for patients were requested to wait 2-3 months or longer to receive results from hospitals for critical commodities such as CD4 reagents.

In terms of capacity building, EPSA deliver Integrated Pharmaceutical Management System (IPLS) training for almost 10,000 health professionals between 2009 and 2015(Shewarega, Abiy, Paul Dowling, Welelaw Necho, Sami Tewfik, and Yared Yiegezu, 2015). Despite a lot of efforts excreted in the provision of IPLS training nationally, Laboratory heads had not acquired enough IPLS training compared to pharmacy heads. A cross-sectional study conducted in 2014 in Amahra region shows that only 10(12.2%) laboratory heads trained compared to 42 (51.2%) pharmacy heads(Sinishaw et al., 2015).

2.3. Conceptual Framework

The logistics cycle provides a guiding framework of the functions needed to manage all health commodities, including laboratory commodities. The study is framed to investigate logistic related problems that displayed on the below adopted logistic cycle form USAID|Deliver (2011).



Fig 2.1: Laboratory Commodities logistics Cycle

Laboratory commodities logistics is interrelated to one to the other in the elements of the logistics cycle; the primary function builds on the previous function and leads logistically to the next.

Product selection based on the experience with health needs and use by one of the five expected laboratory department customers; accurate quantification and procurement decision requirements follow the selection decision. Proper inventory management within its min-max level and storing and transporting laboratory commodities according to the guideline is executed after the procurement process. In each LCL quality of products and operations assured for the physical integrity of commodities and quality of logistics work.

As can be seen from the above diagram, the Logistics Management Information System (LMIS) is at the heart of the cycle, along with other support functions, creating this important linkage between the different interrelated functions.

Failure in one of the logistics cycle will cause an irregular cycle with fragmented functions resulting in service interruption by shortage and or overage of laboratory commodities.

Therefore, identifying the challenges in each logistics cycle and rectifying has significant importance to improve the availability of laboratory commodities.

2.4. Identified Literature Gaps

Most studies done on special focus on the elements of logistics cycle (inventory management, quantification, and LMIS) that were concentrated on health program like HIV/AIDS, Tuberculosis, Malaria with limited line of items (Azeb, 2017; Taddesse, 2015; Tilahun, 2014), (Mulusew Alemneh Sinishaw, Gebremedhin Berhe Gebregergs, Melashu Balew Shiferaw, 2015), (Adino Desale, Bineyam Taye, Getachew Belay, Alemayehu Nigatu, 2013), but this study identified major challenges in the logistics cycle in to consideration of laboratory test menu that accounts 94 line of items.

A number of literatures on customer satisfaction was related to patients' satisfaction on the service of laboratory. For instance, a study conducted in SPHMMC by Yeshanew et al. (2017) was assessed patient and health care workers satisfaction on the laboratory service. It could be complementing the area of logistics challenge on customer satisfaction if the respondents were included from laboratory professionals in the case institute because according to USAID|DELIVER (2008), laboratory staffs are perhaps the most valuable customers of the laboratory logistics system.

A cross sectional study conducted by Azeb (2017) in Zewditu Hospital on inventory management practices and challenges finds a number of challenges, but on descriptive analysis part, she was driven mean for 5 Likert scale response. It has limitation to drive mean for strongly disagree with neutral and strongly agreed responses. The result have no meaning and unable to recommend for the mean of two extreme end responses, strongly disagree and strongly agree. Besides, the response rate was 84.6% of the total sample size.

To assess stock status, a cross sectional study was conducted by Sinishaw et al. (2015) in Amhara Region, Ethiopia. The study assessed a quarter data to check the stock status, this could mislead the availability of health commodities with in a three months period since according to IPLS guideline the facilities have been reporting every other month and the lead time of EPSA or PFSA was a month. Thus, checking in between a quarter could not give sound finding. Besides, based a well know stock status collection tool, LIAT, it is recommended that semi-annual period is better to assess stock status from health facilities.

CHAPTER THREE

METHODOLOGY

3.1. Description of the Study Area

The study conducted at St Paul's Hospital Millennium Medical College (SPHMMC). It is the federal hospital located in central Addis Ababa. It is expected to serve above 3.3 mil people for the city and all referral cases across the nation.

The hospital has 13 departments, more than 2800 clinical, academic and administrative and supportive staffs. As it is a teaching hospital, it has public and private students as well.

SPHMMC has more than 700 beds for inpatient capacity. It had been serving on average for 1200 emergency and outpatient clients, and 309,964 laboratory service seeking clients daily and annually respectively.

3.2. Research Approach

Mixed research approaches, qualitative and quantitative, were employed in data collection. Qualitative data gathered through observations and interviews & Quantitative data gathered through questionnaires.

3.3. Research Design

A Descriptive, Cross-sectional study design used at SPHMMC to assess laboratory commodities logistics practice in identifying the gaps, potentials, and constraints in the logistics cycle. Qualitative, quantitative, and secondary data collected from respondents, subject matter experts, and store records and analyzed in May 2019.

The interview done with persons responsible for managing LC at all laboratory case team leads, store manager, laboratory logistics officer, Drug supply manager, and heads of the laboratory. Secondary data collected from stores by excel spreadsheet customized from Logistics Indicators Assessment Tool (LIAT).

The quantitative part of the study gathered from laboratory professionals and the respondents as mentioned earlier by structured Likert scale questionnaire.

3.4. Population and Sample

Population: The source population of this particular study was St. Paul Hospital Millennium Medical College all departments that have been managing all health commodities for service provision of 1200 clients daily. Of this, around 309,964 people get laboratory service annually by its 7 functional units.

Sample: Since the study conducted in the case of one particular hospital, the sampling technique used for this study was convenient and purposive non-probability sampling techniques.

Convenient sampling technique applied to select laboratory professionals for the questionnaire. Accordingly, the sample size for the study was 32 laboratory professionals who were working in the laboratory department.

Purposive sampling technique applied for selecting laboratory logistics subject matter experts for interview. They were nine interviewees that have a better understanding of the study problem and a direct link with LCLS. These are laboratory logistics officer, five laboratory case team heads, laboratory head, store manager, and drug supply manager.

3.5. Data Sources and Types

Both qualitative and quantitative data were collected. The study relied on both primary and secondary data as well. The laboratory professionals served as a primary source of data to reflect their level of agreement on each element of the logistics cycle through quantitative data collection questionnaire. Key personnel interview of laboratory logistics subject matter experts served as a primary source of data were covered in the assessment to gather qualitative data. Using a customized LIAT tool and storage guideline, the storage, quantification, recording, and reporting practice were reviewed by the principal investigator as secondary data.

3.6. Data Collection Procedures

Data collection procedure conducted by open questionnaire customized from Logistics System Assessment Tool (LSAT) tool for an interview, and by

customized Logistics Indicators Assessment Tool (LIAT) developed by USAID|Deliver project for secondary data.

All data types are collected by the principal investigator s that are mentioned above from all study subjects and records.

3.6.1. Qualitative Data

A one-to-one interview was conducted to collect qualitative data. First, the interviewees were communicated and arrange a convenient place and time for the interview. The principal investigator had described the purpose, question, and objective of the study and get their consent. Before the interview initiated, they were informed for recording by Panasonic RR-US570 mp3 audio recording tape. When there was a misunderstanding of the question, it was elaborated accordingly. Finally, the interview adjourned by appreciating the respondents for their contribution and participation. For the quality of data collection, the interview collected by the principal investigator. Secondary data was collected using customized Logistics Indicators Assessment Tool (LIAT) adopted from USAID|Deliver project. The tool tailored to this study to address its objectives.

3.6.2. Quantitative Data

The questionnaire was collected from respondents of all laboratory department laboratory professionals by Likert scale questionnaire.

3.7. Ethical Consideration

Addis Ababa University, school of commerce issue support letter to SPHMMC. The hospital ethical board is reviewed and approved the study. There is a high degree of confidentiality during data collection and no name of any participating subjects put in the result instead of the aggregate result.

3.8. Data Analysis

Quantitative data collected by the checklists and questionnaire is checked for missing items and consistency before entering on SPSS V 20 and generation of descriptive summary statistics analysis. Appropriate indicators calculated and discussed against perceived laboratory logistics practice and secondary data analysis.

Since the number of the interviewee for the qualitative study is nine, data is organized and analyzed on the word. Thematic analysis of responses performed to identify recurrent plausible challenges in the logistics system as perceived by service providers of the hospital.

3.9. Validity and Reliability

LIAT tool is one of the valid and reliable tools to collect logistics data. Since the adopted questionnaire was customized to address the objectives intend to address laboratory logistics practice, logistics experts were reviewed and amended. A few changes were made to the questionnaire after logistics experts had reviewed. Some of the changes were related to the questionnaire's format and spelling errors. Accordingly, it was amended and employed for data collection.

Reliability test performed to see whether the study was given similar results if the same study repeated. In measuring the reliability of the study and data consistency of the Likert scaled questionnaire, the Cronbach's Alpha was calculated using SPSS and found 0.956. According to Nunnally (1978) offered a rule of thumb of 0.7 to be an acceptable reliability coefficient, and since the score is above the standard threshold level, the questionnaire was reliable.

