Supply Chain Management Performance of laboratory commodities in Selected Public health Facilities of Two Selected Oromia Zones, Ethiopia

By:
Wondwosen G/Medhin(B.pharm)

A thesis submitted to Jimma University Institute of Health Department of Pharmacy for Partial Fulfillment of the Requirements for Masters of Science in pharmaceutical supply chain management

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Abstract

Background: - The purpose of a laboratory logistics system is to obtain and move commodities in a timely fashion to the places where they are needed at a reasonable cost with acceptable quality .Likewise, well-functioning supply chains will enhance the availability of the commodities required to provide necessary laboratory services. In Ethiopia pharmaceuticals including laboratory commodity supply chain management system reported challenges on availability, affordability, storage and stock management and irrational use. Moreover, increased demand for the laboratory services has prompted the need to have an uninterrupted supply of laboratory commodities.

Objective: - To assess the Supply Chain Management of laboratory commodities in Selected Public Health Facilities of Illu Aba Bora and Buno Bedelle zones.

Methods:- A facility based descriptive cross sectional survey design at public health facilities of Illu Aba Bora and Buno Bedelle zones was conducted using both quantitative and qualitative data collection techniques which was adapted and customized to local situation from LIAT, LSAT and ATLAS. A stratified random sampling method was used to create different strata for both of the zones separately according to the type of facility. A total of 28 public facilities involving in supply chain of laboratory commodities (LCs) were selected from all stratums by simple random sampling method except for hospitals in which all were taken by default. Data obtained through structured questionnaires were entered and analyzed using the Statistical Package for Social Sciences version 20 (SPSS). Results from the in-depth interview were analyzed thematically and used for data triangulation.

Result: -A total of 28 public health facilities were involved in this survey. Of these 3 (10.7%) were hospitals and 25(89.3%) health centers (HCs). Ten (35.7%) of health facilities have developed their own essential list of laboratory commodity (ELLC).Only half of them limited to ELLC in conducting procurement. The mean number of test menus not offered at the day of visit was 4.8 (26.7%) and 3(10.7%) for HCs and Hospitals, respectively. For the sampled LCs assessed in the main pharmacy store, hospitals (53.4%) did better updating bin cards than HCs (16.9 %).The accuracy of bin cards was better for hospitals (37.3 %) than HCs (11.6%). The percentage of LCs stocked out on the day of visit was as high as 35.6 and 18.7 in HCs and Hospitals respectively. Overall better average availability at the day of visit was found in hospitals (81.3%) than HCs (50.6%). Laboratory commodities with a total value of 389,118 Birr were expired within the past one year. About 70.7% of the total value of wastage was attributed to program LCs

Conclusion: - From this study it can be concluded that low availability and high stock out rate, number of test menus not offered to clients, poor accuracy in record keeping and high wastage rate of LCs, are an indicators of weak status of supply chain management of LCs.

Recommendation: -Health facilities should prepare and utilize ELLC, DTC must be established and be functional in all health facilities and facilities should work to reduce the wastage level of LCs, health facilities must capture valid logistic data on LCs both at store and laboratory to improve the quantification of these commodities.

Key words: -Laboratory commodities, RDF, program LCs, supply chain management, essential laboratory commodity list, Test menus

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Abbreviations

AIDS	Acquired Immunodeficiency Syndrome
ART	Antiretroviral Therapy
ATLAS	Assessment Tool for Laboratory Services and Supply Chains
CD	Cluster of Differentiation
DTC	Drug and Therapeutics Committee
EDL	Essential drug list
EHNRI	Ethiopian health and nutrition research institute
ELLC	Essential List of laboratory commodity
FEFO	First expire first out
GS	Gram's stain reagent
HCs	Health centers
HIV	Human Immunodeficiency Virus
IFRR	Internal Facility Report and Resupply
IPLS	Integrated pharmaceutical logistics system
KI	key Informant
LCM	Laboratory commodity management
LCs	Laboratory commodities
LIAT	Logistic Indicators Assessment Tool
LMIS	Logistics Management Information System
LSAT	Logistic System Assessment Tool
OJT	On job training
PFSA	Pharmaceutical Fund and Supply Agency
PI	Principal investigator
PLMP	National Pharmaceutical Logistics Master Plan
RDF	Revolving drug fund
RDF LCs	Revolved Drug Fund laboratory commodities
RRF	Report and Requisition
SCM	Supply chain management
SCMS	Supply chain management system
SOPs	Standard operating procedures
TB	Tuberculosis
ZHD	Zonal health department

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1. Introduction

1.1. Background

Health is an important indicator of the status of development of a society and country [1]. Laboratory services are essential components of the health care system [2].This is due to the fact that, Laboratory services support clinical practice by screening for different conditions and providing information for differential diagnosis, allowing clinicians to choose appropriate treatment regimens and monitor treatment. Correct diagnoses based on lab tests would prevent incorrect diagnoses and treatment, and the money saved could be used to purchase drugs and treat patients effectively. Monitoring tests enable clinicians to determine whether treatment is efficacious or toxicity is developing, enabling them to take action to protect the patient. However; Laboratory capacity depends on the availability of the required commodities to perform these tests, with most tests requiring multiple commodities to be available simultaneously. As a result, supply chain management in support of laboratory services is a formidable challenge, especially in developing countries [3].

Supply chain management (SCM) is the process of planning, implementing, managing and controlling all activities involved in sourcing, procurement, conversion, and logistics management, with the aim of satisfying the end users as efficiently as possible. SCM hence seeks to improve collaboration among partners. In order to ensure that commodities are available when and where they are needed, a robust and responsive supply chain must be in place [4].

Logistic management as defined by the Council of Supply Chain Management Professionals is "[The] part of supply chain that plans, implements, and controls the efficient and effective forward and reverses flow and storage of goods including services, and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements"[5]. SCM includes the logistics activities plus the coordination and collaboration of staff, levels, and related functions [6, 7].

In other words, we can consider Logistics activities as the operational component of supply chain management, including quantification, procurement, inventory management, transportation and fleet management, and data collection and reporting [7]. These components are in a continuous cycle where all components are interconnected, so decisions made at a single point directly impact other parts of the cycle [8, 9]. The purpose of a laboratory logistics system is to obtain and move

commodities in a timely fashion to the places where they are needed at a reasonable cost with acceptable quality [9].

A good supply chain is customer driven and all logistics functions within the supply chain must work effectively to ensure commodity availability. Logistics information available through the LMIS drives all decisions in the supply chain, and enables managers to operate supply chain functions including forecasting, quantification, and inventory management [10].At the center of the cycle is management support that includes financing, staffing, monitoring and evaluation in addition to information management [11]. Effective and efficient performance of these systems requires a framework of policy, law and regulation that upholds a commitment to the availability of commodities and their appropriate use [12].The logistics cycle provides a guiding framework of the functions needed to manage all health commodities, typically includes a number of activities that supports the six rights - the right goods in the right quantities and in the right condition delivered to the right place at the right time, at the right cost[13, 1].

In any logistics system, commodities must be selected. The purpose of product selection is to select the most effective and cost-efficient commodities to support the goals of the program [13, 3]. Selection process involves establishing and using a list of carefully selected laboratory commodities. Selection is perhaps the single most cost effective action to: Promote regular supply of quality commodities, prevent the wasting of scarce resources on unnecessary or ineffective commodities and Selection helps to decide which laboratory commodities to purchase [14].When commodities are selected, a number of factors need to be taken into consideration, including: Inclusion of the commodity in protocols and standards and the status of registration of the product with local regulatory bodies needs to be considered, Cost and available financing, Storage requirements, such as cold chain, and capacity to maintain the commodities, Skill level of personnel (or training requirements),Ease of use of the commodity, Packaging of the commodities to facilitate distribution, Shelf life, Compatibility with existing instrumentation (durables) and another consideration for laboratory commodities, particularly in the selection of instruments, is whether the instrument is part of a closed or open system. Closed systems are laboratory instruments that require specific brands of reagents, while open systems do not [7, 3].

After products are selected, the quantity required of each product must be determined and procured. Quantification is the process used to determine how much a product is required for the purpose of

procurement. In addition to estimating the quantities needed of products, quantification should estimate the financial requirements to purchase the Products. Quantification must include contextual factors, such as available funds, storage capacity, capacity to deliver services, and human resources .The next step after quantification is procurement which seeks to ensure the availability of the right products in the right quantities, at reasonable prices, and at recognized standards of quality [15].

After a pharmaceutical is selected and procured, storage and distribution follows [14].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[13].As the quality of pharmaceuticals is very dependable on the storage conditions, a pharmaceutical logistics system should include standard inventory management that provides pharmaceuticals to be stored and distributed on the right conditions. The goals of inventory management are to protect stored items from loss, damage, theft, or wastage, and to manage the reliable movement of supplies from source to user in the least expensive way [14].

The appropriate use of laboratory commodities completes the laboratory commodity management cycle. Appropriate Use of Laboratory commodities (LCs) entails: Correct Use of commodities and supplies to perform tests effectively and efficiently, adhering to standard operating procedures (SOPs), technical specifications and instructions, taking into consideration the cost, i.e. selecting a cost: effective test, inclusion Of Laboratory managers in the health facility's Drug and Therapeutics Committee (DTC) to improve appropriate use of lab commodities in the facility [14].

Logistics management information system (LMIS) is the collection, processing and utilization of logistics information for decision-making. It is the motor that drives the logistics cycle. Information has to be gathered and analyzed about each activity in the system to coordinate subsequent actions. Thus there is a need to manage the information system for other activities of the logistics cycle to function properly [15].

Providing equipment and infrastructure without also ensuring a continuous supply of commodities to perform the tests inhibits effective public health responses, decreases the confidence of clients in laboratory services, and discourages laboratory staff. Investing in developing stronger supply chains will be a key strategy to narrow the gap and ensure the continuous availability of these supplies. Experience shows that strengthening the supply chain leads to improvements in other aspects of the health system [11].

There are two most common approaches to pharmaceuticals supply chain assessment: These are comprehensive structural assessment and limited assessment. A comprehensive structural assessment gathers information from all levels the pharmaceutical system. A specific team is responsible for making field visits to offices, warehouses, health facilities and gathers multiple type of information through document review, interviews, data collection from records, and prospective observation. It is more expensive to conduct and require validating data collection instrument prior to the assessment. On the other hand, Limited assessment rely primarily on interviews and document review, with limited field visit and little if any primary from records or prospective observation. The assessment may be done by a small dedicated team or working group from the pharmaceutical system. It normally has a scope of work and should follow a predefined assessment plan [15]. This particular research has employed limited assessment of the pharmaceutical supply chain system on LCs.

One of the main sources of customer/client dissatisfaction in health facilities of Illu Aba Bora and Buno Bedelle zones was inconsistent provision of laboratory testing services (A report from the two Zonal Health Department (ZHD), 2016).In addition, there were no studies done on Assessment of supply chain management of LCs at facility levels in Ethiopia specifically in Illu Aba Bora and Buno Bedelle zones. Therefore, the purpose of this study was to assess the status and challenges in the SCM of LCs in selected public health facilities of Illu Aba bora and Buno Bedelle zones.

1.2. Statement of the problem

Laboratory services are an integral part of clinical decision-making and contribute to various aspects of health services, including the making of diagnostic and therapeutic decisions for patients, as well as disease monitoring and prevention [16]. In addition, increased demand for the laboratory services has prompted the need to have an uninterrupted supply of laboratory commodities. This can only be achieved when Lab commodities are available and managed appropriately to address shortages, stock outs, expiries and wastages [14].

Effective commodity management which includes rational selection, efficient procurement, effective logistics management systems and promoting rational use is important to ensure improved access to and use of quality diagnostics and laboratory supplies[14].Moreover unlike medicine, Laboratory commodity supply chain systems are complex due to the nature of the commodities in use [17].These unique features include: large numbers of commodities are needed for a single test, LCs come in a variety of preparations, including dry powders, liquids, and kits**,** dry laboratory chemicals and consumable liquids are often packaged in bulk, some LCs have short shelf lives, some LCs have special storage requirements and only some LCs are in full supply[13].As a result SCM of LCs in resource-limited settings are often challenging because of: limited resources for procurement; weak tracking and distribution; the existence of parallel systems (central, local and donor); and challenges in forecasting future needs [17].

Weak management of LCs which includes lack of skills in commodity management, inadequate supply of LCs, weak inventory management, poor records and weak information flow systems [2] has been identified as a major gap in ensuring good quality and uninterrupted laboratory testing in many developing countries. Poor management of LCs results in recurrent stock outs of testing reagents, frequent equipment breakdown, and at times, stoppage of laboratory testing services. Under diagnoses and misdiagnosis of infectious diseases including Human Immunodeficiency Virus/ Acquired Immunodeficiency Syndrome (HIV/AIDS) resulting from a lack of laboratory testing with quality LCs, can lead to incorrect prescribing of treatment, wastage of resources, and poor patient clinical management [18]. Moreover, Laboratory and logistics professionals face numerous challenges when managing LCs. Lack of standardization often leads to a wide variety of available systems, each requiring specific reagents and technical

support. Rapid changes in technology can sometimes result in the withdrawal of certain commodities from the market while creating the need for rapid deployment of others [17].

A baseline survey done in kenya indicated that, Very low availability (14%) of key lab commodities at facilities, Poor facility inventory management with only a 50% match between stock records and actual stock and Profusion of expired commodities (32% of surveyed facilities had expired HIV test kits) [19].Assessment of integrated logistics system performance in Tanzania showed that, 35% of laboratories were stock out. Of these, 10% were stock out for rapid HIV test kits. Thirty seven percent of facilities had stock ledger of which 69% were updated. Fifty-eight percent of facilities had stock ledger forms for rapid test kits of which 91% were updated. 16% of facilities had reported stock outs [20].

In Ethiopia pharmaceuticals including laboratory commodity SCM system had several problems like non-availability, un-affordability, poor storage and stock management and irrational use [21]. One of the major causes of the inefficient management of medical equipment, supplies, and laboratory reagents is known to be lack of proper knowledge and skill on the types, uses and unique characteristics of these pharmaceuticals among pharmacy professionals involved in supply management at different levels of the health care system [22]. However, to overcome these problems Pharmaceutical Fund and Supply Agency (PFSA) became established and empowered to reorganization and consolidation of logistics functions (i.e., central procurement, storage, distribution, LMIS, and inventory control) [23,24].In addition, Cognizant of the fact that efficient supply management of LCs avoids shortage and minimizes wastage rate, PFSA gives special attention to the laboratory commodity management in general and quantification processes in particular[25].

However, the Ethiopian laboratory logistics system was still weak, consistently being hampered by several systemic challenges that caused frequent stock outs of critical items, thus impeding continuous and quality testing for patients[23,24].A study conducted in Addis Ababa in the public health facilities(hospitals and health centers) showed that 60.5% and 37.2 % of health facilities were stocked out for at least one ART(Antiretroviral Therapy)) monitoring and TB(Tuberculosis) laboratory diagnostic reagents within six months of time before the assessment and at the time of visit respectively[26].Another study done in Addis Ababa indicated ,only 10(52.6%) of HCs and 2(50%) of hospitals had bin cards for the test kits on the day of visit while

the remaining 9(47.4%) of HCs and 2(50%) of hospital didn't have bin card for test kits[27].Furthermore, the study done in Amhara region indicated that, 15 (18.3%) HCs had no stocks of at least one of the key items (methylene blue (11%), carbol fuchsin (11%), acid alcohol (8.5%) and sputum cups (3.7%)). Of the 82 HCs, 77 (93.9%) did not fulfill the criteria for effective distribution of tuberculosis laboratory reagents and consumables [28].

When basic testing services cannot be provided because LCs are not available, both client confidence and staff motivation are reduced [29].Moreover, Supply chain strengthening is an essential and often overlooked intervention to strengthening overall laboratory services [30]. Efforts to improve Laboratory commodity has been previously mainly limited to key Ministry of health programs (TB, HIV and Malaria) - the rest of the commodities which form about 90% of the bulk, are left to the facilities to procure through facility improvement fund [14].With the increasing demand on the limited resources for public health systems, supply chains must now determine efficient ways to manage a broad range of laboratory products [16].

So far, the studies done in Ethiopia have been limited to the specific component of LCs management cycles which were focused on the management of program based laboratory commodities. Therefore, this study attempt to provide a glance of the current laboratory commodity supply chain management situation and factors affecting it in health facilities in Illu Aba Bora and Buno Bedele Zones , and to provide baseline information to track changes and improvements in laboratory commodity supply chain management over time.

1.3. Significance of the study

This research is designed to assess the supply chain management of laboratory commodities and the factors that lead to poor supply chain management performance in Illu Aba Bora and Buno Bedelle zones public health facilities and proper corrective action measures to strengthen laboratory supply chain system.

The study will also serve as supplement evidence data for future work in the country. Therefore, the assessment will help to describe how well the supply chain management of laboratory commodity is functioning in the public health facilities of Illu Aba Bora and Buno Bedelle zones and identify the strengths and weaknesses of the existing system.

Decision makers and others who have attachment with supply chain management of laboratory commodities can also use the study as a reference and input.

Therefore, whatever the study could provide input for researches and policy makers that would contribute to improve the status of laboratory commodity supply chain management in the country.

2. Literature Review

This section discusses laboratory commodity management studies carried out in different African countries, and looks also at the literatures that guide the study.

2.1. Selection, and Procurement

The selection of LCs should be based on vital, essential, nonessential (VEN) analysis. The list should be developed based on the prevailing health care needs and must address the essential health package of the country. It should be an inclusive and participatory process to come up with a consensus list [18].

Selecting a limited range and type of diagnostic commodity can lead to better availability, better staff knowledge, more appropriate use and lower costs. As with pharmaceutical selection, sensible commodity and equipment selection is one of the most effective ways to save costs as it has both clinical and economic implications [11]. Lack of laboratory lists usually leads to uncontrolled proliferation of diagnostics and technologies in the country. An assessment of Angola laboratory supply chain system ,showed the absence of a list of standard laboratory reagents and equipment, as a result, existing laboratory equipment, reagents and supplies do not fully address the country's health care needs[18].On the other hand, assessment done in Zambia showed that, by selecting a smaller, more manageable number of commodities, the country was able to focus on making the standard list of commodities available through the quantification, procurement, and resource mobilization process which enables rational decision making in product selection, forecasting, quantification, and procurement [30].

Quantification is the process of estimating the quantity and cost of the products required for a specific health program (or service), and, to ensure an uninterrupted supply for the program, determining when the products should be procured and distributed [31]. The procurement process involves quantifying, ordering, and purchasing of laboratory supplies and equipment. Good procurement practices depend on reliable, accurate quantification of needs, transparent supplier selection, and bidding or contract management [18]. A number of data types can be used to conduct quantification: consumption, services, demographic, or morbidity data [21]. Both stock outs and expired items occur because of poor monitoring of quantification nationally and at the facility level. An assessment conducted in Angola showed that, Quantification is still fragmented; each program doing its own quantification based on available funds. There is no

system yet to quantify laboratory supplies based on what is consumed in the country that contributes to recurrent stock outs of critical reagents and other supplies. Laboratory personnel are not really involved in the quantification and other procurement processes, and do not have skills to effectively manage LCs [18]. In depth assessment of supply management system in Tanzania, found that factors such as error in forecasting leads to both un-availability and expiry of health products at facility level [32]. A study done in Malawi indicated that ,lack of stock data collection for general laboratory products, so the quantification of needs does not consider stocks currently held in the pipeline, actual consumption or issues, or anticipated losses. Moreover, the finding from key informants is that the reported information on tests performed is not accurate or complete; therefore, the quantification process is based on poor data of limited use in doing quantification [33].

2.2. Inventory management

After an item has been procured and received by the health system or program, it must be transported to the service delivery level where the client will receive the products. During this process, the products must be stored until they are sent to the next lower level, or until the customer needs them [31].

An inventory control system informs the storekeeper: when to order or issue, how much to order or issue, how to maintain an appropriate stock level of all products to avoid shortages and oversupply. The continuous supply of LCs can be guaranteed only through the selection, design, and proper implementation of an appropriate inventory control system [13]. A study done in Malawi indicated that, there is no standard inventory control system (established maximum or minimum stock) in place for managing laboratory commodities at any of the facilities, 70% and 40% of the surveyed hospitals and health centers (HCs) respectively had stock/bin cards for laboratory commodities in pharmacy store, however, majority of them were not kept up-to-date. No stock/bin cards were used in the laboratory store room [33].Similarly, a baseline survey of laboratory systems done in Kenya revealed that, Poor facility inventory management with only a 50% match between stock records and actual stock. Less than half facilities have reporting tools or job aids, Inadequate skills in lab commodity management among laboratory staff ,no informed decision making on laboratory commodity management[19].Yet another study done in Lesotho, showed that thirteen (67%) and 16 (83%) of laboratories didn’t set minimum and maximum

stock levels respectively. Thirteen (67%) of laboratories had no stock/bin cards to track laboratory commodities [34]. A study in Ghana showed that, there was no minimum /maximum stock levels for laboratory supplies, laboratories didn't maintain stock cards, laboratory staffs weren't regularly aware of the stock status in the stores due to minimal communication between the storekeeper and the laboratory staff. Moreover, there was no standard ordering schedule and procedures in the system [35].

Proper storage procedures help ensure that storage facilities issue only high-quality commodities and that little or no loss is caused by damaged or expired products [12]. Good management of storage and inventory involves monitoring expiration dates, inventory levels, unexplained losses (leakages), and storage conditions, which are particularly critical for test kits and diagnostic reagents [13].According to a study conducted in Lesotho to see the status of laboratory capacity to support the scale-up of ART showed that, Storage spaces were inadequate and poorly ventilated. Thirty three percent of laboratories reported that, reagents were not stored according to the first expiring first out (FEFO) practice. None of the laboratories practiced the separation of damaged/or expired supplies from usable products and storage spaces were small [34].Similarly Laboratory Services and Supply Chain Assessment done in Malawi indicated that, only Half (50%) of the storage facilities were in compliance with proper storage guide lines, separate storage of hazardous reagents and absence of written storage guide lines were the two weakest storage conditions found [33].Similarly, an assessment of Angola laboratory supply chain system showed that, *S*torage of laboratory supplies is still a major challenge at all levels of the supply chain. Central warehouses and provincial warehouses do not have cold-chain storage capacity. Laboratories generally do not have storerooms. Distribution of laboratory supplies is still a challenge because of lack of inventory in the laboratory system [18]. Yet another study done in Kenya showed that, Distribution of laboratory commodities follows a push system, no sharing of laboratory system information among stakeholders and Profusion of expired commodities (32%) of surveyed facilities had expired HIV test kits) [19]. In depth assessment of supply management system in Tanzania found that factors such as non-adherence to FEFO leads to both un-availability and expiry of health products at facility level [32].

2.3. Logistic Management Information system

Logistics management information system is the collection, processing and utilization of logistics information for decision-making [21]. It is the motor that drives the logistics cycle. A complete LMIS comprises three types of records (stock keeping records, transaction records, and consumption records) that collect the three essential logistics data items (stock on hand, losses and adjustments, and dispensed-to-user data) and the reports that move that data to the personnel who make logistics decisions [33]. A well-functioning LMIS should collect and report key information needed for forecasting commodity needs and making rational decisions on financing, procurement, scheduling of shipments, and routine ordering without burdening service providers [31]. An assessment conducted in Lesotho showed that, there were no developed LMIS guide lines on how to determine orders and few laboratory staffs were trained in LMIS. Similar study conducted in Malawi concluded that Little to no logistics data on laboratory supplies is routinely reported or used for important logistics decisions (e.g., determining order or procurement quantity, forecasting, or monitoring system performance)[33].

2.4. Availability of LCs

The most important outcome of a logistics system is stock availability at the health facility. Well-supplied health programs can provide superior service, while poorly supplied programs cannot. Customers feel more confident about the health program when they have a constant supply of commodities. Likewise, well-supplied health workers can use their training and expertise fully, directly improving the quality of care for clients [31].Stock outs demonstrate one outcome of a poorly functioning logistics system [36].A study done in Malawi indicated that ,28 % and 60% of facilities were stocked out for CD4 and glutamate oxaloacetate transaminase (GOT) reagents respectively. Twenty-two percent and 18% of health centers were stock out for determine and uni-gold test kits respectively on the day of visit. Similarly, 15%, 8%, 18% and 8% of hospitals and 5% of HCs were stock out for carbol fuchsin, methylene blue, acid alcohol and oil immersion on the day of visit respectively [33].

Yet another study done in Angola revealed that, inadequate skills, lack of proper tools, and poor infrastructure hamper effective management of commodities in laboratories resulting into recurrent stock outs of testing reagents, equipment breaking down frequently and for long periods and in some instances stoppage of critical laboratory testing services[18]. A study done

in Nigeria found Reasons for the stock outs as given by participants include non-supply of quantity requested for/inadequate supply, occasional upsurge in consumption, supply of near expiration laboratory commodities, delay in resupply of laboratory commodities (increased lead time), and lack of power supply, hence commodities were transferred to other facilities to prevent deterioration[37]. A health facility survey conducted in Uganda showed that, many laboratories experienced frequent stock outs and delay of key commodities, such as HIV rapid test kits and chemistry reagent. The author concludes, supply chain deficiencies such as lack of standardized LMIS forms and lack of trained staff in LMIS affected the availability and the quality of laboratory services in the country [38].

