



# Standardization and Laboratory Logistics System Design for Botswana

---

Report on the Standardization and Laboratory Logistics System Design Workshops Technical Assistance to the Ministry of Health and Ministry of Local Government of Botswana under US Government Funded Technical Assistance

March 2009



Providing quality medicines for people living with and affected by HIV and AIDS





# Standardization and Laboratory Logistics System Design for Botswana

---

Report on the Standardization and Laboratory Logistics System Design Workshops Technical Assistance to the Ministry of Health and Ministry of Local Government of Botswana under US Government Funded Technical Assistance

March 2009

---

Sarah Andersson, Technical Advisor, JSI  
Marasi Mwencha, Principal Laboratory Advisor, SCMS



Providing quality medicines for people  
living with and affected by HIV and AIDS



## **Acknowledgements**

We wish to express our thanks to Deogratius Kimera, Phetogo Phoi, Andrew Auruku and the rest of the SCMS Botswana office for their warm hospitality, hard work and logistical support during the duration of these exercises. Many thanks also go to Mr. David Matema of the Ministry of Health who opened the standardization and laboratory logistics system design workshops on behalf of the Ministry of Health. Our gratitude also goes to Mr. Ebi Bile of BOTUSA and Dr. Isaac Mtoni of the National Health Laboratory and their respective teams who supported these exercises. Last but not least, we would also like to give special thanks to all the workshop participants for all the input and insight they gave in the standardization of laboratory commodities as well as designing the logistics systems without which this report would not be possible.

## **About SCMS**

The Supply Chain Management System (SCMS) was established to enable the unprecedented scale-up of HIV/AIDS prevention, care and treatment programs in the developing world. SCMS procures and distributes essential medicines and health supplies, works to strengthen existing supply chains in the field, and facilitates collaboration and the exchange of information among key donors and other service providers. SCMS is an international team of 16 organizations funded by the US President's Emergency Plan for AIDS Relief (PEPFAR). The project is managed by the US Agency for International Development.

This document was made possible through support provided by the US Agency for International Development, under the terms of contract number GPO-I-00-05-00032-00. The opinions expressed herein are those of the author(s) and do not necessarily reflect the views of the US Agency for International Development or the US government.

## **Recommended Citation**

Andersson S., Mwencha, E.M., 2009. *Standardization and Laboratory Logistics System Design for Botswana*. Submitted to the Botswana Ministry of Health by the Supply Chain Management System (SCMS).

This document may be reproduced if credit is given to SCMS.

---

## **Supply Chain Management System**

1616 Ft. Myer Drive, 12<sup>th</sup> Floor  
Arlington, VA 22209 USA  
Telephone: +1-571-227-8600  
Fax: +1-571-227-8601  
E-mail: [scmsinfo@pfscm.org](mailto:scmsinfo@pfscm.org)  
Website: [www.scms.pfscm.org](http://www.scms.pfscm.org)

# Table of Contents

---

\_Toc224130390

Acronyms .....	iii
Executive Summary .....	iv
Background of the Laboratory System .....	1
Standardization of Laboratory Commodities .....	3
Current Standardization Situation.....	4
Purpose of the Standardization Exercise.....	6
Logistics Systems .....	7
Current Logistics System for Laboratory Supplies.....	10
Purpose of the Logistics System Design Exercise.....	12
Methodology.....	13
Standardization Workshop .....	13
Laboratory Logistics System Design Workshop .....	15
Outcomes.....	17
Standardization .....	17
Laboratory Logistics System.....	19
<i>Vision for the New System -</i> .....	19
<i>The Pipeline</i> .....	19
<i>Inventory Control System for Laboratory Commodities</i> .....	20
<i>Logistics Management Information System for Laboratory Commodities</i> .....	21
<i>Storage and Distribution</i> .....	23
<i>Roles and Responsibilities of Staff in the Logistics System</i> .....	23
<i>Exceptions in the Laboratory Logistics System</i> .....	24
Recommendations .....	26
Standardization .....	26
Laboratory Logistics System Design Exercise .....	27
Pilot of the Laboratory Logistics System.....	28
Next Steps.....	29
Standardization .....	29
Laboratory Logistics System Design Exercise .....	29
Annex 1: Standardization Workshop Participant List.....	31

Annex 2: Standardization Workshop Schedule .....	32
Annex 3: Standardization Workshop Goals & Objectives .....	33
Annex 4: Logistics System Design Participant List .....	34
Annex 5: Logistics System Design Workshop Schedule.....	35
Annex 6: System Design Workshop Goals & Objectives.....	36
Annex 7: Standardized List of Tests .....	38
Annex 8: Standardized List of Fast Moving Products.....	42
Annex 9: Stock Keeping Record (includes Consumption) .....	47
Annex 10: Consumption Aggregation Worksheet.....	48
Annex 11: Transaction Record .....	49
Annex 12: Daily Activity Registers.....	50
Annex 13: LMIS Report .....	51
Annex 14: Feedback Report.....	52
References.....	53

# Acronyms

---

AIDS	Acquired immunodeficiency syndrome
ARV	Antiretroviral (drugs)
ACHAP	Africa Comprehensive HIV/AIDS Partnership
ART	Antiretroviral Treatment
BHHRL	Botswana Harvard HIV Reference Laboratory
BOTUSA	Botswana/USA
CMS	Central Medical Stores
CHAI	Clinton HIV/AIDS Initiative
CDR	Central Data Repository
CMS	Central Medical Stores
DMLS	Division of Medical Laboratory Services
DRU	Drug Regulatory Unit
GOB	Government of Botswana
HIV	Human immunodeficiency virus
ICS	Inventory Control System
LMIS	Logistics Management Information System
MASA	Botswana National ARV Therapy Program
MOH	Ministry of Health
MOLG	Ministry of Local Government
NHL	National Health Laboratory
PPADB	Public Procurement Asset Disposal Board
PEPFAR	President's Emergency Plan for AIDS Relief
PCR	Polymerase Chain Reaction
PITC	Provider-Initiated Testing and Counseling
PLWHA	People Living with HIV/AIDS
PMTCT	Prevention Mother To Child Transmission
SDP	Service Delivery Point
SCMS	Supply Chain Management System
TB	Tuberculosis
VCT	Voluntary Counseling and Testing

# Executive Summary

---

In January 2008, the international laboratory community converged for a meeting in Maputo, Mozambique to develop recommendations for clinical laboratory testing harmonization and standardization. Central to the theme of this workshop was the call to promote the standardization of laboratory supplies at each tiered level of the laboratory network. Standardization is the process of harmonizing test menus, test techniques, operating procedures, and laboratory equipment for each type of test and for each level in the system. In response to the Maputo conference, a workshop was held in Gaborone, Botswana for laboratory personnel from various types of testing sites across the country to reach a consensus and develop recommendations on how standardization can be attained.

The group decided that standardization should be adopted in Botswana as it will seek to strengthen the countries laboratory capacity and strengthen service delivery. It is believed that through standardization, sustainable laboratory capabilities will be built that in turn will provide access to high quality, rapid, and affordable diagnostic tests for the care, treatment, prevention and surveillance of HIV/AIDS, tuberculosis (TB) and malaria amongst other diseases. From a supply chain perspective, the group recommended the implementation of standardization as it will also help reduce the number of commodities being managed by the Central Medial Stores (CMS) and the National Health Laboratory (NHL) and dictate the six rights of logistics at each level of the system.

Some key recommendations that resulted from the Standardization Workshop:

- A policy paper should be developed, in consultation with PPADB, which will be submitted to cabinet to include provisions for standardization for laboratory commodities within the current law.
- The participants also began the process of standardizing testing menus, techniques, equipment and products by level of the system. This resulted in:
  - Identifying two analyzers to be available per testing area at each level.
  - A reduction of laboratory commodities to be managed from 850 products to just over 500 commodities and further classified these into 250 essential fast moving items.

Following the standardization workshop, a laboratory logistics system design workshop was held to develop a logistics system designed to collect and capture essential data for decision making. The decisions that the system would need to inform include the routine resupply to facilities, monitoring and adjusting stock imbalances within the network of facilities as well as accurate national quantification of essential laboratory commodities. The purpose of the logistics system design workshop was to develop and gain consensus among users and stakeholders on the design decisions and outlook of the new logistics laboratory system.

The system for managing laboratory supplies in Botswana has evolved over many years and as a result there is currently no uniform system that exists across the Ministry of Health (MOH) and Ministry of Local Government (MOLG) facilities on how laboratory supplies are managed. In general, the ordering of supplies occurs on an ad hoc basis without the use of logistics systems or data to determine resupply quantities and prevent stock imbalances. In previous assessments done, it was found that laboratories use different logistics forms to report essential data to the central level

and use of these forms was also found to be inconsistent. As a result of the multiple, vertical supply chains that were found to exist, frequent stock outs of reagents, supplies and test kits, were a common occurrence. A need to redesign the laboratory logistics system capable of ensuring timely distribution, proper storage, orderly ordering and an efficient procurement laboratory supplies was therefore recognized.

Three major recommendations from the logistics system design workshop was the introduction of a Logistics Management Unit (LMU), Regional Hubs and a Central Data Repository (CDR). The LMU will consist of logistics officers who will be responsible for managing and supervising the logistics system ensuring logistics data is available when required. The Regional Hubs were recommended as intermediate storage facilities to ease the storage and distribution challenges in Botswana. The CDR will be developed in the future to store and manage the logistics data and enable easy access to this data by all partners.

In addition to these major recommendations the participants also designed the following:

- *Two Level Pipeline:* A two level pipeline was designed for both the flow of information and commodities with the regional hubs serving as a pass through for commodity storage.
- *Forced Ordering Inventory Control System:* Inventory control parameters were set to guide the ordering and management of laboratory commodities and avoid stock imbalances.
- *Logistics Management Information System:* LMIS records and reports were adapted or new forms were designed to collect the three essential logistics data items.



# Background of the Laboratory System

---

In Botswana, the Ministry of Health (MOH) and the Ministry of Local Government (MOLG) have joint responsibility for the provision of quality laboratory testing services with support from partners including BOTUSA, ACHAP, CHAI and Botswana Harvard Partnership. Most of these activities are overseen by the Ministry of Health's Department of Clinical Services. The Medical Laboratory Services of the Botswana MOH were established decades ago, and only recently in 2003, introduced documented standards to guide laboratorians on their day to day performance of laboratory investigations.

In January 2002, the Government of Botswana (GOB) launched Africa's first National Anti-Retroviral (ARV) Therapy Program, MASA in an effort to provide free ARV therapy to its citizens. The program which is supported and funded by various partners including the Government of Botswana (GOB), United States President's Emergency Plan for AIDS Relief (PEPFAR), Boehringer Ingelheim and the Bill and Melinda Gates Foundation in partnership with Merck Foundation. MASA was initiated after a feasibility study was commissioned by the Africa Comprehensive HIV/AIDS Partnership (ACHAP). The feasibility study led to the development of a strategy document that detailed how the Ministry of Health could build the requisite capacity and scale up therapy of HIV/AIDS for the Botswana. Additionally, the GOB activated a national emergency fast track system to build capacity for launching and maintaining the national program as well as forming a dedicated ART team to implement the program by adopting a phased approach. The implementation plan developed by the MASA ART team also addressed the main areas requiring capacity building.

The Department of Clinical Services at the MOH which oversees testing for all disease areas including HIV/AIDS, is split into three distinct entities, all of which have a role in the delivery of laboratory services. These are:

1. Division of Medical Laboratory Services (DMLS), responsible for management of laboratory services.
2. Central Medical Stores (CMS), the unit charged with procurement, warehousing/storage and distribution of all medical supplies.
3. Division of Biomedical Engineering Services, responsible for procurement and maintenance of all biomedical equipment for the MOH.