Reliability Statistics

Cronbach's Alpha	N of Items
.956	44

CHAPTER FOUR

RESULT AND DISCUSSION

4.1. Introduction

The study result presented a summary of data presentation, analysis, and interpretation of key findings and discussing against across the findings, other literature, and SOPs to address the intended objectives.

For easy understanding and addressing the challenges of logistics practices, the body of this chapter organized in consideration of major elements of logistics cycles with a mixture of the questionnaire, interview and secondary data findings, discussions, and interpretation.

Descriptive statistics was used to analyze the data in this study is based on the responses of sample respondents on their in to account that numbers 1, 2, 3, 4 and 5 represent strong disagree, disagree, neutral, agree and strong agree, respectively. The result of the study in the laboratory logistics practices and challenges showed that the scores of strongly disagree have been taken to represent a variable which had a mode score of 1, the scores of disagree have been taken to represent a variable with a mode score of 2, the score of neutral have been taken to represent a variable which had a mode score of 3, the score of agree have been taken to represent a variable which had a mode score of 4 and the score of strongly agree have been taken to represent a variable which had a mode score of 5.A standard deviation of >0.9 implies a significant difference on the impact of the variable among respondents.

4.2. Socio-Demographic Characteristics of Study Participants

The respondents were working in different laboratory case teams of SPHMMC such as Immunohematology, Blood Bank, Transplant, Parasitology and urine, Clinical Chemistry, and Clinical laboratory reception. A total of 32 questionnaires were delivered to acquire their response. Among these, 29 were collected and analyzed on SPSS 20. And thus, the response rate was 90%.

Most of the respondents' gender was Female 17 (58.6 %). Regarding their educational level, most of them were Bachelor of Science 19(65.5%), followed by Diploma 7 (24.1%), and Masters 3 (10.3%).

Table 4. 1. Respondents' Gender Type and Education Level

		Frequency	Percent
Gender	Male	12	41.4
	Female	17	58.6
	Total	29	100.0
Education	Diploma	7	24.1
	BSc	19	65.5
	MSc	3	10.3
	Total	29	100.0

Generally, above 75% (22) of the respondents have first degree, this may be a good chance for quality data collection.

4.3. Customer Service Practice of SPHMMC

I. Customer Type Perception

Table 4.2: SPHMMC laboratory professionals' perception on Laboratory department customer type

S.N	Customers Type	N	%
1	Lab Professionals	8	28.6
2	Patient	7	25
3	All (patient, clinicians, other health care providers, epidemiologist/researchers, and laboratory technicians/technologist)	6	21.4
4	Patient & Clinicians	2	7.1
5	Patient, Other Health Care Providers, Epidemiologist/Researchers	2	7.1
6	Patient, Clinicians, Other Health Care Providers, Lab Professionals	1	3.6
7	Clinicians	1	3.6
8	Other Health Care Providers	1	3.6
Total		28	100

Source: Own survey, 2019

Most of the respondents (laboratory professionals) perceived that their customers were themselves 8 (28.6%), followed by patients 7(25%), and all five types 6 (21.4%) (patient, clinicians, other health care providers, epidemiologist/researchers, and laboratory technicians/technologist)

II. **Customers Relation Management Perception.**

Table 4.3. SPHMMC laboratory professionals' perception on laboratory customer relation management

Questions	S.D	Disag	Neutral	Agree	S.A	S.Dev	Mode
	N-1	N-2	N-3	N-4	N-5		
Our laboratory shares a sense of fair play with its customers	1	4	0	22	2	0.93	4
Our laboratory has a system to interacts with customers to set its reliability, responsiveness, and other standards	1	2	5	15	6	0.98	4
Our laboratory follow-up with its customers for quality/service feedback	0	5	4	16	4	0.94	4
Our laboratory measures and evaluates customer satisfaction	0	6	7	13	3	0.95	4
Our laboratory determine future customer expectations	2	3	8	12	4	1.09	4
Our laboratory evaluates the formal and informal complaints of its customers	1	1	9	13	5	0.93	4
The laboratory section is recording customers result always	0	3	7	11	8	0.97	4
Grand Mean of Standard Deviation and Mode						0.84	4

Source: Own survey, 2019

Most of the respondents agreed with almost all types of statements, except close to neutral for evaluating customer satisfaction, and determining their future customer expectations. Eight (27.6%) of them are indifferent to the later statement.

They perceived that the laboratory has a system 15 (51.7%) to interact with the customer and a feedback mechanism 16 (55.2%) to evaluate formal and informal compliant 13 (44.8%). Furthermore, almost all believed that they have a sense of fair play with their customer 22 (75.9%), but compared to other levels of agreements, patient result recording is 11 (37.9%) is lower. This might be an automated system that is recording all cases at the time of reception. The grand

average standard deviation and mode was 0.84 and 4 respectively. This indicates that there were a minimum variation of ideas (0.84) among respondents across the question, and had agreed (4) for all customer relation management related issues.

III. Customer Management Practice

i. For the question, who is your customers? How do you know and fulfil their expectations and needs?

Many efforts were excreted to handle customer satisfaction and relationship management. To reach clinicians well, the department had prepared and disseminated "Lab Test Menu Hand Book" that contains "test type, patient preparation information, sample type, container volume, transport storage, method, reference range, turnaround time (TAT), and cost." Furthermore, test menu banner displayed on the gate of laboratory department, and whenever there launched new test types, and stock out tests they have shared the information to Out Patient Departments (OPDs) and wards regularly by posting on sections' wall.

To maintain customer satisfaction, the laboratory has a backup laboratory. During analyzer failure and LC stock out the patient, the sample analyzed at Ethiopian Public Health Institute.

Regarding customer relation management, the laboratory has a customer satisfaction log book, suggestion box, and attending the morning physician meeting by the duty lab professional.

Despite a worth mentioning achievements observed, there is a wide gap between the laboratory and pharmacy department and with other teams too in communication, collaboration, coordination, and cooperation. The two sides are not collaborative from planning, budget allocation, quantification, product selection, procurement, to internal LC movement.

Due to weak joint planning and communication, commodities that are quantified for regular testing had consumed in the middle of the budget year as a result of unknown programs such as fertility service, and male circumcision campaign was launched prior notification to the laboratory.

Furthermore, since the hospital is the teaching one and has different service providers, multiple and non-selective laboratory requests were much experienced. Beyond physicians' request, other health care providers, nurses, and laboratory professionals also requesting laboratory tests for their socials, relatives, etc. Besides, before result collection for pre-requested laboratory testing another similar test had required again. Thus, reagent consumption is raised for non-relevant case identification and also increase workload.

IV. Laboratory Test Menu Availability

From 86 lines of laboratory test menu, below half 42 (48.8%) were available at the time of visit. The finding is almost similar to the indirect study conducted at SPHMMC that had shown for patient satisfaction for the presence of laboratory test menu, 46.5%.

According to Raja and Mohammad (2004), businesses around the world have shown that a customer-driven supply chain. In laboratory logistics, despite all types of customers have a pivotal role for laboratory commodities selection, most agreed that laboratory professionals themselves were their customers. Similarly, a study conducted by USAID|Deliver (2008) substantiated as laboratory personnel plays a vital role in ensuring that the laboratory logistics system works.

According to the level of health facility, handling the other customer, and the dynamism of technology in gearing the type of service provision, laboratory professionals have an immense contribution for product selection, logistics, and setting test menu.

In summary, despite most of the respondents perceived that laboratory is good on customer relationship management and a lot of efforts exerted to satisfy their internal and external customers, the number of test menu at the time of visit was below 50%.

4.4. Product Selection Practice of SPHMMC

I. Product Selection Perception

Table 4.4. SPHMMC laboratory professionals' perception on LC product selection

Questions	S. Disa	Disad	Neutral	Agree	S. Agree	S. Deviation	Mode
	N-1	N-2	N-3	N-4	N-5		
Our laboratory has test menu	0	6	3	15	5	1.01	4
Absence of test menu has no impact on product stock out	1	6	7	3	3	1.15	3
Our laboratory selecting products focusing mainly on cost	0	6	8	12	3	0.95	4
Our laboratory is selecting products focusing mainly on quality of products	2	4	6	16	1	1.01	4
Our laboratory is selecting products focusing mainly on testing techniques	0	4	4	17	4	0.88	4
Our laboratory is selecting products focusing mainly on supplier brand	1	6	9	11	2	0.99	4
Our hospital has established long term contract agreement with its suppliers	1	2	12	11	3	0.91	3
Grand Mean of Standard Deviation and Mode						0.99	3.7

Source: Own survey, 2019

Most respondents perceived that hospital's product selection was based mainly on testing technique 21(72.4%), quality of product 17 (58.6%), cost 15 (51.7%), and supplier brand 13 (44.8%).

Although the hospital had a laboratory test menu, 10 (31%) of them were perceived indifferent and disagree about its availability. Besides, about (24.1%) 7 of respondents were indifferent to the absence of the test menu has no impact on

product stock out. In the case of a contract agreement with its supplier, most are also indifferent 12 (41.4%).