In depth assessment of supply management system in Tanzania showed that ,of the twenty tracer items about 50% were out of stock for a period ranging from 1-120 days, Also 78% of the respondents affirm that very minimal initiatives are in place to provide continuous training on supply chain activities to Health facility staffs, the study has also found that factors such as error in forecasting and non- adherence to FEFO lead to both un-availability and expiry of health products at facility level. These along with other factors such as receiving supplies excess of order, or with short expiry dates or supplies not based on what was demanded are contributed to stock out of lab products [32].

2.5. Management Support

Availability of motivated, adequately trained, and capable staff responsible for every element of the commodity management cycle is critical for successful implementation of activities for each element of the logistic cycle [31].Lack of the ability to measure performance creates weak incentives for public sector staff engaged in supply chain aspects, as the ability to measure their output is extremely limited unlike their counterparts in service delivery who focus on treating patients [39]. A study done in Angola revealed that Human resources are a major challenge, in both staff numbers and their skill levels [27].

Supervision, an important element of quality assurance for the performance of any logistics system, is related to all aspects of logistics management. Monitoring and supervision of the laboratory supply chain system have to be implemented using standard tools including checklists and forms [18]. It helps to improve individual and system performance and can alert managers to potential problems such as stock outs, under stocks and overstocks, poor storage conditions, and

products near their expiry dates [36]. A study done in Ghana indicated, supervision of laboratory logistic is weak, irregular and does not include review of logistics responsibilities such as records and reports, physical inventory and inventory management [35].

2.6. Wastage of laboratory commodities

Wastage caused by irrational use, weak accountability, inefficient procurement and distribution, inappropriate handling, poor inventory control, and inadequate oversight can be alleviated by formal and regular consultation between management and health professionals in a given health service setting. One of the mechanisms for such consultation and oversight is the DTC [40].

If the laboratory LMIS is not functioning well, service delivery points will be forced to experience either stock outs or excess stocks finally leading to dissatisfaction of clients or wastage of commodities [41].A study done in Nigeria indicated that High amount of laboratory commodities were expired due to poor implementation of LMIS, especially supply of commodities that are close to expiration and failure to follow the principle of FEFO. Expiration of commodities was also caused by lack of an efficient mechanism for the redistribution of surplus commodities from facilities that have large quantities to those under stocked or out of stock of such commodities [37].

2.7. Laboratory supply chain management in Ethiopia

In 2009 Ministry of Health launched National Pharmaceutical Logistics Master Plan (PLMP) for all health products, including laboratory commodities [25].The aim of PLMP was ensuring the uninterrupted supply of essential, quality and cost-effective pharmaceuticals at all health facilities [42]. To achieve this, the Pharmaceutical Fund and Supply Agency (PFSA) was established with mandates: to supply the entire country with both Program and Essential pharmaceuticals, as well as serve as the distribution entity for vaccines, other health facility supplies, and laboratory equipment [43]. So as to execute its mandate in the area of pharmaceuticals supply in an efficient and effective manner, PFSA developed the (Integrated Pharmaceutical Logistics System) IPLS that integrates the drug requisition, distribution, and reporting of essential pharmaceuticals that used to be managed vertically into a single mechanism [42]. For the success of one of its goals, PFSA in close collaboration with stakeholders has been exerting tremendous effort to build the capacity of health professionals to improve the supply management of laboratory commodities. With the introduction of IPLS,

various recording and reporting formats were designed for use at different levels of the healthcare supply chain. Availability and usage of standard forms and tools are critical supply chain indicators. At the facility level, bin cards, stock cards, Internal Facility Report and Resupply Form (IFRR), and Report and Requisition Form (RRF) were introduced to record commodity transactions and report quantities for resupply [44].The implementation of IPLS and DTC, which would strengthen the recording and reporting system for laboratory commodities at all levels of the system, contributed to improved availability of LCs [25].

The collaboration of the Supply chain management system (SCMS) and Ethiopian health and nutrition research institute (EHNRI) designed and implemented an effective national logistic system for LCs. To ensure long-term sustainability, SCMS works very closely with PFSA in partnership with university partners are supporting EHNRI in establishing an inventory control mechanism for LCs. A case study conducted on Impact of the Ethiopian National Laboratory Logistics System on the Harmonization of LCs claimed that, the standardized logistics system was set up as a means of eliminating the logistics challenges that existed prior to its design. Since then, no stock outs have occurred for ART laboratory monitoring tests and emergency orders have dropped dramatically. Commodity wastage is also decreased. Laboratory reagents and related supplies are arriving on time in the quantities needed. Patient wait time for tests has been reduced significantly, from two to three months to within hours [24].

In contrast; a cross-sectional descriptive study to assess the status of laboratory LMIS used for managing HIV/AIDS and TB LCs at selected public health facilities, in Addis Ababa showed that, 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 (direct and total bilirubin reagents). Sixteen facilities (37.2%) had stock outs at the time of visit for at least one ART monitoring and TB laboratory commodity. Expired ART monitoring LCs were found in 25 (73.5%) of facilities [26].Yet another study conducted on the assessment of laboratory inventory management practice at Tikur Anbessa specialized Hospital laboratory and medical store, Addis Ababa, showed that overall stock out of LCs on the day of the study was 44 (37.0%). These stock outs included Serology 27 (84.4%), Clinical Chemistry 13 (28.9%), and Hematology 3 (20%), and Urine analysis 1 (33.3%). Some of the reasons mentioned by respondents for stock out included weak selection, quantification, procurement and in adequate stock control and

management, delay in the purchasing procedure; weak/unknown consumption data; absence in the supply agency PFSA to avail needed LCs; shortage of budget; unpredicted services demand or increased patient flow; and short expiry[45].

Assessment of supply chain management of HIV/AIDS related commodities in selected public hospitals and health centers in Addis Ababa revealed that the stock status of test kits on the day of visit was only 7(36.8%) of the HCs were optimum, while the rest of them were encounter stock out of one or more selected test kits. Whereas, all of the hospitals were stock out one or more test kits on the day of visit and only 10(52.6%) of HCs and 2(50%) of hospitals had bincard for the selected test kits on the day of visit [27].National Survey of the IPLS done in 2015 revealed that, availability and utilization of the LMIS formats necessary for recoding and reporting purposes were found to be reasonable; but, discrepancies were observed by level of facility and product types. Moreover, data quality is an issue in a considerable percentage of facilities. Regarding stock status across products most facilities are not stocked according to the recommended two to four months of stock. For almost all products assessed, overstocking was higher than under stocking, which might lead to stock being wasted or expire [44].

2.8. Conceptual framework

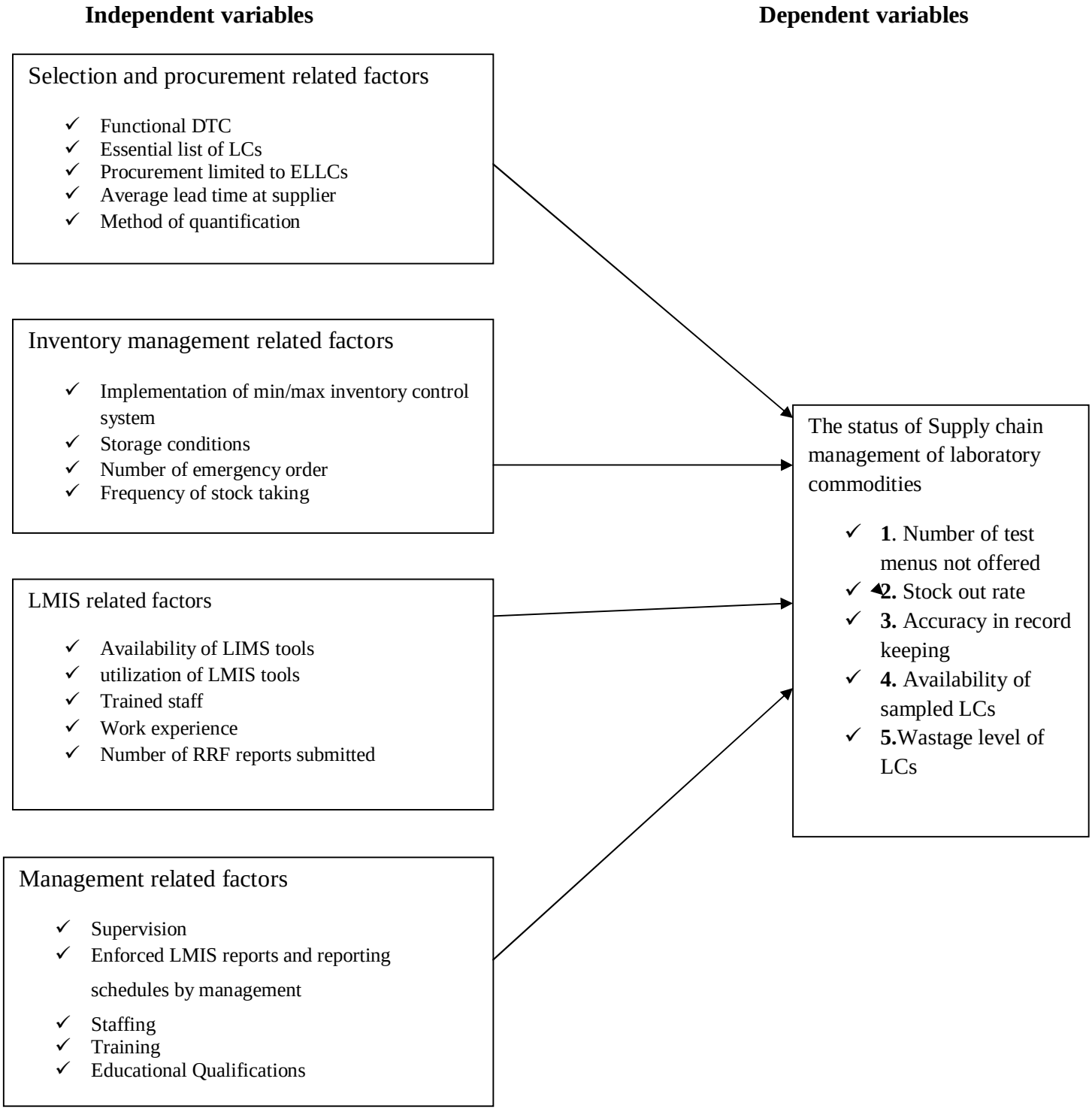


Figure 1: Conceptual framework developed after reviewing different literatures

3. Objectives

3.1. General Objective

- ✓ To assess the Supply Chain Management of laboratory commodities in Selected Public Health Facilities of Illu Aba Bora and Buno Bedelle zones.

3.2. Specific objectives

- ✓ To assess selection, and procurement of LCs
- ✓ To assess inventory management and storage conditions of LCs
- ✓ To identify the logistics management information system implementation status for LCs
- ✓ To assess availability of key LCs
- ✓ To assess the wastage level of LCs
- ✓ To explore the challenges in the supply chain management of LCs

4. Methods and Materials

4.1. Study setting

The study was conducted in selected public health facilities of Illu Aba Bora and Buno Bedelle zones, Ethiopia. These two zones are among 20 zones of Oromia Regional state. Illu Aba Bora zone administratively divided into 16 districts and 1 town administration, Mettu is the capital of the zone found 541 km from Addis Ababa. Likewise, Buno Bedelle zone divided into 9 districts and 1 town administration, Bedelle is the capital of the zone found 425 km from Addis Ababa. According to the 2017 population projection by Central statistical agency Illu Aba Bora and BunoBedelle zones comprised a total population 956,328 and 719,623 respectively. There are 43 HCs and 2 hospitals, and 26 HCs and 1 hospital in Illu Aba Bora and Buno Bedelle zone respectively.

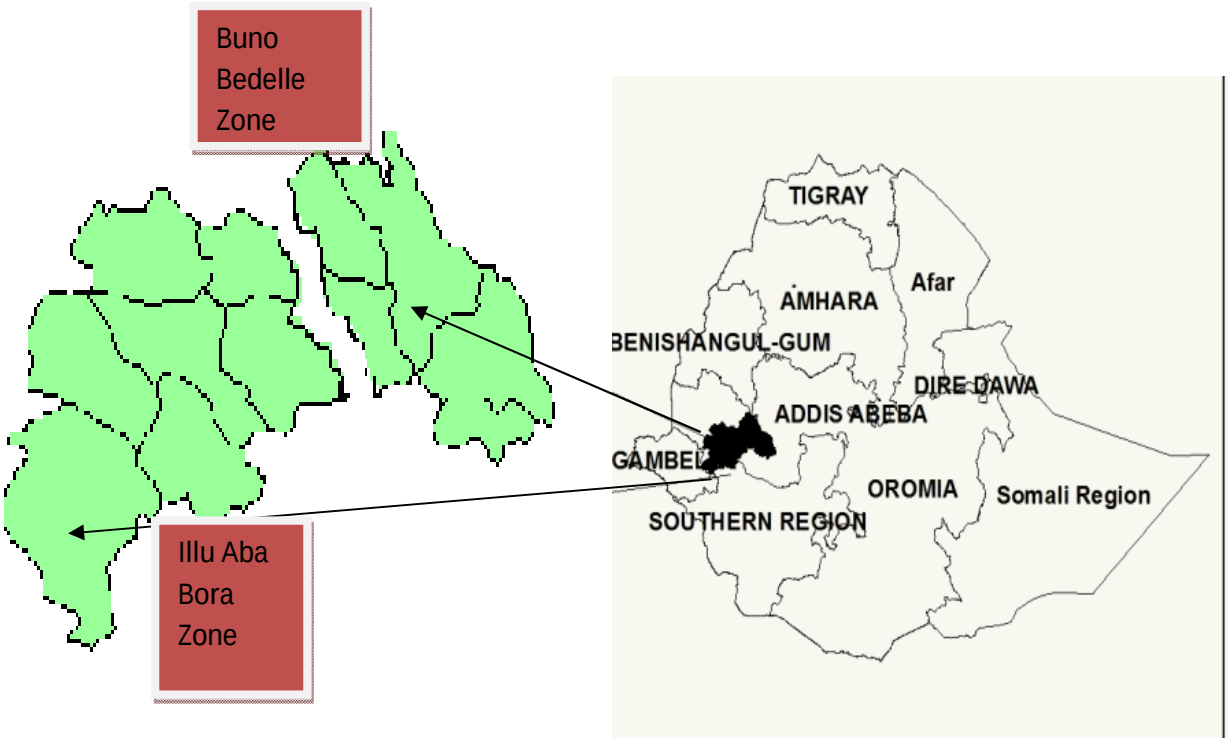


Figure 2. The map showing the location of the study area in Illu Aba Bora and Buno Bedelle zones of Oromia Region, Western Ethiopia, May 2017

4.2. Study period

The study was conducted from April 15-May 15/2017on the supply chain management of LCs.

4.3 .Study design

The study employed a facility based descriptive cross sectional survey design and used both quantitative and qualitative data collection techniques to gather the required information.

4.4 .Population

4.4.1. Source population

The source population was all the facilities providing basic laboratory services such as diagnosis, monitoring and treatment and store and distribute LCs. These facilities were all hospitals, all health centers, all zonal health departments (ZHDs) and PFSA Jimma hub and all pharmacy, laboratory personnel and other health professionals involved in supply chain management of LCs.

4.4.2. Study population

Two hospitals and 15 HCs and 1 hospital and 10 HCs were the sample facilities included in this study from Illu Abora and Buno Bedelle Zones respectively. Pharmacy department heads, store managers, laboratory heads at respective facilities, logistic officers at ZHD and forecasting and capacity building officer, storage and distribution officer, laboratory technology officer and warehouse manager at PFSA Jimma Hub were interviewed. Twenty five sampled LCs were selected for the assessment, bin cards, stock cards, RRF reports, IFRR reports, essentials list of commodities, quantification documents, minutes of DTC meeting, disposal documents, government receiving and issue documents and service register books at laboratory were reviewed.

4.4.3. Inclusion and exclusion criteria

4.4.3.1. Inclusion criteria

All public health facilities that provide basic laboratory service, and store and distribute LCs to other health facilities were included in the study. All documents relevant for the study retained for 3 moth-1 year prior to the data collection were reviewed .All pharmacy heads, store managers and laboratory heads in the selected facilities involved in laboratory commodity management were included in the study.

4.4.3.2. Exclusion criteria

Those facilities that started providing service recently (less than 3 month) at the time of data collection .Those healthcare personnel who were unwilling to participate and those who were on leave during the study. Pharmacy and laboratory heads appointed as heads less than 2 weeks period at the time of data collection.

4.5 .Sample size and sampling procedures

4. 5.1. Sample Size

4.5.1.1. For quantitative part

The sample size was determined according to the guide to conducting Supply Chain Assessments Using the Logistic System Assessment Tool (LSAT) and Logistic Indicators Assessment Tool (LIAT). For generating representative samples for a LIAT survey, a margin of error at or below 20 percent and a confidence level at or above 90%, the margin of error and confidence level may be relaxed to allow for an attainable sample size [46];

Therefore, by choosing at 10% margin of error and 95 % confidence level and assuming that 50% of the facilities are with poorly functioning laboratory commodity supply chain management due to lack of similar study in Ethiopia, sample size was calculated as follows:

The general formula for calculating a sample size is:

$n = z^2 * p(1-p)/d^2$

Where:

n = required sample size

z = the value of the confidence level of 95% = 1.96

p = 0.5. Estimated prevalence of the indicator, therefore, when implementation status is unknown, 0.5 will be used

d = margin of error (at 10% m = 0.1)

Therefore: - $n = 1.96^2 * 0.5(1- 0.5)/0.01$

$n = 3.842 * 0.25/0.01$

$n = 96$

However, where there is a predetermined population (e.g., total number of facilities in the region and zone), the sample size generated from the above equation needs to be multiplied by the Finite Population Correction (FPC) factor. For that purposes, the formula can be expressed as:

New n = n/1+ [(n-1)/N]

Where:

New n = the adjusted new sample size

N = the population size (40)

n = the sample size obtained from the general formula (96)

New n = 96/1 + [(96 – 1)/40

New n = 96/3.38

New n = 28.44 ≈28 facilities

4.5.1.2. For qualitative part

Purposive sampling was used to select 12 key informants for in depth interview from PFSA Jimma Hub, ZHD and from sampled public health facilities for the quantitative part.

4.5.2. Sampling procedure

A total of 24 and 16 public facilities in Illu Aba Bora and Buno Bedelle zones respectively, involving in supply chain of LCs were listed. Different strata were created according to the type of facility for each zone separately. However; based on the above calculation the adjusted sample size is 28 public facilities. All hospitals were taken by default. Then HCs were selected from each stratum using proportionate to size stratified sampling technique. Therefore, 2 hospitals, 15 HCs and 1 hospital and 10 HCs were the sample population included in this study from Illu Aba Bora and Buno Bedelle Zones respectively. All pharmacy heads, store managers and laboratory heads were part of the assessment.

4.6 .Study variables

4.6.1. Dependent variables

- ✓ 1.Number of test menus not offered
- ✓ 2.Stock out rate
- ✓ 3.Accuracy in record keeping
- ✓ 4.Availability of sampled LCs

- ✓ 5.Wastage level of LCs

4.6.2. Independent variables

- ✓ Functional DTC
- ✓ Essential list of LCs
- ✓ Procurement limited to ELLCs
- ✓ Average lead time at supplier
- ✓ Method of quantification
- ✓ Number of emergency order
- ✓ Storage conditions
- ✓ Implementation of min/max inventory control system
- ✓ Availability of LMIS tools
- ✓ utilization of LMIS tools
- ✓ Number of RRF reports submitted
- ✓ Training
- ✓ Educational Qualifications
- ✓ Work experience
- ✓ Frequency of stock taking
- ✓ Supervision
- ✓ Enforced LMIS reports and reporting schedules by management
- ✓ Staffing

4.7. Data collection

4.7.1. Data collection instrument

The Assessment Tool for Laboratory Services and Supply Chains (ATLAS), developed by the USAID | DELIVER PROJECT, was used as data collection tool for assessing laboratory supply chains. The ATLAS provides a comprehensive overview of how laboratory commodities supply chain and the structures that support its function, particularly at the facility level [47].ATLAS and LIAT data collection tools were adapted to gather the required information together with self-developed questionnaires by principal investigator (PI). There was also review of stock keeping records, receiving and issue documents and observation of physical inventory of laboratory commodities available at the time of visit to the facilities. Data was collected by

observation, physical inventory, and assessment of facility records in addition to semi structured interviews.

A qualitative data collection tool named LSAT which is originally developed by USAID/DELIVER was customized to local situation was used as interview guide for KIs interviews with persons responsible for managing laboratory commodities at the study facilities, ZHD and PFSA Jimma hub. A digital voice recorder was used to record the in-depth interviews.

4.7.2. Data collectors

Two data collectors who are pharmacist in profession were selected and trained for one day on the data collection tool and observation checklists on how to collect and review documents. The data collectors mainly involved in the collection of quantitative data. In depth interview for the qualitative data was collected primarily by PI for the richness and analysis purpose. PI was involved in monitoring and supervision, follow up and overall coordination of data collection process.

4.8. Data processing and analysis

The quantitative data was entered and analyzed using the Statistical Package for the Social Sciences version 20 (SPSS). Descriptive statistics was computed and results were presented using tables and graphs. Spearman correlation was computed to see the existence, direction and strength of association between and within dependent and independent variables.

For the qualitative part, data was analyzed using a thematic analysis approach. The records were listened several times and transcribed from the voice recorder. The findings were grouped according to key themes; and positions that emerged under each key theme were identified and summarized after assessing the position held by participants. Finally, the verbatim phrases that represent each position were pulled out and the findings are presented by narration.

4.9 .Ethical considerations

Ethical clearance was obtained from ethical review board of Jimma University and Letter of cooperation and support from Illu Aba Bora and Buno Bedelle zones .The data collection was started after the facilities approval of the official letter. Participants of the study were asked for consent before participating in the study. There was a high degree of confidentiality during data collection and no name of any health facility and participating personnel mentioned

in the result rather the aggregate result of the facilities was reported**.** With regard to the qualitative study part, interviews were recorded on digital voice recorder after interviewees gave informed consent and summary results of in-depth interview were reported.

4.10. Data quality assurance

The data collection tool was tested on 2 (5%) facilities with similar service level which were not part of the study having similar service level prior to the data collection to insure the validity of the survey tools. The PI discussed with the data collectors on regular basis and reviewed the collected data for completeness. The collected data was summarized on daily basis. Interviews responses were confirmed by looking to what was really on the ground at the health facilities where it can be applicable.

4.11. Operational definitions

Availability: laboratory commodity is said to be available if either available in a store or laboratory room which is equal to or above average daily consumption for each commodity on the day of visit.

Bin card utilization by the facility-Bin card is said to be utilized by the facility if bin card was opened at least for 20 % sampled LCs (laboratory and store).

Days out of stock: for LCs without bin cards/ without updated bin cards, was assessed from the date last time the commodity was issued (model 22) and from the date the commodity received for the first time (model 19).

Functional DTC: DTC was considered as functional if members were assigned by letter, prepared ELLC, had its own minutes and conducted at least 2 meetings (with minute's reference) during the past year.

Laboratory commodity: are laboratory reagents, chemicals and laboratory supplies both program and non-program origin to be utilized for basic laboratory service. It does not incorporate laboratory equipment.

Laboratory commodity essential list: Are list of laboratory reagents, chemicals and laboratory supplies prepared by each level of health facilities based on the prevalence disease conditions

and other factors. A list incorporated into overall pharmaceutical list of the facility is considered as having list for laboratory commodities.

LCs specific to lab monitoring sites- were analyzed among the facilities that handle them.

Non-program/RDF LCs: reagents and supplies those procured by RDF for laboratory services.

Program LCs: reagents, test kits and supplies uses for HIV/AIDS, TB and malaria testing, treatment and monitoring and are delivered to/collected by the facilities free of charge.

Sampled LCs: are 25 LCs, selected based on literatures available for program commodities which are 14 in number out of which 6 are specific to lab monitoring sites and the rest are non program commodities which are 11 in number, selected based on literatures and discussion with few laboratory professionals considering the local situation.

Stock out: unavailability of usable stocks of laboratory commodity both in the store and in a laboratory for which a balance of zero on the bin cards.

Supply chain management of LCs: means the assessment of downstream supply chain management of LCs starting from PFSA Jimma hub to the selected public health facilities.

4.13. Plan for Dissemination of Findings

The final paper will be submitted to Illu Aba Bora and Buno Bedelle ZHD, Jimma University Institute of Health and Department of pharmacy graduate study

The result of this study will be communicated to Federal Ministry of Health, Oromia regional health bureau and for other concerned bodies including the study facilities which can be accomplished through: presenting the findings at the appropriate meetings, workshops, seminars and publishing in a journal.

Those stakeholders in laboratory commodity supply chain can use the finding and the recommendation of this study for the system strength.

5. Result

5.1. Health facilities and study participants characteristics

Twenty five (25) HCs and 3 hospitals involved in the SCM of LCs were included in the study. Out of 25 HCs, 13(52%) are ART sites and 2(8%) of them are ART and Lab monitoring sites. Regarding hospitals all of them are ART and Lab monitoring sites.

