

REPUBLIC OF LIBERIA

NATIONAL LABORATORY SYSTEM

PROCUREMENT AND SUPPLY CHAIN MANAGEMENT IMPROVEMENT PLAN

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1. Introduction

Laboratory tests vary in complexity, and the type of reagents and supplies required to carry out these tests is as varied as the type of tests. Although certain laboratory tests share supplies, a significant inventory of the said supplies is still necessary. Considering this, supplies have serious implications for the design of the logistics information and inventory control systems that support laboratories.

An effective procurement and inventory system will address testing service sustainability while simultaneously avoiding waste and increased costs. Both systems require these processes and procedures to be standardized and that tasks are assigned to keep them current and organized.

By accurately forecasting supply needs, reagent costs may be reduced by negotiating contracts that involve bulk purchases as well as accurately calculating of supply needs for the laboratory. This will eliminate or reduce the number of emergency deliveries required to maintain services and their associated increased costs.

In Liberia, supply chain challenges include inadequate storage space, lack of transport and insufficient inventory and warehouse management practices. Poor communication channels further compound the problems¹. In the current laboratory strategic plan for Liberia, one of the objectives is to support the provision of a comprehensive, integrated, sustainable, and high-quality laboratory system that will support diagnostic services, disease surveillance and research. It is envisioned, that the implementation of a coordinated, sustainable supply chain management and logistics system for the laboratory will support this objective². Therefore, the World Health Organization (WHO) seeks to identify the current challenges that plague the supply chain and propose possible solutions for overall improvement of the system.

2. The National Tiered Laboratory Network in Liberia

To understand the varied nature of supplies handled by the supply chain to support laboratory testing, we must understand the laboratory network in Liberia and the general testing menu at each level. **Figure 1** depicts this tiered network in Liberia, with the National Public Health Reference Laboratory (NPHRL) at the top of the network and

peripheral Laboratories at the bottom. The complexity of testing increases upwards with molecular tests being done at NPHRL and the regional laboratories while simpler tests such as urinalysis and routine hematology carried out at the district level laboratories (**Table 1**). Staffing patterns and resource constraints dictate the type and number of tests run at the various levels of the tiered system.

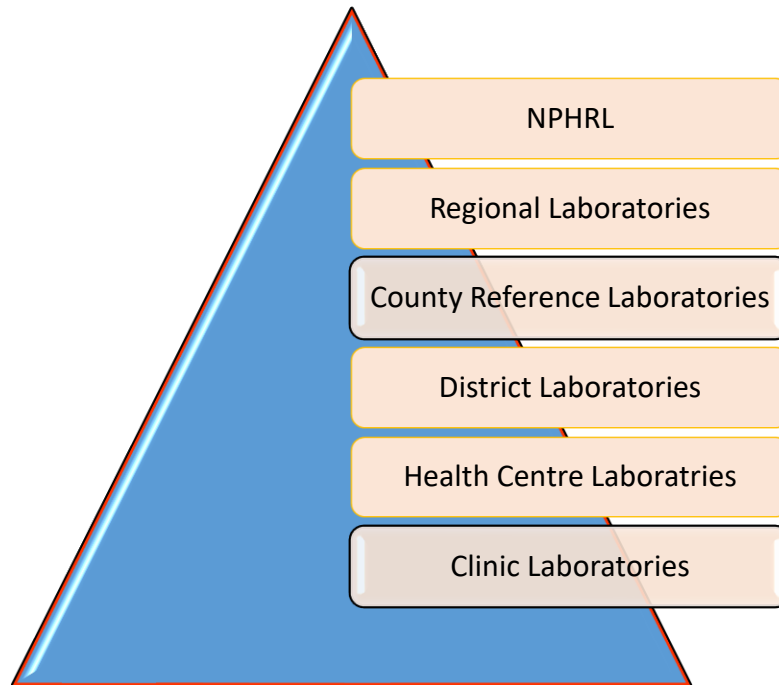


Figure 1. The National Laboratory Tiered Network

Table 1. The General Testing Menu for Laboratories on the Tiered Network

NPHRL	Regional Laboratories	District Laboratories
Molecular/Sequencing diagnostics	Molecular diagnostics	Routine hematology and parasitology
Serology screening IgM/IgG	Routine clinical diagnostics e.g. chemistry, serology screening and hematology	Urinalysis
Bacteriology culture and sensitivity	Parasitology and urinalysis	Chemistry and serology screening