Generally, the grand mean of standard deviation and mode show that there were a minimum variation of ideas (0.99) of respondents across the question, and closer to an agreement (3.7) for all product selection issues. This indicates that there were a closer to variation of ideas (1) among respondents across the question, and had closer to agree (3.7) for all product selection related issues raised

II. Product Selection Practice

ii. For the question, how do you practicing in selecting laboratory commodities?

All laboratory case team leads were not involved in selecting laboratory commodities. Since most of the analyzers were a closed system and brand specific, selection mechanism was accordingly.

For others, not brand specific ones that can be accessed by their generic name selection may rely on cost difference. Whenever commodities are available at EPSA, the hospital is procuring with credit before any selection criteria.

Most literature recommended standardization of list of analyzers, test menu, and test technique help to ensure the correct testing supplies are available whenever needed. For instance, In Kenya, national standardization reduced the total LC in circulation from over 3,000 varieties to fewer than 300 without sacrificing the quality of care (Peter et al., 2009).

Although some efforts had done by the case institution in listing out laboratory test menu, it is not yet been standardization according to test techniques, quality, user capacity, etc. According to USAID|DELIVER (2008) recommendation and most respondents' perception product better if selected based on testing technique, quality of the product, cost, and supplier brand.

If there is available stock at EPSA, the product had been procuring in the basis of test or disease type. As most of the respondents experienced, such kinds of procurement had quality defects.

Generally, although laboratory case team leads were subject matter experts technically and administratively to their respective department, no one of them was involved during product selection. Furthermore, the laboratory had no guideline, SOP, and standardized line of laboratory items/test menu that could be defined in testing technique, quality of the product, cost, training of personnel, changes in test technology, system orientation, supplier brand, and infrastructure for storage and transportation.

Proper selection of products and suppliers has importance for uninterrupted service provision and to build good and long term relationship with suppliers for mutual benefit. Accordingly, the hospital should develop guideline and standardize products according to the recommendations mentioned above to ease product selection decision.

4.4. Quantification Practice of SPHMMC

I. Quantification Perception

Table 4.5. SPHMMC laboratory professionals' perception on LC quantification exercise

Question	S. Disa	Disagree	Neutral	Agree	S. Agree	S. Devn	Mode
	N-1	N-2	N-3	N-4	N-5		
Our laboratory quantifying laboratory commodities periodically	0	1	3	21	4	0.63	4
Our laboratory involving laboratory professionals in its quantification exercise	1	3	5	15	5	1.00	4
Professionals quantifying laboratory commodities has limited skills and knowledge	1	2	5	15	6	0.98	4
Our laboratory is quantifying products based on morbidity data	0	2	12	14	1	0.69	4
Our laboratory is quantifying products based on service data	2	1	9	16	1	0.91	4
Our laboratory is quantifying products based on target plan	1	5	9	12	2	0.97	4
Quantification error (improper quantification) was the cause for service interruption	0	4	10	15	0	0.73	4
Grand Mean of Standard Deviation and Mode						0.84	4

Source: Own survey, 2019

Seven quantification exercise related questions were administered to respondents to understand their perception. Of these, most respondents, 25 (86.2%), believe that

LC was quantified periodically. Though during quantification exercise laboratory professionals were involved 20 (68.9%), they had limited skills and knowledge 21 (72.4%). As an input data for quantification, most perceived that service data 17 (58.6%) was an input for quantification exercise followed by morbidity data 15 (51.7%), and target plan 14 (48.3%).

Regarding quantification error-prone service interruption level of agreement, 15 (51.7%) believed that due to an error in quantification laboratory service will interrupt.

II. Quantification Exercise Practice

iii. For the question, how do you exercising quantification? What kinds of resources you are taking as an input for quantification?

Annually, the laboratory department reported to top-level management the quantified line of items, unit of measurement, average monthly consumption, maximum stock, minimum stock, quarter consumption, annual consumption, unit and total price.

The department was solely quantifying commodities — no other departments and experts involved during quantification exercise. Besides, as per case team heads information, quantification had done without their involvement. Involvement of all experts, stakes, and triangulating service data with other logistics and morbidity data, consideration of wastage is not much practicing in quantification.

Quantification prone error is the cause for LC stock out. Quantified versus procured commodities are not matching. Less secured compared to quantified and vice versa.

III. Quantification Vs Receiving, Secondary Data

The data show that only 54 (57.4%) line of commodities quantified at the end of budget year (June 2018) for the next budget year (July 1, 2018, to June 30, 2019). Of these, only 20 (37%) commodities received until the 11th month of the budget year, or this assessment conducted, May 17, 2019. In contrary, 11(35.5%) commodities received without quantification.

Table 4.6. Quantified versus received laboratory commodities

Quantified and Received Cross tabulation					
			Received		Total
			No	Yes	
Quantified	No	Count	29	11	40
		% within Quantified	72.5%	27.5%	100.0%
		% within Received	46.0%	35.5%	42.6%
		% of Total	30.9%	11.7%	42.6%
	Yes	Count	34	20	54
		% within Quantified	63.0%	37.0%	100.0%
		% within Received	54.0%	64.5%	57.4%
		% of Total	36.2%	21.3%	57.4%
Total		Count	63	31	94
		% within Quantified	67.0%	33.0%	100.0%
		% within Received	100.0%	100.0%	100.0%
		% of Total	67.0%	33.0%	100.0%

USAID/Deliver (2014) recommended that many data types can be used to conduct health commodities quantification: consumption, services, demographics, or morbidity data. Here in the case hospital, too service data had been using for quantification exercise. Same trends were observed in Angola (Charles K., 2011), Tanzania (USAID|DELIVER, 2016), and Ghana (Addo et al., 2006).

Generally, although the laboratory department was quantifying annually, it was not involved laboratory case team heads and other departments or stakeholders during quantification exercise. Besides, most believed that they had limited skills and knowledge to perform quantification and supply planning. Moreover, no full package quantification and partial or no commodities were received compared to quantified and expected in a year.

The grand average standard deviation and mode of quantification related questions was 0.84 and 4, respectively. This indicates that there were a minimum variation of ideas (0.84) among respondents across the question, and had agreed (4) for all quantification exercise-related issues raised.

4.5. Procurement Practice of SPHMMC

I. Procurement Perception

Table 4.7: SPHMMC laboratory professionals' perception on laboratory commodities procurement practices

Question	S. Disagree	Disa.	Neutral	Agree	S. Agree	S. Devn	Mode
	N-1	N-2	N-3	N-4	N-5		
The hospital maintains a data base for all suppliers	4	4	6	14	1	1.16	4
Long term agreements between hospital and its suppliers for products is important to avail test menu	1	1	8	19	0	0.74	4
Long-term agreements between hospital and analyzer vendors important to avail test menu	0	5	7	16	1	0.83	4
Procurement process is acceptable	0	2	10	15	2	0.73	4
Full package laboratory commodities are procured	1	6	12	7	3	1.00	3
From full package procured laboratory commodities partial items is/are received	0	5	9	11	4	0.95	4
Procurement lead time (from order to secure products for use) is acceptable	0	6	9	11	3	0.94	4
Grand Mean of Standard Deviation and Mode						0.90	3.85

Source: Own survey, 2019

Most respondents believe that long term agreements between the hospital and its suppliers 19 (65.5%) for products and analyzer 17 (58.6%) were essential to the avail test menu. In contrary, for the case of suppliers' database record keeping, and procurement process acceptability, most of them 14 (42.3%), and some 10 (34.5%) were reserved respectively.

On the package list of LC procurement and receiving, most of them are indifferent 12 (41.4%) for procurement and agreed for partial items receiving 15(51.7%) from

full package list of products to run a test. For the case of the hospital's procurement lead time for LC, most 14 (48.2%) responded as acceptable.

II. Procurement Practice

iv. In your opinion, how do you judge the hospital procurement process and strategy that might be contributing to product stock out

The hospital procurement process had different approaches; for commodities that are available by EPSA, direct procurement made before check quality and any further process. For other commodities stock out in EPSA and brand specific, commodities managed by framework agreement for 1 to 2yrs after open/particular tender. Whereas, the open one is handled by public tender whenever procurement is needed. These whole procurement process may take up to 3 months.

According to experts' opinion, no significant fund constraint to procure laboratory commodities, but the national hard currency challenges contributing to product stock out. Although the laboratory had prepared a budget project plan of 42 million birr, the budget is allocating in general for all hospital's medical supplies demand. Like in many countries, SPHMMC's budget allocation and utilization for LC is not known independently by the department. The budget for laboratory services usually included in the budget for essential health services. In some countries, national public health laboratory services have separate budgets for performance improvement, supervision, and supplies (USAID|Deliver, 2009)

Apart from the government procurement process, limited and sometimes no involvement of laboratory professionals in the procurement process contributing for none- full packaged procurement, no supply planning scheme, single source of quantification data, unsatisfactory internal transaction and recordings may result to hinder economic scale of procurement benefit and service interruption.