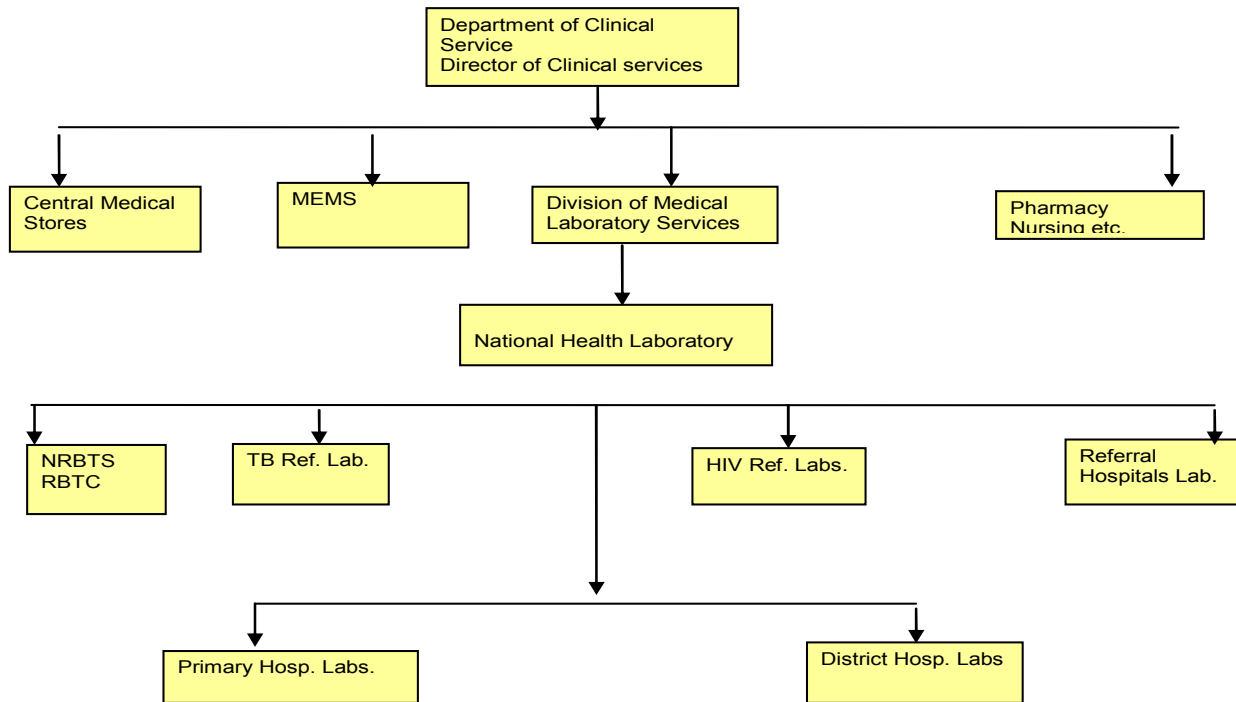
The Department of Clinical Services (DCS) has organized the laboratory system sector is organized into six levels, mobile stops which represent the lowest level in the healthcare system, followed by health posts, clinics run by the local government, primary hospitals, district hospitals and national referral hospitals.

The National Health Laboratory (NHL) plays both administrative and service delivery roles with respect to the provision of quality laboratory testing services and commodity management. NHL is also the referral laboratory for all specialized chemistry tests and microbiology testing services. At facility level, the daily management of laboratory services is the direct responsibility of the facility's Medical Officers-In-Charge and their respective Laboratory In-Charges or Supervisors.

Although there is a healthcare referral system which starts from the health post, clinic, and primary levels through the district hospitals to the national referral hospitals, the laboratory services referral

system is governed much by the availability of supplies and equipment functionality at neighboring sites. ART tests which primary and district hospitals could not do are frequently referred to the Botswana Harvard HIV Reference Laboratory (BHHRL) in Gaborone for facilities in the southern region or Nyangagbwe HIV Reference Laboratory in Francistown for the facilities in the northern region. The most referred tests were mainly CD4, viral load and infant diagnostic DNA polymerase chain reaction (PCR). DNA PCR testing facilities are only available at the Nyangagbwe and BHHRL. Technical oversight of all these functions is provided by the BHHRL.

**Figure 1: Organization of Laboratory Services**



One of the challenges with the current laboratory system is the consistent interruption of testing services resulting from unplanned activities, reagents stock outs and expiries because of poor quantification and inadequate logistics systems to support the flow of these commodities. Prolonged equipment down time as a result of poor service and maintenance, excessive emergency order situations that interrupts the supply plan and lack of documented procedures was also another issue identified with the current laboratory system.

The lack of adequate coordination and consistent communication between testing facilities and key entities at the central level are some of the other major constraints that are currently impeding the proper functioning of the logistics system. A gap also exists between the government and donors on information sharing regarding donated equipment, products and consumables. At the service delivery point (SDP), critical logistics records are not well kept and tend to be frequently unavailable at the time of need. Technical staff are required to send monthly reports on a regular basis. Many of these reports were however found to be unavailable most of the time. It was also noted that distribution remains a key challenge in the existing system and as such, the lead time for the delivery of commodities tends to be exceptionally long, often resulting in stock outs of key testing reagents at the SDP. There are also inadequate inventory control procedures often resulting in excessive ordering or frequent emergency orders.

# **Standardization of Laboratory Commodities**

---

Standardization is the process of harmonizing test menus, test techniques, operating procedures, and laboratory equipment for each type of test and for each level in the system. Standardization is important from a supply chain perspective, because it has a bearing on the number of commodities being managed by a particular system and dictates the six rights of commodity availability at each level in the system. Standardized laboratory systems require the management of hundreds of commodities; in non-standardized systems the number of commodities easily runs into the thousands, since different tests can be conducted using different techniques, each of which can have unique commodity requirements.

Standardization leads to improvements in both efficiency and effectiveness, since it provides the basis for developing standard procedures and processes for operating a program or system. Standardization has numerous benefits on all aspects of the program, not only from a supply chain perspective. From a clinical perspective, standardization facilitates uniform and consistent case definition and case management, and thus improved service provision to the clients. It also enables the comparison and interpretation of results from different laboratories, thus facilitating referrals and transfers of cases throughout the system. Clinical audits can be conducted with meaningful results and the quality of testing between sites can be compared. From a human resource perspective, standardization can achieve greater efficiency in training and management of staff. When testing techniques used in the system are limited, staff can be trained on these techniques and standards by level, and can more easily transfer between facilities. Standardization also enables the development of a robust quality assurance program, since it allows for results to be compared across facilities, which increases the reliability and consistency of test results.

From the supply chain perspective, standardization helps facilitate affordability through economies of scale. Affordability is attained through the bulk purchasing of testing products from the same manufacturer or vendor. By doing so, consumers are better able to negotiate lower prices. Standardization also helps to enhance manageability by streamlining the number and range of laboratory products. Many central medical stores are overburdened by the sheer number of commodities they have to manage. Through standardization, these lists of commodities can be drastically reduced by retaining only commonly used products as well as those currently being used at the SDP level. Reducing the number of commodities that need to be managed will in the long run ease the burden on distribution and inventory control systems. Last but not least, standardization further enables rational decision making throughout the supply chain, particularly in product selection, forecasting, quantification, and procurement. It also facilitates easier service and maintenance by reducing the number of types of equipment that the biomedical engineers and clinical staff will have to service.

Standardization is not just a matter of just deciding which supplies are needed. The process must also address what testing services are provided based on the technique and equipment at each level of a tiered laboratory system. A tiered laboratory network is an integrated system of laboratories organized in alignment with the public health delivery network in a country. In resource-limited settings, the organization of laboratories into distinct levels is the best way in which services can be delivered to patients to meet their individual testing needs.

## Current Standardization Situation

The current management of laboratory supply chains is a challenging and complex undertaking because of the wide range of commodities required to conduct a single laboratory test and the plethora of tests that exist. In Botswana, this is even more challenging because of the multiple platforms and techniques used for the same test in the country. Currently there are nine known types of hematology testing equipment in-country, twelve chemistry platforms, four CD4 machines and four viral load analyzers. The full list of these apparatus can be seen in Table 1. This wide range of platforms, most of which come from distinct manufactures make not only resupply challenging but also lend to challenging quantification exercises and difficult and costly procurement processes.

In a recently developed commodity database that compiled the list of commodities currently being stored, procured and distributed by the Central Medical Stores (CMS) and the National Health Laboratory (NHL) a total of 859 items were identified. These items are for all testing areas which include Chemistry, Hematology, Immunology, Virology, Blood Bank, Microbiology, Molecular Biology, Histology and Cytology. In developing this list of commodities, it was found that on multiple occasions, existing products were found to be obsolete. Many of the similar type chemicals also came in various pack sizes. Some of the reagents found in storage were also found to have expired. The reason for these identified problems can be attributed to the sheer volume of commodities that the CMS and NHL have to manage.

**Table 1: Overview of Available Clinical Testing Analyzers**

Hematology	Chemistry	Flow Cytometry (CD4)	Viral Load	Other Analyzers
1. Sysmex K800	1. ILAB 300	1. FACSCalibur	1. Nuclisense Easy Mag/Easy Q	1. Genetic Analyzer
2. Sysmex KX 21N-	2. Cobas Integra 400 Plus	2. FACSCount	2. Cobas Ampliprep / TaqMan 48	2. Lasec
3. Sysmex xt 1800i	3. ABX Pentra	3. Beckmann Coulter EPICS- XL- 1	3. Cobas Ampliprep / Amplicor	
4. Sysmex xt 2100i	4. Auto Humalyser 900 Plus	4. CyFlow Partec	4. Exavir - Cavid	
5. Sysmex PocHi	5. Humalyzer 2000			
6. Sysmex SF3000	6. LP 400			
7. BC AcT Diff. 2	7. LP 800			
8. BC AcT Diff 5	8. Visual			
9. ABX Micros	9. Humalyte ISE			
10. ACL 100	10. Cobas C111			
	11. Vitros			
	12. ACS 180 Plus			

Currently, equipment is procured following the Public Procurement Asset Disposal Board (PPADB) act which embodies guidelines that promote competition, fairness and transparency. When enacted in good faith, these guidelines help to promote healthy competition but do however have their shortcomings when it comes to the procurement of laboratory equipment. The reason being that during each procurement cycle multiple types of technologies are procured resulting in several different platforms existing within the country to do a similar test. As each platform requires multiple reagents and consumables that are specific to the equipment the result is an unmanageable number and variety of products that must be managed. The Central Medical Store (CMS) and National Health Laboratory (NHL) are currently overburdened by the sheer number of commodities they have to manage. The variety of equipment also presents a challenge to the biomedical engineering department who then have to maintain, service and/or repair various type of platforms from different manufactures. The country has trained medical laboratory personnel and biomedical engineers in the maintenance and repair of these equipment, but frequent staff movement and attrition necessitates constant training which is unaffordable and uneconomical but still however required.

Earlier mention has been given to the importance of having a tiered laboratory system, which has often been cited as the best way to improve laboratory service delivery in developing countries. In Botswana, the MOH has classified the countries laboratory levels, though these categories have not been revised for some time now. Furthermore, in the given structure, no clear distinction has been made as to which tests can and should be performed at each level of the laboratory. As a result, you have a situation where a tiered laboratory system exists, yet no clear guidance is available on the comprehensive the test menu, technique and equipment differences exist between each level of the system.

## **Purpose of the Standardization Exercise**

In January 2008 a team of experts, policy makers and major stakeholder held a consensus meeting in Maputo, Mozambique consensus meeting of major stakeholders who were charged with making recommendations on laboratory testing standardization and harmonization in three major areas. The objectives of the meeting were: 1) to review and agree on a list of supplies and tests needed at each level of integrated tiered laboratory network; 2) to develop a consensus to guide standardization of laboratory equipment at each level of the laboratory network; 3) to develop a consensus on key considerations to guide maintenance and service contracts at various levels of the laboratory network.

The meeting was attended by 33 countries including Botswana. From the meeting, a written declaration that establishes the global commitment to strengthening integrated national public health laboratory systems was developed and participating countries agreed to ratify the declaration. As a next step following ratification of the Maputo declaration, SCMS agreed to support the Ministry of Health and Ministry of Local Government to implement the harmonization and standardization guidelines and develop guiding policies for Botswana through a consultative workshop.