Professional characteristics of the study hospitals and HCs as shown in table 1, 25 (78.1 %) and 10(19.6 %) of pharmacy unit professionals were pharmacists in hospitals and HCs, respectively.

Table 1. Professionals' characteristics of selected public health facilities of Buno Bedelle and Illu Aba Bora zones,May 2017

SN	Professional Category	Health professionals IPLS and LCM training profile	Hospital	HC	Total Trained
1	Pharmacist(Hospital(HP)=25,Health center(HC)=10)	IPLS trained	10	9	19
		LCM trained	1	1	2
2	Druggist(HP=7,HC=17	IPLS trained	2	17	19
		LCM trained	1	3	4
3	Lab professional(HP=24,HC=44)	IPLS trained	6(OJT)	23(OJT)	29
		LCM trained	0	0	0
4	Nurse(HP=0,HC=21)	IPLS trained	0	8	8
		LCM trained	0	0	0
5	Health Officer(HP=0,HC=2)	IPLS trained	0	1	1
		LCM trained	0	0	0
6	Midwife(HP=0,HC=1)	IPLS trained	0	1	1
		LCM trained	0	0	0

With regard to the study participants, as shown in table 2, pharmacy heads, store managers and laboratory heads have worked for 3.92, 4.82 and 4.91 years on average. Twenty (71.4%) of pharmacy heads and 21(75%) of store managers, were trained in IPLS. Majority of laboratory heads got on job training (OJT) on LMIS and none of them were trained in laboratory commodity management (LCM).

Table 2. Study participant characteristics of selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

	Sex				Training				Years of experience					
Study participant	M	%	F	%	IPLS	%	LCM	%	≤ 5 years	> 5 Years	Max	mean	Var.	Ran.
Pharmacy head	22	78.6	6	21.4	20	71.4	3	10.7	18	10	10	3.92	9.01	9.7
Store manager	25	89.3	3	10.7	21	75.0	3	10.7	12	16	12	4.82	9.93	11
Laboratory head	23	82.1	5	17.9	(**OJT**) 17	(**OJT**) 60.7	0	0.0	14	14	20	4.91	14.2	19

Generally, only 48(57.8%) and 6 (7.2%) of pharmacy unit professionals were trained in IPLS and LCM, respectively. Figure 3 shows differences for hospitals and HCs.

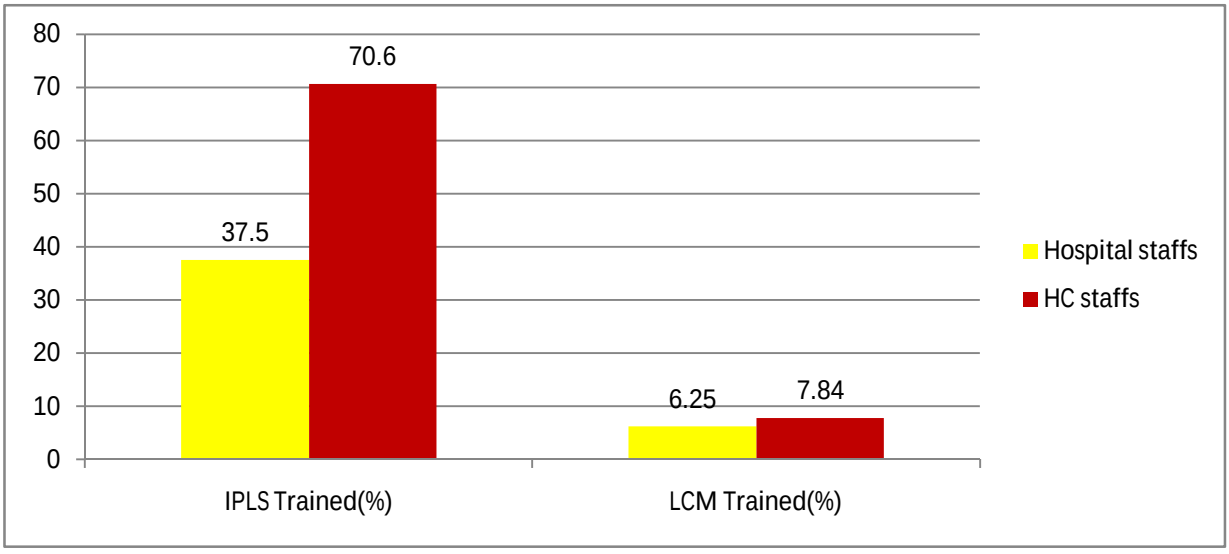


Figure 3.Training characteristics of pharmacy unit professionals in selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

5.2. Selection and procurement of LCs

5.2.1. Selection

The selection practice of LCs was very weak in the assessed facilities as compared to other pharmaceuticals. In this study, among the assessed facilities only 10(35.7%) of them has

developed essential list of laboratory commodities (ELLC).In developing ELLC**,** patterns of prevalent diseases and costs were criteria for selection in 6 health facilities, whereas 3 of them use patterns of prevalent diseases and previous consumption as a criteria and a single facility use combination of pattern of disease, previous consumption and cost.

Among the facilities developed ELLC, only 5 (50%) of them conducted procurement limited to ELLC.

Regarding DTC, 21 (75%) of facilities have implemented but functional only in 10 (35.7%) of the facilities (Figure 4 showed difference in hospitals and HCs).

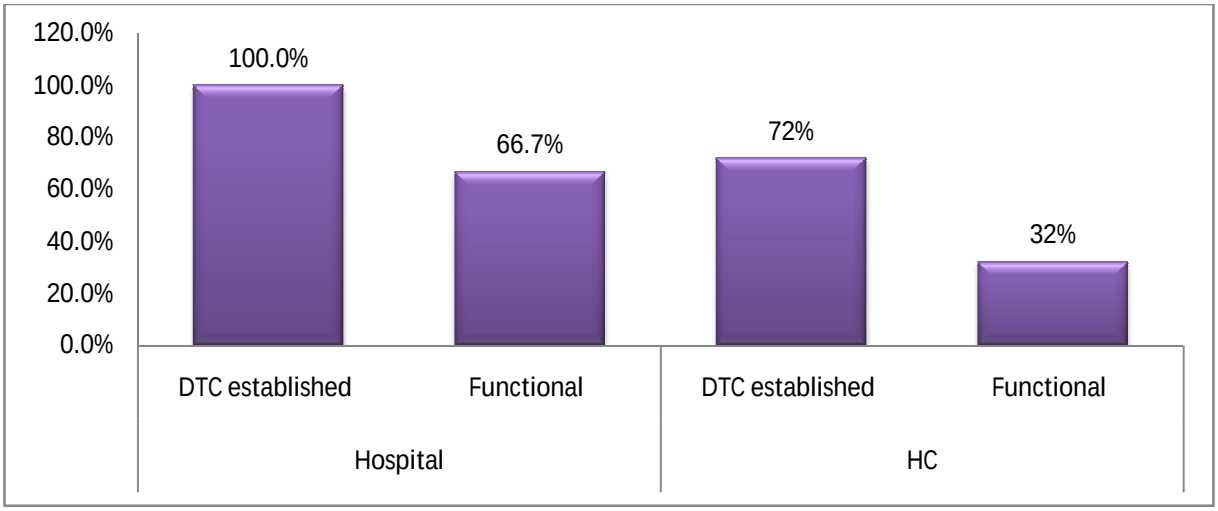


Figure 4.DTC establishment and functionality of selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

Among the facilities with functional DTCs, on average 3.4 meeting was conducted, with maximum and minimum of 5 and 2 meetings, respectively, during the past year.

The selection practice was not basically different between facilities with non functional DTCs and those without DTCs at all. However, variation was observed between facilities with and without functional DTCs. In facilities with non functional DTCs, selection was conducted either by laboratory or pharmacy unit alone without formal agreement. In these facilities pattern of disease and personal experience and knowledge on LCs were mainly used as a criterion for selection.

5.2.2. Quantification and procurement (resupply for program LCs)

The majority of the respondents 16(57.1%) said that resupply quantities for program LCs was determined by PFSA (push system). The push/pull classification depends on who determines the final resupply quantity for program LCs. Figure 5 indicates the variation by zones and type of facilities.

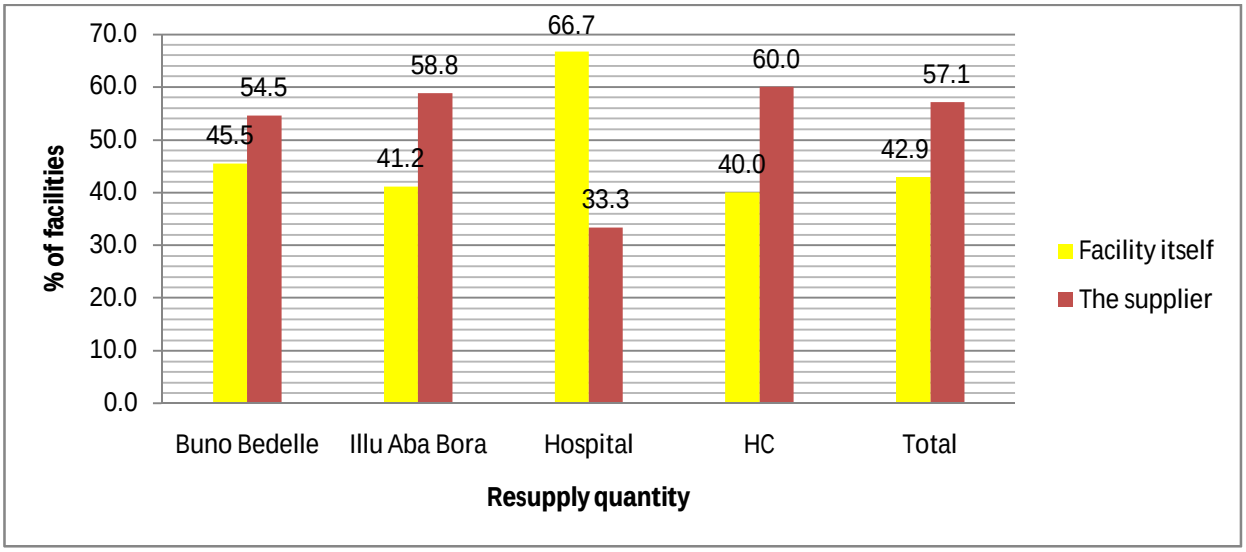


Figure 5. The push/pull system for program LCs in selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

In majority of health facilities 13(46.4%), the laboratory unit determines the quantity to order for RDF LCs (Figure 6).Almost all agree that the final quantity and item to be procured was determined by pharmacy unit depending on availability at supplier, shelf life, budget and knowledge on these commodities. It was found that only in one facility laboratory professionals were incorporated in the procurement team. In this particular facility the final quantity to be procured was determined by the agreement between pharmacy and laboratory units.

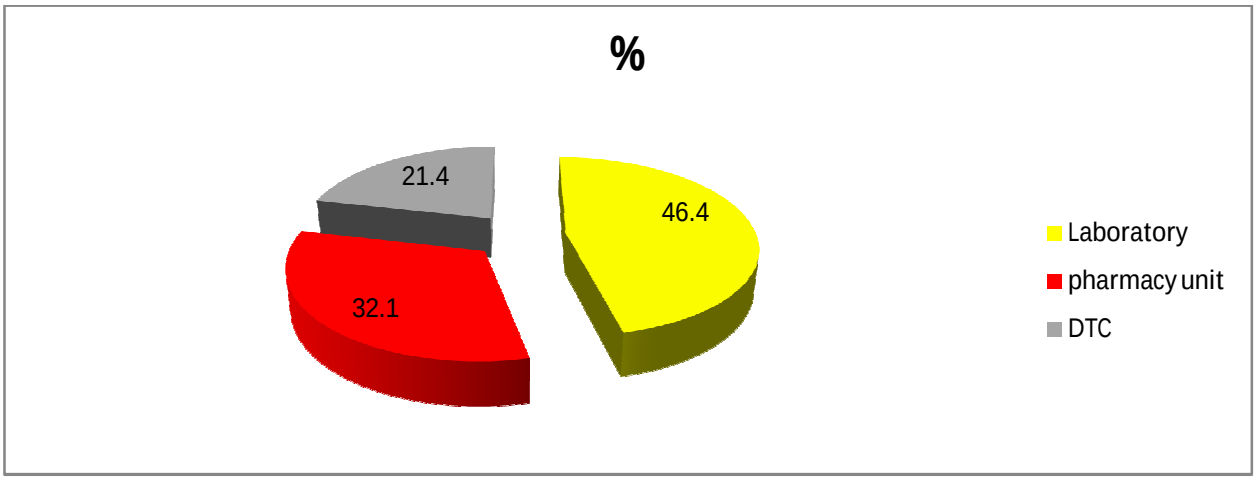


Figure 6. Who determines quantity to order for RDF LCs in selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

The assessment showed that, most of the facilities quantify their LCs by guessing whereas only 5 (17.9%) of the facilities rely on morbidity method (Figure 7). The quantification practice in the majority of the facilities with non functional DTC was comparatively poor. In 12(42.9 %) of facilities with non functional DTC, quantification was done by merely guessing without the use of valid logistic data needed to conduct quantification. In these facilities available fund was the main source of data to determine quantity to order. It was found that combination of sources of data was used, in facilities with functional DTCs.

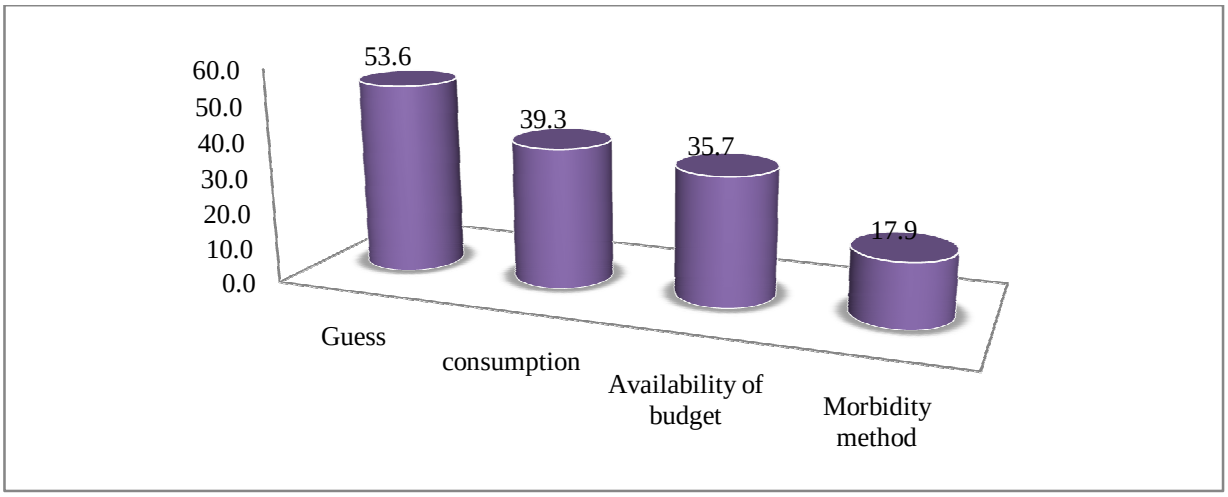


Figure 7. Quantification method used for LCs in public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

None of the assessed facilities were received the quantity of LCs they ordered (both for program and RDF). When they asked to mention the reason for not obtaining, the majority 22(78.6%) mentioned resupply point does not have adequate supply and 19(67.9%) mentioned the resupply point was stocked out of commodities .One facility mentioned more than one reason (For detail Figure 8).

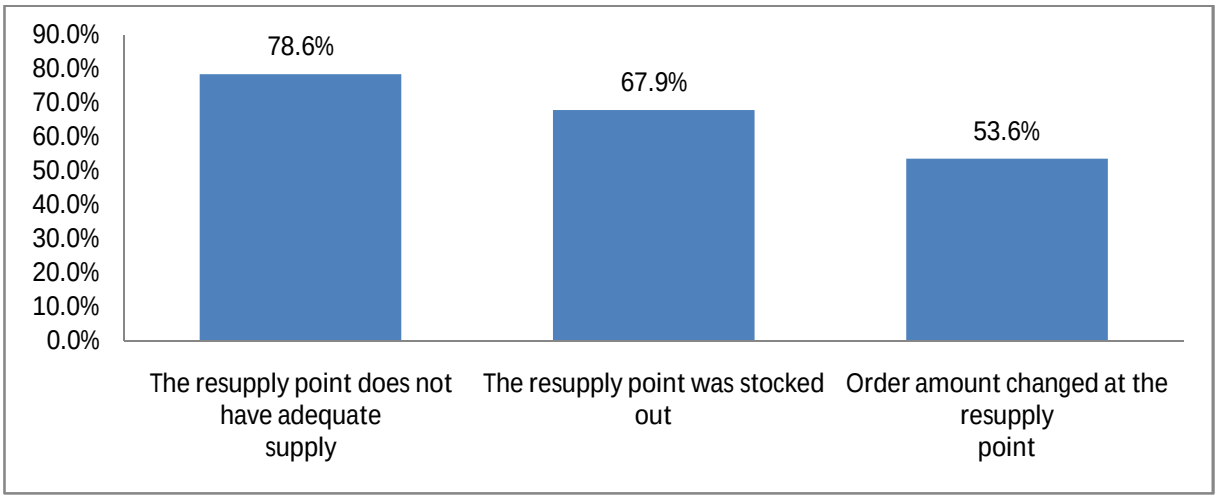


Figure 8. Reasons for stocked out as mentioned by respondents in public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

Regarding lead time for procurement, under normal circumstances, it took 6.36 days on average to place orders to the time the LCs available for use, with maximum and minimum of 8 and 3 days, respectively.

Concerning laboratory services, the number of test menus each facility planned to provide in its set up and posted in the laboratory was taken as criterion to select the number of test menus for each facility. The test menus not provided at the day of data collection was identified for each facility.

Out of a total of 536 test menus assessed, it was found that 130 (24.25%) test menus not provided at the time of data collection in all surveyed facilities.

The mean number of test menus planned to be offered were 18 and 28 in HCs and hospitals, respectively, whereas the mean number of test menus not offered at the day of visit was 4.8 (26.7%) and 3(10.7%) for HCs and Hospitals, respectively.

The Laboratory heads were asked the reason why not providing these tests. The reasons frequently mentioned for not offering the tests, were reagents not available 27 (96.4 %), equipment breakdown 9 (32.1%), 2 (7.1 %) lack of training and other 6(21.4%). Power interruption and the test do not requested were the two commonly mentioned reasons under other (Figure 9).

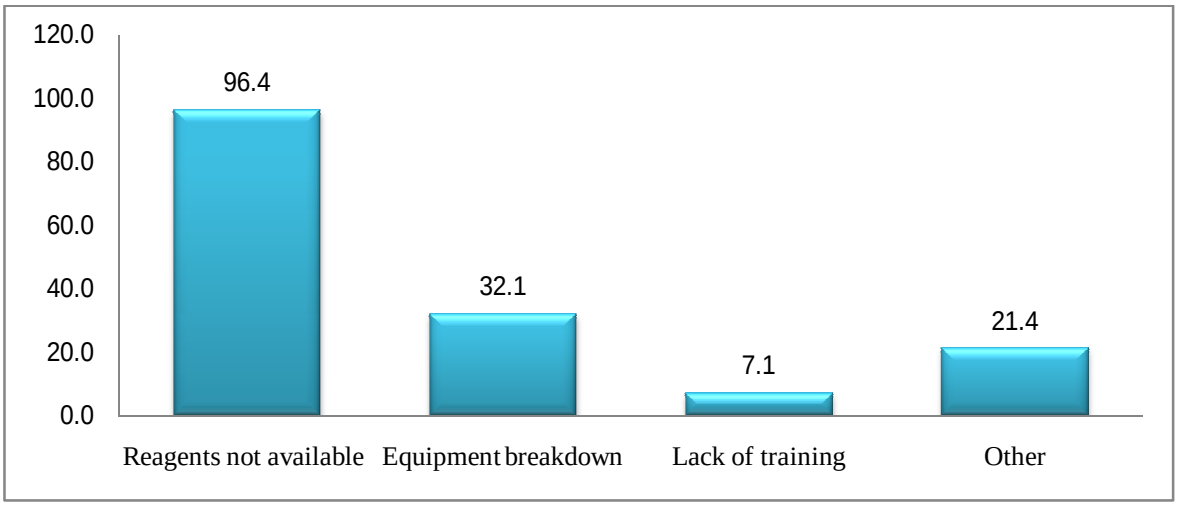


Figure 9. Reasons for not giving tests at the time of visit in selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

5.3 .Inventory management of LCs

None of surveyed facilities established maximum/minimum and reorder levels for LCs. In 21(75%) facilities, standard ordering schedules and procedures was established for LCs. However, the schedule was not strictly followed in the majority of health facilities; the reason given was unavailability of the commodities.

When asked the type of data used by facilities to determine quantity to order for RDF LCs, majority 10 (35.7%) and 7(25%) mentioned number of tests performed and available funds, respectively. Facilities commonly mentioned more than one data type (Figure 10).

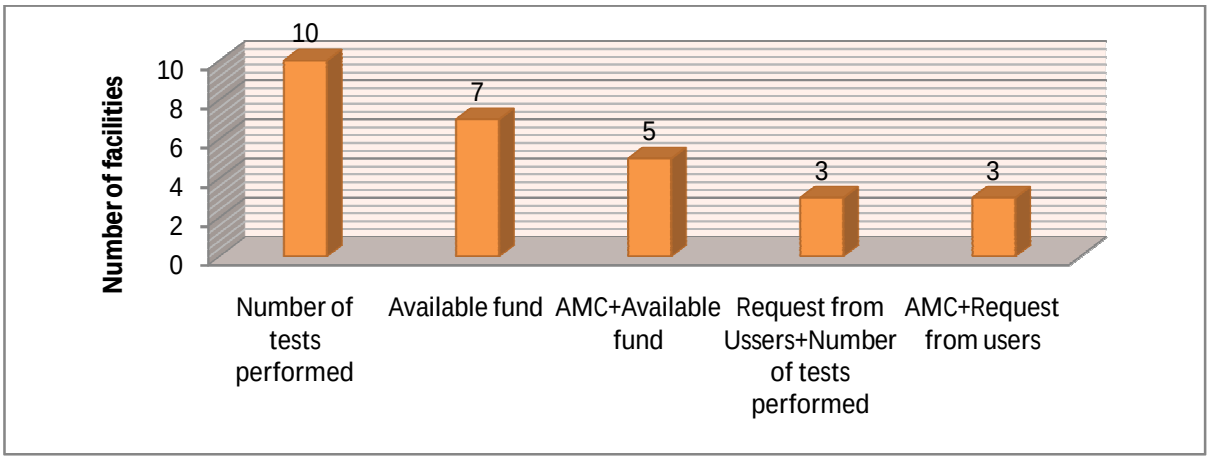


Figure 10. Data used to determine quantity to order for RDF LCs in selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

Concerning the frequency of placing orders for RDF LCs, in 15 (53.6%) facilities there was no defined schedule, whereas, 8 (28.6%) facilities place orders every six months and the rest quarterly (Figure 11).

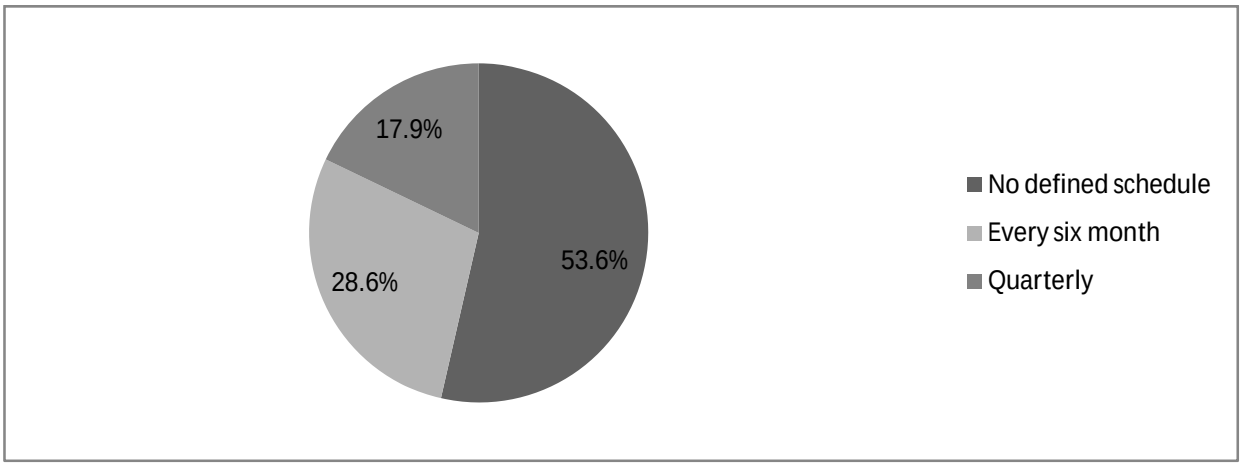


Figure 11. Frequency of placing orders for RDF LCs in selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

With regard to emergency orders, 22 (78.6%) of the assessed facilities had got established procedures for placing emergency orders, Out of these health facilities 18 (81.8%) made one or more emergency orders for LCs during the past year, with average of 3.5 emergency orders per health facility. On the other hand, 6(21.4%) of the facilities did not know whether they do have established procedures or not for placing emergency orders.