For closed hematology and clinical chemistry with hormonal testing analyzers, EPSA has launching 2- 3 years framework agreement. SPHMMC is one of the beneficiaries of this framework. Accordingly, most respondents are interested in this to be implemented. For other types of analyzers' products and open system,

EPSA identifying 178 lines of items to procure and deliver to all public health institutes, including SPHMMC (PFSA, 2018).

In summary, the grand mean of standard deviation and mode show that there was a minimum variation of ideas (0.90) of respondents across the question, and closer to an agreement (3.85) for all types of procurement practicing issues.

Besides, sole supplier and their weak performance, hard currency shortage, short expiry procurement that may not be able to consume in its lifetime, long procurement process, product unavailability on the market, and essential (common) commodities that are a precursor to run other tests consumption miss-match were major procurement challenges identified.

These all challenges might be driven from lack of identifying, organizing and addressing challenges based on their peculiar characteristics.

4.6. Inventory Management Practice of SPHMMC

I. Inventory Management Perception

The hospital's min-max inventory control system is forced ordering for program commodities and continuous review min-max for revolving drug fund commodities (procured by facility). In the former system, the institute was generating RRF bimonthly, but during the later one RRF was made when product depleted below min.

Table 4.8: SPHMMC laboratory professionals' perception on commodities inventory management

Question	S. Disagree	Disag	Neutral	Agree	S. Agree	S. Devn	Mode
	N-1	N-2	N-3	N-4	N-5		
The hospital maintain Maximum, Minimum inventory level for each laboratory products at main store, mini-store, and testing unit	2	2	5	18	2	0.99	4
The hospital is managing laboratory commodities inventory as a package that are needed to run a test	1	2	6	16	0	0.82	4
The laboratory established procedures for placing emergency orders	1	2	6	17	3	0.90	4
The laboratory uses of periodical replenishment of stocks	2	4	8	13	2	1.04	4
The laboratory has an integrated information sharing system	2	2	9	15	1	0.94	4
The laboratory uses ABC/VEN(Vital, Essential& Non-essential) analysis to classify items according to their stock value	1	4	9	13	2	0.94	4
Obsolete, expired, or damaged inventories properly identified and segregated at stock keeping points	1	2	8	18	0	0.78	4
Products are stored and organized in a manner accessible for first-to-expire, first-out counting and general management	1	3	6	17	2	0.91	4
Grand Mean of Standard Deviation and Mode						0.91	4

Source: Own survey, 2019

Most of the respondent 20 (69%) perceived that for each LC minimum and maximum inventory level was maintained, periodic stock 16 (51.1%) replenished, inventory as a package 16 (55.2%) managed. In case of emergency, about 69% (20) agreed that their laboratory had established procedures for placing emergency orders.

Above half of the respondents believe that the laboratory had a mechanism of integrated information sharing system 16 (55.1%). Related to stock classification by ABC/VEN (Vital, Essential& Non-essential), 15 (51.7%) were agreed with 9 (31%) in different and disagreed and below by 5 (17.2%) respondents.

Most 18 (62.1%), except the reserved 8 (27.6%) respondents believe that obsolete, expired, or damaged inventories adequately identified and segregated at mini-store, and testing unit level. The result was similar to Ghana, expired products were typically separated from usable supplies but were not removed and disposed of (Addo et al., 2006).

II. Stock Status

The secondary data show that forty-nine (52.1%) laboratory commodities were stock out at the time of the visit. The six months (Nov 16 to May 17, 2019) periodic stock out assessment result show that about 53.3% (50) commodities were stock out in the period at least once. Most, 42 (44.7%), LC stock out once stock-outs in six months period. The rest were for two, five, and seven times for 6 (6.4%), 1 (1.1%), and 1 (1.1%) types of commodities respectively.

Most hormonal tests and CBC reagents were stock out at the time of the visit. Whereas bleeding, coagulation, Prothrombin, Partial Thromboplastin Time and some hormonal tests are stock out above a year.

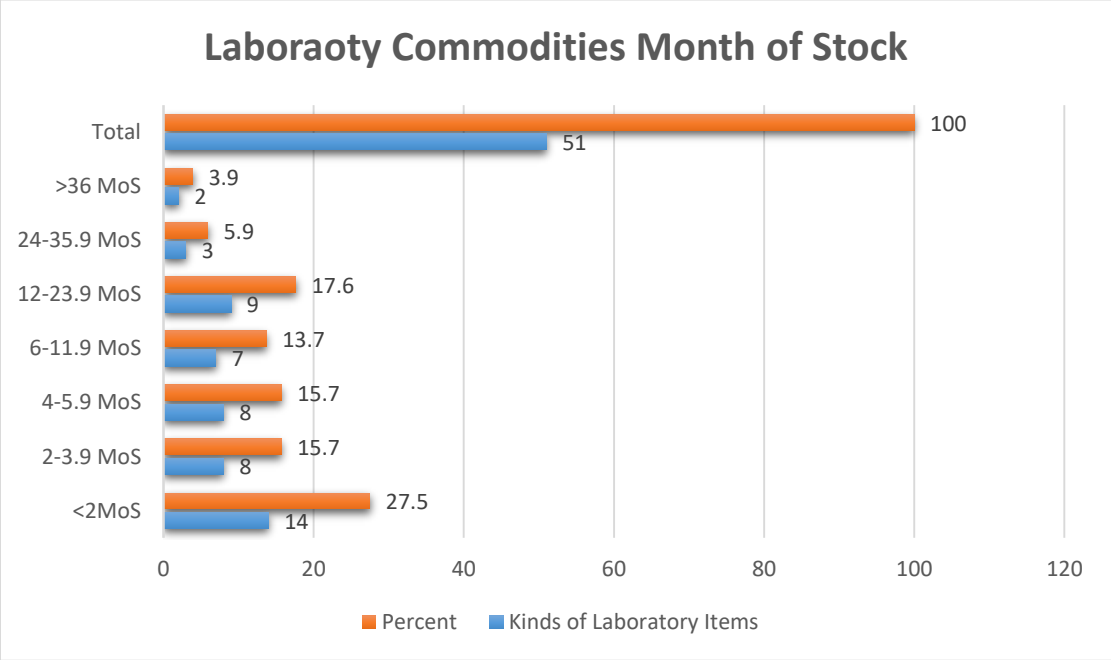
Concerning to the duration of stock outs, most commodities 18 (19.1%) were stock out for above six months, 12 (12.8%) for 3, and 10 (10.6%) for a month, and 5 (5.3%) for two months. The rest 6 (6.4%) were stock out from four to six months.

Table 4.9. Laboratory commodities stock out duration

Month of Stock	Frequency	Percent
No Stock Out (SO)	43	45.7
One Month SO (1-29)	10	10.6
Two Months SO (30-59)	5	5.3
Three Months SO (60-89)	12	12.8
Four Months SO (90-119)	2	2.1
Five Months SO (102-149)	3	3.2
Six month SO (150-179)	1	1.1
> Six Month SO (>180)	18	19.1
Total	94	100.0

Source: Own survey, 2019

Most, 14 (27.5%), of laboratory commodities' month of stock were below two months of inventory. Eight (15.7%) line of commodities are within normal min-max range. The remaining 29 (56.8%) commodities overstocked.



Source: Own survey, 2019

Fig 4.1. Laboratory items month of stock

Weak inventory control system led to experience laboratories for frequent and prolonged stock-outs of key reagents. Like in SPHMMC, in Lesotho (Pharasi, 2007), and Tanzania (Ifeanyi and Abum, 2018) most facilities did not set min-max

inventory control level. Similarly, this study result shows that above 84% (43) of commodities were above max or minimum stock level, and 29 (56.8%) were above max. The cumulative effect led to storage space constraints and product expiry

A cross-sectional study conducted in Ethiopia, in 2011 shows that the majority of the facilities 60.5% stock out for at least one ART monitoring and TB laboratory reagents. Whereas, at SPHMMC forty-nine (52.1%) LC were stock out at the time of the visit.

In summary, the grand mean of standard deviation and mode show that there was a minimum variation of ideas (0.91) of respondents across the question, and closer to an agreement (4) for all types of the inventory as mentioned above management practices. Secondary data show that almost half of laboratory commodities were stock out at the time of the visit. Most of them are hormonal tests and CBC reagents. Above 80% (43) of LC were not maintained in its min-max level. Most of them stocked above maximum (4month) level. Ranging from 4 to above 36 months of stock. The result indicated that despite the hospital had an automated recording system and had multiple inventor management features, there were weak supply planning, and min-max maintaining practices observed.