This standardization effort will also seek to strengthen laboratory capacity in Botswana. It is believed that the best way to do this is by building sustainable laboratory capabilities that will provide access to high quality, rapid, and affordable diagnostic tests for the care, treatment, prevention and surveillance of HIV/AIDS, tuberculosis (TB) and malaria amongst other diseases. From a supply chain perspective, standardization will also help reduce the number of commodities being managed by the CMS and NHL and dictate the six rights of commodity availability at each level in the system.

These rights, which also pertain to the need for a logistics system, are:

- To provide the **right** quantities of the
- **Right** laboratory supplies to the
- **Right** facilities at the
- **Right** time in the
- **Right** condition at the
- **Right** cost.

The objective of this standardization exercise was for the participants, whose names are provided in Annex 1, to agree on a standardized list of laboratory supplies for each type of test and for each level in the system. The participants were also asked to identify the products that were, or should be, in full supply and that are appropriate for inclusion in a maximum-minimum inventory control system (ICS). Inventory control systems are referred to later in this report. The equipment list also generated by level as a result of this standardization exercise would also help guide the future procurements of equipment. The anticipated reduction of the types of available equipment will also ease the burden on the biomedical engineering department who currently have to maintain, service and/or repair various types of platforms from different manufactures.

# Logistics Systems

---

## **Logistics Management Information System (LMIS)**

In all programs and for all product categories, logistics managers at all levels need to make routine decisions that affect commodity availability. They need to determine how much of each product to order or resupply, to forecast future demand for a product, and to plan procurements and commodity shipments. They also need to be able to identify potential supply problems at facilities or storage sites or to handle other issues related to commodity management. These decisions must be made using timely logistics data that are provided by a logistics management information system (LMIS). Over the long term, data provided through the LMIS can also help inform policy and product selection decisions.

An LMIS helps personnel collect and manage the information necessary to support sound and objective decision making in managing the supply chain; the goal of this decision making is to ensure an uninterrupted supply of commodities and to identify any problems in the supply pipeline. The LMIS is composed of all the forms and documentation used to maintain records and produce reports on the logistics system. An effective LMIS makes regular and timely information available to decision makers. Information is used to make short-term resupply decisions and long-term procurement and program management decisions. Timely and accurate commodity data are critical for logistics system performance.

## **Inventory Control Systems (ICS)**

An inventory control system informs the warehouse manager or laboratory technicians, when to order or issue, how much to order issue, and how to maintain an appropriate stock level of all products to avoid shortages and oversupply. The continuous supply of quality laboratory commodities can be guaranteed only through the selection, design, and proper implementation of an appropriate inventory control system. A number of strategies or inventory control systems can be designed or adopted to manage commodities of any kind. Some of these, such as a rationing system, are more appropriate in situations where there is uncertainty or shortages in the product supply being managed or the financial resources available to purchase the products being managed. In a traditional rationing system, supplies are allocated on the basis of some set of chosen criteria—for instance, to serve a certain proportion of the poorest clients, to treat a certain proportion of the priority disease burden in the region, or to ensure that a certain product accounts for no more than a certain proportion of the available budget. However, laboratory commodities are expected to be in full supply for a desired number of patients, at least in the short term. To manage full-supply products appropriately, a maximum-minimum inventory control system (also known as a max-min system) is recommended and has been shown to work effectively.

### **Maximum – Minimum Inventory Control Systems Full-Supply Situation**

Implementation of a max-min inventory control system is most effective in a full-supply situation, where sufficient quantities of all commodities are available to meet all needs, such as an ART program or HIV testing programs (e.g., voluntary counseling and testing [VCT], provider-initiated counseling and testing [PITC], or preventing mother-to-child transmission [PMTCT]). A max-min system allows rational resupply decisions based on need and takes into account established levels of safety stock, with the ultimate goal of having product available each and every time it is needed.

When designing a logistics system, one of the first decisions that will have to be made is the type of max-min inventory control system to use. There are several types of max-min inventory control systems, each of which has slightly different transportation, personnel training, and storage requirements and the other elements that comprise a supply pipeline. Among the options are:

- **Forced ordering:** Orders are placed at the end of the review period; all products are ordered or resupplied to the maximum stock level.
- **Continuous review:** Orders are placed each time a product reaches its minimum stock level; products which are at or below the minimum stock level are ordered and resupplied to the maximum stock level.
- **Standard:** Orders are placed at the end of the review period, but a product is ordered only if it has reached its minimum stock level; products which are at or below the minimum stock level are ordered and resupplied to the maximum stock level.

### **Pull or Push System**

In any version of the max-min system, the designer must also decide who will calculate the reorder quantities: the “pull” system refers to if personnel receiving the supplies calculate resupply quantities and in a “push” system the personnel issuing the supplies calculate the resupply quantities (e.g. the Central Medical Stores or a Logistics Management Unit).

It must be noted that the resupply quantities in a “full supply” situation will be always be calculated using the same formula whether it is a push system or a pull system. In a “push” system the issuing facility will use data sent by the facility to determine the order quantities. The “push” system should not be confused with a rationing system as in a “full-supply” situation rationing should not occur.

The choice of implementing a push or a pull system will depend largely on in-country capacity at each levels of the supply chain as well as the availability of technology. Countries/programs that have well trained staff at the lower levels (or the potential to train such staff adequately) could easily choose a pull system. Countries or programs that have more trained staff or the availability of computerized systems at the upper levels, or those wishing to reduce the commodity management workload of lower-level staff, could choose a push system. In either case, adequate information and data must be made available for calculating order quantities.

### **Link between the LMIS and the ICS**

The LMIS and inventory control system have a close relationship as the LMIS provides the data required to maintain the inventory control system. Data collected through the LMIS enable a laboratory manager to determine how many months of stock are currently kept at the facility; knowing this, the laboratory manager will know if the supply is above, below, or within the established maximum and minimum stock levels, or whether an emergency order must be placed. At the end of the order interval, the laboratory manager will compare current stocks to maximum stock level and order the quantity needed to bring stock levels to maximum.

Upper-level commodity managers can use the LMIS to track trends in overall consumption and adjust national-level procurements as needed. They can identify overstocks of laboratory commodities or HIV tests and redistribute the products. Commodity managers can also use the data

to identify exceptionally high levels of product expiry, and then initiate action to prevent this situation from recurring. LMIS data can even help program managers identify incorrect testing practices. This can result in targeted supervision and, thus, improve the overall quality of care for clients.

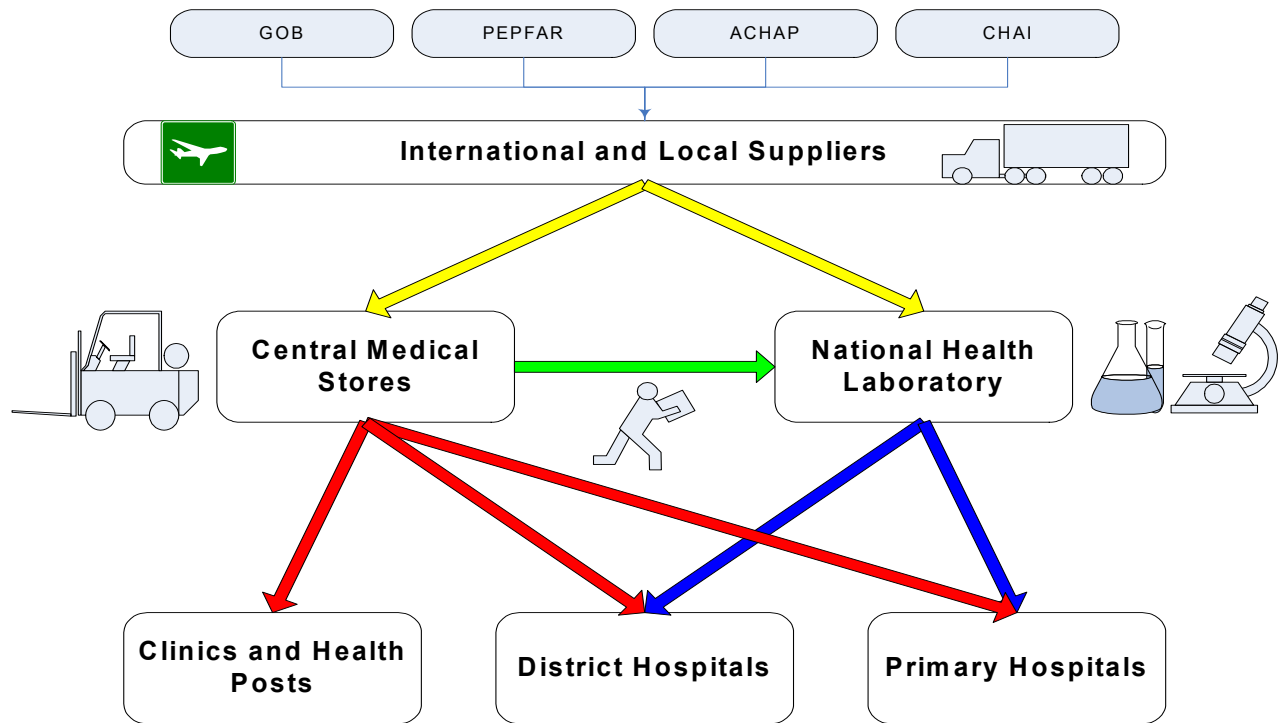
## Current Logistics System for Laboratory Supplies

The system for managing laboratory supplies in Botswana has evolved over many years and as a result there is no uniform system across Ministry of Health and Ministry of Local Government facilities as to how laboratory supplies are managed and maintained. In general the ordering of resupplies occurs on an ad hoc basis without the use of logistics data to determine resupply quantities and prevent stock imbalances.

Laboratory commodities for the Ministry of Health and Ministry of Local Government facilities are stored and distributed from both the Central Medical Stores (CMS) and the National Health Laboratory (NHL). The main reason for this is that CMS at present does not have the capacity to manage all 850 plus laboratory products and so the NHL has taken the responsibility for certain products to fill the gaps and ease the workload for the CMS. There are however plans to eventually have all commodities stored and distributed from the CMS.

The Central Medical Stores currently serves over 700 facilities distributing a wide variety of health commodities including essential medicines, medical supplies and laboratory commodities. The CMS is facing numerous challenges in managing this number of facilities and commodities. As a result certain services such as scheduled deliveries have been abolished and now commodities are distributed via a combination of deliveries by CMS and pick ups by facilities. To address the challenges that CMS is facing the Government of Botswana is in the process of negotiating a contract with a private company UTI to manage the CMS.

**Figure 2: Organization of Current Laboratory Logistics System**



At service delivery points (SDPs) which include laboratories and facilities, the management of laboratory commodities is ad hoc and informal; orders are generally made on an as required basis and resupply quantities are not calculated using logistics data. No consumption or usage data is collected and reported to the central level making it difficult for CMS and NHL to forecast and monitor stock levels. Frequent stock outs have been reported at SDPs. There are currently no established maximum and minimum stock levels to guide commodity management and most laboratory staff have not had any training in logistics.

As laboratory commodities are stored and distributed from both CMS and NHL this sometimes causes confusion for facility staff who must determine where to order each product. If an item is ordered from CMS that is actually stored and distributed from the NHL the facility is informed and required to place a separate order to NHL, which can cause delays in receiving supplies. Figure 2, depicts the current pipeline.

In designing this logistics system for laboratory commodities many factors needed to be considered. One major consideration was the future of the CMS and how to ensure that the new system could be easily adapted to future changes without causing disruptions to the flow of commodities and information. Another consideration was how other commodity categories are currently managed in Botswana. It is impractical to assume that laboratory commodities should be handled separately to all other commodities. Distribution and ordering systems should work harmoniously between commodity categories so that available resources can be used efficiently.

## **Purpose of the Logistics System Design Exercise**

The logistics system design provided an opportunity for those working in laboratories in Botswana to create a national system for managing laboratory commodities that is based on rational decision making. In Botswana the logistics system design extends to all Ministry of Health and Ministry of Local Government supported sites.