Operational research	Bacteriology culture and sensitivity	Blood banking
Designated reference center	Blood Banking	RDTs
Training	Rapid Diagnostic Tests (RDTs)	TB diagnostics and bacteriology

3. The National Reference Laboratory Stores

There are seven NPHRL stores on site. These stores are used to store national supplies for COVID testing and general supplies and reagents for daily NPHRL operations. That said, challenges identified in the handling of supplies at this center, and subsequent improvement plans, can be projected to the larger operation at the Central Medical Stores (CMS).

3.1 Characteristics of the Laboratory Supplies

The laboratory supplies stored at NPHRL come in a variety of preparations, including liquids, dry powders, and kits. Note that the physical presentation of a commodity has implications for its storage and distribution and may present challenges in quantifying the commodity.

3.2 Classification of Laboratory Supplies

Laboratory supplies can be classified into three categories: reagents, consumables, and durables.

Reagents are chemicals and biological agents that are used in laboratory testing for detecting or measuring an analyte. The reagents vary widely in cost, stability, cold or cool chain requirements, availability, and the hazards associated with each variant. Reagents can be further subcategorized into liquid and solid reagents.

Consumables are items that are used once while performing a test and are not reused. Consumables can include such test-specific items as microscope slides and cover slips. Other consumables, such as bleach, alcohol, and gloves etc., cut across all testing services and are classified as general laboratory consumables.

Durables are items that can be reused for multiple tests. They include items such as glassware that can be washed, sterilized, and reused. This classification also includes equipment and instruments used for testing.

4. The Logistics Cycle

Effective management of the supply chain will ensure that commodities are always readily available to support testing.