4.7. Storage and Transportation Practice of SPHMMC

I. Storage and Transportation Perception

Table 4.9. SPHMMC laboratory professionals' perception on storage and transport practice

Question	S. Disagree	Disag	Neutral	Agree	S. Agree	S. Devn	Mode
	N	N	N	N	N		
The laboratory has standard guideline for health commodities storage and management	1	2	5	17	4	0.92	4
The store is sufficient to accommodate room temperature required laboratory commodities	0	7	5	15	2	0.95	4
The store is sufficient to accommodate cold chain (2-8^{0}C) required laboratory commodities	0	4	3	19	3	0.84	4
I have experienced testing failure due to improper storage of laboratory commodities	0	4	9	12	4	0.91	4
The store is located suitable for laboratory department	1	4	5	14	4	1.03	4
Grand Mean of Standard Deviation and Mode						0.93	4

Source: Own survey, 2019

Related to storage practice, most respondents believe that the laboratory had a standard guideline for health commodities storage and management 21 (72.4%). Except respondents disagree about the existing storage capacity is not sufficient to accommodate room temperature 7 (24.1%), and cold chain 4(13.8%) laboratory commodities, most believe that the existing store can accommodate sufficiently for room temperature 17 (58.3%), and cold chain commodities 22(75.8%). In contrary, above half of the respondents, 16 (55.2%) had experienced testing failure due to improper storage of laboratory commodities.

According to USAID/DELIVER (2009), the general storage guideline of laboratory commodities, relatively good storage practice observed in mini store 11(73%) compared to the main store (33%). Storing above 80 % of storage guideline is accepted as good storage practice.

In response to the transportation of LC, most of respondents 16 (55.2%) perceived that LC come from the different source without integrating 13 (44.8%) all laboratory units' demand. Similarly, 10 (34.5%) believed that the supplier delivers most of the time LC. Eighteen respondents (62.1%) believed that their store located suitable for laboratory department.

II. Storage and Transportation Practice

Infrastructure challenges raised as an internal factor for commodities stock out. Lack of adequate storage for room temperature and cold chain commodities at all level of stock keeping points. Testing units, mini-store, and the main store could accommodate a week, half month, and two months maximum consumption respectively

Related to cold chain commodities management, the refrigerator made for domestic purpose, not for pharmaceuticals. Furthermore, whenever the power goes off difficult to maintain 2-8 oC temperature since the refrigerators have no generator power line. The power supply was not reliable to guarantee continuous cold storage (Addo et al., 2006) in Ghana too.

In summary, the grand mean of standard deviation and mode show that there were a minimum variation of ideas (0.93) of respondents across the questions, and agreement (4) for issues such as store location, store sufficiency, testing failure due to storage. Storage space constraint for cold chain and room temperature at all level of the stock keeping units made unable to maintain the maximum stock level. In contrary, the store stocked 56.8% (29) of laboratory commodities above its maximum level. The commodities also were not stocked according to the storage guideline as well.

4.8. Logistics Management Information System (LMIS) Practice of SPHMMC

I. LMIS perception.

Logistics Management Information System (LMIS) is the heart of the logistics cycle. Almost all laboratory professionals 21 (72.4%) did not take Integrated Pharmaceutical Logistics System (IPLS) training.

Table 4.11. SPHMMC laboratory professionals' perception on LMIS.

Question	S. Disag	Disag	Neutral	Agree	S. Agree	S. Devn	Mode
	N-1	N-2	N-3	N-4	N-5		
Information exchange between our Laboratory and its main store is timely	0	5	5	16	1	0.85	4
Information exchange between our Laboratory and its OPD is timely	2	6	6	10	3	1.15	4
I have skills and knowledge about logistics Management information system	0	8	3	13	3	1.05	4
Grand Mean of Standard Deviation and Mode						1.01	4

Source: Own survey, 2019

Most of the respondents 23 (79.3%) believed that they were updated bin card, and had for all kinds of LC 23 (79.3%). Despite the PFSA's (2017) IPLS SOP recommends for updating bin card during receiving, utilization, loss/Expiry, and reporting IFRR, 58.6% (17) respondents believed that bin card was updated either one of the activities performed.

Regarding Internal Facility Report and Resupply (IFRR) report form implementation, there is no standardized reporting schedule across the respondents. Ten (34.5%), 2 (6.9%), 3 (10.3%), and 12 (41.4%) respondents were agreed on reporting weekly, biweekly, monthly, and not know when do they report respectively. Similarly, all of them had no uniform understanding of its content too.

II. LMIS Practice

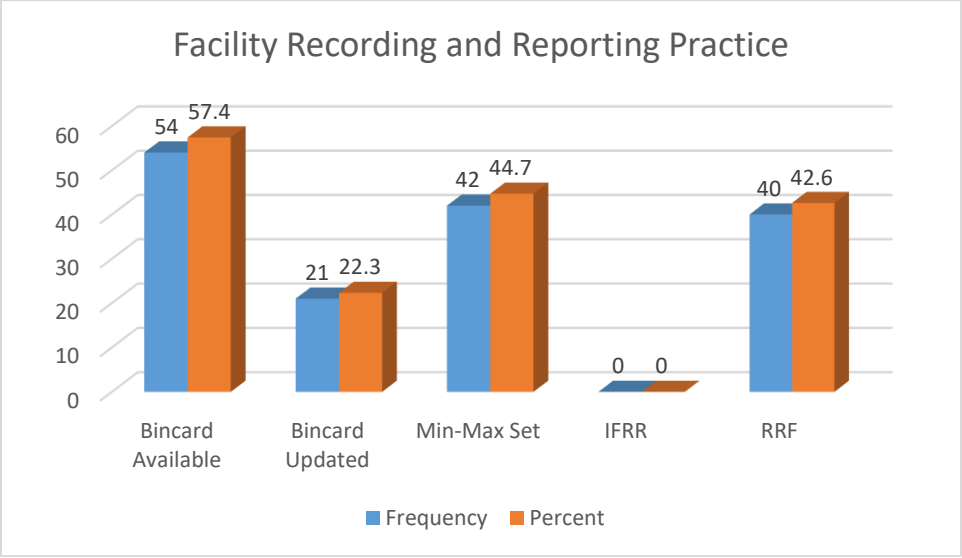
v. Do you use and update bincard and are you utilizing IFRR, and RRF to request and report products?

Bin card was available in most case teams of laboratory, but the updating knowledge was somewhat different. Some of them are updating when receiving and recording different items on the same bin card, in contrary, the main store and mini stores were managing well by electronically deployed, and by paper-based bin card respectively.

IFRR has two sections that contain completed by testing unit and store. Parts expected to be filled by the testing unit has beginning balance, quantity received, loss/adjustment, and ending balance spaces, but all testing units are solely reporting quantity ordered for their weekly resupply.

III. LMIS, Secondary Data

Even though IFRR had not been filled for all types of laboratory commodities, for 40 (42.6%) line of commodities RRF generated. From 94 range of laboratory items, bin card was available only for 54 (57.4%) line of items. Of all, 21 (22.3%) and 42 (44.7%) updated and set its minimum and maximum stock level respectively.



Source: Own survey, 2019

Fig 4.2. Bincard, IFRR, and RRF recording and reporting practice

In triangulating the relationship across bin card availability, update, and set min-max stock level, from 54 availed items, 40 (74.1%), and 18 (45%) were set min-max, and update respectively

Generally, the grand mean of standard deviation and mode show that there was a 1.01 variation of ideas of respondents across the questions, but agreed (4) on the questions like for good information exchange between store and units and LMIS skills. In stock keeping, bin card was not available for almost half of the products. Of these, half were not updating. Similarly, the hospital was not implementing RRF and IFRR as per IPLS guideline (PFSA, 2017). Since the inventory system is forced ordering, RRF was expected to generate every two months with 2 months of stock as a minimum and 4 months of max stock.

4.9. Quality Control and Quality Assurance Practice of SPHMMC

I. Quality Control and Quality Assurance Perception

Regarding quality assurance on LC logistics, most respondents 27 (93.1%) approved for the written quality assurance policies and procedures the laboratory has.

As part of policies and procedures, for the room and cold chain LC recording refrigerator and freezers temperature charts and involvement in External Quality Assurance Scheme, most of them 26 (89.7%), and 19 (65.5%) assured for the respectively activities as mentioned earlier.

II. Quality Control and Quality Assurance Practice

vi. How do you maintain quality assurance of laboratory commodities integrity in the logistics cycle?

The hospital has two sources of suppliers, EPSA, a sole public agency to deliver the program and revolving drug fund commodities, and private vendors. Whenever commodities received from EPSA no inspection is done except analyzing quality control tests by the laboratory department. Sometimes, poor quality products such as pregnancy test, HBsAg, serum separator tube, etc. delivered from EPSA

On the other hand, despite there is no quality assurance policies and procedures available, randomly inspecting during receiving for other than EPSA supplying commodities, and transporting between store and mini-store and then to testing units had been managing well.

According to Raja and Mohammad (2004), quality of the products needs to be maintained throughout the supply chain, starting from the manufacturer, all the way through the distribution network until the patient consumes it.

Since the scope of the study is limited to assess commodities storage and movement in the perspective of LCL, quality assurance scheme was not developed and implemented in developing specification (brand specific and generic), procurement (partial commodities procuring and lengthy process), transportation (inaccessibility), refrigerators (making ice and no generator power), and storage (congested, pest). Therefore, according to Raja and Mohammad (2004), quality is a central focus of all activities throughout the product management process and supply chain.