The logistics system design focused on establishing:

- a **logistics management information system (LMIS)** capable of collecting and reporting timely logistics data to enable quantification, procurement, storage, and distribution,
- an **inventory control system (ICS)** that ensures proper management of stock levels, to avoid shortages and oversupply,
- **storage and warehousing** that is capable of storing commodities so that integrity and quality is maintained,
- a **distribution system** for efficient movement of commodities from manufacturers through to facilities, and
- **trained personnel** in logistics at health facilities with adequate **supervision** and support from the central level.

# Methodology

---

## Standardization Workshop

A three day workshop was held with 25 stakeholders on the standardization of laboratory commodities using the Maputo guidelines as guidance for the exercise. The workshop schedule and participant list are in Annex 1 and 2 respectively. The goals and objectives of the standardization exercise can also be found in Annex 3. The workshop brought together a group of 25 Procurement Officers, Policy Makers, Laboratory Heads and Technicians in an effort to develop a standardized test menu, test technique, testing equipment, reagents and consumables for each level in the system. The workshop included participants drawn from all levels of the system both in the Ministry of Health and Ministry of Local Government.

This process which was billed as the first stage in the implementation of the Maputo guidelines in Botswana focused firstly on developing a tiered, integrated laboratory network by redefining laboratory levels I through IV. A tiered laboratory network is an integrated system of laboratories organized in alignment with the public health delivery network in a country. The workshop which was facilitated by the SCMS consultants, allowed the participants to have free reign on how they standardize their commodity list.

Prior to conducting the workshop, the consultant teams met with key stakeholders, namely CMS, NHL and BOTUSA to discuss the goals and objectives of the activity and to obtain a consensus on the proposed outcome of the standardization exercise. It was also an opportunity to be informed on how current procurement guidelines might affect the implementation of the standardized levels, equipment, reagents and consumables.

The workshop began by introducing the participants to the concepts of standardization, steps to standardization and why standardization is important to logistics and supply chain managers. Those presentations were then followed by a review of the Maputo Guidelines which was used as a guidance document for the standardization process and a participant, who attended the Maputo meeting presented on how these guidelines might be adopted in Botswana. These presentations were then followed by a panel discussion focusing on the barriers to standardization in the Botswana context, in particular the procurement laws which prevent sole sourcing. This session was used to develop strategies to overcome these hurdles so that standardization could become a reality.

Following those presentations and panel discussion, the participants, through facilitated discussion, collectively agreed on the definitions of each of the four levels of the laboratory network. In those deliberations, they also attempted to group the various health facilities into each defined level.

Once those definitions had been ratified, the participants were then placed into four distinct groups by level (Level I, II, III & IV) where they began the process of deciding what test menu, technique, equipment, reagents and consumables would be used at each level of the laboratory system. Participants continually referred to the Maputo Guidelines as a benchmark for their standardization process as the document provided recommendations for each standardization step.

The groups were then also asked to classify each product into either fast moving or slow moving category. Fast moving was defined as a product that would be ordered within a 3 month interval. Slow moving was regarded as products ordered after every 4 months. All of the products classified as fast moving would be considered for the inventory control system which will be discussed in the subsequent sections of this report.

## Laboratory Logistics System Design Workshop

To design the logistics system a participatory design workshop facilitated by SCMS consultants was conducted. The workshop approach to designing a logistics system engages participants within the health system in constructing an appropriate logistics system, guided by the consultants, but based on their own “hands-on” experience and meeting their own needs. Involving participants from both program management and service delivery points enables realistic decisions to be made that consider both policy and environmental factors. The participants also play a key role as positive endorsers and champions of the new system when the system is implemented.

Prior to conducting the workshop various meetings were held with key stakeholders to discuss the intentions of the activity and to obtain a comprehensive view of the current system. It was also an opportunity to be informed of any future plans that may affect the design and subsequent implementation of the new system. Stakeholder meetings were held with BOTUSA, Central Medical Stores and National Health Laboratory.

The workshop included participants drawn from all levels of the system both in the Ministry of Health and Ministry of Local Government. The workshop was undertaken from the 9<sup>th</sup> – 13<sup>th</sup> February 2009 at the Gaborone International Convention Centre. A total of 26 participants constituted the *design team*. A complete list of the workshop attendees, workshop schedule and the goals and objectives of the workshop can be found in Annex 4, 5 and 6 respectively.

The participants were taken through a series of technical presentations that focused on key logistics principals, given an overview of the current situation and then eventually began the process of designing a new system for managing laboratory commodities in Botswana. The following steps outline the process that the participants were guided through:

### 1) Review of Logistics Principles

To begin the workshop a logistics simulation was used to introduce the participants to logistics and expose them to what makes a logistics system work and what makes it fall apart. A logistics simulation is an exercise where reality is simulated to show how a pipeline functions and each participants experiences first hand what it is like to work on the ground managing commodities.

Following the simulation the following two days were dedicated to teaching critical logistics definitions and concepts to prepare the participants for the upcoming task of designing a logistics system. Topics covered included *Introduction to Health Logistics*, *Introduction to LMIS*, *Assessing Stock Status* and *Inventory Control Systems* all of which are fundamental when undertaking a logistics system design.

### 2) Review of the Current System

With their new found knowledge the participants were given the opportunity to describe how they saw the current laboratory commodity distribution system in Botswana. They described the flow of products and information through the system and the type of records used. The consultants also presented a brief review of assessments conducted in previous years of different aspects of the laboratory supply chain, see references for assessments reviewed. This exercise produced a diagram on the current pipeline which acted as a baseline for designing the new system. See Figure 2 for the current pipeline.

### **3) Group Design Stage**

To initiate the design process, participants were given the opportunity to articulate their vision of the recommended system and its characteristics. This vision forms the basis of the indicators for monitoring this new system.

Next the participants were divided into three working groups with one group focusing on designing the LMIS system, another designing the ICS and a final group reviewing the storage and distribution and providing recommendations to improving these critical components of the supply chain. Each group was provided with step by step instructions on how to design their section of the system. The whole design process was iterative in nature. The groups were given time to discuss and make recommendations for the new system and then reconvened into one large group to share their work in progress and to build synergies within the recommended systems. The small groups then continued fine-tuning their recommended design with considerations of the other aspects of the system.

Once consensus was achieved between all participants on a final design recommendation they began developing a combined presentation for stakeholders. Finally a participant from each design group presented the recommendations to stakeholders on the final day of the workshop. See Annex 4 for the list of stakeholders who attended and the presentation by the participants.

# Outcomes

---

## Standardization

The standardization process began with the workshop participants redefining each level in Botswana's tiered laboratory network. A tiered laboratory network is an integrated system of laboratories organized in alignment with the public health delivery network in a country. They did so because there was consensus within the group that a tiered, integrated laboratory network may provide the best model for service delivery across various levels of the laboratory system in Botswana.

The redefined levels are as follows:

### **LEVEL I LABORATORIES**

Laboratories or health care facilities in this category shall perform point of care tests (including but not limited to rapid HIV tests, malaria, pregnancy tests, glucose, urine dip-stick). These sites should have the capacity to collect and refer samples that they cannot test.

### **LEVEL II LABORATORIES**

Laboratories in this category shall perform basic tests in microbiology, virology, clinical chemistry, hematology, parasitology and appropriate screening tests in immunology. In addition to this, these laboratories will be capable of performing all functions as in Level I laboratories and health care facilities. Where applicable, Level II laboratories shall assist and supervise Level I facilities.

### **LEVEL III LABORATORIES**

Laboratories in this category shall be capable of performing all functions as for level II, and in addition, perform a range of specialized tests. Level III laboratories, shall, where applicable, assist and supervise the work of Level II laboratories.

### **LEVEL IV LABORATORIES**

National or multi-country public health reference laboratories for Botswana and/or other countries, shall provide specialized services in a particular specialty. These laboratories shall carry out scientific research and investigations for the control and prevention of epidemics and emerging diseases within the country and advise government on such matters. These laboratories shall validate test methods and equipment.

Following the defining of each level of the laboratory system, participants then proceeded to define the test menu and techniques at each level. The full list of tests is included in annex 7. For each of the tests, an accompanying list of associated testing products was also recommended. That list of products can be found in annex 8.

At the end of the standardization exercise, the list of over 850 commodities had been streamlined to just over 500 commodities. These were further classified into 250 essential fast moving items required to meet the countries testing needs. All of these commodities were going to be incorporated in the ICS that was to be designed in the LMIS design workshop. From that list, a vital set of commodities were then going to be chosen for inclusion onto the LMIS forms. The full list of standardized products can be seen in annex 8.

Prior to the standardization exercise, nine known types of hematology testing equipment, twelve chemistry platforms, four CD4 machines and four viral load analyzers were found to exist in country for their respective tests. Through the standardization workshop, recommendations were made that the list be dramatically to two types of hematology equipment, two types of chemistry equipment, two types of CD4 machines and maintain the current number of viral load analyzers. For TB sensitivity testing, only one type of analyzer would be used. The equipment currently in use will be phased out over time; when an analyzer needs to be replaced the analyzers listed below will be procured. The full list of these apparatus can be seen in Table 3.

**Table 3: Standardized List of Clinical Testing Analyzers**

	Level I	Level II	Level III	Level IV
<b>Chemistry</b>	None	ILAB 300 Plus	COBAS Integra 400 Plus	COBAS Integra 400 Plus
<b>Hematology</b>	None	Sysmex XT-1800i	Sysmex XE-2100	Sysmex XE-2100
<b>CD4</b>	None	BD FACSCount	BD FACSCalibur	BD FACSCalibur
<b>Viral Load</b>	None	Exavir CAVIDI Nuclisens Easy Q/ Easy Mag	COBAS Ampliprep / COBAS TaqMan 48	Nuclisens Easy Q/ Easy Mag COBAS Ampliprep / COBAS TaqMan 48 & 96 COBAS Amplicor
<b>Other</b>	None			•ILAB 300 Plus *Sysmex XT-1800i ◆BACTEC MGIT 960

•Chemistry – Blood Transfusion

\*Hematology – Blood Transfusion

◆TB DST

## Laboratory Logistics System

The following recommendations were the result of the system design workshop and represent the ideas agreed upon by all participants. These recommendations were presented by the participants at the stakeholder meeting on the last day of the workshop. As the Standard Operating Procedures (SOPs) are written the system will be refined and small changes need to be made to ensure that the system has the best possible chance of succeeding based on realities on the ground. Below outlines the key decisions made for each component of the system.

### Vision for the New System -

- Reduce stock outs and wastage
- 100% reporting rates
- Good communication between central level and facilities
- Strong supportive supervision

### The Pipeline

Certain changes to the organizational structure and flow of commodities were recommended by the participants. There are currently two proposed pipeline diagrams; one is an interim pipeline which includes NHL as a distribution point and ideal pipeline shows all laboratory commodities stored and distributed from the CMS. The purpose of two versions is to accommodate the planned changes that will occur at the CMS. Below are diagrams of the ideal and proposed pipeline diagrams.