Hospitals made maximum of 5 and a minimum of 2 emergency orders whereas HCs made maximum of 6 and a minimum of zero emergency orders for LCs during the past year.

Table 3 shows the frequency and the last time physical inventory was conducted for LCs. It was found that, 9(32.1%), 7(25%), and 7(25%) of facilities conducted physical inventory every year, twice a year and every 2 months, respectively. On the other hand, 5(17.86 %) of facilities never conducted physical inventory for LCs. The assessment showed that, 23(82.14%) of facilities conducted one or more physical inventory for LCs within the past year. Among the facilities conducted physical inventory(23), 9 (39.1%), 7(30.4%) and 7(30.4%) of the facilities conducted physical inventory before 6 months, within 6 months and within 3 months, respectively ,at the time of data collection.

Table 3. The frequency of conducting physical inventory and the last time physical inventory conducted in selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

Frequency of stock taking	**Number of facilities**	**%**
Every 2 months	7	25.0
Every 6 months	7	25.0
Every year	9	32.1
Never	5	17.9
The last time physical inventory conducted	**Number of facilities**	**%**
Within 3 months	7	30.4
within 6 months	7	30.4
Before 6 months	9	39.1

As indicated in the Table 4 below, the average availability of bin cards for the sampled LCs was 28.3% for HCs and 90.8% for hospitals .The overall percentage of updated and accurate bin cards in hospitals and HCs for sampled LCs was found by calculating percentage of updated and accurate bin cards for each commodity in the strata of facilities in comparison with the total number of bin cads opened for respective LC in 3 hospitals and 25 HCs. The summation of updated and accurate bin cards was done and finally divided by the number of sampled LCs managed in each stratum of facilities. On average, HCs had an updated bin card for 16.9 % of

LCs while hospitals had an updated bin card for 53.4% of LCs. With regard to record accuracy on average 11.6% and 37.3 % of bin cards were accurate for HCs and hospitals respectively for commodities selected.

Table 4. Percentage of Bin cards available, updated and accurate for sampled LCs in selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

	Buno Bedelle			Illu Aba Bora			HC			Hospital		
LCs	**Available**	**Updated**	**Accurate**	**Available**	**Updated**	**Accurate**	**Available**	**Updated**	**Accurate**	**Available**	**Updated**	**Accurate**
HIV test kit (Colloidal Gold)	55	33	17	65	36	27	56	29	14	100	67	67
HIV test kit (Uni-Gold TM)	55	33	33	47	25	13	44	9	9	100	100	67
Blood group and Rh factor	64	14	14	59	30	20	48	17	8	100	67	67
Rapid plasma regain /VDRL(syphilis)	45	40	40	47	25	13	40	20	10	100	67	33
Hepatitis B surface Ag	36	25	0	29	20	0	24	0	0	100	67	0
Pregnancy test strip	73	50	50	65	55	45	60	53	47	100	67	67
Immersion oil	82	22	22	47	50	0	56	36	36	67	100	50
GS, crystal violet	45	40	20	35	33	17	32	25	13	100	33	33
GS, iodine	36	25	0	35	33	33	28	14	0	100	67	67
GS, alcohol	36	0	0	24	50	0	24	17	0	67	50	0
GS, safranin	36	25	0	29	20	20	28	14	14	67	50	0
Carbofuchsin	36	25	25	47	38	25	36	33	22	100	33	33
Acid alcohol	27	33	33	41	14	14	28	14	14	100	33	33
Methylene Blue	45	20	20	47	13	13	40	10	10	100	33	33
Microscpe slide	55	33	33	59	40	30	52	31	23	100	67	67
H.Pylori Antigen	45	60	40	41	43	14	36	45	22	100	67	33
Geimsa stain	27	67	67	29	20	20	20	20	20	100	67	67
Acetic acid, glacial	18	0	0	18	33	33	12	0	0	67	50	50
Urine multi test 10 /3 par .	55	67	50	47	25	25	44	36	27	100	67	67
Viral load reagents	0	0	0	12	50	0	0	0	0	67	0	0
CD4 test reagents	0	0	0	12	50	0	0	0	0	67	0	0
Bilirubin (Direct),375 ml	0	0	0	18	33	33	0	0	0	100	33	33
Bilirubin (Total),375 ml	0	0	0	12	50	0	0	0	0	67	50	0
GOT/AST, 8x50 ml,400ml	0	0	0	18	33	33	0	0	0	100	33	33
Creatinine ,250 ml	0	0	0	18	67	33	0	0	0	100	67	33
Average	35	25	18.6	36	35	18.5	**28.3**	**16.9**	**11.6**	**90.8**	**53.4**	**37.3**

5.3. 1.Storage conditions

Only one hospital fulfils 100 % storage conditions of all the criteria. The mean storage condition fulfilled per health facility was 61%. The mean storage condition fulfilled per Hospital was 92.9 % as compared to that of HCs (57.1 %).Only 4 facilities (2 hospitals and 2 HCs) met acceptable storage conditions (fulfilled 80 percent of the criteria or more) (Figure 12).

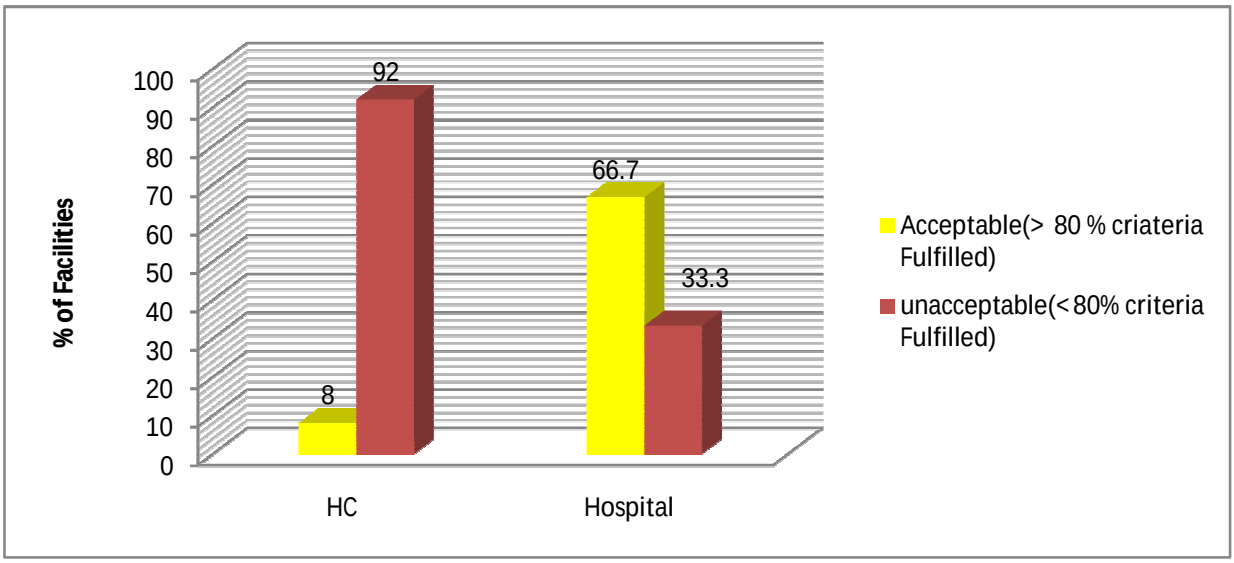


Figure 12. Percentage of Facilities Meeting Acceptable Storage Conditions in selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

As it can be seen from Table 5 below, the two top storage conditions fulfilled were storage security 27 (96.4 %) and protection from direct sun light 26 (92.9 %).The two weakest storage criteria fulfilled were availability of fire safety fulfilled only by 3 (10.7 %) and cold chain items are stored in appropriate temperature only fulfilled by 7 (25 %) of facilities. Storage space adequacy criteria of store room was only fulfilled by 12 (42.9%) of facilities.

Table 5. Percentage of Storage conditions fulfilled at main pharmacy store in selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

		Hospital		*HC*		*Total*	
S/n	*Criteria*	*Frequency of Yes*	*%*	*Frequency of Yes*	*%*	*Frequency of Yes*	*%*
1	Pharmaceuticals are arranged & organized according to a logical categorization, e.g. zoning	3	100	15	60	18	64.3
2	Bin Cards are used & updated regularly? (Observe by checking a three or more sample BCs.)	3	100	8	32	11	39.3
3	Are unwanted items (damaged or expired LCs, non-pharmaceutical items, etc.) in the store room separated from the usable stock?	3	100	21	84	24	85.7
4	Products are arranged so that ID labels, expiry dates, and/or manufacturing dates are visible.	3	100	20	80	23	82.1
5	Laboratory commodities are stored to facilitate FEFO procedures and stock management.	3	100	12	48	15	53.6
6	Products are protected from direct sunlight and high heat at all times of the day/during all seasons.	3	100	23	92	26	92.9
7	The storeroom is maintained in good condition (clean, no trash, sturdy shelves, and boxes well-organized).	3	100	14	56	17	60.7
8	Fire safety equipment available, accessible, and functional. Train employees to use the equipment.	2	67	1	4	3	10.7
9	Store lab commodities according to their properties: chemicals, flammable products, Hazardous materials, office supplies, and equipment.	2	67	8	32	10	35.7
10	The current space and organization is sufficient for existing products and reasonable expansion	3	100	9	36	12	42.9
11	Storage area is secured with a lock and key, but is accessible during normal working hours; access is limited to authorized person.	3	100	24	96	27	96.4
12	Storage area is visually free from harmful insects and rodents.	3	100	21	84	24	85.7
13	Cold chain items are always stored at appropriate temperatures	2	67	5	20	7	25.0
14	Cartons and products are in good condition, not crushed due to mishandling.	3	100	19	76	22	78.6

5.4. Logistic management information system

The assessment result indicated that, LMIS tools (bin cards, IFRR and RRF) were available and utilized in all hospitals. However, stock record card was available in 2 hospitals but merely utilized in 1 hospital, even it was not updated in this particular hospital, so that conducting accuracy of records was not possible for stock record card.

The availability of LMIS tools in HCs were 25(100%), 2(8%), 25(100 %) and 22 (88 %) for bin cards, stock cards, RRF and IFRR respectively .Whereas, it was 20 (80%), 0%, 22 (88%) and 16 (64 %) utilization in HCs for the same LMIS tools, respectively (shown in Figure 14 below).

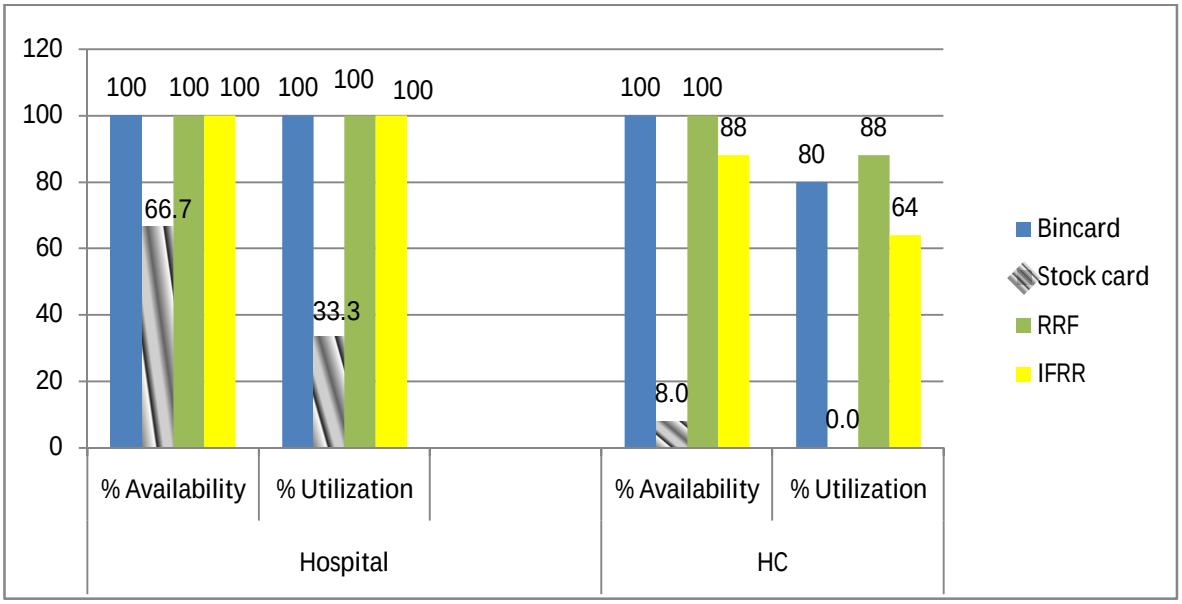


Figure 13. Availability and utilization of LMIS tools in selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

As shown in Figure 15, the utilization of LMIS tools at laboratory room, 18(64.3%) of studied facility laboratories use IFRR to request from store, however only 13(46.4%) of them use bin cards, out of which only 9(32.1%) with at least one updated bin card. There were 5 (17.9%) laboratories found using IFRR without bin card.

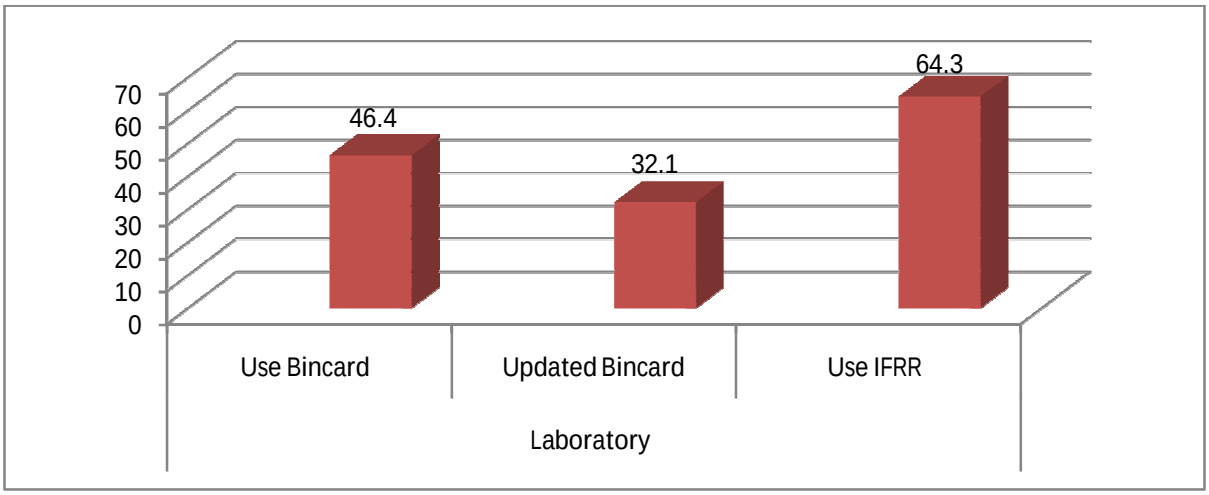


Figure 14. Utilization of LMIS tools in laboratory in selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

Figure 16 showed differences for hospitals and HCs laboratories, all hospitals 3(100%) use and update bin cards as well as use IFRR. Whereas 10(40 %), 6(24 %) and 15(60 %) of HCs use bin cards, update bin cards and use IFRR respectively. Among HCs laboratories that used IFRR (60%), 10 (66.6%) of them use bin cards, only 6 (40%) with at least one updated bin cards and 5(33.3%) use IFRR without bin cards.

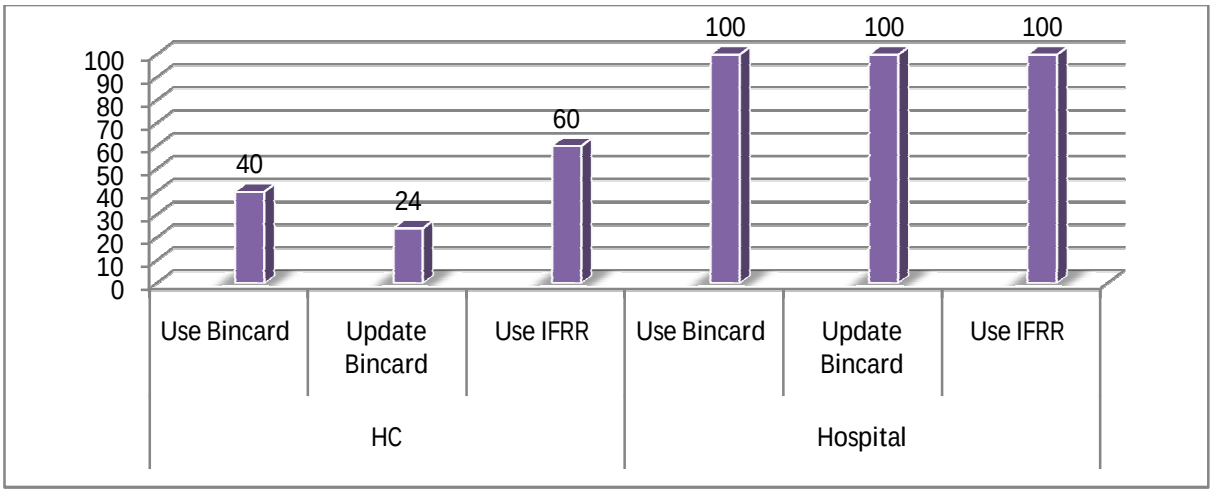


Figure 15. Utilization of LMIS tools by hospital and HC laboratories in selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

With regard to record accuracy of bin cards at laboratory room in all of the hospital laboratories at least one updated bin card was found but only 40% updated and 17.3% accurate as compared to the total number of sampled LCs for which bin card was opened. Similarly 6 (24%) of HC

laboratories had at least one updated bin card for LCs but only 9.2 % updated and 6.7 % accurate as compared to the total numbers of bin cards opened for sampled LCs.

There were 20 facility laboratories found utilizing either or both bin cards and IFRR. Those using either or both of the tools (20 facilities) were asked on how did they learnt to complete the forms, 16 (80%) and 4(20%) of them mentioned OJT and on job self learning, respectively.
The study found that, 19(67.8%) of facility laboratories did not use either or both of the forms, among these facilities , when asked the reason why, majority 10 (52.6%) gave reason that the facility management did not enforce them to use and 6 (31.6%) of them mentioned lack of commitment that came from lack of product availability (Detail figure 17).

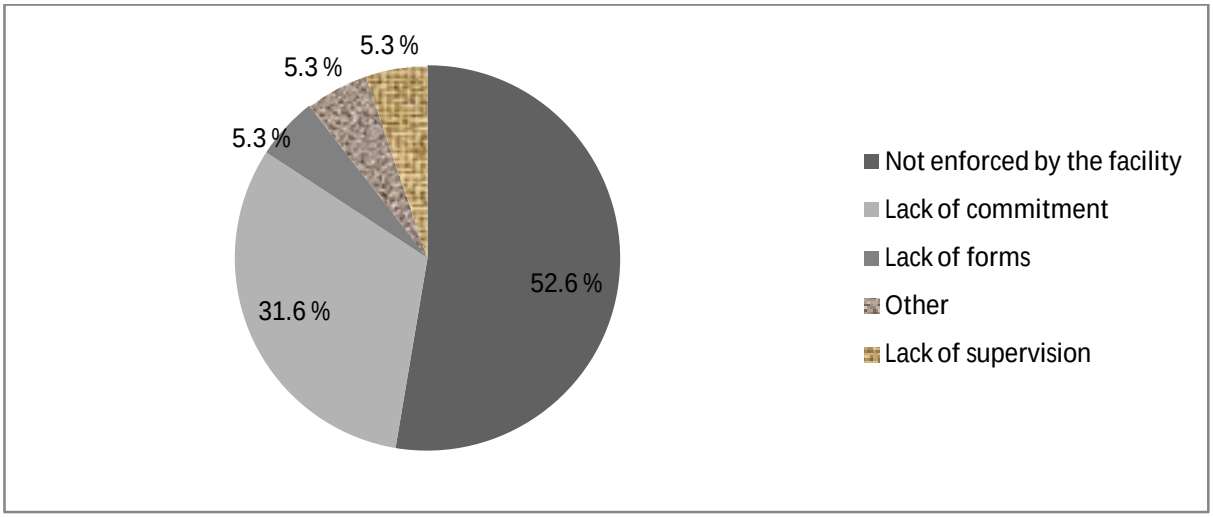


Figure 16. Reason mentioned for not using LMIS tools in laboratories in selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

Concerning RRF reporting of health facilities, 25 (89.3%) of facilities submitted at least one or more number of RRF reports to PFSA during the past year prior to the data collection. From the expected 150 RRF reports from all facilities 125 (83.3%) reports were submitted within the past year. The report completeness was determined from the most recent report submitted, which was 15 (60%) out of 25 facilities submitted reports.

Table 6 shows, Facilities stocked out on the day of visit, Facilities stocked out in the past 3 months and Mean number of days of stocked out in the past 3 months for sampled LCs. The maximum stocked out at the day of visit was found for viral load reagents and acetic acid glacial stocked out by all 5(100%) of lab monitoring sites and 24(85.7%) of facilities, respectively.

Whereas, microscope slide not stocked out at all and Immersion oil stocked out only by a single facility.

Maximum out of stock within the past 3 months were found for viral load and CD4 reagents, which were stocked out by all lab monitoring sites (5 eligible sites) .The minimum was for Immersion oil and microscope slides stocked out by 2 and 5 facilities, respectively, during the past three months. The maximum mean number of days out of stock in the past 3 months was 82.5 and 70.7 days for viral load reagents and Acetic acid, glacial respectively. Minimum Mean number of days out of stock was 1.1 and 7.2 days for Microscpe slide and pregnancy test strip, respectively, (Table 6 shows the detail for all commodities).

Generally it was found that, 25 (89.3%) and 11 (39.3%) of facilities stocked out for at least one HIV/AIDS and TB LCs during the past three months and at the time of data collection, respectively.

Table 6. Facilities stock out rate for LCs at the different times within the past 3 months in selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

List of sampled LCs	Facilities stocked out on the day of visit		Facilities stocked out any time in the past 3 months		Mean number of days of stock outs in the past 3 months
	N	%	N	%	
HIV test kit (Colloidal Gold)	4	14.3	9	32.1	10.3
HIV test kit (Uni-Gold TM)	4	14.3	15	53.6	20.0
Blood group and Rh factor	3	10.7	10	35.7	26.4
Rapid plasma regain /VDRL(syphilis)	7	25.0	18	64.3	41.6
Hepatitis B surface Ag	14	50.0	19	67.9	49.9
Pregnancy test strip	2	7.1	4	14.3	7.2
Immersion oil	1	3.6	5	17.9	7.9
GS, crystal violet	19	67.9	20	71.4	55.9
GS, iodine	18	64.3	21	75.0	47.6
GS, alcohol	16	57.1	17	60.7	42.0

GS, safranin	17	60.7	18	64.3	43.9
Carbofuchsin	6	21.4	13	46.4	14.1
Acid alcohol	6	21.4	15	53.6	14.1
Methylene Blue	7	25.0	17	60.7	18.1
Microscpe slide	0	0.0	2	7.1	1.1
H.Pylori Antigen	7	25.0	14	50.0	28.2
Geimsa stain	5	17.9	11	39.3	14.1
Acetic acid, glacial	24	85.7	27	96.4	70.7
Urine multi test 10 /3 parameters	4	14.3	9	32.1	16.2
Viral load reagents	5	100	5	100.0	82.5
CD4 test reagents	4	80	5	100.0	58.0
Bilirubin (Direct),375 ml	3	60	4	80	45.0
Bilirubin (Total),375 ml	3	60	4	80	49.8
GOT/AST, 8x50 ml,400 ml	3	60	4	80	60.5
Creatinine ,250 ml	3	60	3	60	52.5

*****Viral load reagents , CD4 test reagents , Bilirubin (Direct), Bilirubin (Total), GOT/AST and Creatinine, the number of facilities eligible to manage them (n=5)

Generally, as it can be seen from Table 7 below, the mean no of LCs stocked out on the day of visit was 7.3 and 4.7 in HCs and hospitals respectively, whereas the percentage of LCs stocked out on the day of visit was as high as 35.6 and 18.7 in HCs and Hospitals respectively. Mean number of LCs stocked out in the past three months was 10.4 and 9 in HCs and hospitals respectively, whereas the percentage of LCs stocked out in the past three months was as 50.6 and 30 in HCs and Hospitals, respectively.

Table 7. LCs managed and stock out at the day of visit and past 3 months in selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

	On the day of visit		Past 3 months	
	Mean±SD (min,max)	Mean±SD (min,max)	Mean±SD (min,max)	Mean±SD (min,max)
	HCs	Hospitals	HCs	Hospitals
No sampled LCs managed	13.1±3.0 (7,18)	20.3±1.5 (19,22)	13.1±3.0 (7,18)	20.3±1.5 (19,22)
No of LCs stock out	7.3±3.1(2,13)	4.7±1.5 (3,6)	10.4±3.9 (3,18)	9.0±2.0 (7,11)
% of LCs stock out	35.6±15.0(10,65)	18.7±6.1(12,24)	50.6±18.3(15,80)	36.0+8.0(28,44)

Regarding reasons for stocked out, unavailability at supplier/PFSA 26 (92.9%) and non supply of quantity requested 11(39.3%), stock out and rationing 21(75%) and supply of near expiry 13(46.4%) were the two most commonly cited reasons for program and RDF LCs ,respectively, (Figure 18 and 18).