Generally, there was no guideline and procedure to monitor quality assurance scheme. A well-managed laboratory should have a good QA system that checks and eliminate errors (USAID|Deliver, 2009)

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1. Summary of Findings

Serving Customer: Most respondents perceived that their customers were themselves followed by patients and all. To maintain external customer relationship, the laboratory availed customers' feedback log book, suggestion box. On the other hand, to keep internal customer satisfaction, the laboratory test menu handbook was prepared and disseminated to physicians. Besides, the duty laboratory professionals were attending the physicians morning session. Paradoxically, despite all these efforts had been done to satisfy customers the availability of laboratory test menu was 48.8% (44) at the time of visit.

Product Selection: All laboratory case team leads not involved during product selection. Product selection practiced based on the disease (testing), product type, and brand followed by cost, not based on test technique, and quality.

Quantification: Quantification was exercised annually using service data as an input and the department lonely quantifying products. No other laboratory case team leads, and departments or stakeholders were involved in the quantification. Furthermore, they had limited skill and knowledge. From the expected 94 lines of items needed to run 85 types of test menu, 54 (57.4%) quantified. Of these, 20 (37%) received till the 11th month of the fiscal year. In contrary, 11 (35.5%) received despite not quantified.

Procurement: Direct procurement made from EPSA for available commodities. If stock out at EPSA, hospital float tender and collect proforma for open and closed system laboratory commodities. After technical and financial evaluation done for closed system commodities, 1-2yrs framework agreement made with sole suppliers. Usually, the procurement process took three months. As a challenge, pharmacy professionals had limited skill and knowledge about laboratory commodities, procured the short lifetime, no involvement of laboratory professionals, no allocated and remaining budget was known.

Inventory Management: Most believe that the lab segregates obsolete items in mini-store and testing units. Although most of them believe that the laboratory maintains min-max, 14 (27.5%) commodities were below 2 months of stock, and 29 (56.8%) above maximum stock. Only 15.7% (8) line of items was in the min-max range. Besides, the point and period stock status assessment shows that 49 (52.1%), and 50 (53.2%) commodities stock out, respectively.

Storage: Most believed that due to the improper storage of laboratory commodities, test failure experienced. Storage capacity was not sufficient to maintain min-max. The testing unit, mini-store, and main store enforced to stock 1 week, 2weeks and less than 4 months maximum stock. To keep 4 months stock of cold chain commodities, the existed refrigerators was not sufficient and made to stock pharmaceutical commodities, rather for domestic products. It is known that cold chain commodities are temperature sensitive and perishable, but the refrigerators found in mini-store had no generator power supply.

LMIS: Almost all laboratory professionals did not train for IPLS. From 94 line of laboratory items, bin card was available only for 54 (57.4%) line of items. Of all, 21 (22.3%) and 42 (44.7%) updated and set its minimum and maximum stock level, respectively. Most of the study participants not known the moment when bin card is updating and its content. Almost all units and mini-store were not reporting IFRR, only requesting their demand weekly to maintain a week stock from testing unit to mini-store and from mini-store to the main store weekly to maintain half month's maximum inventory. Besides, almost all did not know the contents of IFRR. RRF reporting schedule for program commodities was not regular, and they did whenever commodities depleted. From 94 line of items, 40 (42.6%) reported on RRF.

QC and QA: The hospital had two suppliers, the government, EPSA, and sole suppliers. No physical inspection is done for commodities received from EPSA. Here, the quality defect observed for some commodities. During receiving for non-closed system commodities quality was checked by a quality officer. Storage and transportation adhered according to the manufacturer recommendation.

5.2. Conclusion

The following conclusions are drawn based on the results of the study.

Despite at the time of visit about half of laboratory commodities were stocked out, SPHMMC laboratory department had good internal and external customer service provision and customer relation management.

The logistics subject matter experts raised a lot of gaps created as a result of a lack of their involvement and limited skill and knowledge in the logistics cycle, mainly on product selection, quantification, and procurement.

Based on secondary data, storage capacity constraint practiced at each level of stock keeping units, as one of the factors, they had not implemented LMIS (IPLS). Besides, above half of the LC were socked above maximum, and stock out at the time of the visit.

Further to unable to maintain min-max, weak stock keeping and stock transaction recording contributed for poor quantification and procurement decision. The hospital does not know its consumption, budget allocation, and dispersal as well.

These all challenges are because of limited understanding of logistics cycle that may contributing for product availability. Each major function builds on the previous function and leads logistically to the next and so on. Disruption on one seriously affect the ultimate outcome of the logistics. Besides, weak professional knowledge and skills in developing, adopting, and implementing guidelines, SOPs, standards, and protocols contributing for product stock out.

5.3. Recommendation of the Study Participants

Based on the level of expert knowledge, the following advice forwarded to the hospital and government.

- The laboratory should work closely with the hospital's management to show the laboratory work burden
- Design a system to avoid unnecessarily (repeated) and non-selective laboratory request made by physicians, health care providers, and students
- Involvement of laboratory professionals in the procurement process

- Capacity building for laboratory professionals in quantification exercise and by laboratory logistics training, and for pharmacy professionals about LC management
- Support local private sector manufacturing for laboratory reagents and supplies like pharmaceutical drugs.

5.4. Recommendation of Investigator

While most of the findings of this assessment are encouraging, some identified gaps need to address for system improvement. After a thorough analysis of data, the following recommendations forwarded:

- Customer Service

Customer satisfaction in the health sector is beyond the usual business firm customer satisfaction by fulfilling Just in time, quality product/service with low cost, it needs gearing with technology and disease type. Thus, to address the dynamic need of internal and external customers, a program for addressing customer satisfaction requires good planning, the development of appropriate monitoring tools, the knowledge to apply the tools to gain usable information.

- Product Selection

Product selection appropriate based on the testing protocols, cost, training of personnel, and infrastructure for storage and transportation. To address in priority, the hospital better to include laboratory professionals in the product selection team, standardization of test menus and techniques, and executing the proceeding activities. In product selection, the laboratory considers trade-offs between open and closed systems for test instrumentation, and be prepared for changes in test technology.

- Quantification and Procurement

The laboratory department had not involved laboratory case team heads and other departments/stakeholders during quantification exercise. Collaborative planning, involvement of different stakeholders, and provide training on quantification

exercise for laboratory professional support to minimize quantification prone product stock out.

Quantification based on service data. Use and compare multiple types of forecasts using logistics, demographic, and service statistics data to forecast requirements for laboratory commodities has paramount importance for triangulation.

- Inventory Management

As per IPLS SOP and contract agreement, the hospital used to place an order for program and revolving drug fund (RDF) commodities based on forced order and continuous max-min inventory control system respectively. Since the program commodities have the disease and fund related, the forced ordering system (placing order for all commodities bimonthly) will be better system among the three. Whereas, in case of RDF commodities, since they had been managing by contract agreement for a yearlong consumption, better to schedule supply planning quarterly.

- Storage and Transportation

The study shows that above quarter of commodities were over-stocked from 4 to 36 month of stock. Furthermore, commodities stocked was not according to the storage guideline. Avoiding these challenges may resolve the existed storage space constraint. The location of the store was not convenient for laboratory department. Locating storeroom adjacent to the laboratory will improve internal product movement and minimize damage.

- Logistics Management Information System

LMIS is the heart of the logistics cycle. For effective and efficient logistics system, a quality stock keeping and transaction recordings should be in place and maintained. The laboratory should provide IPLS/LMIS training for its staffs, and adhere the SOP will improve quantification accuracy and manage service provision. Besides, automating the recording system for all laboratory commodities will have an immense contribution to ease stock status management and informed decision making.

- Quality Control and Quality Assurance

Quality assurance scheme started with implemented in developing the specification, procurement process, supply planning and contract agreements, transportation in maintaining physical product integrity and delivering the full package, physical inspection during receiving, and storing according their peculiar temperature recommendation and storage guideline, quality control check before the product is received and in regular basis . Thus, the hospital should have quality assurance policy (guideline), and implement accordingly in all cycle of logistics.

General recommendation. It is proposed that with the above mentioned each recommendation continuous professional development for laboratory professionals and logistics experts about LMIS, product selection and quantification, and good storage practices has significant importance to solve most challenges raised in the logistics cycle.

Besides, the national laboratory improvement strategy plan of EPHI is for implementing Stepwise Laboratory Improvement Process Towards Accreditation (SLIPTA) at all hospital laboratories from 2015-2020 (EPHI, 2015). SPHMMC is one of the beneficiaries and also on the verge of SLIPTA. Since most of the SLIPTA criteria are related to logistics cycle elements of the study that accounts 114points (44%) [(Client Management and Customer Service (8pts), Documents and Records (25pts), Purchasing and Inventory (30pts), Information Management (18pts), Process Control and Internal and External Quality Assessment (33pts)] from 258, improvement on each elements of the logistics cycle may improve their laboratory SLIPTA process particularly and addressing accuracy, reliability and timeliness of reported test results to the patient at large.

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Annex – I: Questionnaire

ADDIS ABABA UNIVERSITY SCHOOL OF COMMERCE LOGISITCS SYSTEM ASSESSMENT QUESTIONNAIRE

Greetings. My name is Fasil Bekele. I am a graduate student of Logistics and Supply Chain Management at the School of Commerce, Addis Ababa University. Currently, I am working my thesis entitled as "An assessment on Logistics practice of Laboratory Commodities: The Case of St. Pauls Millennium Medical College, Addis Ababa, Ethiopia".