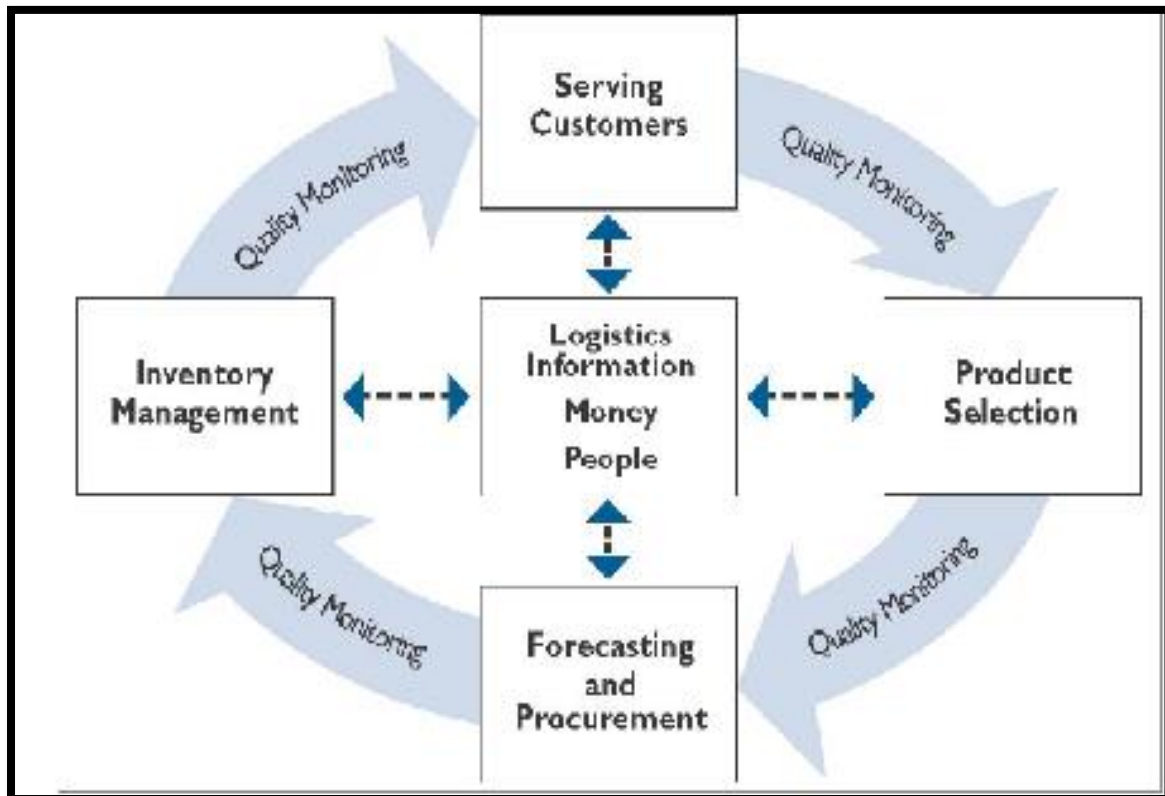


Figure 2. The Logistics Cycle

The logistics cycle (**Figure 2**) provides a guiding framework of the functions needed to manage all health commodities, including laboratory commodities. Each stage of the cycle will be addressed uniquely to ensure improvement covers the whole cycle.

4.1 Customer Service

At this stage, the NPHRL Stores will need to acknowledge that the big challenge is ensuring that there are no stockouts for their varied clientele which includes laboratories among other clinical sectors. Vendors must consider all factors pertaining to product safety as per the manufacturer description.

4.1.1 Main Challenges

The main challenges currently experienced at NPHRL stores are:

- Stockouts which affect patient management.
- Lack of a unified adequate storage space. Currently, there are seven different storage spaces at different locations in the facility making coordination of activities complicated.
- The storage spaces are not up to standard because of temperature variation due to frequent AC breakdown and leakage.
- Lack of dedicated transport for shipping supplies to the counties.
- Lack of a departmental computer for stock management.

4.1.2 Improving Customer Service

General improvements to the supply chain will definitely improve customer service. The key to these improvements is largely dependent on availability of funds. Therefore, securing adequate and reliable funding is a prerequisite.

4.2 Selection of Products

The criteria for selection of laboratory commodities is multi-pronged and quality must be balanced with cost-effectiveness. Some factors to consider when selecting products include (but are not limited to):

- Cost and available financing.
- Storage requirements, such as cold chain, and the capacity to maintain the commodities.
- Compatibility to testing platforms
- Packaging of the commodities to facilitate distribution.
- Shelf life.
- The status of registration of the product with local regulatory bodies.
- The test sensitivity and specificity.
- Whether equipment are open or closed systems. Sourcing for supplies for closed systems may present more challenges (3).

4.2.1 Main Challenges

The main challenge at NPHRL is the fact that procurement of supplies is donor driven thus taking the control of selection of many products out of the hands of the stores. Uncoordinated donations of equipment and/or reagents can result in poor standardization of procedures.

4.2.2 Recommendations for Selection of Products

There are several things that can be done to improve the selection of products, they are as follows:

- Donors can be positively engaged in the procurement process to ensure that their support is in line with the CMS selection criteria.
- The Ministry of Health (MoH) and the National Public Health Institute of Liberia (NPHIL) can advocate for a larger budget from the government to support the supply chain management.
- Testing platforms can be streamlined to avoid too much variation for better coordination of supplies.
- The referral network can be put to good use to ensure that specialized testing is centralized at designated facilities; this will bring down costs.
- Test selection should be done with utmost care because this will inform the selection of the testing platform, which in turn influences infrastructure, storage and transportation. Personnel skills should also be taken into consideration.
- Put in place protocols for change management; with innovations, testing protocols are bound to change from time to time.

4.3 Forecasting and Procurement

An effective procurement management system is one that ensures sufficient inventory is available to meet testing needs while simultaneously avoiding waste incurred from unused and expired reagents. It also ensures that an orderable amount needed to sustain testing can be calculated instead of relying on guesswork by utilizing data available to laboratory staff. Therefore, due to the interrelationship between the procurement and inventory management systems, errors or oversight in one will affect the other resulting

in service interruptions and decreased patient care. Needless to say, inventory management at each and every laboratory will affect overall procurement activities.