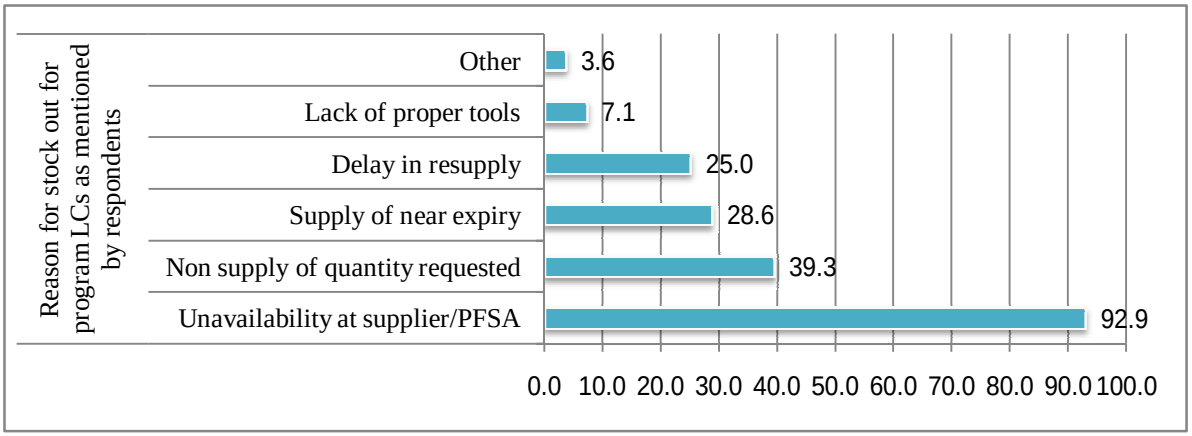


Figure 17. Reasons for stocked out for program LCs in selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

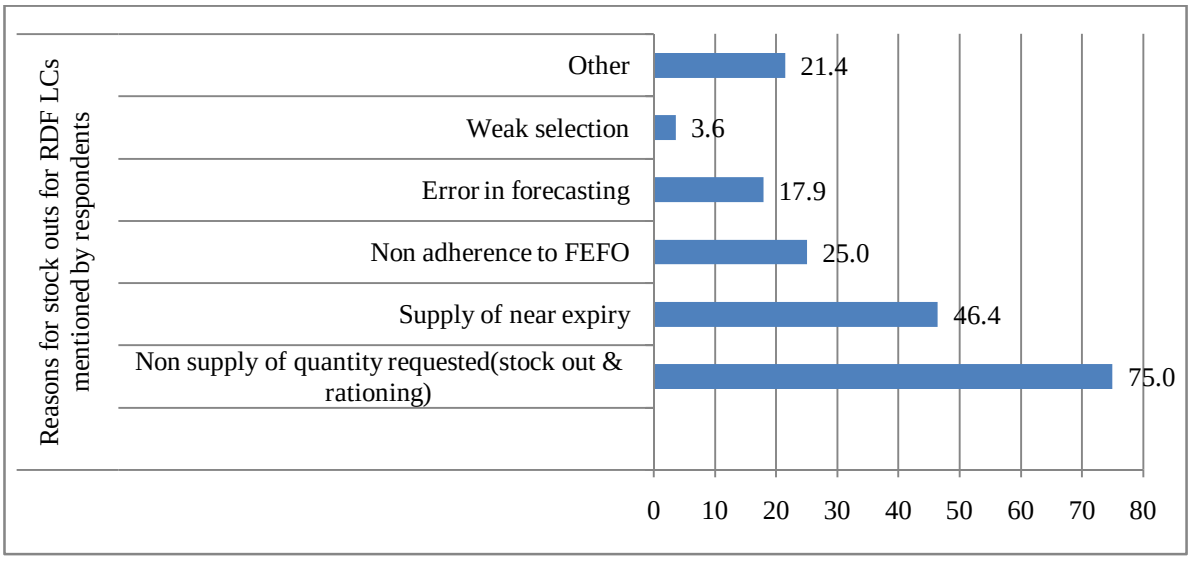


Figure 18.Reasons for stocked outs for RDF LCs as in selected public health facilities of Buno Bedelle and Illu Aba Bora zones,May 2017

Over stock of certain LCs encountered in 15(53.6%) of facilities and 14(50%) had tried to implement redistribution of these commodities to minimize expiration. In 18(64.3%) facilities laboratory heads reported that they knew the LCs stock status in store. They mention that there was a good communication with pharmacy unit.

5.4. 1.Management support

The majority 12(42.86%) of the facilities assessed reported that, they received supervision on pharmaceutical logistics every six months as compared to 5(17.86%) of facilities never received supervision during the past year where as 6(21.43%) supervised quarterly, (Figure 20).

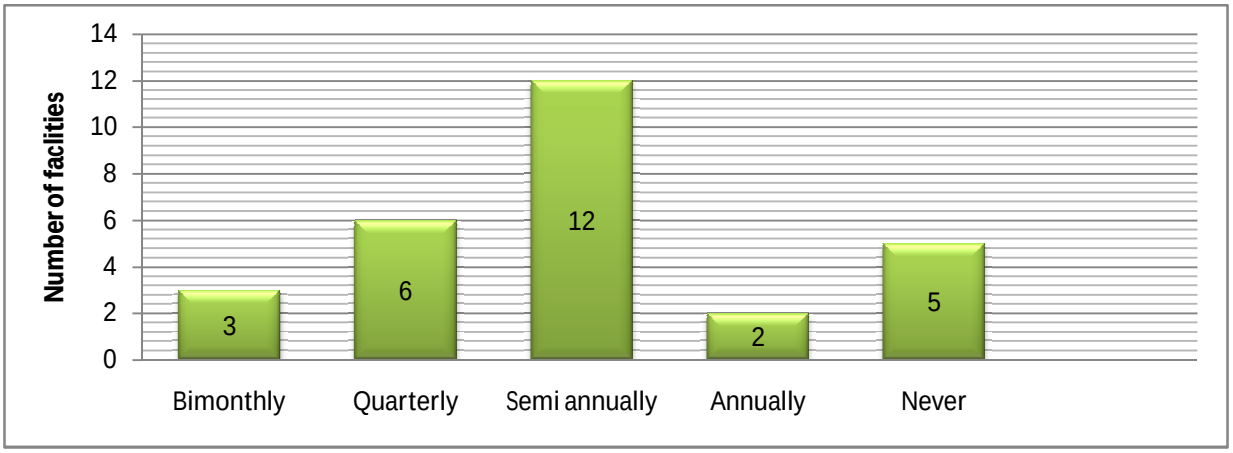


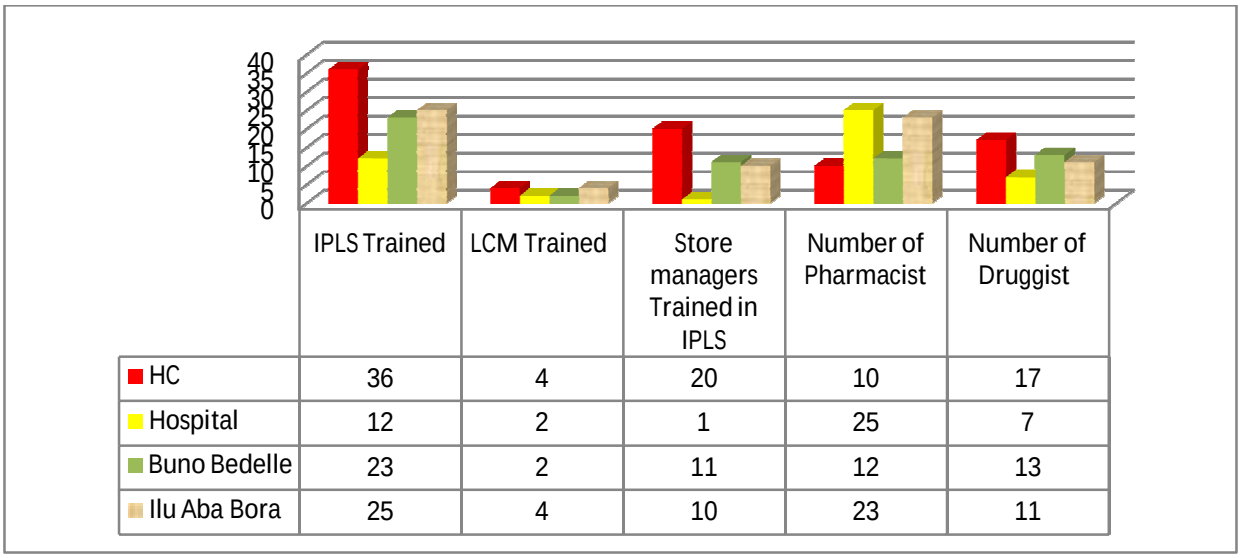
Figure 19. Frequency of supervision on pharmaceutical management in selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

Supervision was conducted commonly on more accessible HCs and hospitals. As a result, some less accessible HCs never got supervision during the past year. Sometimes supervision was conducted by inappropriate person as well.

Concerning management supportive action for the implementation of IPLS for LCs as reported by respondents, it was found that ,11(39.3%) and 12(42.9%12) of facilities have got management support in the use of IFRR by dispensing units and enforcing regular schedule for reports respectively.

Similarly, with regard to performance measure for personnel involved in pharmaceuticals management, only 1(3.6%) facility reported having performance measurement criteria on pharmaceuticals management including for dispensing units, however, none of the study facilities reported the availability of incentives based on performance.

It was found that all (100%) and only 58.8% of store managers were trained in IPLS in Buno Bedelle and Illu Aba Bora zone, respectively (For detail Figure 21).



	IPLS Trained	LCM Trained	Store managers Trained in IPLS	Number of Pharmacist	Number of Druggist
HC	36	4	20	10	17
Hospital	12	2	1	25	7
Buno Bedelle	23	2	11	12	13
Ilu Aba Bora	25	4	10	23	11

Figure 20.Training and number of pharmacy professionals by facility type and zones of Buno Bedelle and Illu Aba Bora, May 2017

With regard to the principal persons managing LCs in the pharmacy unit, the mean number of pharmacist was about 0.4 and 8.3 in HCs and hospitals, respectively, whereas, the mean number of druggists was only 0.7 and 2.3 in HCs and hospitals, respectively (Table 8).

Table 8. Mean Number of pharmacists and Druggists in selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

	HC			Hospital		
	Minimum	Maximum	Mean ±SD	Minimum	Maximum	Mean ± SD
No of pharmacist	0	1	0.4±.50	4	14	8.3±5.12
No of druggists	0	2	0.7+.63	1	5	2.3±2.31

There were only 15 HCs with at least one pharmacy professional, among these 8 (32%) HCs were with 2 pharmacy professionals, the rest (10 HCs) were delivering service without any pharmacy staffs. Out of 25 HCs, in 17(68 %) HCs pharmacy store was managed with non pharmacy professionals.

5.5. Availability of LCs

The availability at the day of visit was assessed for sampled 25 LCs (14 program and 11 RDF sources). The number of facilities with the LCs available was counted for each commodity which was divided by the total number facilities to get percentage availability (percentage of facilities in which the LC was available). Similarly, over all availability for class of commodities and cluster of facilities was calculated by counting the number of LCs available for each facility which was divided by the total number of sampled LCs in each class of commodities (RDF and program) then finally the sum was divided by the number of facilities in each cluster to get overall all availability.

All of the study facilities 28 (100%) encountered stock out of certain LCs before resupply. As shown in Figure 23 below, for program LCs in HCs ,better availability was found for Immersion oil 24(96%) and Microscpe slide 25(100%),whereas, Viral load reagents, CD4 test reagents, Bilirubin (Direct), Bilirubin (Total), GOT and Creatinine , were totally stocked out by 2 lab monitoring HCs (0%).In hospitals ,the two HIV test kits and the three AFB reagents ,immersion oil, microscope slide and Geimsa stain were available in all hospitals at the day of data collection. On the other hand, Viral load reagents were totally stocked out by all of the hospitals (Table 9).

As it can be seen from Table 9 below, for RDF LCs across HCs, better availability was witnessed for Pregnancy test strip which was available in 23 (92 %) of HCs and Blood group and Rh factor was available in 22 (88 %) of HCs. whereas, low availability was found for Acetic acid, glacial and GS, crystal violet only available in 3 (12%) and 7 (28%) of HCs. In Hospitals, Blood group and Rh factor, VDRL (syphilis), Pregnancy test strip, GS, alcohol, GS, safranin, H.Pylori Antigen and Urine multi test were available in all of the hospitals 3(100%).On the other hand, Hepatitis B surface Ag and GS, iodine was available in 2 (66.7%) of hospitals, low availability was found for Acetic acid,glacial which was available only in 1(33.3%) hospital(see Table 9).

Table 9. Availability of program and RDF LCs at the day of visit in selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

Availability of program LCs				
	HC		**Hospital**	
LCs	n	%	n	%
HIV test kit (Colloidal Gold)	21	84	3	100
HIV test kit (Uni-Gold TM)	21	84	3	100
Immersion oil	24	96	3	100
Carbofuchsin	19	76	3	100
Acid alcohol	19	76	3	100
Methylene Blue	18	72	3	100
Microscpe slide	25	100	3	100
Geimsa stain	20	80	3	100
Viral load reagents	0	0	0	0
CD4 test reagents	0	0	1	33.3
Bilirubin (Direct),375 ml	0	0	2	66.7
Bilirubin (Total),375 ml	0	0	2	66.7
GOT/AST, 8x50 ml,400 ml	0	0	2	66.7
Creatinine ,250 ml	0	0	2	66.7
Over all		**47.7**		**78.6**
Availability of RDF LCs				
	HC		**Hospital**	
LCs	**n**	**%**	**n**	**%**
Blood group and Rh factor	22	88	3	100
VDRL(syphilis)	18	72	3	100
Hepatitis B surface Ag	12	48	2	66.7
Pregnancy test strip	23	92	3	100.0
GS, crystal violet	7	28	2	66.7

GS, iodine	8	32	2	66.7
GS, alcohol	9	36	3	100.0
GS, safranin	8	32	3	100.0
H.Pylori Antigen	18	72	3	100.0
Acetic acid, glacial	3	12	1	33.3
Urine multi test 10 /3 para.	21	84	3	100
Over all		**54.2**		**84.8**

The average availability at the day of visit across all HCs and hospitals was 50.6 % and 81.3% for sampled LCs respectively. Over all availability for RDF LCs was 54.4% and 84.8 % for HCs and hospitals respectively, whereas, for program LCs 47.7 % and 78.6 % respectively for HCs and hospitals (Figure 22).

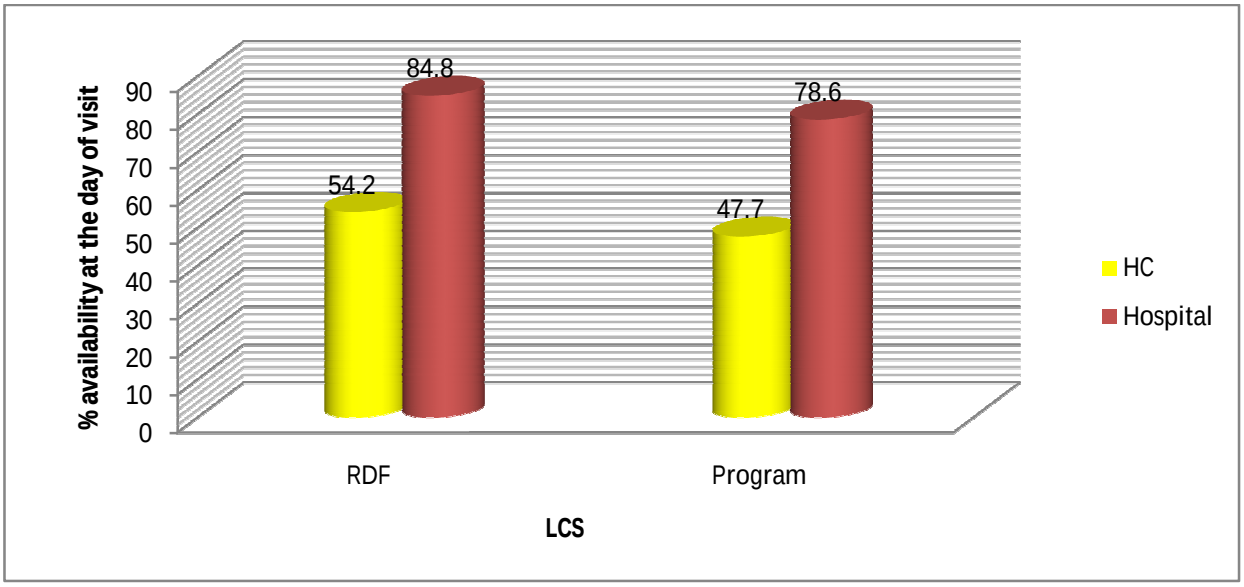


Figure 21. Over all Availability at the day of visit in selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

5.6. Wastage of LCs

Out of the 28 health facilities sampled for this study, expired LCs were found in 26(92.8%).All expired LCs found at the day of data collection in these facilities expired within the past year was recorded. Then the wastage value was calculated. Expired LCs with total cost of 238,211.6 Birr in hospitals and 150,906.70 Birr in HCs were found. On average each hospital and each HC lost 79,403.9 and 6,561.2 Birr, respectively, from the expiry of LCs during the past year (Detail Figure 23).

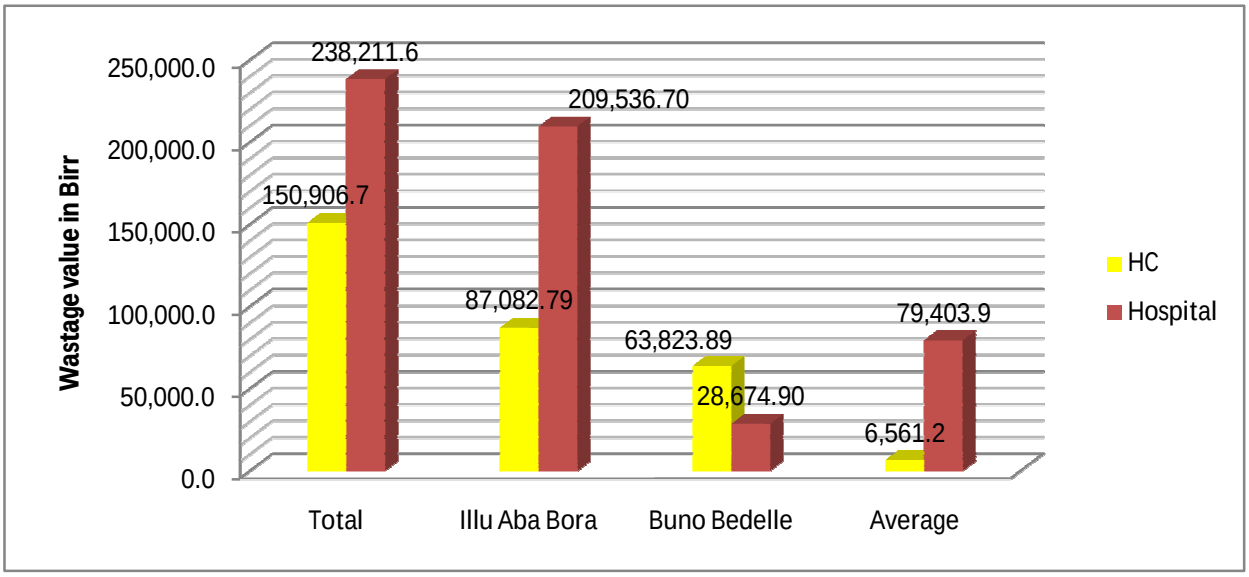


Figure 22.Wastage value of LCs by facility type in selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

In general a total cost of 389,118 Birr expired LCs was found .The maximum and the minimum wastage value per health facility was 197,625 and 2,941 Birr, respectively. On average each facility lost 14, 966.09 Birr per year from the expiry of LCs (Detail Figure 24).

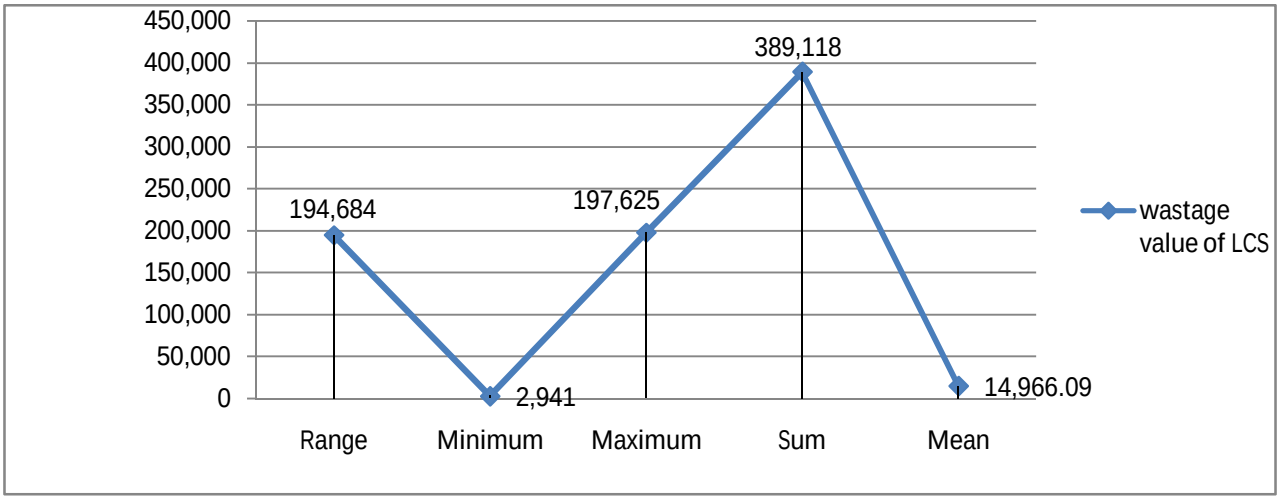


Figure 23.wastage of LCs in selected public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

The wastage rate of LCs due to expiration in proportion of the facilities annual pharmaceuticals budget was 2.47%, 0.5% and 1.7%, respectively for maximum, minimum and mean wastage rate.

Among 26 facilities in which expired LCs found,8(30.8%),11(42.3%) and 7(28.9%) of facilities were with wastage rate of greater than 2%,between 1%-2% and less than 1% ,respectively.

Program and RDF LCs accounted for the 275,266.6 (70.7%) and 113,851.4(29.3 %.) of the wastage value (Figure 25).

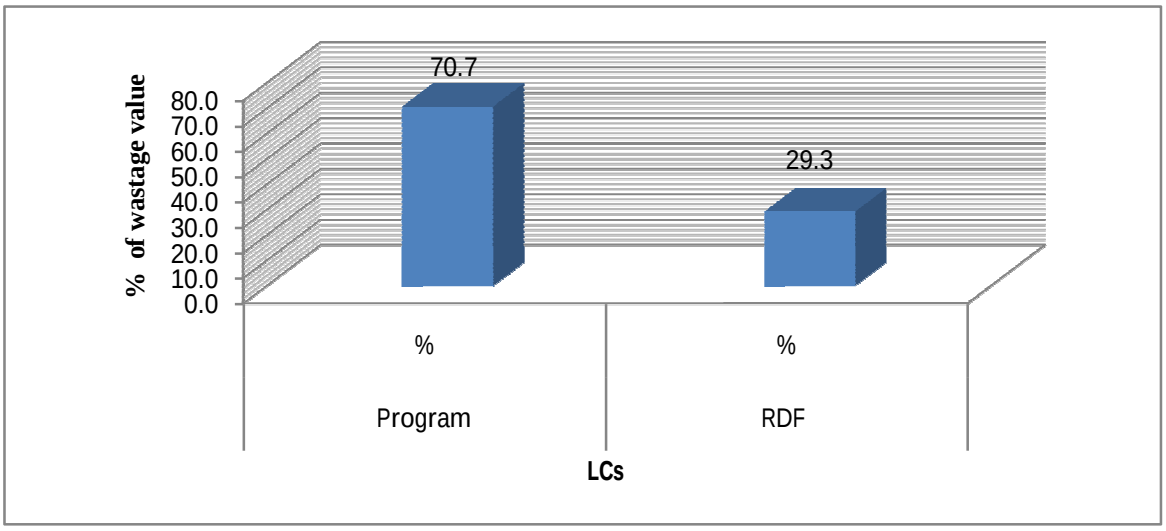


Figure 24.Wastage value of LCs by program and RDF sources in public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

The great share of expired Program LCs was taken by HIV/AIDS commodities 85.7% (235,797.51 Birr) followed by malaria LCs accounted for 12.6% (34,662.27 Birr) (Figure 26).