The objective of this study is to assess the logistics practice of laboratory commodities in the elements of the logistics cycle to indicate gaps, identify constraints, and propose recommendation.

I want to ask you a few questions about the LCLS practices and perceived challenges that will lead to the absence of laboratory test menu due to laboratory commodities stock out and other related problems.

Your genuine information has paramount importance as an input for the investigator to forward a possible recommendation.

Your interview response is protected confidentially. Name or any other distinguishing factor will not identify you. I will be the only person who will access to this data, including transcription if necessary. Furthermore, the information you provided will be encoded, analyzed, and communicated the result to the hospital and readers without bias. The data intend to this study consumption only.

Finally, I do believe that your participation in this study will help the hospital greatly to improve Logistics System of Laboratory Commodities by avoiding product stock-outs.

For any clarity or in need of additional information, you can contact me via email at fasilandbekele@gmail.com and/or Cell Phone +251-911-123-922.

Section – 1: General Questions Collection questionnaire

A: General Information			
No.	**Question**	**Code Classification**	**Comments**
GI2.	Title of person interviewed for this section	_____	
GI3.	Department/Section you are working now		
GI4.	Gender	Male Female	
GI5.	Number of years and months you have worked at this facility?	Years: _____ Months:_____	
GI.6	Educational level	Diploma BSc MSc Other….	

SECTION – B: Serving customer level of agreement on the following practices

SC1	Who are your principal customer? (Multiple response is possible)	1. Patients				
		2. Clinicians				
		3. Other health care providers				
		4. Epidemiologist/Researchers				
		5. Laboratory technicians				
Please indicate your level of agreement on the following statements based on your experience working in this hospital. The rating is from 1=Strongly Disagree to 5=Strongly Agree						
		1= Strongly Disagree	2= Disagree	3= Unknown	4= Agree	5= Strongly Agree
SC1	Our laboratory shares a sense of fair play with its customers	1	2	3	4	5
SC2	Our laboratory has a system to interacts with customers to set its reliability, responsiveness, and other standards	1	2	3	4	5
SC3	Our laboratory follow-up with its customers for quality/service feedback	1	2	3	4	5
SC4	Our laboratory measures and evaluates customer satisfaction	1	2	3	4	5
SC5	Our laboratory determine future customer expectations	1	2	3	4	5
SC6	Our laboratory evaluates the formal and informal complaints of its customers	1	2	3	4	5

SC7	The laboratory section is recording customers result always	1	2	3	4	5

SECTION -- C: Product selection level of agreement of the following practices

Please indicate your level of agreement on the following statements based on your experience working in this hospital. The rating is from 1=Strongly Disagree to 5=Strongly Agree						
		1= Strongly Disagree	2= Disagree	3= Unknown	4= Agree	5= Strongly Agree
PS1	Our laboratory has test menu	1	2	3	4	5
PS2	Absence of test menu has no impact on product stock out					
PS3	Our laboratory selecting products focusing mainly on cost	1	2	3	4	5
PS4	Our laboratory is selecting products focusing mainly on quality of products	1	2	3	4	5
PS5	Our laboratory is selecting products focusing mainly on testing techniques	1	2	3	4	5
PS6	Our laboratory is selecting products focusing mainly on supplier brand	1	2	3	4	5
PS7	Our hospital has established long term contract agreement with its suppliers	1	2	3	4	5

SECTION – D: Issues related to laboratory commodities quantification related level of agreement on the following practices

Please indicate your level of agreement on the following statements based on your experience working in this hospital. The rating is from 1=Strongly Disagree to 5=Strongly Agree						
		1= Strongly Disagree	2= Disagree	3= Unknown	4= Agree	5= Strongly Agree
Q1	Our laboratory quantifying laboratory commodities periodically	1	2	3	4	5
Q2	Our laboratory involving laboratory professionals in its quantification exercise	1	2	3	4	5
Q3	Professionals quantifying laboratory commodities has limited skills and knowledge	1	2	3	4	5
Q4	Our laboratory is quantifying products based on morbidity data	1	2	3	4	5

Q5	Our laboratory is quantifying products based on service data	1	2	3	4	5
Q6	Our laboratory is quantifying products based on target plan	1	2	3	4	5
Q7	Quantification error (improper quantification) was the cause for service interruption	1	2	3	4	5

SECTION – E: Issues related to procurement of laboratory commodities

Please indicate your level of agreement on the following statements based on your experience working in this hospital. The rating is from 1=Strongly Disagree to 5=Strongly Agree						
		1= Strongly Disagree	2= Disagree	3= Unknown	4= Agree	5= Strongly Agree
P1	The hospital maintains a data base for all suppliers	1	2	3	4	5
P2	Long term agreements between the hospital and its suppliers for products is important to avail test menu	1	2	3	4	5
P3	Long-term agreements between hospital and analyzer vendors important to avail test menu	1	2	3	4	5
P4	Procurement process is acceptable	1	2	3	4	5
P5	Full package laboratory commodities are procured	1	2	3	4	5
P6	From full package procured laboratory commodities partial items is/are received	1	2	3	4	5
P7	Procurement lead time (from order to secure products for use) is acceptable	1	2	3	4	5

SECTION – F: Inventory Management agreement on the following practices

Please indicate your level of agreement on the following statements based on your experience working in this hospital. The rating is from 1=Strongly Disagree to 5=Strongly Agree						
		1= Strongly Disagree	2= Disagree	3= Unknown	4= Agree	5= Strongly Agree
IM1	The hospital maintain Maximum, Minimum inventory level for each laboratory products at main store, mini-store, and testing unit	1	2	3	4	5
IM2	The hospital is managing laboratory commodities inventory as a package that are needed to run a test					

IM3	The hospital established procedures for placing emergency orders	1	2	3	4	5
IM4	The hospital uses of periodical replenishment of stocks	1	2	3	4	5
IM5	The hospital has an integrated information sharing system	1	2	3	4	5
IM6	The hospital uses ABC/VEN(Vital, Essential& Non-essential) analysis to classify items according to their stock value	1	2	3	4	5
IM7	Obsolete, expired, or damaged inventories properly identified and segregated at all stock keeping points (Main store, mini-store, testing unit)	1	2	3	4	5
IM8	Products are stored and organized in a manner accessible for first-to-expire, first-out counting and general management	1	2	3	4	5

SECTION – G: Storage agreement on the following practices

Please indicate your level of agreement on the following statements based on your experience working in this hospital. The rating is from 1=Strongly Disagree to 5=Strongly Agree						
		1= Strongly Disagree	2= Disagree	3= Unknown	4= Agree	5= Strongly Agree
S1	The laboratory has standard guide line for health commodities storage and management	1	2	3	4	5
S3	The store is sufficient to accommodate room temperature required laboratory commodities	1	2	3	4	5
S4	The store is sufficient to accommodate cold chain (2-8^{0}C) required laboratory commodities	1	2	3	4	5
S5	I have experienced testing failure due to improper storage of laboratory commodities	1	2	3	4	5
S6	The store is located suitable for laboratory department	1	2	3	4	5

SECTION – H: Transportation level of agreement on the following practices

(section heads, lab head, pharmacy head, logistics officer, store manager)

T1	Does all of the laboratory supplies come from the same source?	Yes No
T2	Is the receiving of laboratory supplies integrated across all laboratory units' demand?	Yes No

T3	How does lab supplies usually arrive at the laboratory?	Laboratory picks them up Higher level deliver Supplier Vendor Other (*specify*): ……..
T5	Does the laboratory use the vehicle to pick up supplies?	Yes No

SECTION – I: Logistics Management Information System agreement on the following practices

L1	Do you use bin card?	Yes No
L2	Do you have bin card for all kinds of laboratory commodities?	Yes No
L3	How often do you updating the bin card. Multiple response is possible.	During receiving from store During utilization When it expire During reporting IFRR 99. I do not Know
L4	Have you ever filled IFRR?	Yes No
L5	Do you take IPLS training?	Yes No
L6	How often reporting IFRR to main store?	Weekly Biweekly Monthly 99. I do not know
L7	Please tick the contents reporting in IFRR. Multiple response is possible.	Beginning balance Quantity received Loss/Adjustment Ending balance /stock on hand 99. I do not Know

Please indicate your level of agreement on the following statements based on your experience working in this company. The rating is from 1=Strongly Disagree to 5=Strongly Agree

		1= Strongly Disagree	2= Disagree	3= Unknown	4= Agree	5= Strongly Agree
L8	Information exchange between our Laboratory and its main store is timely	1	2	3	4	5
L9	Information exchange between our Laboratory and its OPD is timely	1	2	3	4	5
L10	I have skills and knowledge about logistics Management information system	1	2	3	4	5

Annex - II: Interview questions

ADDIS ABABA UNIVERSITY SCHOOL OF COMMERCE LOGISITCS SYSTEM SURVEY QUESTIONNAIRE

Greetings. My name is Fasil Bekele. I am a graduate student of Logistics and Supply Chain Management at the School of Commerce, Addis Ababa University. Currently, I am working my thesis entitled as "An assessment on Logistics System of Laboratory Commodities in the Case of St. Pauls Millennium Medical College, Addis Ababa, Ethiopia."