Figure 3: Ideal Laboratory Logistics Pipeline

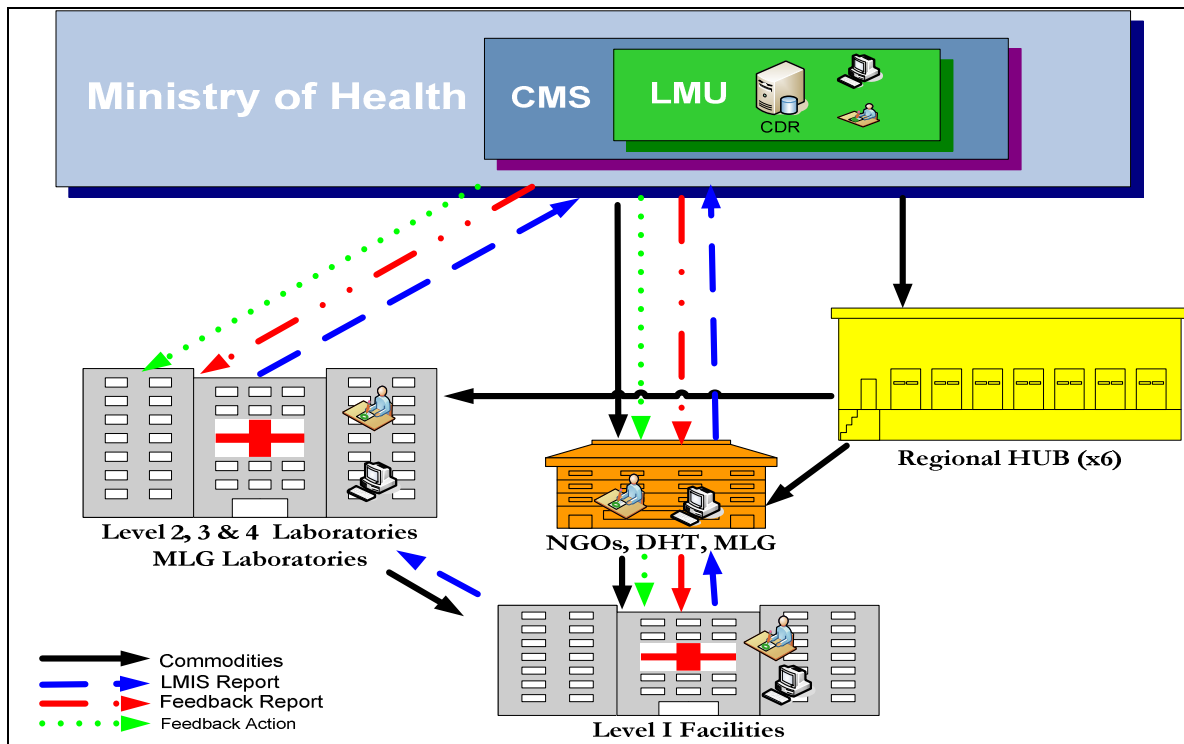
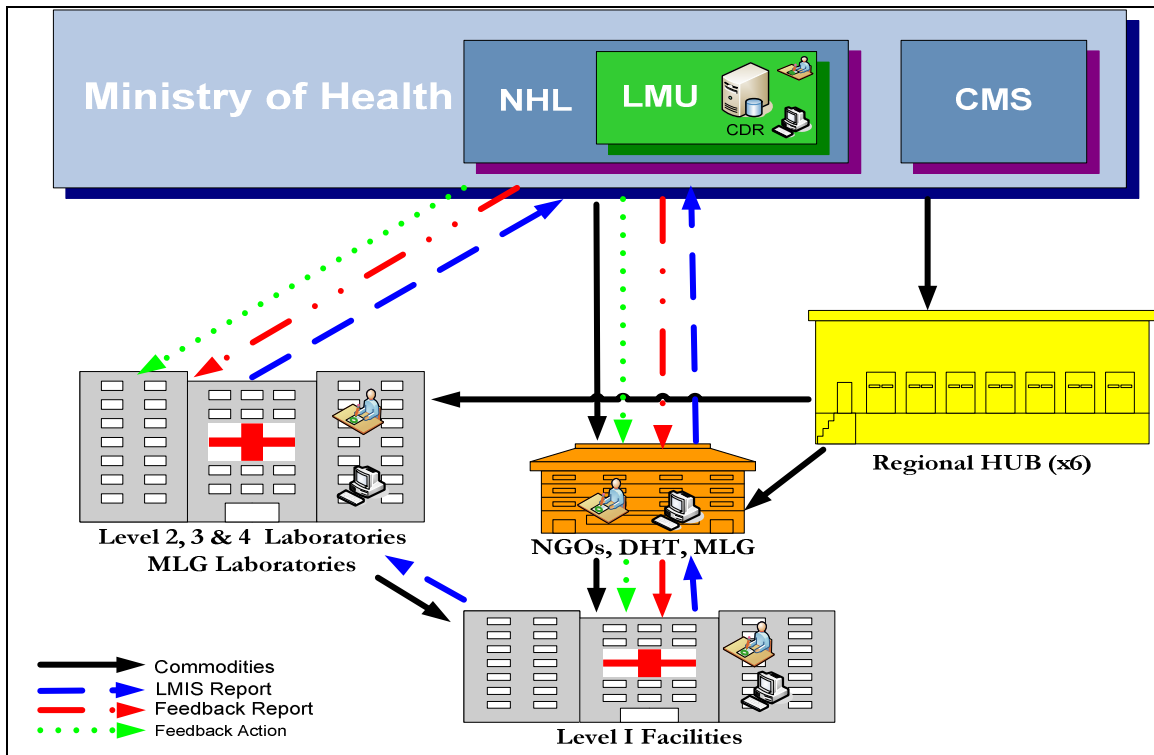


Figure 4: Practical Laboratory Pipeline



### Inventory Control System for Laboratory Commodities

The purpose of an inventory control system (ICS) is to determine when stock should be ordered, how much stock should be ordered and how to maintain an appropriate stock level of all products to avoid shortages and oversupply. By establishing a maximum, minimum and emergency order point stock levels and routine monitoring of consumption and stock on hand, it is possible to monitor stock levels to avoid overstocking and expiry, and to ensure a continuous supply of quality laboratory commodities.

A forced ordering maximum-minimum inventory control system was chosen by the participants; the description of the different variations is included in the introductory portion of this report. A forced ordering ICS compels facilities to order all products at the end of the review period or order interval. In this system it was decided that all laboratories and facilities review period would be monthly.

Of the different versions of inventory control systems, the forced ordering version was the most appropriate for Botswana due to the challenges in transportation and storage. The continuous review system required that transport be available at all times, whereas the forced ordering system has predictable ordering dates which allows for deliveries to be scheduled and vehicles to be pre-arranged. The standard version of ICS requires facilities to have large storage capabilities as the stock levels are higher than for other systems as more safety stock is required to prevent stock outs and as storage remains a challenge for Botswana this system was not chosen.

Re-supply quantities in a forced ordering system are determined by establishing the maximum stock quantity for each product and subtracting the current stock on hand. The maximum stock quantity is determined by calculating the average monthly consumption from the previous three months and multiplying by the maximum stock level. A computer generated requisition system will calculate re-supply quantities based on the logistics data entered at the facility at the end of the review period. This LMIS report and requisition will then be printed and faxed to the central level for filling the order. The next section describes this process in more detail.

If all products are brought up to the maximum stock level at the beginning of the review period then there should be adequate stock for the entire review period. However, it is still important to put into place an emergency order point at all levels of the system in case something unexpected occurs. The emergency order point indicates that a facility must place an order immediately or risk stock out. The emergency order point is based on the longest lead time for receiving an emergency order for all facilities across the country.

The review period and lead times were determined by the participants based on previous experience and these parameters were used to set maximum, minimum and emergency order points for each level of the system. Buffer stock levels were determined using the rule of thumb of half the review period. As the logistics system is implemented this can be reviewed and adjusted if required based on the performance and predictability of the system.

**Table 4: Inventory Control Parameters**

	Review Period	Lead time	Buffer Stock	Minimum	Maximum	Emergency Order Point
<b>Central</b>	2 month	3 months	1 month	4 months	6 months	2 weeks
<b>Laboratories &amp; Facilities</b>	1 month	1 ½ months	2 weeks	2 months	3 months	1 week

### **Logistics Management Information System for Laboratory Commodities**

The purpose of a logistics management information system (LMIS) is to collect, organize, and report data that will be used to make decisions. Experience has been shown that the management of supply chains for health commodities dictates the need of three minimal and essential data items; stock on hand, consumption and losses and adjustments. This information must therefore be captured by the LMIS and flow up to the central level of the system to be used for making critical supply chain decisions.

In addition to the three essential data items, the participants agreed that some specific data items are also required when managing laboratory commodities. These items are the number of tests conducted and machine functionality which are required for quality monitoring and quantification purposes. Generally three types of records are used to capture this data at the facilities; stock-keeping records, transaction records and consumption records. An LMIS report is then used to transport this information up the system to program managers to make timely decisions. In designing forms for the new LMIS the records and reports currently used were reviewed and either

these forms were adapted or new forms were designed to meet the needs of the new LMIS. The following forms were developed:

- **Consumption Records**

A consumption record as the name suggests collects consumption on a daily basis. In terms of laboratory commodities an item is considered consumed when it has been issued to the bench for use from the storeroom or storage shelf. In this system quantity used will be collected on the Laboratory Stock Bin Card. (See annex 9)

As the clinics and health posts obtain their supplies directly through the DHT or MOLG laboratories, the DHT or MOLG laboratories must compile an LMIS report that includes consumption for all clinics, health posts and their own facility. The participants developed a worksheet to assist the DHT or MOLG laboratory staff in aggregating the consumption. (See annex 10)

- **Transaction Records**

Transaction records move with the products as they move between facilities, examples including invoices, issuing vouchers, picking slips. In this system the participants decided that the transaction records that are currently in place in Botswana will continue to be used. These forms include the Gen 12, packing list, and discrepancy form (damaged / rejected / waste). No new forms were designed. (See annex 11)

- **Stock Keeping Records**

In Botswana there are no standard stock cards used by all facilities but different facilities and programs have designed their own stock keeping records that are currently in use. The participants decided to adapt the Laboratory Stock Bin Card currently being used by a few facilities to meet the needs of the LMIS. This inventory control card will be introduced to all facilities when the system is rolled out so that a uniform system for recording data is established. The major addition made to the Laboratory Stock Bin Card was to include losses and adjustments (such as expiries, loans, and breakages). (See annex 9)

- **Activity Registers**

As previously mentioned, it is also important to collect information on the number of tests conducted and the machine functionality when it comes to the management of laboratory commodities. Daily worksheets are already in place in Botswana for counting the number of tests conducted for chemistry, hematology and microbiology and reported to the central level for management decisions. As this information was already being captured, it was not necessary to create new forms. Recently, some forms for monitoring CD4 and viral load machines were developed and these were subsequently adopted with minimal changes. (See annex 12)

- **LMIS Reports**

A logistics management information system report collects the logistics data required to make critical supply chain decisions. As previously mentioned it needs to collect the three essential data items and the number of tests and machine functionality. An LMIS report form had been developed previously for CD4 and viral load testing and this form was adapted to include all logistics data and all commodities. The LMIS report is divided into two sections; the first section collects the three essential data items for all fast-moving standard products and the second section collects the

number of tests conducted on each equipment and machine functionality. (See annex 13 for an example of this form.)

This form will be developed as an Excel spreadsheet into which the staff will transfer the logistics information from the inventory control card into the electronic report every month. The spreadsheet will be set up so that the resupply quantities for each product will be automatically calculated based on the information entered by the facility. The facility will then be able to submit their report by email, fax, post or in person depending on what is the most the most efficient and convenient means. The report will be sent to the LMU so that the completeness and correctness of report can be assessed and the information can be aggregated to monitor national stock levels.

▪ **Feedback Reports**

Feedback reports flowing from the central level to the facilities are also very important for a logistics system. Feedback reports inform personnel on how the system is working at their level, motivates them to improve performance, and indicates if any reports have not been completed correctly or if certain products are currently in short supply nationally. A feedback report was designed to be completed by the LMU to feedback information to the facilities every month. (See annex 14)

A Standard Operating Procedures (SOP) Manual will be written on the basis of these recommendations and contain in it comprehensive Job Aids to guide staff on how the records and reports should be completed and used. The SOP Manual will also outline who is responsible for each form and when each form is to be used.

## **Storage and Distribution**

The storage and distribution group were tasked with reviewing the current capacity for storing commodities appropriately and distributing commodities efficiently. On reviewing the current situation the participants were then asked to make recommendations and suggestions on how the system could be improved.

Generally the participants found that storage capacity was inadequate and cold storage areas needed to be expanded at the CMS and in facilities. Furthermore there was a need for more refrigerated trucks and temperature controlled cooler boxes to protect the commodities from the Botswana heat while being transported.

The participants also recommended that the distribution system be improved to ensure that the regular orders be delivered and that pick ups should only be required for emergency orders. If pick ups are required then designated vehicles at the facilities should be identified for pick up.

## **Roles and Responsibilities of Staff in the Logistics System**

Roles and responsibilities were defined by the participants throughout the design process by all groups. Detailed descriptions including the title of the staff member responsible for these activities will be included in the Standard Operating Procedures Manual. The general roles and responsibilities at the level of the system are outlined below. The system here includes the regional hubs, however until these intermediary facilities are implemented all communication will occur directly between the central level and the facilities (interim procedures are in brackets).