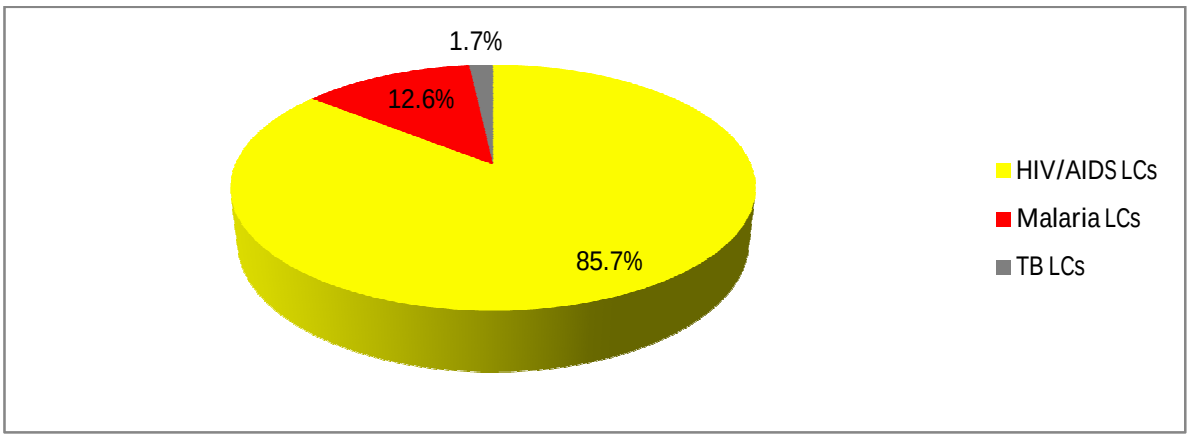


Figure 25.Wastage value of program LCs public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

About 48 %(55,110 Birr) of RDF LCs wastage value was taken by the following 10 commodities .The wastage value for Urine multi test, H-pylori, RPR ,0.1 N HCL and 3.8% Trisodiun citrate was 9,299 ,7603,7241,7137 and 7080 birr respectively (Figure 27).

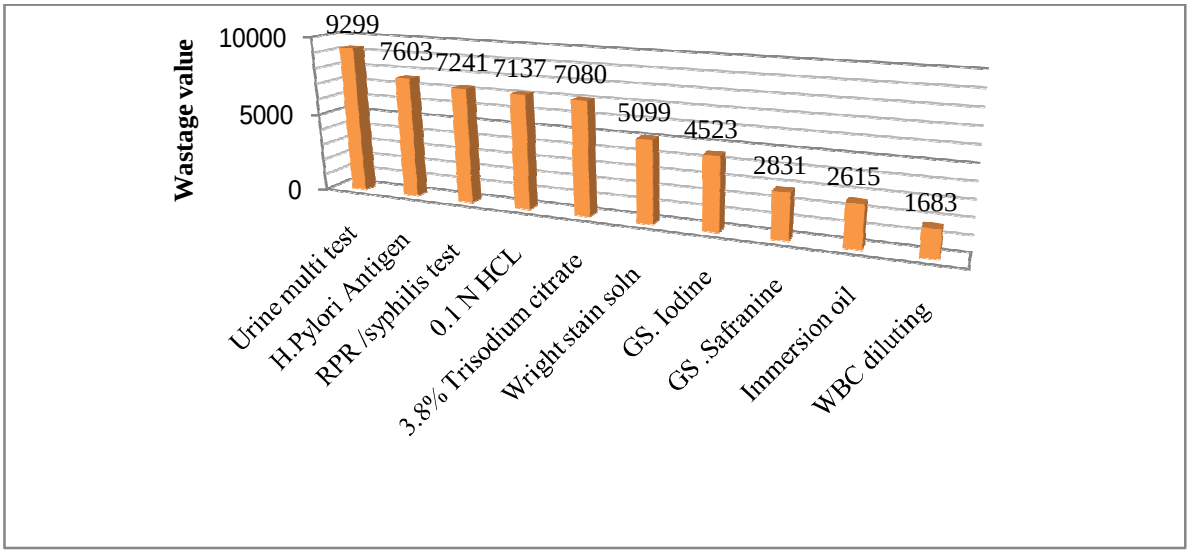


Figure 26. Top Ten Wastage value of RDF LCs public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

The major reasons contributed to expiry of LCs as mentioned by respondents include near expiry LCs received from PFSA 25 (89.3%) and poor quantification of needs within the facility 17(60.7%) (Figure 28 show the detail).

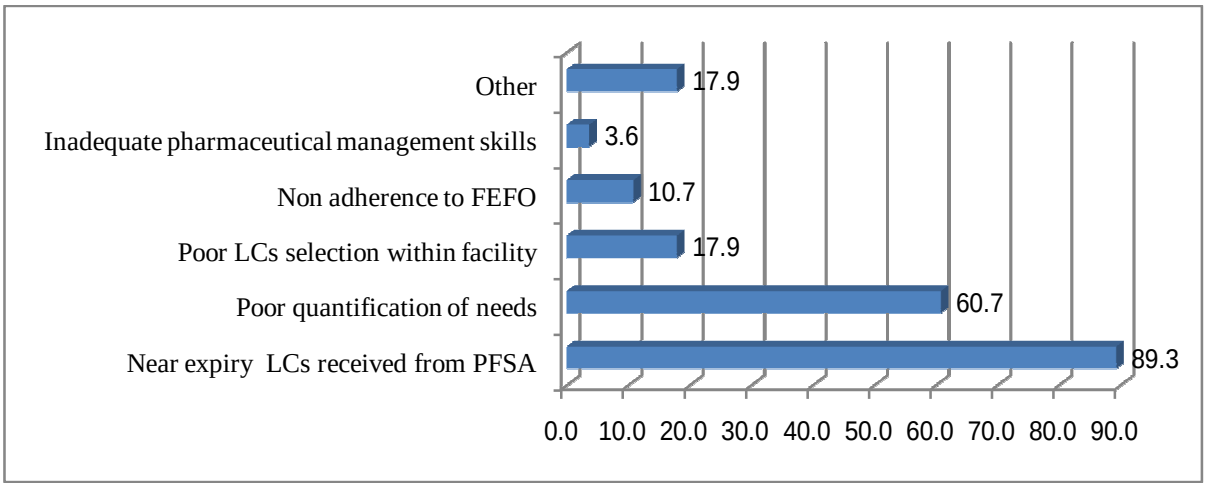


Figure 27. Reasons contributed to expiry of LCs in public health facilities of Buno Bedelle and Illu Aba Bora zones, May 2017

5.7. Challenges in supply chain management of LCs

In-depth interview were held with selected KIs comprised of pharmacy heads, store managers, laboratory heads, zonal logistic officers and officers from key functions of PFSA Jimma Hub. All participants identified the current challenges on the LCs SCM. They also forwarded important recommendations to improve LCs SCM problems in the system. The study result from an interview was categorized into selection to procurement, inventory management, LMIS, availability and wastage related factors of LCs.

1. Selection to procurement of LCs

The challenges related to selection of LCs as mentioned by the majority of the respondents include, lack of establishment of DTC, non functionality of DTC, lack of training related to LCM and lack of developing ELLC . One KI explained that:

" We had DTC which was posted in the office …it was not functional …sometimes at the end of management meeting …DTC members were retained to approve procurement of pharmaceuticals that was planned to be conducted in the next day."

The majority agreed that low attention given to LCs in selection and quantification starting from PFSA to facility level was one main challenge in SCM of LCs. Unavailability of these commodities at PFSA was another main challenge that hinders facilities in serving patients. Moreover, one of KI added that unavailability of LCs at PFSA negatively affected the selection practice. The KI said that:

"The current unavailability at PFSA does not motivate us to make our DTC functional and to prepare facility specific list of essential LCs."

The majority concluded that lack of having ELLC in their facility was not the main reason contributed to unavailability. Rather quantification was negatively affected by unavailability problem at PFSA. The reason given by one of the facility's KI was.

"We have been submitting annual quantification including for LCs at the beginning of each fiscal year for budget allocated by Oromia Regional Health Bureau which was 180,000 Birr for each HC...however, the supply was not improved ...almost no budget was consumed for RDF

LCs because of unavailability....unless otherwise such annual quantification solved the problems ...I don't think it would be solved by developing ELLC merely."

On the other hand, it was mentioned that specification problem during procurement(procuring reagent not appropriate to the machine and procuring incomplete set of reagents for a single test) emanated mainly from poor communication due to lack of functional DTCs was mentioned commonly as a challenge in procurement of LCs in which one KI pointed out the following,

"Many times…as a laboratory unit we have requested LCs...but when a pharmacy professional conduct a procurement need to check whether or not the specified LC is printed in a pick list and a specified commodity has been received …last time I had ordered acetone but the pharmacist brings acetone alcohol which is completely different chemical."

With regard to program LCs the delivery of near expiry commodities was the challenge that negatively affected the forecasting and quantification practice at facilities which leads to wastage of commodities. One of the KI said.

"Regarding program commodities, near expiry LCs were commonly arrived …and items not requested were also delivered …they deliver what they have rather than what was requested by RRF…what can they do if no stock was at their hand….It seems the problem was beyond the capacity of the Hub."

The majority agreed that lack of retaining valid logistic data for LCs forced facilities to quantify by guessing rather than using standard quantification methods. One of the KI said that

"Dispensing units including laboratory did not update their bin cards…however they fill IFRR as a request form similar to the previously used model 20 (before IPLS)and simply request by guessing …as they did not capture accurate records, this in turn negatively affected our quantification practice. "

Almost an agreement was reached that there has been numerous challenges in the selection, quantification and procurement of LCs. Some of the respondents reported that they place orders for LCs in order to get permit to procure from private suppliers. One of our KI said

"Do you think PFSA supply RDF LCs…I don't think so …we have been placing orders for such commodities in order to get stock out report with an intension to legalize the procurement from private suppliers."

The unavailability of LCs both program and RDF sources were agreed by the majority of participant's .In addition one key KI at PFSA Jimma Hub said.

"It was fact that a LC was not commonly refilled/ supplied as per the health facilities requisition…because these commodities were unavailable at PFSA as compared to medicines and we as a branch not commonly refilled by Central office as well."

Lack of appropriate knowledge on these commodities both at PFSA and facility's staff was mentioned as a challenge as well. However, the progress has not yet been witnessed, as the majority agreed ,the incorporation of 2 laboratory technology officers to play advisory role on these commodities(selection to quantification process) was considered as an opportunity for future improvement.

Some of the respondents mentioned challenges related to the lack of timely arrangement transportation and committee issues in the procurement of commodities from private suppliers.

Recommendations forwarded by KIs

- ✓ Health facilities, PFSA and partners need to work on establishment of functional DTCs.
- ✓ PFSA need to give enough attention to LCs like medicines in improving their availability.
- ✓ Training should be organized to narrow the knowledge gaps on appropriate management of LCs for pharmacy staffs.
- ✓ For better result laboratory personnel need to be incorporated in a procurement team.
- ✓ Facilities need to improve the capture of valid logistic data for better quantification which can improve the current unavailability problem

2. Inventory management and storage of LCs

From the in-depth interview it was identified that, the inventory management of LCs was very weak. The stock status of these commodities was poorly managed; procurement was initiated

when stocked out encountered and chronic stock outs of these commodities at PFSA were commonly mentioned challenges in inventory management. The KI said the following.

*"the min max inventory control system is not followed in this facility because the current availability status does not allow us to implement it for LC*s."

The other KI said *"we were not appropriately monitoring our stock status …procurement was initiated when stock out has been encountered …poor monitoring of our stock status …which was intensified by chronic stock outs at PFSA …put difficulties in providing laboratory services in our facility."*

In the majority of health facilities, no defined schedule was in place for procurement of commodities. In facilities were defined schedule was available, not strictly followed. This issue was further explored during our in -depth interview, almost all mentioned that lack of availability of these commodities forced facilities not to establish or follow the already defined procurement plan .As a result the number of emergency orders placed even for program LCs was numerous.

One of our KI said that.

"The commodity which was stocked out at a particular day may be available within a week time and vice versa …as a result we had preferred to place an order on as needed basis …in order to improve the current un availability problem for LCs as much as possible."

Challenges in storage of LCs such as lack of adequate storage space, lack of refrigerator and lack of guidelines and poor knowledge on storage requirements of LCs were the major challenges cited by KIs. In in-depth interview KI said.

"One of the main challenges we have faced so far was shortage of storage space …as you can witness this store is not properly designed …with poor ventilation, congested, we couldn't separately store LCs by zoning . I did inform the health center management to purchase ventilator …no response till now…not only this but also ,no refrigerator in store room to handle LCs requiring cold chain …as a result all LCs requiring refrigeration has been issued to laboratory room regardless of the stock status."

Appropriate storage problem for RDF LCs is evident at PFSA Jimma hub and as further mentioned by KI who said

"There has been a problem in storage of RDF LCs …no appropriate zone is given for theses commodities as a result they were stored here and there …because of these problem some facility may get a certain LCs other may not even if the commodity is available…unless defined zone or separate room has been given them the problem may not be addressed…even if we have tried to arrange a certain location because of shortage of storage space could not be realized so far."

Similarly majority mentioned lack of or inappropriate labeling of certain reagents such as Gram's stain and AFB reagents ,shortage of pharmacy man power and multiple responsibility of store managers as a challenge in appropriate inventory management of LCs.

Recommendations forwarded by KIs

- ✓ The storage condition of LCs must be improved, such as availing refrigerator at pharmacy main store and allocation of adequate storage space.
- ✓ Reagents need to be appropriately labeled before moved to the next level of service delivery point.
- ✓ Personnel working in pharmacy(other professions) main store should not be assigned other responsibility
- ✓ The government should work to increase the number of pharmacy professionals.

3. LMIS in managing LCs

The majority reported that chronic stock out of LCs at PFSA negatively affected LMIS performance for these commodities, the motivation for personnel involved in LMIS could be demolished unless the availability of commodities improved from time to time. One KI said

"we were not motivated to update bin cards and fill IFRR regularly as per our schedule …because the requested items were not available in store …always fill IFRR but no product…. it does not make a sense to fill forms merely…our motivation should be getting the requested commodities and then serving our clients by providing the necessary tests."

Another challenge identified was, the utilization of RRF and IFRR without bin cards utilization which cannot achieve the purpose of IPLS. Similar challenge mentioned in the appropriate utilization of LMIS tools was lack of retaining valid logistic data and utilization of these data for making logistic decisions. KI at facility mentioned.

"occasionally I made ending balance zero …intention to increase quantity requested to get more commodities in fear of future stock out…however I knew this was a mistake."

With regard to supervision on LMIS, majority agreed that supervision on LMIS was commonly conducted by partners. The other commonly mentioned issue was, some easily accessible facilities were supervised now and again, and others with accessibility problems were occasionally or not supervised at all. Sometimes supervision was conducted by a person with no/less orientation on logistics. Interview with KI mentioned that,

"Occasionally higher levels such as ZHD conduct supportive supervision with checklists …but the one who conduct it have no IPLS orientation which did not helped us to progress the system in our facility."

Some of the respondents reported that trained staff turnover, resistance to use and update bin cards at laboratories and store and lack of incentives for store managers were challenges in LMIS performance. In almost all facilities, it was identified that, lack of performance measurement for personnel involved in pharmaceuticals logistics negatively affected LMIS performance. Whether someone performs better or not, there is no means of motivation in place to differentiate good performing DUs from poor performing. As situation was mentioned by KI who said,

"The head of the facility tried to incorporate bin card and IFRR utilization as performance evaluation criteria for dispensing units…besides his efforts no progress has been witnessed as no incentives package in place based on their performance…then good performing dispensing units moved back."

The participation of laboratories in EQA was identified as an opportunity in strengthening LMIS for LCs at laboratory rooms; strengthen by, a KI at laboratory who mentioned as:

"Our laboratory have been participating in external quality assurance (EQA) …one of the criteria is utilization of bin cards and IFRR 'under purchasing and inventory management…it

carries 27 points out the total 160 points in EQA…last quarter we have got 21 /27..we have planned to get better points by further working on it."

Recommendations forwarded by KIs

- ✓ The current chronic stock out of LCs at PFSA must be improved.
- ✓ The utilization of recording tools must be improved especially for bin cards to achieve the purpose of IPLS
- ✓ Supervision on pharmaceuticals logistics conducted by concerned bodies need to consider less accessible areas as well for system improvement.
- ✓ Incentives (of any kind) have to be arranged for personnel involved in SCM.

4. Availability of LCs

The majority agreed that budget allocated for pharmaceuticals including LCs was so far satisfactory; the main problem was unavailability of these commodities at PFSA. When asked about challenges in the availability of LCs .KI from PFSA said.

*"*Since LCs are commonly *short in shelf life and almost all chemicals and reagents are procured from foreign and long lead time for open tender procurement system of the country and delivery problems encountered in the process …finally made LCs delivered to the facilities with near of their expiry dates due to such …port clearing and delivery issues near expiry items and hence stock out encountered."*

Lack of standardization of laboratory equipment was commonly mentioned challenge in improving the availability of these commodities. This issue was raised by KI from PFSA who said

"Another very important problem is that, facilities commonly procured laboratory equipment by themselves from private suppliers which was not in PFSA list …and they expect reagents from PFSA …however PFSA cannot supply such reagents because not included in the quantification process…by identifying these problem …specifically this year ….inventory was conducted on the types of equipment available at health facilities …and we have tried to incorporating them in this quantification…we hope changes will be there in the future. "

A number of respondents mentioned that frequent stock out and the use of *quota at PFSA as well as restriction* of the frequency of procurement from private suppliers were common challenges in the availability of LCs. In addition, challenges such as delivery of some reagents without control group (eg.widal and CD 4 reagent) and delivery of powder which cannot be reconstituted at facility level ,even without its solvent (eg.Geimsa powder) was negatively affect the availability in health facilities. *One KI said.*

"We had recently purchased widal reagent from PFSA…however, when I receive from our store no control group in it at all …this is a quality problem…currently no widal test in this health facility…PFSA need to work on such issues."

Challenges in availability as mentioned by some respondents, included, unable to obtain purchase permit (stock out report) from PFSA for newly delivered items for which selling price has not yet fixed. One KI said.

"At the time of procurement newly arrived items at PFSA for which selling price is not fixed …either stock out report or the items was not given to us since it need 2-3 days until price has been set …so that we were unable to purchase from private suppliers or get it from PFSA us it needs re arrival to PFSA…PFSA need to consider this issue."

Some of the respondents also reported that challenges including ordering reagents by brand/familiar names/ rather than names in the PFSA system/generic, was a source of miscommunication and unavailability at facility level. Another challenge mentioned was management restricting procuring from private suppliers at all. The KI mentioned the following.

"The procurement rule of the health center does not enable us to purchase stocked out LCs from private suppliers the management always associate the procurement other than PFSA is risky as well as vulnerable to corruption….simply we are dependent on what is available at PFSA …we have been try to compensate un availability by increasing the procurement frequency."

The majority of the respondents also mentioned the challenges in availability due to miscommunication within the PFSA itself. One KI said the following.

"During annual inventory period facilities may receive commodities as an emergency order by delivery notes…then after completion of inventory, items issued by delivery note need to be issued from health commodity management information system(HCMIS)…however due to different reasons including work load and carelessness theses products were not issued from the system …as a result an item may be in a HCMIS system but not physically available …this and additional problems originated from the system itself …contributed to miscommunication between storage and distribution officers and store managers as items printed in a pick list but not physically available in store."

Recommendations forwarded by KIs

- ✓ PFSA need to strive to improve the availability of LCs
- ✓ Pooled procurement of laboratory equipment must be planned between PFSA and health facilities to reduce proliferation of laboratory equipment in the country.
- ✓ The miscommunications within the PFSA itself have to be solved from its source.
- ✓ The involvement of laboratory technology officers within the PFSA key functions need to be improved.
- ✓ For improved availability of LCs permit should be given from the management and PFSA to purchase from private suppliers.

5. wastage/expiry level of LCs

The majority of the respondents reported that delivery of near expiry LCs from/by PFSA, the procurement of incomplete set of reagents for a single test and procuring reagents without considering laboratory equipment functionality status due to miscommunication between pharmacy and laboratory unit staffs were challenges in utilization of LCs contributed to wastage. One KI reported the following.

" For a single test we may require a number of reagents, but due to unavailability at PFSA only a single of simultaneously required reagents commonly procured, this was wastage of resources … commonly encountered due to pharmacy professionals had limited knowledge on these commodities and miscommunications as well. "

The majority also mentioned that poor quantification of needs, power interruption, poor communication between laboratory and clinicians, lack of requesting tests from clinicians were challenges contributing to expiry of LCs. One KI said

"Poor communication between laboratory staffs and clinicians …there was a problem in requesting laboratory tests …some request the same test now and again …did not request the rest…we had discussed this issue on DTC and the test menu was provided to all clinicians …but still nobody request gram's stain as an example …so such reagents commonly expire in our facility."

Recommendations forwarded by KIs

- ✓ Laboratory commodities need to be procured with communication between pharmacy and laboratory staff as much as possible
- ✓ Facilities need to improve their quantification practice for LCs.
- ✓ The knowledge gap and miscommunication in the utilization of LCs /requesting tests need to be improved.
- ✓ Before the procurement of LCs laboratory equipment functionality status must known.

5.6. Correlation result between and within different variables

5.6.1. Correlation between dependent and various independent variables

As shown in Table 10, the existence of correlation was tested between dependent and independent variables. The first dependent variable (number of test menus not provided at the time of visit) showed negative correlation with functional DTC (r= -0.676, p=0.000), number of DTC meeting (r=-0.500, p=0.007), number of pharmacist (r=-0.381, p=0.045), Availability of ELLCs(r=-0.567, p=0.001),and procurement/order limited to ELLCs (r=-0.543, p=0.003).No statistically significant association was obtained for independent variables: average lead time, method of quantification, training and emergency order.

Availability of sampled LCs was positively correlated with three of the independent variables: procurement/order limited to ELLCs (r=0.447, p=0.017), Functional DTC(r=0.51, p=0.005) and number of DTC meeting(r=0.497, p=0.07).Whereas no statistically significant correlation was

found with the rest of independent variables (availability of ELLCs, average lead time, method of quantification, training, educational Qualifications and emergency order).

Stock out rate showed negative correlation with only two independent variables: Number of pharmacists(r=-0.380, P=0.046) and number of staffs trained in LCM (r=-0.407, p=0.031).No correlation was observed with the independent variables: implementation of min/max inventory control system, storage conditions and frequency of stock taking.

Accuracy in record keeping showed positive correlation with independent variables: number of pharmacy professionals (r=0.395, P=0.037), p=0.038), and % of acceptable storage conditions (r=0.509, p=0.006).Statistically significant correlation was not found with the rest of independent variables: implementation of min/max inventory control system, frequency of stock taking and training.

Wastage value showed positive correlation with % of record discrepancy (r=0.434, p=0.027) and weak negative association with: Utilization of RRF (r=-0.424, p=0.031), RRF reporting rates (r=-0.523, p=0.006). No correlation was observed with the following independent variables: availability of LIMS tools, training and work experience.

Table 10. Statistically significant correlation/Correlation between the dependent and the independent variables, Buno Bedelle and Illu Aba Bora zones, May 2017

Independent variables	**Dependent variables**	**P-Value at 95 CI**	**100*r^2(Coefficient of determination)**
	Number of test menus not provided at the time of visit		
Functional DTC	r= -0.676 **	p=0.000	45.7%
Number of DTC meeting	r= -0.500 **	p=0.007	25%
Number of pharmacist	r= -0.381 *	p=0.045	15%
Availability of ELLCs	r= -0.567 **	p=0.001	32.1%
procurement/order limited to ELLCs	r= -0.543 **	p=0.003	29.5%
	Availability of sampled LCs		
Procurement Limited to ELLC	r=0.447 *	P=0.017	20%
Functional DTC	r= 0.51 **	p=0.005	26%

No of DTC meeting	r= 0.497 **	p=0.007	24.7%
	Stock out rate		
Number of pharmacists	r= -0.380 *	P=0.046	14.4%
No of staffs trained in LCM	r= -0.407 *	p=0.031	16.6%
	Accuracy in record keeping		
Number pharmacy professionals	r= 0.395 *	P=0.037	15.6%
% of acceptable storage conditions	r= 0.509 **	p=0.006	25.9%
	Wastage value		
% of record discrepancy	r= 0.434 *	p=0.027	18.8%
Utilization of RRF	r= -0.424 *	p=0.031	18 %
Number of RRF reports	r= -0.523 **	p=0.006	27.4%
*.Correlation is significant at the 0.05 level **.Correlation is significant at the 0.01 level			

5.6.2. correlation/Interdependence among independent variables

As it can be seen from Table 11 below, the interdependence among independent variables were evident. Number of RRF reports have been shown positive interdependence with store managers work experience (r= 0.419, p=0.027). Storage conditions (%) had a positive interdependence with standard ordering schedules and procedures for LCs (r= 0.689, p=000), management enforced regular schedule(r= 0.382, p=0.045), number pharmacy professionals (r= 0.528, p=0.004) and number of pharmacist (r= 0.581, p=0.001).