The objective of this study is to assess the logistics practice of laboratory commodities in the elements of the logistics cycle to indicate gaps, identify constraints, and propose recommendation.

I want to ask you a few questions about the LCLS practices and perceived challenges that will lead to the absence of laboratory test menu due to laboratory commodities stock out and other related problem that are perceived to improve your facility supply chain management practices.

Your genuine information has paramount importance as input for the investigator to forward a possible recommendation.

Your interview response is protected confidentially. Name or any other distinguishing factor will not identify you. I will be the only person who will access to this data, including transcription if necessary. Furthermore, the information you provided will be encoded, analyzed, and communicated the result to the hospital and readers without bias. It will also be utilized for the consumption of this study

Finally, I do believe that your participation in this study will help the hospital greatly to improve Logistics System of Laboratory Commodities by avoiding product stock-outs.

For any clarity or in need of additional information, you can contact me via email at fasilandbekele@gmail.com and/or Cell Phone +251-911-123-922

Do you have any question?

1. Who are your customers? How do you know and fulfill their expectations and needs?

2. How do you practice in selecting laboratory commodities?

3. How do you exercise quantification? What kinds of resources are you taking as input for quantification?

4. In your opinion, how do you judge the hospital procurement process and strategy that might be contributing to product stock out

5. Are there standard forms available and used to register service data (logbook), stock keeping (bin card), and transaction activities (IFRR and RRF)

6. In your opinion, do you believe that external factors contributing to product stock out? If so, what external barriers are constraining for product stock out?

7. In your opinion, do you believe that internal factors contributing to product stock out? If so, what internal barriers are constraining for product stock out?

8. Are funds sufficient to cover the needed supplies and equipment? If not, what is the gap?

9. How do you maintain quality assurance of laboratory commodities integrity in the logistics cycle?

10. What do you recommend for optimal availability of laboratory test menu/product at your hospital?

Annex - III: Secondary Data Collection Checklist

TABLE 1: Stock Status

Column:

1. Check if the bin card is available, answer Y for yes or N for no.
2. Check if the bin card had been updated within the last 30 days, answer Y for yes or N for no. Note: If the bin card was last updated with the balance of 0 and the facility has not received any resupply, consider the stock card up-to-date. Also, if the product has not been issued since the last entry, consider the bin card up-to-date.
3. Are stock levels (maximum and minimum) for each products reviewed periodically?
4. Record the balance on the bin card.
5. Record if the facility has had any stock out of the product during the most recent six full months before the survey (three months for test kits), answer Y for yes or N for no
6. Record how many times the product stocked out during the most recent full 6 months before the survey according to bin cards, if available, or to a key informant if not. Note source information.
7. Record the total number of days the product was stocked out during the most recent full 6 months before the survey.
8. Record the quantity of product dispensed to users or issued from the primary storeroom during the most recent 6 months before the survey
9. Record the number of months the issued data represents (may be less than 6); record the months for which there is any data recorded, including 0.
10. Record the quantity of usable product in the storeroom. (Usable = ready for distribution and not expired)
11. Record the quantity of usable product in the mini store. (Usable = ready for distribution and not expired)

12. Record the quantity of expired products. Count all expired products on the day of the visit. If there are products that are near expiry (within one week), note in the comments section
13. Quantity of expired products observed in latest six month
14. Quantified quantity of laboratory commodities per line of items for the budget year
15. Quantity of received quantity from the start of budget year to date.
16. List of products requested by Internal Facility Report and Resupply (IFRR)
17. List of products requested by Report and Resupply Form (RRF)

SN	LIST OF LABORATORY REAGENTS & CHEMICALS	Unit	Bin Card available (1)	Bin card updated (2)	SOH from Bin card (3)	Min-Max set (Y/N) (4)	Stock out most recent 6 months (Y/N) (5)	Number of stock outs (6)	Total number of days (7)	Total issued (most recent 6 months(8)	Number of months of data available (9)	Physical inventory Ministore (10)	Physical inv-Testing unit (11)	Stock out today? (Y/N (12)	Quantity of expired products (13)	Qty of quantified product(14)	Qty received (15)	IFRR (16)	RRF (17)
	1. CHEMICALS																		
1	Giemsa Stain - 0.76% - Solution	1L	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
2	Carbol Fuchsin (Basic Fuchsin)	1L	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
3	Acid Alcohol 3%/Hydro Chloric Acid/ Ethanol	1L	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
4	Methlylene Blue Powder	1L	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
5	Crystal violet stain/ Gentian violet or methyl violet	1L	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
6	Lugol's iodine /Gram's Iodine - 0.33% - Solution	500 ml	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
7	Acetone–alcohol decolorizer	1L	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
8	Neutral red, 1 g/l (0.1% w/v) Safranin - 0.25% - Solution	1L	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
9	Potassium Hydroxide 10% Solution	1L	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
10	Wright Stain - 0.30% - Solution	1L	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
11	0.9% Sodium Chloride/N.Saline	1/2L																	
	2.CLINICAL CHEMISTRY		Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
1	ALT/SGPT	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
2	Albumin Liqucolor	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
3	Alfa Amylase	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
4	Alkaline Phosphatase (ALP)	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
5	AST/ SGOT	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
6	Bilirubin Direct(BILD)	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
7	Bilirubin Total (BILT)	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
8	BUN (Urea)	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
9	Cholesterol Total	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
10	Creatinine	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
11	Glucose Enzymatic Colorimetric	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N

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12	LDL-C	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
13	HDL-C	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
14	Triglyceride (TG)	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
15	Uric Acid	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
16	Sodium +Potassium + Chloride	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
17	Urine Dipstick 10 Parameters	Pack	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
	3. HEMATOLOGY/IMMUNO																		
1	Diluent	20L	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
2	LBA Lyse	4L	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
3	LEO (I) Lyse	4L	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
4	LEO (II) Lyse	1L	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
5	LH Lyse	3L	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
6	Probe cleanser	50ml	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
7	Cell Pack	20L	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
8	Stromatolyser, 3x500ml	Pack	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
9	ESR- Wetergreen Tube-	Each	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
10	Prothrombin Time	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
11	Partial Thromboplastin Time	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
13	Coombs test	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
14	FACS Presto or CD3/4/8/45 Multi t	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
15	Bleeding Time	Pcs	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
16	Coagulation Time	Pcs	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
	4. SEROLOGY		Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
1	Pregnancy Test Strip	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
2	Anti-A, Anti-B, Anti-D Monoclonal Antibody	3Vials	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
3	H. Pylori Ag	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
4	Hepatitis BsAg Test	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
5	Hepatitis C Antibody Test	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
6	Widal	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N

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	Weil-felix reagent	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
7	RPR/VDRL	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
9	ANA(SLE)	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
10	C-reactive protein	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
11	TPHA	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
12	ASO	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
13	RF	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
	MICROBIOLOGY		Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
1	Blood agar	Tin	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
2	Chocolate agar	Tin	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
3	*Cooked meat medium/ thioglycollate broth*	Tin	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
4	Cystine lactose electrolyte deficient agar (CLED)	Tin	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
5	MacConkey agar	Tin	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
6	Thioglycollate broth	Tin	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
7	Xylose lysine deoxycholate (XLD)	Tin	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
8	Sensitivity Antibiotic Discs	Each	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
9	Indian Ink	Tube	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
10	GenXpert – MTB/RIF	kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
6	Urine cup	Pack	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
7	Sputum cup	pack	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
	HORMONAL ASSAY																		
1	FT3 Gen.2	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
2	T3	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
3	T4	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
4	TSH	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
5	Troponin T hs	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
6	Cortisol	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
7	Estaradiol	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N

SN	LIST OF LABORATORY REAGENTS & CHEMICALS	Unit	Bin Card available (1)	Bin card updated (2)	SOH from Bin card (3)	Min-Max set (Y/N) (4)	Stock out most recent 6 months (Y/N) (5)	Number of stock outs (6)	Total number of days (7)	Total issued (most recent 6 months(8)	Number of months of data available (9)	Physical inventory Ministore (10)	Physical inv-Testing unit (11)	Stock out today? (Y/N (12)	Quantity of expired products (13)	Qty of quantified product(14)	Qty received (15)	IFRR (16)	RRF (17)
8	FSH	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
9	HCG + *beta* II	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
10	LH	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
11	Progesterone	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
12	Prolactin	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
13	CA 125	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
14	Ck- MB	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
15	FT4	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
16	FPSA	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
17	TESTO	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
18	FERRITIN	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
19	CA15-3	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
20	CEA	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
21	PSA	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
22	D- Dimer	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
23	COMPLEMENT C3	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
24	COMPLEMENT C4	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
25	GENTAMYCINE	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
26	VANCOMYCINE	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N
27	cyclosphorine	Kit	Y / N	Y/ N		Y / N	Y / N							Y/N				Y/N	Y/N