Forecasting future demands in terms of commodities and calculating the quantities to procure must take into account service capacity, supply chain capacity, and the resources that are available at hand³.

4.3.1 Main Challenges

Challenges at NPHRL with respect to quantification and procurement include (but are not limited to):

- Forecasting of supplies is not done.
- In the absence of complete standardized testing procedures (resulting from use of different testing platforms), it is difficult to use test numbers to prepare a forecast because there is no correlation between the number of tests performed and the types and quantities of commodities used to perform any specific test.
- Inadequate inventory management at NPHRL and at individual facility level such that data on past consumption, losses due to expiry or breakage, and wastage may be difficult to obtain. Also, data on stock balances may not be available.
- Multiple donors (or providers of lab supplies) may use different procurement mechanisms and sources of supplies.
- For a test procedure to be carried out, all the components required to carry out the test must be available concurrently.
- Donated test kits may not always match available equipment.
- Newly purchased equipment may conflict with existing equipment.

4.3.2 Improving Forecasting and Procurement

- Consumption based forecasts should be adopted as it provides a good reflection of demand for a commodity. Test statistic trends can be used to project future demand for commodities. This methodology relies on a good reporting system for laboratory services provided. As with any forecast that is not based on actual

commodities used, several intervening variables affect the reliability of the forecast:

- It assumes that standardized tests and techniques will be used and that testing protocols will remain constant into the forecast period.
- It also assumes that each analyst performing a test will strictly follow the technical standard operating procedures (SOPs), that is, use the same quantities of reagents for each test and have the same rates of wastage³.
- If using test numbers to prepare the forecast, include supplies required for quality assurance and quality control, loss and wastage, and training.
- Establish and maintain contracts with vendors to allow flexibility in quantities and timing of orders.
- Synchronize the procurement of all items required for a given test to ensure that all supplies are available as needed.
- For laboratory supplies, changes in equipment or testing protocols may drastically impact consumption of products, and these changes should be closely monitored for their impact on the supply chain, so that appropriate adjustments can be made.
- Before procuring, specifications for laboratory reagents and consumables should be clearly defined. The grade, size, nature, and all relevant characteristics should be specified as clearly as possible, including the packaging size. An example of this is given in **Table 2**.

Table 2. Examples of Defined Specifications

Reagents	Specifications
Field stain A (malaria)	Azure blue powder, GPR (general purpose reagent), 25 g
Commercial reagent kit (hepatitis B screening)	Commercial latex based non-cross reactive; Titer 1:256, sensitivity 100%, specificity at least 98%, kit of 50

Consumables	Specifications
Vacutainer	Plain red top, rubber cork, 4 mL, pack of 100 pieces
Microscope slide	Single frosted, pre-cleaned, 76.2 mm x 25.4 mm x 1.2 mm, glass; pack of 72 slides

Laboratory commodity freight costs can range from 5% to 50%, and therefore an estimation of the realistic freight costs of these commodities should be completed during the quantification process in order to get a representative cost for shipping these products.

4.4 Inventory Management

To create a comprehensive inventory list, the laboratory must first identify which essential supplies are needed to support the total testing process. An inventory control system informs the storekeeper of the following:

- 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 laboratory commodities can be guaranteed only through the selection, design, and proper implementation of an appropriate inventory control system. The current system used at NPHRL and CMS is the maximum and minimum method where inventory cards are employed. However, this method is not practical because requisitioned supplies are not always received on any given schedule, lead times are difficult to establish for donor driven supplies and there is no established list of local supplies because NPHRL has no control over requested items that are purchased locally.

4.4.1 Main Challenges

Current challenges with respect to inventory management at NPHRL include:

- Existing supply chain is indirect. Supplies reach county facilities through the count health team.
- Supplies are not standardized with respect to brands, hence sensitivity and specificity may also be affected.

- Quantities received are sometimes inadequate.
- Frequent stockouts of laboratory commodities.
- Weak or no standard ordering process and procedures; supplies are donor driven.
- Associated products not ordered concurrently (buffer solution, lancets, etc.) complicating operations in the laboratory and compromising patient care.