Availability of functional DTC have been shown positive interdependence number of pharmacy professionals(r=0.539, p=0.03).Again procurement limited to ELLC has been shown positive interdependence with number of pharmacists(r=0.543, p=0.003) and training in LCM(r=0.0529, p=0.004).

Table 11. Statistically significant correlation/Interdependence among independent variables, Buno Bedelle and Illu Aba Bora zones, May 2017

Independent variables	Independent variables	P-Value at 95 CI	100*r^2(Coefficient of determination)
	Store managers work experience		
Actually submitted reports during the past year	r=0.419 *	p=0.027	17.6%
	% of acceptable storage conditions		
standard ordering schedules and procedures for LCs	r=0.689 **	p=000	47.5%
Management enforced regular schedule	r=0.382 *	p=0.045	14.6%
Number pharmacy professionals(degree+diploma)	r=0.528 **	p=0.004	27.9%
Number of pharmacist	r=0.581 **	p=0.001	33.8%
	Functional DTC		
Number pharmacy professionals	r=0.539 **	P=0.003	29.1 %
	Procurement Limited to ELLC		
Number of pharmacist	r=0.543 **	p=0.003	29.5 %
Trained in LCM	r=0.529 **	p=0.004	28 %

5.6.3. Coefficient of determination result

Correlation result of the study between dependent and independent variables showed the existence of moderate association with significant values of coefficient of determination (r^2). Accordingly, 45.7%, 25%, 15%, 32.1% and 29.5% of variation in test menus not offered at the time of visit were explained by unavailability of functional DTC, number of meeting not attended by DTC, un availability of pharmacist at health facilities, un availability of ELLCs and procurement of LCs not limited to ELLCs, respectively. Likewise, 20%, 26% and 24.7% of variation in availability of sampled LCs were explained by procurement of LCs limited to ELLC, availability of Functional DTC and no of DTC meeting, respectively. Similarly, 14.4% and 16.6% of variation in stock out duration was explained by the unavailability of pharmacists at health facilities and lack of training in LCM, respectively. With regard to the other dependent

variable, 15.6% and 25.9% of variation in accuracy in record keeping was explained by availability of pharmacy professionals and % of acceptable storage conditions, respectively. Finally, 18.8%, 18% and 27.4% variation in wastage value of LCs was explained by % of record discrepancy, lack RRF Utilization and poor RRF Reporting rates, respectively.

Moderate interdependences have been shown between % of acceptable storage conditions and standard ordering schedules and procedures for LCs (47.5%), Management enforced regular schedule (14.6%), Number pharmacy professional (27.9%), number of pharmacists(33.8%).The availability of functional DTC showed positive interdependence with number of pharmacy professionals(29.1%) whereas as procurement limited to ELLCs have been shown interdependence with number of pharmacists(29.1%) and training in LCM(28%).

6. Discussion

6.1. Selection to procurement of LCs

In this study, downstream supply chain management of LCs was assessed .To manage LCs effectively the role of ELLC is indisputable. Developing standard lists of commodities that are based on the level of the lab and the tests performed will aid in commodity selection and management [13].In the current study, however , it was found that only 10 (35.7%) of the facilities has developed facility specific ELLC. Lack of laboratory lists usually leads to uncontrolled proliferation of diagnostics and technologies in the country [18]. Selection of LCs among the facilities that developed ELLCs was done by DTC but only 5(50%) procure LCs from ELLCs. This finding was comparable with Sub-Saharan countries like Tanzania where only 38% of the surveyed health facilities had essential drug list (EDL) and among them only 52% of the facilities procured pharmaceuticals within the EDL [32].

In the current study DTC was established in 21 (75%) of facilities, however, functional only in 10 (35.7%) of them. This finding was lower than, the baseline assessment done in Uganda where, 22(50%) health facilities had functional DTCs and 18 (40.9%) of these met regularly [48].This difference might be due to weak implementation of DTCs in our set up because of lack commitment and low awareness on the benefit of DTCs improving availability.

In the assessment of supply system followed for program LCs from PFSA, the majority of the respondents agreed that the system was push 16 (57.1%), whereas, 12(42.9%) said it was pull. We call the system is push, if the final resupply quantity is determined by the higher level/PFSA. This finding was in contrary to the inventory control system in IPLS which is a forced ordering maximum/minimum inventory control system which is pull [19].The probable explanation for this may be un availability of LCs at PFSA emanated from inefficient SCM of LCs, might shift the system gradually to push, this was also supported by the finding from the in-depth interview where the respondents explained that PFSA commonly deliver what they have at hand instead of the commodities requested by RRF. For a pull system to work properly sufficient supplies must be available at supply sources to meet all health facilities demand .However, the main advantage of pull system over push is that health facilities are supplied according to their commodity demand [15].

The assessment showed that 53.6%, 39.3% and 35.7 of facilities quantify their LCs by guessing, consumption and available budget, respectively. This is mainly due to the absence of retaining valid logistic data on LCs that leads to poor quantification of needs, that either ends with stock outs or wastage of commodities. Our finding was in line with the study done in Malawi that indicated, lack of stock data collection for general laboratory products was reason for poor quantification of LCs and there is no system yet to quantify laboratory supplies based on what is consumed in the country that contributes to recurrent stock outs of critical reagents and other supplies [33].

Concerning laboratory services, the number of test menus each facility planned to provide in its set up and posted in laboratory was taken as criteria to select the number of test menus for each facility. The mean number of test menus planned to be offered were 18 and 28 in HCs and hospitals, respectively, whereas the mean number of test menus not offered at the day of visit were 4.8 (26.7%) and 3(10.7%) for HCs and Hospitals, respectively. The Laboratory heads were asked the reason why not providing these tests. The reason mentioned for not providing these tests were, lack of reagent 27(96.4%), equipment breakdown 9(32.1%), lack of training 2(7.1%) and other 6(21.4 %). Our result was comparable with a study done in Ghana found that lack of reagents and lack of equipment were the two most common reasons a test was not offered. The unavailability of reagents might occur because the test was not requested, with the result that reagents were not procured or the laboratory became stocked out of reagents [35].

6.2. Inventory management of LCs

For any max-min system, it should set the max and min levels high enough to avoid stock outs, yet low enough not to increase the risk of expiration or damage[7].In this study ,however, none of surveyed facilities establish maximum/minimum and reorder level for LCs. They said that the min max inventory control system was not followed in their facilities because; the current availability status does not allow them to implement it for LCs. Similar study conducted in Malawi indicated, the absence of standard inventory control system (established maximum or minimum stock) in place for managing laboratory commodities at any of the facilities[33]. This finding was in line with the study done in Addis Ababa where none of the facilities used minimum maximum inventory control system for test kits due to fluctuation in the supply chain of these commodities [27]. Studies recommend that for implementation of maximum-minimum

inventory control system, sufficient commodity supplies must be ensured [13],so that, the min max inventory control system might not work for LCs with current availability status at PFSA.

A well designed and well operated inventory control system helps to prevent shortages (stock out and emergency order) ,over supply and expiry of pharmaceuticals [21] .In this study ,however, all hospitals placed more than 3 emergency orders and 15(68.2%) of HCs place at least one emergency orders during the past year. Similarly the study done in Malawi indicated that 70% of the district hospitals placed one or more emergency orders in the last year, while 60 % of HCs had at least one emergency order in the last year[33].Another base line survey in Uganda indicated that,18(62%) made emergency orders for HIV test kits and 9(31%) made emergency orders for CD4 reagents [48].The higher number of emergency orders in the current study could be due to ineffective management of LCs in Ethiopia.

For the sampled LCs assessed in the main pharmacy store, the average availability of bin cards were lower at the HCs (28.3%) compared to hospitals (90.8 %).On average, hospitals (53.4%) did better updating bin cards than HCs (16.9 %)).The accuracy of bin cards was better for hospitals (37.3 %) than HCs (11.6%). A study done in Addis Ababa on laboratory LMIS practice for HIV/AIDS and TB LCs indicated, 50% of the assessed hospitals and 54% of HCs were currently using bin cards for all HIV/AIDS and TB (Tuberculosis) LCs in main pharmacy store, among these only 25% and 20.8% of them were updated with accurate information matching with the physical count done at the time of visit for hospitals and HCs respectively [49]. Another study done in Malawi indicated that 70 % of District Hospitals and 40 % of HCs Use Stock Cards for Lab Supplies .Likewise, 100 % of hospitals and 33% of HCs use standard ordering form for lab supplies [33]. The lower result in our study in HCs could be due to poor implementation of LMIS for LCs, on the other way, better result for hospitals could comparatively be due to better LMIS implementation and small number of hospitals in our study.

Concerning the utilization of bin cards for TB LCs, 11 (39.3 %), 12 (42.8%) and 9 (32.1%) for Carbol fuchsion, methylene blue and acid alcohol, respectively. This result was comparable with the study done in Addis Ababa that indicated, 13(39.4%) of facilities were using bincard for both Carbol fuchsion and acid alcohol [49]. In our study the utilization of bincard for colloidal cold and unigold was 60.7% and 50 % respectively. This finding was consistent with the study done

in Addis Ababa that identified 15(57.7%) utilization of bin cards for KHB [49] and the study done in Tanzania that showed 58% of facilities had stock ledger forms for rapid test kits [20].

In this study, all hospitals and only 11(44%) HCs had bin cards for the selected HIV test kits. Similar study done in Addis Ababa indicated that only 10(52.6%) of HCs and 2(50%) of hospitals had bin cards for the test kits on the day of visit while the remaining 9(47.4%) of HCs and 2(50%) of hospital didn't have bin card for test kits [27]. These differences might be due to better implementation of IPLS in the hospitals and lower implementation of IPLS in HCs for LCs in the current study.

To provide clients with quality and high standard laboratory services, commodities need to be stored in appropriate storage conditions, however, in contrary to this; the assessment revealed that only one hospital fulfilled 100 % storage conditions of all the criteria. The two weakest criteria of storage conditions fulfilled were availability of fire safety equipment 2(10.7%) and cold chain items storage in appropriate temperature 7(25%).Regarding storage space adequacy it was 42.9%. An evaluation done in Ethiopia similarly showed that there was inadequate storage facilities and temperature monitoring, especially for the cold chain in the selected health facilities [50]. FEFO principles for LCs were applied in 14 (53.6%) of facilities. The finding was different from the study done in Addis Ababa where 70% of facilities fulfilled the condition[26].This difference may be due variations in the availability of trained pharmacy professionals .But the finding was comparable with the study done in Malawi 59.8% of facilities fulfilled the condition. In our study the availability of Storage guidelines for LCs found to be 2(7.1%). The result was comparable with a study done in Malawi where only 4% of facilities had storage guidelines for LCs. However, higher than the study conducted in Lesotho, where all laboratories reported that they had no written guidelines for storage of laboratory supplies according to their specifications [34]. But much less than the study done in Addis Ababa, where 5 (45.5%) had written guideline for storing laboratory supplies or commodities according to their specification [45].The difference could be due to more store managers in Addis Ababa might trained in LCM where they received guidelines with them after training. Another explanation could be frequent supervision in Addis Ababa.

6.3. LMIS and its management support

In our study the availability of blank logistic tools (bin cards, RRFs and IFRRs) for LCs are all 100% in hospitals and 100% (Both for blank bin cards and RRFs) and 88% for IFRRs respectively in HCs. This result was slightly better than IPLS national survey conducted in 2015,where availability of blank bin cards, IFRRs, and RRFs was high at hospitals (above 90 %) and HCs (close to 80 %)[44]. This difference could be due to more works done to avail LMIS tools by PFSA in collaboration with partners especially in the current year.

All of the hospitals utilize bin cards for LCs both in store and laboratory but only 53.4% and 40% updated in store and laboratory room, respectively. Whereas 10 (40%) of HCs store and 6(24%) laboratory utilize bin cards for LCs, however, only 16.9% in store and 9.2% in laboratory updated. It was found that all hospitals (3) and 15(60%) of HCs use IFRR respectively to request LCs from main pharmacy store. As compared to the study done in Addis Ababa on Bin card utilization of LCs, it was 50% in hospitals and 54% in HCs [26] .The higher result in utilization of bin cards in hospitals might be due to more supportive actions carried out for IPLS implementation in recent years. In addition, there were only 3 hospitals in the study area, more attention has been given to these hospitals by higher level as compared to HCs in supportive supervision. But, our result was comparable with both the study done in Lesotho where 33 % of laboratories utilize stock/bin card [34] and a study done in Malawi where use of stock/bin cards, use of stock/bin cards to calculate order and use of standard ordering form was 40%, 20% and 31% respectively for HCs and 70%, 30% and 100% respectively in hospitals for similar tools [33].The finding for hospitals was different from the current study this may be due to small number of hospitals in our study.

Our study also revealed that availability of management support on pharmaceuticals management as reported by respondents helped for better utilization of IFRR by laboratory unit, the rate of updating bin cards and better functionality of DTCs. This finding is comparable with the study done in Addis Ababa where management support helped for better implementation of IPLS [49].

6.4. Availability of LCs

Overall better average availability at the day of visit was found for hospitals (81.3%) than HCs (50.6%).Likewise, the overall availability for RDF and program LCs was 84.8 % and 78.6 % , 54.2% and 47.7 % for hospitals and HCs, respectively. Better availability of LCs at hospitals might be due to the availability of better functional DTC, better availability of pharmacy professionals, better implementation of IPLS, more demanding society and better management support in hospitals.

In management of TB control services, stock outs of TB LCs are unacceptable [12].However, in this study 6 (24%), 6 (24 %) and 7(28%) of HCs were stocked out of carbol fuchsin ,acid alcohol and methylene blue respectively, whereas, hospitals were not stocked out of these commodities at the day of visit. The finding was higher than the study done in Amhara where, 11% of HCs were stocked out for each of Carbol fuchsin and methylene blue, whereas, 8.5% were stocked out of acid alcohol at the time of visit [28]. A study done in Addis Ababa showed that only 2.9% of facilities stocked out of acid alcohol and all had adequate supplies of carbol fuchsin and methylene blue on the day of visit [26]. In Malawi, 5% of HCs had stocked out of carbon fuchsin, methylene blue and acid alcohol [33].The higher stock out rate found in our study at HCs could be due to infrastructural problems of the study area where transportation poses challenges, poor inventory management in HCs and also due to reagents with quality problem were found in some HCs.

The availability of Giemsa stain in the current study was 20(80%) and 3(100%) in HCs and hospitals, respectively. This finding was higher than both the study done in Malawi 84% for district hospitals [33] and IPLS national survey in Ethiopia, 34% and 28 % for HCs and hospitals, respectively [44]. The higher availability in our study could due to the fact that dramatically reduced malaria morbidity cases in Ethiopia as an impact of prevention works done including in the study area that might greatly reduce its consumption and hence improved availability. The other reason might be because of better availability of the commodity probably due to attention given to malaria diagnostic treatment from partners working in the area of laboratory accreditation.

In the current study, 4(16 %) of HCs were stocked out for each of Colloidal Gold and Unigold at the day of visit, whereas, all the three hospitals did not encounter stock out at the day of visit for the same commodities. Similar study in Malawi indicated that, 22 % and 8% of HCs and District hospital laboratories were stocked out of Determine and 18 % and 25 % of HCs and District hospitals were stocked out of Unigold, respectively, on the day of the visit [33]. This finding was comparable with the study done in Addis Ababa, from 33 facilities, 9 (27.3%), 3 (9%) and 7 (21%) of facilities were stock out for KHB, stat-pack and uni-gold test kits respectively [49]. Another study in Addis Ababa indicated that, 12 (63.2 %) of the HCs were stocked out of one or more selected test kits at the day of visit [27]. Higher availability of HIV/AIDS test kits in hospitals of our study could be, the newly shift of screening test from first response to colloidal cold, and hence all hospitals were recently supplied.

The current study revealed that, 3(60%) and 4(80%) of eligible facilities were stocked out of GOT and CD4 reagents respectively, at the day of visit. Higher than both the study done Addis Ababa where, 37.5% & 33.3 % of facilities stocked out of CD4 and GOT reagents, respectively [49]. Another study done in Addis Ababa also revealed 12.5% of facilities were stocked out for each of CD4 and GOT reagents, at the day of visit[26],respectively for similar reagents . Again it was higher than the study done in Malawi that indicated, 28 % and 60% of facilities were stocked out for CD4 and GOT reagents, respectively [33]. These differences could be due to, the small number of lab monitoring sites (5) in the current study and breakage of CD4 machine and hence the reagent was not handled in one of the hospitals. Another explanation could be due to inefficient SCM of HIV/AIDS lab monitoring reagents in the study area as expired lab monitoring chemistry reagents found in these eligible sites.

In our study 4(80%) of facilities were stocked out for each of GOT, Bilirubin (Direct) and Bilirubin (Total), during the past three months prior to the study. Likewise 5(100%) and 3(60%) of facilities were stocked out of CD4 reagents and creatinine, respectively, during the past 3 months. Higher stock out rate than the study conducted in Addis Ababa indicated that 43.8% and 9.1% of facilities were stocked out of GOT and CD4 reagents, respectively, during the past 6 months [49]. Again higher stock out rate than another study done in Addis Ababa where 37.5%,50% ,75%,75% and 25 % of facilities were stocked out GOT,CD4 reagents, Bilirubin (Direct) ,Bilirubin (Total) and Creatinine, respectively, during the past six months[26].

Regardless of the time frame, higher stocked out rate in our result for such commodities could be due to more interruptions and inconsistencies in SCM of lab monitoring reagents. Even though, the time period in our study was shorter (three months), the stock out rate was higher, indicating the problem could be worse than this.

In the current study stock out on the day of visit for gram's stain reagents were, 67.9%,67.9% 57.1 % and 60.7% for GS crystal violet, GS iodine , GS alcohol and safranine, respectively. The finding was higher than the study done in Malawi which was 28%,19% 37% and 38 % for similar reagents respectively[33] .This difference was due to the fact that in many of the assessed facilities gram's test was not requested by clinicians ,even though, it was included in their test menus. For this reason the majority of store managers said that these reagents were among the commonly expired LCs and as a result majority stopped to procure these commodities. Similarly communication problem between pharmacy and laboratory was common in the majority of HCs, such as procuring one, two, or three of simultaneously required of 4 Gram's test reagents.

Regarding reasons for stock out of LCs, unavailability at PFSA ,26 (92.9%) and non supply of quantity requested 11(39.3%) were commonly mentioned reasons for being stocked out of program LCs ,whereas, stock out at PFSA 21(75%) and supply/availability of near expiry commodities 13 (46.4%) were the two most commonly cited reasons for stocked out of RDF LCs. This study was in line with a study done in Nigeria that revealed the reasons for stock out as ,non-supply of quantity requested for/inadequate supply, occasional upsurge in consumption, supply of near expiration LCs, delay in resupply of LCs (increased lead time) [34].

6.5. Wastage of LCs

There was a high amount of expired LCs in the facilities while others were stocked out of key LCs. It was found that a total of 389,118 Birr lost due to expiry LCs within the past year. The maximum being 197,625 Birr and the minimum value was 2,941 Birr. On average each hospital and each HC lost 79,403.9 and 6,561.2 Birr, respectively, from the expiry of LCs during the past year. The value of LCs lost due to expiration in proportion to their annual pharmaceuticals budget was 2.47%, 0.5% and 1.7% respectively for maximum, minimum and average wastage rate. Among 26 facilities in which expired LCs found,8(30.8%),11(42.3%) and 7(28.9%) of facilities were with wastage rate of greater than 2%,between 1%-2% and less than 1%

,respectively. Program LCs accounted for 70.7 % of the wastage value, out of which expired HIV/AIDS LCs accounted for 235,797.51 Birr (85.7%). This difference might be due to push supply of near expiry commodities and poor inventory management within the facilities for program LCs .The finding of the study was in compliance with the study done in Addis Ababa in which a huge amount Expired HIV/AIDS LCs were found in 25 (73.5%) of facilities [26]. Another research conducted in Nigeria indicated, ARVs and Rapid test kits (RTKs) formed the basis of most expired commodities encountered. Total cost of 1,181,487 Birr of fund lost due to expiry of ARV and LCs. Lab reagents and consumables merely accounts for 599,659 Birr of the lost from March 2013 to August 2014[51].In line with our study findings the wastage of LCs due expiration were high.

About 48 %(55,110 Birr) of RDF LCs wasted due to the expiry of 10 commodities merely .The top 5 commodities in wastage value were, Urine multi test, H-pylori, RPR ,0.1 N HCL and 3.8% Trisodium citrate 9,299 ,7603,7241,7137 and 7080 birr, respectively. The of wastage of RDF LCs was attributed to, as evidenced in KI interview, because of poor selection and quantification within the facility, lack of knowledge on some LCs, breakage of cold chain management as a result of power interruption, miscommunication among pharmacy, laboratory and clinicians in the procurement and utilization of LCs.

The current study found that the major reason contributed to the expiry of LCs as mentioned by the respondents were near expiry LCs received from PFSA 25 (89.3%), poor quantification of needs within the facility 17 (60.7%) and non adherence to FEFO 3 (10.7%).These results were in compliance with the study done in Nigeria in which supply of commodities that are close to expiration and failure to follow the principle of FEFO were mentioned as the common reasons contributed to expiration of LCs [34]. The findings of our study are also supported by a study done in Kenya that showed, Distribution of laboratory commodities follows a push system, no sharing of laboratory system information among stakeholders and Profusion of expired commodities in which 32% of surveyed facilities had expired HIV test kits) [19].There were also commonly mentioned contributing factors identified during in depth interview such as lack of requesting tests from clinicians, power interruption, specification problems and procuring in complete set of simultaneously required reagents for a single test(often due to lack of awareness by pharmacy professionals).

6.6. Correlation among different variables

The result of the study indicated that, moderate negative correlation have been shown between number of test menus not provided at the time of visit and availability of functional DTCs with a coefficient of 0.676**,** meaning availability of functional DTCs at health facilities reduce the number of test menus not offered at the time of visit by 45.7%, through avoiding stock out and improving utilization of LCs. Availability of sampled LCs has been positively correlated with functional DTCs with a coefficient of 0.51 meaning availability of functional DTCs improve the availability of LCs by 26% . Stock out rate showed moderate negative correlation with number of staffs trained in LCM with coefficient of 0.407 indicating stock out rate can be reduced by 16.6% by providing training in LCM. Accuracy in record keeping showed moderate positive correlation with % of acceptable storage conditions with coefficient of 0.509, which means 25.9% of accuracy in record keeping can be attained by the improvement in % of acceptable storage conditions. Wastage value of LCs has been shown moderate negative correlation with number of RRF reports with coefficient of 0.523, indicating improvement in RRF reporting rates can reduce wastage of LCs by 27.4%.

According to a literature the value of r is considered as weak correlation if ($0 < |r| < .3$), moderate/fair correlation when ($.3 < |r| < .7$) and strong correlation for ($|r| > 0.7$) [52]. In the current study the value of $|r|$ ranges from 0.380 to 0.689 when tested between dependent and various independent variables which is moderate correlation.

7. Strengths and limitations of the study

7.1 Strengths of the study

- ✓ The study was conducted on both program and non program LCs both at store and laboratory and hence unique in its kind by covering broader issues
- ✓ Combination of both quantitative and qualitative method helps to supplement the findings each other
- ✓ The study was conducted on less accessible zones and not too nearby PFSA hub and helped to identify real problems in SCM of LCs.

7.2 Limitation of the study

- ❖ The study did not include all parts of downstream supply chain management such as transportation systems
- ❖ Limitation of valid logistics data on LCs
- ❖ Small number of hospitals in the study area put difficulty in comparing the finding with other study

8. Conclusions and Recommendations

8.1. Conclusions

The importance of preparing facility specific ELLC was not given enough attention. Not only the preparation, but also the utilization of the prepared list by itself was below the standard. As a result of specification problems emanated from unavailability of ELLC in facilities, poor communication between laboratory and pharmacy professionals and lack of knowledge on LCs, much wastage and stock out were encountered in majority of health facilities. With its problems, functionality of DTC was better in hospitals as compared to HCs. Lack of retaining valid logistic data both at laboratory and store, enforced the majority of facilities to quantify LCs by guessing. Besides, the number of test menus not offered were large in HCs than hospitals, Significant numbers of test menus were not offered to clients at the day of visit, mainly due to lack of reagents.

Generally, inadequate availability of LCs both in kind and quantity intensified by shortness of its shelf life, made the min/max inventory control system set in IPLS totally impractical for LCs. As a result, the supply system PFSA followed gradually moved to push system for program LCs. The number of emergency order placed within the past year was numerous, which indicates inefficiencies in SCM of these commodities. The utilization of bin cards for sampled LCs even though it varies among facilities, hospitals did better in updating and in keeping accuracy of bin cards. The storage conditions of health facilities need an action, especially with regard to fire safety, implementation of FEFO, and lack refrigerators in store which was partly associated inadequacy of storage space.

The availability of logistic tools were high, however the utilization was different from facility to facility, but in general better utilization was seen in hospitals. Generally, it can be concluded that, the implementation of LMIS for LCs was weak. However, the availability of management support in health facilities comparatively helped for better implementation of LMIS.

Regardless of variation between facilities and across commodities, high stock out rate was recorded for sampled LCs. Generally the availability across commodities was better in hospitals.