- **Logistics Management Unit**
  - Receive reports from facilities
  - Forward logistics information to the relevant offices as required
  - Maintain facilities logistics data in computerised system and have a back up
  - Provide data for national quantification and procurement planning
  - Monitor and supervise the logistics system for all facilities
  - Provide training to facilities that need it
- **CMS / NHL**
  - Procure commodities from suppliers / manufacturers
  - Receive orders from laboratories and facilities and distribute commodities to all the Regional Hubs (facilities) in a timely manner
  - Communicate with the Regional Hubs (facilities) and LMU on any logistics matters
- **Regional Hubs** (once introduced)
  - Act as transit point facilities
  - Serve as short time storage for facilities with inadequate storage space
  - Monitor that commodities have reached facilities in the form of receipts and forward onto CMS
- **Laboratories and Facilities**
  - Receive supplies and give receipts to the Regional Hubs (CMS / NHL)
  - Submit usage reports monthly to the LMU
  - Use and manage lab commodities
  - Capture essential data items (usage, losses, stock at hand, equipment functionality)
- **Ministry of Local Government and NGO Centres**
  - Receive commodities and distribute to SDPs
  - Send confirmation of receipt to the Regional Hubs (CMS / NHL)
  - Aggregate data from SDPs and forward LMIS report to LMU
  - Monitor usage at SDPs
  - Send feedback report to SDPs

## **Exceptions in the Laboratory Logistics System**

### **Ordering Laboratory Supplies not Included in the System**

During the process of standardization a standard list of products was developed reducing the number of commodities in the system. In addition to standardizing the products participants were also asked to categorize products into fast moving and slow moving products. Certain fast moving standard products will be included on the LMIS form to be counted and monitored every review period and reordered to their maximum stock level.

Slow moving products are products where one unit of issue lasts longer than three months, e.g. a new bottle of MacConkey agar is opened every six months. These products will be ordered on a replacement basis, where as one unit is opened or issued to the bench the product will be replaced at the end of the review period with the other fast moving products.

Any other products that are not on the standard list and therefore not preprinted on the LMIS form but are fast moving products will still be available and can still be ordered through the CMS. Blank

lines will be included at the bottom of the form for these products. The resupply quantity should be calculated in the same way as the other fast moving products.

- **Logistics System to Manage Controls with Short Shelf Lives**

Short shelf life products are reagents with less than 3 months shelf life, such as the Sysmex E-Check Control. The short shelf life products will be delivered by courier to facilities immediately upon arriving in country.

# Recommendations

---

## Standardization

Implementing standardization is not expected to be something that will happen overnight, but rather a process that will be long and arduous but eventually beneficial for the country once it comes into fruition. The workshop was considered as a starting point of many milestones that will need to be met along the way if we are ever to realize standardization in Botswana. The workshop participants therefore recommended the formation of a standardization committee to be led by Mr. Thuso Senosi which will include other workshop participants. This group will serve as the body to ensure that timelines are being met and that the standardization agenda is consistently being pushed forward. It is important that this group begin the next steps so that no momentum is lost with the implementation of this activity.

As the PPADB act in its current format was recognized as an impediment to standardization, the workshop participants also recommended that even as the country works towards this goal, all parties involved need to ensure that everything is being done in accordance with the current laws and regulations in country.

The workshop participants also recommended that the standardized lists they developed be used as a starting point, once a standardization policy is in place. These lists, which were developed on using technical and practical considerations, should be revised every three to four years to ensure healthy competition remains amongst suppliers and that laboratory commodities are consistently updated. The recommended lists and products are in no way meant to favor a particular manufacturer or vendor of any laboratory equipment, reagent or associated supply.

Furthermore, as the concept of standardization was unanimously adopted by the workshop participants, they recommended that an accompanying standardization policy be inserted into the laboratory policy which is due to come before parliament shortly for adoption. Adopting this policy will help facilitate, its implementation. The subsequent steps to be taken are discussed in the next chapter.

## **Laboratory Logistics System Design Exercise**

There were some major recommendations that emanated from the system design that need to be highlighted and will require support and input from program managers and decision makers if they are to be successful.

### **A. Logistics Management Unit:**

One major recommendation is to create a Logistics Management Unit (LMU) that will manage and supervise the logistics system. This unit will be crucial to the new system both for their role in managing logistics data and for coordinating the logistics system between the CMS and NHL.

The presence of the LMU will simplify the system for facility staff and central level staff alike by acting as the communication hub for the system. Central level staff will have access to better information for procurement and stock management. The LMU will also provide supervision and feedback reports to the facilities. The LMU's main function however will be to ensure that logistics data is available for all who need it and ensure rational ordering occurs throughout the country improving the overall efficiency of the supply chain.

### **B. Regional Hubs:**

As Botswana is sparsely populated it is recommended that regional hubs be created to temporarily store facilities resupplies. Currently facilities have limited storage space and the introduction of regional storage hubs will mean that resupplies can be divided into smaller portions so that facilities only collect as much as they can store at a time.

The idea of regional hubs is not unique to this system design, the indication from the CMS is that intermediary facilities is planned for the future to ease the workload of the CMS and make the system more responsive. At this stage it has been decided that the logistics system for laboratory commodities should be delayed while the hubs are implemented but in the interim the system will bypass the hubs until they have been introduced nationally for all commodities.

### **C. Central Data Repository:**

Accurate and timely capture of essential data items, aggregation and timely reporting for short and long term decisions is an utmost priority in order to facilitate logistics system implementation. The proper storage and dissemination of this data also remains a priority so that timely decisions can be made. It is proposed that a Central Data Repository (CDR) be built. Logistics data from all sites will be entered into the CDR and the LMU, CMS, NHL and other partners will be able to pull information when and where needed directly from the CDR.

The CDR will be built on the backbone of the patient information management system (PIMS) which is expected to be rolled out to all MOH and MOLG supported facilities. The CDR in the laboratory logistics system will use the same infrastructure that will be deployed during the rollout of the PIMS. The development of the CDR is a long term plan and until it has been developed the LMU will play the role of managing the logistics data.

## **Pilot of the Laboratory Logistics System**

It is recommended that the system be piloted in at least six sites before it is rolled out nationally. The rationale for conducting a pilot is that this new system involves a lot of changes to current practices and a change in the behavior of laboratory staff. The pilot will enable major issues with the new system to be identified quickly and the system revised before all staff are trained. This way only a few staff will need to be retrained in the revised system.

The pilot also provides the opportunity for the Logistics Management Unit to be established and personnel to be trained to manage the logistics system. The LMU's role in this system will be crucial to its success especially because the current system does not have a central coordinating body. During the pilot the unit will have the opportunity to start slowly managing only a few sites while developing databases and systems for organizing and analyzing the data and building the capacity of logistics officers within the unit.

The sites chosen should include laboratories from both the Ministry of Health and facilities from the Ministry of Local Government. Staff from the sites will undergo a brief training workshop (two to three days) in how to use the LMIS forms, monitor their stock levels and use the SOP manual. The length of the pilot should be for at least three months to allow a few ordering cycles to pass and the system to be properly tested. Once the pilot is complete the pilot facilities will continue to use the LMIS forms rather than returning to previous practices and in this way the pilot also acts as the first step in implementation. Any changes to the system will be implemented at these sites when the national roll out occurs as the pilot will give a good indication as to what is working and not working well in the designed system.

Following the pilot there needs to be an evaluation of how the new system performed at the sites and the system will then need to be revised and the SOPs and training materials adapted to reflect these changes.

# Next Steps

---

## Standardization

The standardization workshop participants agreed that a policy paper on standardization of laboratory equipment should be prepared and given to the MOH to get their buy in into the process. Once the MOH is on board and willing to support the established standardization committee, the committee will then approach PPADB and begin dialoging on developing a policy on standardization. The committee will work closely with PPADB to develop a policy, which can be adopted at cabinet level that embodies the competition, fairness and transparency of the current laws but also enables the national laboratory service to standardize the variety of equipment used in Botswana.

As this is not expected to be an easy, straightforward or short-term process, it is recommended that steps be taken immediately to move the process towards the eventual implementation of the test menu, test technique, equipment and associated testing product recommendations. Implementation will require support and dedication from personnel at all levels of the laboratory system including policymakers, donors, and laboratory staff. Further follow on steps are presented in Table 5.

## Laboratory Logistics System Design Exercise

The first step to implementing the new logistics system for laboratory commodities is to develop the Standard Operating Procedures. While the SOPs are being developed the new system needs to be endorsed by all partners and stakeholders who will be affected by this new system and were not present at the final debriefing. Once full support for the new system has been obtained and the SOPs finalized then the pilot can be conducted. Getting full support from stakeholders is crucial to a successful implementation of this system.

It is recommended that steps be taken immediately to begin the implementation of this system to keep the momentum and enthusiasm created during this workshop alive. Implementing this system will ease the job of personnel at both the central and facility level laboratories and the sooner it is implemented the sooner the benefits can be appreciated. The new system will benefit the whole laboratory system as it will enable central level staff to:

- ensure a continuous supply of laboratory commodities to Ministry of Health and Ministry of Local Government sites in the short and medium terms,
- assess the national stock status of laboratory commodities regularly and reduce stock imbalances throughout the country,
- institutionalize technical capacity in forecasting, quantification, supply planning, and inventory management of laboratory commodities, and
- ultimately achieve long-term sustainability and success of the national laboratory service.

Below is a full list of activities that are required for implementation of both standardization and the new logistics system.

**Table 5: Follow-up Actions**

Action	Person(s) or Organization Responsible	Estimated Completion Date	Location of Work
Finalize Standardized List of Products	Phetogo Phoi	27/02/2009	Botswana
Develop Concept paper that will be used to get MOH buy in	Mr. Thuso Senosi & Standardization Committee	13/03/2009	Botswana
Insert standardization clause into laboratory policy	Mr. Thuso Senosi & Dr. Mtoni	13/03/2009	Botswana
Map out all facilities and identify type of communication mechanisms	Phetogo Phoi & Andrew Auruku	TBD	Botswana
Standardization Committee to approach PPADB on how to implement standardization within the current PPADB framework	Mr. Thuso Senosi & Standardization Committee	TBD	Botswana
Development of Standard Operating Procedures	Sarah Anderson & Marasi Mwencha	19/03/2009	SCMS PMO
Implement PPADB recommendations and implement standardization	Mr. Thuso Senosi & Standardization Committee	TBD	Botswana
Authorization of Standard Operating Procedures	SCMS Botswana	15/04/2009	Botswana
Development of curriculum	Sarah Anderson & Marasi Mwencha	25/05/2009	SCMS PMO
Training for pilot	Sarah Anderson & Marasi Mwencha	10/06/2009	SCMS PMO
Piloting of system in about six facilities	SCMS Botswana	01/07/2009	Botswana
Evaluation of pilot and revise system	SCMS Botswana Sarah Anderson & Marasi Mwencha	01/10/2009	Botswana & SCMS PMO
Training of Trainers for National System	SCMS Botswana Sarah Anderson & Marasi Mwencha	25/11/2009	Botswana

# Annex 1: Standardization Workshop Participant List

## Laboratory Standardization Workshop for the Ministry of Health and Ministry of Local Government, Botswana, Participant List

No	Participant's First Name	Participant's Last Name	Organization
1	David	Matema	MOH
2	Thuso Joseph	Senosi	MOH
3	Dr. Isaac M.	Mtoni	NHL
4	Dr. Nandan	Gokhale	NRH
5	Bazibi	Moiteelasilo	NRH
6	Dr. Mukendi K.	Kayembe	PMH-NHL
7	Kgomotso	Makhaola	BHHRL
8	Bright Kofi	Sakyi	BHHRL
9	Kereng	Mphoyakgosi	BHHRL
10	Catherine	Pule	NBTC
11	Margaret	Bafana	NHL
12	Alfred R	Busang	NHL
13	Boselo	Banyatsang	CMS
14	Koobeditse	Radisowa	NTRL
15	Casper	Ketlaareng	S/Phikwe Government Hospital
16	Caroline	Kekana	SLH
17	Bathapi	Kolou	MLG-Francistown
18	Selato	Peter Selato	NRH
19	Olefile Bickie	Bagwasi	MLG Gaborone city
20	Dorcus	Molefhe	NACA
21	Boipelo	Phiri	NACA
22	Dr Ebi	Bile	BOTUSA
23	Lady	Phokoletso	MoH
24	Bushy Boitshoko	Gombalume	PMH
25	Robinson R.	Masole	MLG
26	Stanley	Mapiki	SCMS
27	Phetogo	Phoi	SCMS
28	Deogratus	Kimera	SCMS
29	Andrew	Auruku	SCMS