4.4.2 Recommendations for Improving the Inventory System

- Create more direct supply networks such that supplies from the stores are delivered directly to the requesting facilities. This will ensure that these supplies are not delayed due to lack of transport which may further compromise product integrity depending on the cold chain requirements.
- Engage donors so that acquisition of supplies is standardized to avoid assay variations.
- Standardize the maximum - minimum inventory control system so that slow - moving and fast-moving supplies are given different limits.
- Quantifications should be done, and order quantities adjusted for stockouts.
- Request ordering facilities to send the monthly testing statistics so that ordering or resupply is linked to reporting.
- Consider the acquisition of a Logistics Management Information System (LMIS) to support inventory management.

5. Storage and Distribution of Supplies

The storage of laboratory supplies is as varied as the supplies needed to carry out testing. Some products require refrigeration at specified temperature ranges, and some do not necessarily require cold chain storage but may be invalidated by room temperatures that are in excess of 30°C. For this reason, temperatures in any storage space must be monitored, recorded and corrective action taken when specifications are exceeded. In addition, the storage place must be kept clean and secure.

5.1 Main Challenges

The storage spaces at NPHRL present the following challenges:

- There is no unified storage space. The seven allocated spaces are far flung making coordination of activities difficult.
- The ACs breakdown often which may compromise the integrity of the stored supplies.
- The NPHRL has storage spaces that need complete renovation while NDD stores supplies at the Central Medicine Store (CMS). A unified storage space for all laboratory supplies is required.

With respect to transportation of supplies, there is no dedicated vehicle to ship supplies to the required destination. The stores rely on transport from partners that may be heading to the counties, or the counties may occasionally have transport coming to NPHRL and the CMS

5.2 Recommendations for Improvement

- Provision of a larger, unified storage space that considers the different types of requirements for different products.
- Maintain cold chain for items that need it.
- Acquire different storage space for flammables.
- Purchase of at least two vehicles specifically for shipping of supplies.
- Maintain 24-hour power supply daily.

6. Quality Assurance

ISO 15189:2012 stipulates that consumables that can affect the quality of examinations must be verified for performance before long term storage. This acceptance testing is best done within 72 hours of receipt so that any complaints to the supplier can be done expeditiously.

6.1 Challenges

At NPHRL stores, acceptance testing is currently not done. Also, there are certain assays that do not have internal positive controls (e.g. Ebola, virus disease, hepatitis B virus,

hepatitis C virus, rapid plasma reagent tests, rapid malaria diagnostic tests and meningitis) making verifications of certain supplies difficult.

6.2 Recommendations for Improving Quality Assurance

- Revise the SOP for Inventory Management to capture a section of quality assurance.
- Implement acceptance testing at stores level.

7. Monitoring and Evaluation

Once improvements are made to the existing supply chain, performance will need to be monitored and evaluated.

7.1 Criteria for Evaluation of the Improved System

The criteria will include (but is not limited to):

- The new system should yield higher levels of supply chain performance compared with the existing supply chain system.
- It should provide higher quality reporting of logistics data compared with the existing supply chain system.
- The system should demonstrate improved product management, for example, stocking according to plan and reduced stockout rates at the facility level.
- There should be minimized losses from product expiry.
- The new system should be more efficient (cost-effective) than the existing supply chain system.

7.2 Quality Indicators

NPHRL stores should select indicators that will support evaluation of the new system including:

- Information availability and quality
 - Reporting coverage
 - On-time data collection
- Customer response
 - On time delivery

- Time and level of effort to complete a resupply cycle
- Commodity availability/inventory management
 - Near-full supply of selected critical commodities
 - Stockouts
 - Overstocking
 - Expiry rate
- Cost and cost-effectiveness
- Cost distribution
 - Transport
 - Storage
 - Operating expenses
 - Management and supervision
 - Data management

8. References

1. USAID. Global Health Supply Chain Program- Liberia
2. Ministry of Health. The National Laboratory Strategic Plan (2019 – 2024)
3. USAID. Guidelines for managing the laboratory supply chain (v.2). July 2008