It was evident that high wastage rate was documented for LCs mainly due to supply of near expiry form PFSA and poor quantification of needs within the facility. A total of 389,118 Birr was lost within last year due to the expiry of LCs.

The study result from KI with personnel involved in SCM of LCs indicated that challenges in SCM of LCs categorized into selection to procurement, inventory management, LMIS, availability and wastage related factors of LCs and important recommendations also forwarded.

Though the degree of correlation between dependent and independent variables was moderate/fair, they can be significant predictors for SCM of LCs as evidenced by coefficient of determination.

The study concludes that low availability, high stock out rate, significant number of test menus not offered, poor accuracy in record keeping and high wastage rate of LCs, are all an indicators of weak status of supply chain management of LCs.

8.2. Recommendations

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

- ✓ Health facilities should prepare and utilize ELLC based on the prevalence disease conditions
- ✓ DTC must be established and be functional in all health facilities and pharmacy unit must play a leading role together with a support from partners and stake holders
- ✓ PFSA need to work to improve pushed delivery of near expiry items for program LCs
- ✓ Storage condition of nearly all the facilities should be improved quality of testing services and for reduction of damage and expiry of LCs.
- ✓ Health facilities must capture valid logistic data on LCs both at store and laboratory to improve the quantification of these commodities for the final outcome of improved availability for provision quality lab testing services
- ✓ Health facility and ZHD management need to play supportive role including the utilization of LMIS performance as evaluation criteria for concerned personnel working in store and laboratory for better LMIS implementation

- ✓ PFSA should work to improve the availability of LCs in particular and their SCM in general from the grass root with long term plan
- ✓ Regular supportive supervision by ZHDs should be conducted to improve the LMIS as well as the whole supply chain management of LCs
- ✓ Health facilities should work to reduce the wastage level of LCs
- ✓ Illu Aba Bora and Buno Bedelle ZHD should establish a system of transferring LCs between facilities to reduce the wastage rate
- ✓ The two ZHDs should work to increase the number and the skills of pharmacy professionals in the health facilities
- ✓ The two ZHDs together with their partners need to organize training on LCM for pharmacy professionals
- ✓ More detailed and large scales studies need to be conducted to see the status of SCM for LCs nationally.

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Annexes

Annex I: sampling procedure

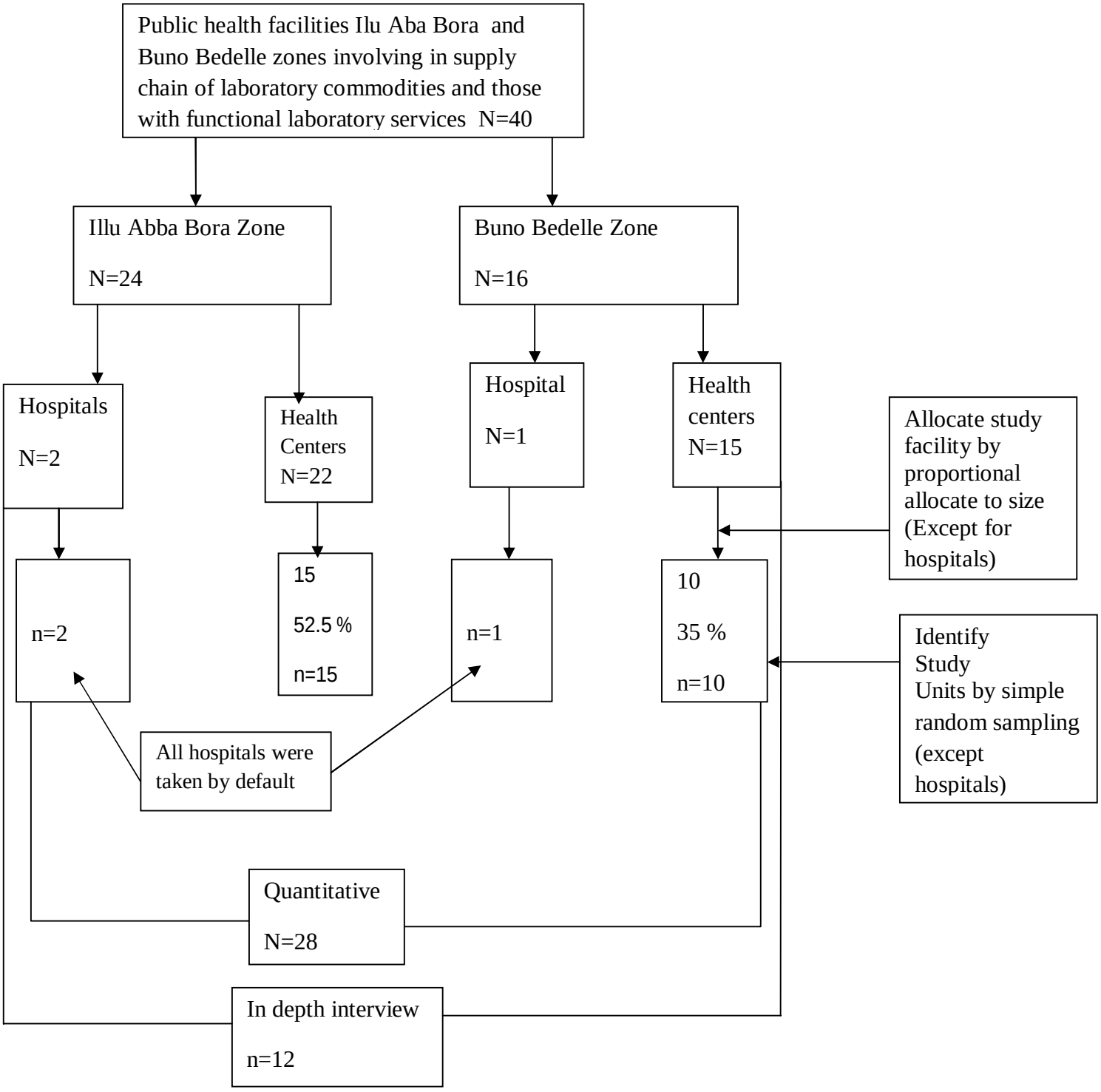

Figure 28.Sampling procedure

Annex II: Information sheet

Assessment of supply chain management of laboratory commodities in selected public health facilities of Illu Aba Bora and Buno Bedelle Zones

Questionnaires for public health facilities in Illu Aba Bora and BunoBedelle Zones April 15-May 15 /2017

Good day my name is Wondwosen G/medhin, a student of pharmaceutical supply chain management Msc program in Jimma University, Institute of Health sciences, Department of pharmacy; I am going to conduct study on the assessment of laboratory commodity supply chain management and collect data on the overall laboratory commodity management in your facility. The objective of the study is to collect current information on laboratory commodity supply chain management status and its associated challenges. The information you provide will be used to improve the supply chain management of laboratory commodities and hence better quality service provision to the clients. The study will identify gaps and challenges and provide recommendations for proper interventions of government and supply chain interventions for the future. If you decide to participate, we will guarantee that there is no any influence related to study but only request you that to provide all relevant information regarding the study. Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Your participation is voluntary and you are free to withdraw your consent and to discontinue participation at any time without consequence. Your participation or not, do not have any influence for your position or responsibilities in your health facility. For the successes of our study, you are kindly requested to respond genuinely and voluntary with patience. Your signature below indicates that you have read the information above and have decided to participate in the study.

You have been identified as someone who can assist by responding to the questionnaire intend for the research. All of the information collected is strictly confidential. No one other than the research team will have access to your responses. Your personal identifiers such as your name and that of your health facility will not be used. The principal investigator will not refer to individual respondents or individual facilities in the report, but rather will describe the overall picture of all facilities.

Thank you!

Annex III: Consent form

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

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

N.B: If you want to request additional information about the study, you will call by those Phone numbers contact address of Principal investigator, 0912075462

Annex IV: Facility Identification

No.	Question	Code Classification	Go To/ Comments
1	Zone		
2	District/Town		
3	Supplying Hub:		
4	Facility Code:		
5	Type of facility	1=ZHD store 2= Hospital 3= Health center 4=Other _____	
6	Provide ART Service	1=Yes 2=No	
7	Provide ART lab monitoring service	1=Yes 2=No	

Note: Throughout this tool LCs-means laboratory commodities which includes program based reagents /test kits and supplies (HIV/AIDS, TB and malaria) and non- program reagents and supplies those purchased by RDF for laboratory services.

Annex V: Questionnaire to Pharmacy Heads of health facility

II.Background Characteristics of the Respondent and facility staff information

Question	Code Classification	Comment
1. Title and mobile phone number of person interviewed for this section	Title: _____ sex_____ Mobile number: _____	
2. Number of years and months you have worked at this facility?	Years: _____ Months: _____	
3. Received training in IPLS?	Yes ….....1 No……0	
4. Received training in laboratory commodity management?	Yes ….....1 No……0	
5. How many staff the facility has under the pharmacy unit?	Number of pharmacy unit staff /_____/	
6. How many of them are trained in IPLS?	Number trained /_____/	
7. How many of them are trained in laboratory commodity management?	Number trained /_____/	
8.Educational qualification of pharmacy unit staff	# of staff with Degree /_____/ # of staff with Diploma /_____/ Other(profession) # /_____/	
9. Who is /are the principal person responsible for managing laboratory commodities at this facility? Multiple responses are possible	Pharmacist …… 1 Pharmacy Technician…….2 Laboratory technologist…….3 Lab technician ……...4 Druggist ……5 Nurse ……..6	

II. Selection and Procurement of laboratory commodities

2.1. Does the facility have its own essential laboratory commodity list?	Yes ……..1 No ….....0(**Go to Q 2.5**)	
2.2. Who do the selection?	The pharmacy unit only ….....1 Laboratory unit….....2 DTC….....3 Other (specify) _____9	
2.3. What are the criteria for laboratory commodity selection in the Facility? (Circle all applies)	Pattern of prevalent disease ….....1 Efficacy and safety….....2 Cost of the LCs ….....3 Preference for well-known LCs ….....4 Others (specify) _____9	
2.4. Is the procurement/order limited to the Laboratory commodity list?	Yes ……..1 No…..... 0	
2.5.Is the facility have DTC?	Yes ……..1 No ….....0(**Go to Q 2.9**)	

2.6. Is it functional?	Yes ……..1 No …..... 0	If members appointed by letter, ELLC and at least 2 meetings with minutes references
2.7. Number of meeting DTC conducted within the past 1 year?	_____	**Cross check minutes of the committee meeting**
2.8. Is laboratory personnel is member of the committee?	Yes ……..1 No ….....0	
2.9. Who determines this facility's resupply quantities of Lab commodity?	The facility itself ….....1 Health office/health bureau….....2 Suppliers/PFSA ….....3 Other_____9	
2.10. Which types of quantification methods is/are employed for LCs? (Circle all applies)	Consumption method ….....1 Morbidity method….....2 Availability of budget……...3 Other (Please specify) _____9	
2.11. Does the facility usually get the quantities of products it orders?	Yes ……..1 (**Go to Q 2.14**) No ….....0	
2.13. If no, why not? _____	The resupply point does not have adequate supply….....1 The resupply point was stocked out….....2 Order amount changed at the resupply point….....3 Other (specify)_____9	
2.14. Why do you think LCs expire? (Multiples answers possible)	Near expiry LCs received from PFSA……1 Poor LCs selection within facility……2 Poor quantification of needs……3 Inadequate pharmaceutical management skills……4 Donations (with short expiries)……..5 Frequent stock shortages from suppliers hence bulk stocking ……....6 Lack or inadequate systems……7 Non adherence to FEFO…….....8 Other specify……9	
2.15. Could you mention which laboratory commodities commonly expire?(Up to 5 products)	1._____ 2._____ 3._____ 4._____ 5._____	

Annex VI: Questionnaire to Store manager of Health Facility

I. Background Characteristics of the Respondent

Question	Code Classification	Go To
1. Title and mobile phone number of person interviewed for this survey	Title: _____sex_____ Mobile number: _____	
2. Number of years and months you have worked at this facility?	Years: _____ Months: _____	
3. Are you the primary person responsible for managing Laboratory commodities at this facility?	Yes ……..1 No…..... 0	
4. Received training in IPLS?	Yes ……..1 No…..... 0	
5. Received training in laboratory commodity management?	Yes ……..1 No…..... 0	

II. Inventory management of LCs

2.1. Do you establish Maximum, Minimum, and Re-order levels for the laboratory commodities?	ˆYes….....1 ˆNo….....0	
2.2.Is there standard ordering schedules and procedures for LCs?	ˆYes….....1 ˆNo….....0	
2.3. Who determines how much to order for LCs?	Laboratory….....1 Pharmacy unit….....2 Higher level authorities….....3 Other (*specify*)_____9	
2.4. Which data elements do you use to calculate how much to order? DO NOT READ LIST. PROMPT "ANYTHING ELSE?" *(Check all that apply.)*	Average monthly consumption….....1 Number of tests performed.. ….....2 Request from users….....3 Available funds….....4 Other (*specify*)_____9	
2.5. How often do you place orders for RDF LCs?	ˆMonthly….....1 ˆQuarterly….....2 ˆEvery 6 months….....3 No defined schedule……..4 ˆOther (*specify*) _____9	
2.6. Are there established procedures for placing emergency orders for Program LCs?	ˆYes….....1 ˆNo….....0 ˆDon't know….....9	
2.7. How many emergency orders have you placed in the last year?	Number: _____	

2.8. Under normal circumstances, how long does it take from the time you place an order to the time the LCs are available for use?	_____ days ˆDon't know/not sure_____	
2.9. What were the reasons for the delay in receiving the LCs? (For any delays encountered recently)	_____ _____ _____	
2.10. How often is a physical inventory of LCs conducted in the store?	Every _____ months	
2.11. When was last inventory made?	A) before 3 months….....1 B) within 3 months….....2 C) before 6 months…..... 3 D) within 6 months…..... 4	
2.12.Is there storage guidelines for LCs	ˆYes….....1 ˆNo….....0	
2.13. Flammable and hazardous chemicals are stored in specialized storage areas.	ˆYes….....1 ˆNo….....0	
2.14. Cold chain items are always stored at appropriate temperatures.	ˆYes….....1 ˆNo….....0	
2.15. Have there been any problems with storing laboratory commodities?	ˆYes….....1 ˆNo….....0(**skip Q 2.16**)	
2.16. If yes, list the three major problems with storing laboratory commodities? *(Start with the highest priority.)*	1._____ 2._____ 3._____	

III. Logistic management information system and management support

3.1. Are the following LMIS Formats and Job Aides are available at the facility? (Ask for documents to verify)		
A. Bin Cards	Yes ……...1 No ….....0	
C. Stock record cards	Yes ……...1 No ….....0	
C. Internal Facility Report and Requisition form(IFRR) for LCs	Yes ……...1 No ….....0	
D. Facility Report and Requisition Form (RRF) for program LCs	Yes ……...1 No ….....0	

3.2. Do you use and fill out the following logistics forms to manage LCs?		
A. stock record cards	Yes ……..1 No ….....0	
B. bin cards	Yes ……..1 No ….....0	
C. Internal facility report and requisition form (IFRR) laboratory	Yes ……..1 No ….....0	Check files
D. Reporting and resupply form (RRF) for program LCs	Yes ……..1 No ….....0	
3.3. Do you report program LCs to PFSA?	Yes ……..1 No ….....0(**Go to Q.3.6**)	
3.4. What are the expected number of reports and actually submitted reports during the past year?	Expected_____ Submitted_____	
3.5. Does the report for program LCs include the following?		
A. stock on hand	Yes ……..1 No ….....0	
B. quantities used	Yes ……..1 No ….....0	
C. losses and adjustments	Yes ……..1 No ….....0	
3.6. Approximately, how often you get supervision on Pharmaceutical logistics mostly?	Monthly.….....1 Bimonthly ….....2 Every 4 months ….....3 Semi-annually ….....4 Annually ….....5 Other (specify).….....9	
3.7. Does management (Head of the health facility, CEO, Medical Director, and DTC) take supportive actions for the implementation / improvement of the IPLS for LCs?		
A.Has management enforced the use of a regular schedule for internal reporting and resupply?	Yes ……..1 No ….....0	
B. Has it enforced use of IFRR for reporting & resupply?	Yes ……..1 No ….....0	
3.8. I there a system for performance measure for personnel involved in pharmaceutical management?	Yes ……..1 No ….....0(**Skip Q 3.9**)	
3.9. I s there a system for incentives based on performance?	Yes ……..1 No ….....0	

IV. Availability of LCs

4.1. Are there certain LCs that you often stock out of before resupply?	Yes ……..1 No ….....0 (**Go to Q 4.3**)	
4.2.List the main reasons contribute to stock out of LCs		
A .For Program LCs(multiples answers possible)	Delay in resupply……..……1	

	Unavailability at supplier/PFSA……...2 Lack of proper tools……..…3 Non supply of quantity requested…….4 Supply of near expiry……5 In adequate skills……6 Non adherence to FEFO……..7 Consumption variation……....8 Other(specify)_____ 9	
B. For non-program LCs (multiple answers possible)	Weak selection……..……...1 Error in forecasting……..…,,,,2 Non supply of quantity requested……...3 Supply of near expiry……..4 In adequate skills…….5 Non adherence to FEFO……..6 Consumption variation……7 Other(specify)…….9	
4.3. Do you often have a surplus/overstock of certain LCs before resupply?	Yes ……1 No …….....0 (**skip Q 4.4 & 4.5**)	
4.4. List the commodities you have a surplus of most frequently (up to 5 products).	1._____ 2._____ 3._____ 4._____ 5._____	
4.5.Is there a system of redistribution of surplus LCs?	Yes ……..1 No …….....0	

Annex VII: Questions for laboratory heads

I. Background Characteristics of the Respondent

Question	Code Classification	Go To
1. Title and mobile phone number of person interviewed for this survey	Title: _____Sex____ Mobile number: _____	Number of staffs under lab unit_____
2. Number of years and months you have worked at this facility?	Years: _____ Months: _____	
3. Received training related to commodity management?	Yes……1 No……..0	

II.Commodity management at laboratory room

2.1.Is bincard used for commodities in the laboratory	Yes ……..1 No …….....0 (**Go to Q 2.3**)	
2.2. Is the bincard updated? (Take sample of 5 products to check)	Yes ……..1 No …….....0	
2.3. Do you use IFRR for LCs to request from store?	Yes ……..1 No …….....0 (**Go to Q 2.5**)	
2.4. If the above forms are used in the laboratory room, how do you learn to complete?	During a logistics workshop….1 On-the-job training ….....2 On-the-job (self-learning) ….....3 Other (specify) _____9	
2.5. If the above forms are not used, what is the main reason for that?	Lack of training/skill…….1 Not enforced by the facility…..2 Lack of forms……....3 Lack of commitment ……4 Lack of supervision…….....5 Other (specify)_____9	
2.6.Is laboratory staff aware of LCs stock status in store?	Yes ……..1 (**Go to Q 2.8**) No …….....0	
2.7. If no why?_____		
2.8.Total number list of test menus the facility providing	_____	
2.9. The number of test menus not provided at the time of visit?	_____	
2.10. The main reasons for not providing the tests?(multiple answers possible)	Reagent not available…….1 Personnel not trained……..2 Equipment breakdown……...3 Other(specify)_____9	

Annex VIII: Storage conditions

Storage Conditions Items 1 -14 should be assessed for all facilities for products that are ready to be issued or distributed to clients. Place a check mark in the appropriate column based on visual inspection of the storage facility; note any relevant observations in the comments column must meet the criteria for each item.

No	*Description*	*Yes*	*No*	*Comment*
1	Pharmaceuticals are arranged & organized according to a logical categorization, e.g. zoning			
2	Bin Cards are used & updated regularly? (Observe by checking a three or more sample BCs.)			
3	Are unwanted items (damaged or expired LCs, non-pharmaceutical items, etc.) in the store room separated from the usable stock?			
4	Products are arranged so that ID labels, expiry dates, and/or manufacturing dates are visible.			
5	Laboratory commodities are stored to facilitate FEFO procedures and stock management.			
6	Products are protected from direct sunlight and high heat at all times of the day/during all seasons.			
7	The storeroom is maintained in good condition (clean, no trash, sturdy shelves, and boxes well-organized).			
8	Fire safety equipment available, accessible, and functional. Train employees to use the equipment.			
9	Store lab commodities according to their properties: chemicals, flammable products, hazardous materials, office supplies, and equipment; always take appropriate safety precautions.			
10	The current space and organization is sufficient for existing products and reasonable expansion (i.e., receipt of expected product deliveries for foreseeable future).			
11	Storage area is secured with a lock and key, but is accessible during normal working hours; access is limited to authorized personnel.			
12	Storage area is visually free from harmful insects and rodents. (Check the storage area for traces of bats and/or rodents [droppings or insects].)			
13	Cold chain items are always stored at appropriate temperatures			
14	Cartons and products are in good condition, not crushed due to mishandling. If cartons are open, determine if products are wet or cracked due to heat/radiation			

Annex IX: Availability and inventory accuracy of Sample Laboratory Commodities

Note: Record required information separately for store and laboratory rooms for each respective product under the space provided and write not applicable (NA), if the LCs is above the level of the facility

Sample Reagents	**Units**	Bincard available(yes/ no)		Stockout on day of the visit (Yes/No)		Balance on bincard		# Days out of stock within the last 90 days.	Physical quantity(based physical count)	
		Store	Lab.	store	Lab.	Store	Lab.	Store	Store	Lab.
A	B	C	D	E	F	G	H	I	J	K
HIV test kit (Colloidal Gold)response)	50 tests									
HIV test kit (Uni-GoldTM)	20 tests									
Blood group and Rh factor	4 ml									
Rapid plasma regain /VDRL(syphilis)	Kit									
Hepatitis B surface Ag	Kit									
Pregnancy test strip	50 strip									
Immersion oil	1 ml									
Gram stain reagent, crystal violet	1 liter									
Gram stain reagent, iodine	1 liter									
Gram stain reagent, alcohol	1 liter									
Gram stain reagent, safranin	1 liter									
Carbofuchsin	1liter									
Acid alcohol	1liter									
Methylene Blue	1liter									
Microscpe slide	50									
H.Pylori Antigen	50 strip									
Geimsa stain	500 ml									
Acetic acid, glacial	1 ml									
Urine multi test 10 /3 parameters	150 strip									
Viral load reagents	1 kit									
CD4 test reagents	1 kit									
Bilirubin (Direct),375 ml	Pk									
Bilirubin (Total),375 ml	Pk									
GOT/AST, 8x50 ml,400 ml	Pk									
Creatinine ,250 ml	Pk									

Annex X: Wastage of laboratory commodities

A. Record the cost of pharmaceuticals at hand/Annual pharmaceutical budget for the facility

B.Record the quantity of program LCs expired/damaged in the last 1 year prior to the study and calculate the total price for each product, by taking its unit price from model-19 or current unit price

C.Record the quantity of RDF LCs expired/damaged in the last 1 year prior to the study and calculate the total price for each product, by taking its unit price from model-19 or current unit price

Note: The total value of laboratory commodities expired in the specified year from disposal registration form if expired LCs were disposed

Cost of inventory at hand /Annual pharmaceuticals budget	Cost of **program LCs** lost due toexpiry, loss or damage	Cost of **non programLCs** lost due toexpiry, loss or damage
A	B	C

Annex XI: Key Informant interview guide

1. How do you assess the current process from selection to procurement of LCs in your health facility giving emphasis to the strengths and limitations?

✓ Probing (1): With respect to:
   a. Developing and usage of essential list of LCs
   b. Specification of laboratory commodities
   c. ordering and receiving lab commodities

✓ Probing (2): What are challenges encountered from selection to procurement of LCs and what barriers do you encountered?

✓ Probing (3): What is your recommendation for improving the process from selection to procurement of LCs further?

2. How do you assess the availability of LCS both in type and quantity in the facility?

✓ Probing (1): What are the challenges encountered in availing LCs in the needed type and quantity?

✓ Probing (2): What is your recommendation for improving the availability of LCs further?

3. How do you assess the inventory management, storage and use of for LCs in the health facility giving emphasis to the strengths and limitations?

✓ Probing (1): With respect to:
   a. Inventory control techniques and procedures
   b. Storage conditions
   c. Storage space and location
   d. Use

✓ Probing (2): What is your recommendation for improving inventory management for LCs?

4. How do you assess the LMIS in managing LCs in the health facility giving emphasis to the strengths and limitations?

✓ Probing (1): With respect to:
   a. availing logistic forms?
   b. using logistics forms?
   c. reporting of the stock status and consumption of LCs?

✓ Probing (2): What are the challenges encountered for using LMIS in managing LCs?

✓ Probing (3): What is your recommendation for improving the LMIS for LCs further?

5. How do you assess the LCs wastage/expiry level in the facility giving emphasis to the strengths and limitations?

✓ Probing (1): With respect to reasons for wastage/expiry

✓ Probing (2): What conditions facilitates for reducing wastage level and what challenges do you encountered?

✓ Probing (3): Whatis your recommendation to reduce the wastage of LCs?

6. Is there anything more you would like to add?_____

I will analyze the information you and others gave me and submit a draft report to my advisor at department pharmacy, Jimma University. I will be happy to send you a copy to review at that time, if you are interested. Thank you for your time and cooperation.