## Annex 2: Standardization Workshop Schedule

Laboratory Standardization Workshop for the Ministry of Health and Ministry of Local Government, Botswana – Schedule of Activities: February 2009, 04 <sup>th</sup> to 06 <sup>th</sup> Gaborone, Botswana.			
Monday, 02/02/09	Tuesday, 03/02/09	Wednesday, 04/02/09	Thursday, 05/02/09
		<b>8:00 – 9:30</b>	<b>8:00 – 9:30</b>
		Introductions, Objectives Official Workshop Opening	Review of Day 1
		<b>9:30 – 10:15</b>	<b>9:30 – 10:15</b>
		Session 1: Standardization Principals	Group Standardization Activity II
		<b>10:15 – 10:30</b>	<b>10:15 – 10:30</b>
		<b>Break</b>	<b>Break</b>
		<b>10:30 – 11:00</b>	<b>10:30 – 12:30</b>
		Session 2: Logistics Concepts	
		<b>11:00 – 12:00</b>	
		Session 3: Review of Maputo Guidelines	Group Standardization Activity II (Cont.)
		<b>12:00 – 13:00</b>	
		Session 4: Panel discussion on Standardization	
		<b>13:00 – 14:00</b>	<b>12:30 – 13:30</b>
		<b>Lunch</b>	<b>Lunch</b>
		<b>14:00 – 15:00</b>	<b>13:30 – 15:00</b>
		Group Standardization Activity I	Group Standardization Activity III
		<b>15:00 – 15:15</b>	<b>15:00 – 15:15</b>
		<b>Break</b>	<b>Break</b>
		<b>15:15 – 16:00</b>	<b>15:15 – 16:00</b>
		Group Standardization Activity I (Cont.)	Group Standardization Activity III (Cont.)
			Group Standardization Activity IV Activity IV
			<b>10:15 – 10:30</b>
			<b>Break</b>
			<b>10:30 – 12:30</b>
			Group Standardization Activity IV (Cont.)
			<b>12:30 – 13:30</b>
			<b>Lunch</b>
			<b>13:30 – 15:00</b>
			Final presentation of standardized list of laboratory commodities

## **Annex 3: Standardization Workshop Goals & Objectives**

### **Botswana Ministry of Health & Ministry of Local Government Standardization Workshop for Laboratory Commodities February 4<sup>th</sup> – 6<sup>th</sup>, 2009**

#### **Goal:**

Participants will begin the process of standardizing testing menus, techniques and laboratory supplies in Botswana.

#### **Objectives:**

By the end of this workshop, participants will be able to:

1. Set test menus by level.
2. Agree on priority equipment and technique by level to fulfill test menus.
3. Identify the products that correspond to the agreed testing technique and equipment by level that will become the standard list.
4. Outline next steps for standardization.
5. Achieve commitment from all stakeholders for standardization.

## Annex 4: Logistics System Design Participant List

### Logistics System Design Workshop for the Ministry of Health and Ministry of Local Government, Botswana, Participant List

No	Participant's First Name	Participant's Last Name	Organization
1	Bazibi	Moiteelasilo	NRH
2	Kgomotso	Makhaola	BHHRL
3	Bright Kofi	Sakyi	BHHRL
4	Kereng	Mphoyakgosi	BHHRL
5	Catherine	Pule	NBTC
6	Margaret	Bafana	NHL
7	Alfred R	Busang	NHL
8	Boselo	Banyatsang	CMS
9	Obert	Kachuwaire	NTRL
10	Casper	Ketlaareng	S/Phikwe Government Hospital
11	Caroline	Kekana	SLH
12	Bathapi	Kolou	MLG-Francistown
13	Olefile Bickie	Bagwasi	MLG Gaborone city
14	Dorcus	Molefhe	NACA
15	Boipelo	Phiri	NACA
16	Godfrey	Nawa	NHHRL
17	Sheila	Ditsebe	CMS Receipts
18	Letsibogo	Letsibogo	NRH
19	Liziwe	Chebani	Mahalapye Hospital
20	Keoratile	Ntshambiwa	Sekgoma Memorial Hospital
21	Keabetswe	Ramalepa	Letsholathebe Memorial Hospital
22	Shirley	Jahane	PMH
23	Thabo	Phirie	Ghanzi Primary Hospital
24	Godfrey	Mogorosi	Palapye Primary Hospital
25	Kabontshetsa	Podi	Tsabong Primary Hospital
26	David	Matema	MOH
27	Dr. Isaac M.	Mtoni	NHL
28	Ebi	Bile	BOTUSA
29	Stanley	Mapiki	SCMS
30	Phetogo	Phoi	SCMS
31	Deogratus	Kimera	SCMS
32	Andrew	Auruku	SCMS
33	Scott	Merritt	SCMS
34	Mark	Ogbuabo	SCMS

## Annex 5: Logistics System Design Workshop Schedule

<b>Logistics System Design Workshop for the Ministry of Health and Ministry of Local Government, Botswana – Schedule of Activities: February 2009, 9<sup>th</sup> to 13<sup>th</sup> Gaborone, Botswana.</b>			
<b>Monday, 09/02/09</b>	<b>Tuesday, 10/02/09</b>	<b>Wednesday, 11/02/09</b>	<b>Thursday, 12/02/09</b>
<b>8:00 – 9:00</b>	<b>8:00 – 10:15</b>	<b>8:00 – 9:30</b>	<b>8:00 – 9:30</b>
Ice breaker/Schedule/ Norms	Session 3: Introduction to LMIS (cont.)	Session 6: Participants’ view of current logistics systems in Botswana	Review of group design activities I & II
<b>9:00 – 10:00</b>		<b>9:30 – 10:15</b>	<b>9:30 – 10:15</b>
Session 1: Introduction to logistics		Session 7: Inputs from the logistics System Assessment	Group design activity III
<b>10:00 – 10:15</b>	<b>10:15 – 10:30</b>	<b>10:15 – 10:30</b>	<b>10:15 – 10:30</b>
Break	Break	Break	Break
<b>10:15 – 13:00</b>	<b>10:30 – 12:00</b>	<b>10:30 – 12:00</b>	<b>10:30 – 12:00</b>
Session 2: Logistics System Simulation	Session 4: Assessing stock status	Session 8: Ethiopia case study presentation and impact of standardization	Group design activity IV
	<b>12:00 – 13:00</b>	<b>12:00 – 13:00</b>	<b>12:00 – 13:00</b>
	Lunch	Lunch	Lunch
<b>13:00 – 14:00</b>	<b>13:00 – 15:00</b>	<b>13:00 – 13:30</b>	<b>13:00 – 15:00</b>
Lunch	Session 5a: Inventory Control System (ICS) Part I	Session 9: Introduction to the design	Review of group design activities III & IV
<b>14:00 – 15:00</b>		<b>13:30 – 15:00</b>	
Session 2: Logistics System Simulation		Group design activity I	Plenary session on recommended Botswana Logistics System
<b>15:00 – 15:15</b>	<b>15:00 – 15:15</b>	<b>15:00 – 15:15</b>	<b>15:00 – 15:15</b>
Break	Break	Break	Break
<b>15:15 – 16:00</b>	<b>15:15 – 16:00</b>	<b>15:15 – 16:00</b>	<b>15:15 – 16:00</b>
Session 3: Introduction to LMIS	Session 5b: Inventory control system (ICS) II	Group design activity II	LMIS & ICS group presentation prep.
			Closing and Certificates

# **Annex 6: System Design Workshop Goals & Objectives**

## **Botswana Ministry of Health and Ministry of Local Government System Design Workshop for Laboratory Commodities February 9 – 13, 2009**

### **Goal:**

To design a logistics system for the management of laboratory supplies for all Ministry of Health and Ministry of Local Government supported sites. .

### **Objectives:**

By the end of this workshop, participants will be able to:

1. Describe the design principles of the logistics management information system and the inventory control system laboratory commodities.
2. Design a standardized logistics management system for laboratory commodities for all Ministry of Health and Ministry of Local Government sites
3. Design one common inventory control system for laboratory commodities including establishing max-min stock levels for each level in the system, order, re-order/review period, for stock-keeping/stores management, and for reporting and ordering from the higher levels.
4. Determine collection, aggregation, ordering, reporting, and approval procedures, including frequency and information flows, to ensure that accurate and timely commodity information is produced, reported, and used for ordering and regular commodity management for laboratory commodities. This information will also allow managers to monitor system performance.
5. Identify roles and responsibilities for site managers, pharmacists, medical laboratory scientists at ART sites, CMS, NHL, distribution agents, and for other personnel and agencies with supply management responsibilities.



# Annex 7: Standardized List of Tests

Level I	Level II	Level III	Level IV*
<b>Blood Bank</b> Blood glucose Urine Chemistry	<b>Blood Bank</b> Ab Screening & Identification ABO/Rh Grouping Coombs - Direct Coombs - Indirect Cross Match	<b>Blood Bank</b> Ab Screening & Identification ABO/Rh Grouping Coombs - Direct Coombs - Indirect Cross Match	<b>Blood Transfusion</b> Ab Screening & Identification ABO/Rh Grouping ALB ALP ALT AST HBsAg HCV Ag/Ab HIV Ag/Ab Syphilis Factor 8 & 9 Estimation FBC Haemoglobin Estimation Sterility Testing Tissue Typing TP
<b>Chemistry</b> Blood glucose Urine Chemistry	<b>Chemistry</b> Acid Phosphatase ALB ALP ALT Amylase AST Blood glucose Blood Protein* Calcium Carbon Dioxide Chloride Cholesterol Creatinine CSF Direct- Bilirubin GGT HBA1C HDL LDL Lithium Potassium Sodium Total-Bilirubin	<b>Chemistry</b> Acid Phosphatase ALB ALP ALT Amylase AST Blood Protein Bence Jones protein Calcium Chloride Cholesterol Creatine Kinase CKMB Carbon Dioxide Creatinine CSF Direct- Bilirubin GGT Blood glucose HBA1c HDL Lactate LDH	<b>Chemistry</b> Acid Phosphatase ALB ALP ALT Amylase AST Blood Protein Bence Jones protein Calcium Chloride Cholesterol Creatine Kinase CKMB Carbon Dioxide Creatinine CSF Direct- Bilirubin GGT Blood glucose HBA1c HDL Lactate LDH

Standardization and Laboratory Logistics System Design for Botswana

	<p>Triglycerides Urea Uric acid Urine Chemistry Urine Protein*</p>	<p>LDL Lithium Lipase Phosphate Potassium Sodium Total-Bilirubin TP Triglycerides Urea Uric Acid Urine Chemistry Urine Protein*</p>	<p>LDL Lithium Lipase Phosphate Potassium Sodium Total-Bilirubin TP Triglycerides Urea Uric Acid Urine Chemistry Urine Protein*</p>
<p><b>Hematology</b> Haemoglobin</p>	<p><b>Hematology</b> Blood Film Blood Parasites Bone Marrow Clotting Time ESR FBC with 5 part Diff, plus Retics Haemoglobin LE Cells PT PTT Reticulocytes Sickling test</p>	<p><b>Hematology</b> Blood Film Blood Parasites Bone marrow Clotting Time Electrophoresis ESR Haemoglobin FBC with 5 part Diff, plus Retics LE Cells PT PTT Reticulocytes Sickling test</p>	<p><b>Hematology</b> Blood Film Blood Parasites Bone marrow Clotting Time Electrophoresis ESR Haemoglobin FBC with 5 part Diff, plus Retics LE Cells PT PTT Reticulocytes Sickling test</p>
<p><b>Histology</b></p>	<p><b>Histology</b></p>	<p><b>Histology</b> Grossing H&amp;E and Special Stains Microscopy Non-gynae slide prep Pap smears Pap Staining Section cutting Slide mounting Tissue embedding Tissue processing</p>	<p><b>Histology</b> Grossing H&amp;E and Special Stains Microscopy Non-gynae slide prep Pap smears Pap Staining Section cutting Slide mounting Tissue embedding Tissue processing</p>
<p><b>Immunology</b> Pregnancy Test</p>	<p><b>Immunology</b> CD4 Pregnancy Test Prostate Specific Antigen Rheumatoid Factor</p>	<p><b>Immunology</b> CD4 Pregnancy Test Prostate Specific Antigen Rheumatoid Factor</p>	<p><b>Immunology</b> CD4 Pregnancy Test Prostate Specific Antigen Rheumatoid Factor</p>
<p><b>Microbiology</b> Malaria rapid test</p>	<p><b>Microbiology</b> Beta Lactamase Biochemical &amp; Identification tests</p>	<p><b>Microbiology</b> Beta Lactamase Biochemical &amp; Identification tests</p>	<p><b>Microbiology</b> Beta Lactamase Biochemical &amp; Identification tests</p>

	<p><b>Catalase</b>                  Coagulase - Slide                  Coagulase - Tube                  Cryptococcal Antigen test                  CSF &amp; body fluids cell count                  Germ Tube                  Gram Stain                  Mycology Skin                  Oxidase                  Semen Analysis                  Sensitivity Test                  Specific Gravity                  Stool Direct Microscopy                  Stool Occult Blood                  TB - AAFB Smear                  TSI                  Typing / API                  Urine Chemistry                  Urine Microscopy                  Wet Prep (KOH)                  Wet Prep( saline)</p>	<p><b>Catalase</b>                  Coagulase - Slide                  Coagulase - Tube                  Cryptococcal Antigen test                  CSF &amp; body fluids cell count                  Culture                  Germ Tube                  Gram Stain                  Microscopy,                  Mycobacteriology                  Mycology Skin                  Oxidase                  Parasitology                  Semen analysis                  Sensitivity Test                  Specific gravity                  Stool Direct Microscopy                  Stool Occult Blood                  Susceptibility                  TB - AAFB Smear                  TSI                  Typing / API                  Urine Chemistry                  Urine Microscopy                  Wet Prep (KOH)                  Wet Prep( saline)</p>	<p><b>Catalase</b>                  Coagulase - Slide                  Coagulase - Tube                  Colony counts (CFU)                  Cryptococcal Antigen test                  CSF &amp; body fluids cell count                  Culture                  DST                  Genotyping                  Germ Tube                  Gram Stain                  Identification                  MBC                  Media preparation                  MIC                  Microscopy                  Mycobacteriology                  Mycology Skin                  Oxidase                  Parasitology                  Semen analysis                  Sensitivity Test                  Specific gravity                  Stool Direct Microscopy                  Stool Occult Blood                  Susceptibility                  TB - AAFB Smear                  TSI                  Typing / API                  Urine Chemistry                  Urine Microscopy                  Wet Prep (KOH)                  Wet Prep( saline)</p>
<p><b>Virology</b>                  HIV                  Syphilis</p>	<p><b>Virology</b>                  ASOT                  Hepatitis B                  Hepatitis C                  HIV                  Syphilis                  Viral Load</p>	<p><b>Virology</b>                  ASOT                  Hepatitis B                  Hepatitis C                  HIV                  Syphilis                  Viral Load</p>	<p><b>Virology</b>                  ASOT                  Avian Flu                  CMV                  Genotyping                  Hepatitis B                  Hepatitis C                  HIV 1 &amp; 2                  HSV                  Measles                  PBMC                  Polio                  Rabies                  Rubella</p>

*Standardization and Laboratory Logistics System Design for Botswana*

			Syphilis Viral Culture Viral Hemorrhagic fevers Viral Load (RNA PCR) DNA PCR
<b>Referral tests</b> Collection of blood specimens Collection of DBS Collection of pap smears Collection for microbiology Preparation of Malaria Smears	<b>Referral tests</b> Collection of pap smears Collection for microbiology Collection of blood specimens Collection of DBS Hormones Cardiac Enzymes Preparation of Malaria Smears Measles Polio		

\* Level IV includes specialized laboratories and therefore some might groups may only be pertinent to the specialized labs, for example Blood Transfusion would apply to the lab involved with Blood Transfusion.

# Annex 8: Draft Standardized List of Fast Moving Products

Consumables and Reagents Listed in Categories	Level 1	Level 2	Level 3	Level 4
<b>Hematology</b>				<input type="checkbox"/>
ESR stand			√	
Sysmex XE 2100 Cell Clean			√	√
Sysmex XE 2100 Cell Sheath			√	√
Sysmex XE 2100 Cell Pack			√	√
Sysmex XE 2100 E-Check High			√	√
Sysmex XE 2100 E-Check Normal			√	√
Sysmex XE 2100 Eight Check Control Low			√	√
Sysmex XE 2100 Eight Check Control Normal			√	√
Sysmex XE 2100 Ret-Search II Diluent+Dye			√	√
Sysmex XE 2100 Stromatolyser 4DI ( FFD)			√	√
Sysmex XE 2100 Stromatolyser 4DS ( FFS)			√	√
Sysmex XE 2100 Stromatolyser FBA 200A			√	√
Sysmex XE 2100 Stromatolyser WH			√	√
Sysmex XE 2100 Stromatolyser-FB			√	√
Sysmex XE 2100 Stromatolyser IMI			√	√
Sysmex XE 2100 Stromatolyser NR			√	√
Sysmex XE 2100 Stromatolyser-FD I			√	√
Sysmex XE 2100 Stromatolyser-FD II			√	√
Sysmex XE 2100 Sulfolyser SLS 200A			√	√
Sysmex XT 1800i - Cellpack 20L		√		
Sysmex XT 1800i - Control E-CHECK H-Control 7x5 ml		√		
Sysmex XT 1800i - Control E-CHECK L-Control 7x5 ml		√		
Sysmex XT 1800i - Control E-CHECK N-Control 7x5 ml		√		
Westergreen cup		√	√	
Westergreen pipette		√	√	
<b>Blood Bank</b>				<input type="checkbox"/>
Anti -A		√	√	√
Anti -AB		√	√	√
Anti -B		√	√	√
Anti -C			√	√
Anti -D		√	√	√
Anti -D Control				√
Anti -E			√	√
Anti -K				√
Anti-Human Globulin - AHG		√	√	√
Coombs Control Cells		√	√	√
LISS		√	√	√
Selectogen cells I & II		√	√	
<b>Blood Transfusion</b>				<input type="checkbox"/>
Alzervers Solution				√
Blood - Triple Blood Bags				√
Blood Collection Supplies			√	√
Bottom and Top Triple Bags				√
Cuvettes	√			√
HCV Combo Kit				√
Hemocue reagents	√			√
HIV Combo Kits (? What is this?)				√

Pediatric Blood Bags				√
<b>Immunology</b>				□
BD FACS Calibur - TriTEST CD3/CD4/CD45 with TruCOUNT Tubes			√	
BD FACS Calibur - TriTEST CD4/CD8/CD3 with TruCOUNT Tubes			√	
BD FACS Calibur CD 3/4/8/45- Calibrite 3 Beads CE 25T		√	√	√
BD FACS Calibur CD 3/4/8/45- Calibur APC Beads 25T CE		√	√	√
BD FACS Calibur CD 3/4/8/45- FacsClean		√	√	√
BD FACS Calibur CD 3/4/8/45- FacsFlow		√	√	√
BD FACS Calibur CD 3/4/8/45- FacsLysing Solution		√	√	√
BD FACS Calibur CD 3/4/8/45- FacsRinse		√	√	√
BD FACS Calibur MultiTEST CD3/CD8/CD45/CD4 with TruCOUNT Tubes		√		√
BD FACS Calibur Total CD4 Tests on FACS Calibur CD 3/4/45			√	□
BD FACS Calibur Total CD4 Tests on FACS Calibur CD 3/4/8		√		
BD FACS Count CD3/4/8 Reagent Kit		√		
BD FACS Count Total CD4 Tests		√		
BD FACS Count-Control Kit		√		
BD FACS Count-FacsFlow		√		
BD FACS Count-Thermal Paper		√		
BD FACS Monoclonal Antibodies		√		√
Determine Test Kit	√	√	√	√
Exa Vir Load Reagent Kit - 32 Tests		√		
Exa Vir Load Reagent Kit- Consumables 32 Tests		√		
Murex Anti HCV V 4.0				√
Murex HbAsg v 3.0				√
Murex HIV 1&2			√	√
Nuclisens (Easy MAG/Q) - 1000ul Tips Filtered		√		√
Nuclisens (Easy MAG/Q) - 200ul Tips Filtered		√		√
Nuclisens (Easy MAG/Q) - 20ul Tips Filtered		√		√
Nuclisens (Easy MAG/Q) - Biohit 1200 Tips 1000		√		√
Nuclisens (Easy MAG/Q) - Easy MAG Disposable		√		√
Nuclisens (Easy MAG/Q) - EasyQ Cal/ C Diluent		√		√
Nuclisens (Easy MAG/Q) - Extraction Buffer 1 4L		√		√
Nuclisens (Easy MAG/Q) - Extraction Buffer 2 4L		√		√
Nuclisens (Easy MAG/Q) - Extraction Buffer 3 4L		√		√
Nuclisens (Easy MAG/Q) - Lysis Buffer 3 4L		√		√
Nuclisens (Easy MAG/Q) - Magnetic Silica 48 x 3ml		√		√
Nuclisens (Easy MAG/Q) - Microwells 1x96 (100)		√		√
Nuclisens (Easy MAG/Q) - Nuclisens Easy Q HIV Kit		√		√
Nuclisens (Easy MAG/Q) - PCR Lids (100)		√		√
Nuclisens (Easy MAG/Q) - PCR Strips (100)		√		√
Oraquick HIV tests	√			√
Pregnancy test kit		√	√	
Syphilis - EIA Syphilis Kit				√
Syphilis - RPR kit		√	√	
Unigold rapid HIV test kit	√	√	√	
Vironostika Uniform HIV 1&2			√	√
<b>Chemistry</b>				□
Cobas AmpliCor - A-Rings 24				√
Cobas AmpliCor - D-Cups 840				√
Cobas Ampliprep - 1000ul Tips - Filtered 1000			√	√
Cobas Ampliprep - 200ul Tips Filtered 960			√	√
Cobas Ampliprep - 5ml Pippette Tips			√	√
Cobas Ampliprep - AmpliCor Wash Buffer 2L			√	√
Cobas Ampliprep - Ampliprep Wash Buffer 2L			√	√
Cobas Ampliprep - A-Rings 24			√	
Cobas Ampliprep - D-Cups 840			√	

Cobas Ampliprep - K-Tips 432			√	√
Cobas Ampliprep - Reagent Cassettes (48)			√	√
Cobas Ampliprep - S Input Tubes 288			√	√
Cobas Ampliprep - S Output Tubes 360			√	√
Cobas Ampliprep - SPU 288			√	√
Cobas Integra 400 - (ALT/GPT) 500 tests			√	√
Cobas Integra 400 - (AST/GOT) 500 tests			√	√
Cobas Integra 400 - Albumin			√	√
Cobas Integra 400 - ALP			√	√
Cobas Integra 400 - Amylase			√	√
Cobas Integra 400 - Chloride ISE 3 500 tests			√	√
Cobas Integra 400 - Cholesterol 400 tests			√	√
Cobas Integra 400 - Cleaner 1 liter			√	√
Cobas Integra 400 - CO2 tests			√	√
Cobas Integra 400 - Creatinine 700 tests			√	√
Cobas Integra 400 - Cuvettes 20 x 1000 microcuvettes			√	√
Cobas Integra 400 - Direct Bilirubin			√	√
Cobas Integra 400 - GGT			√	√
Cobas Integra 400 - Glucose 500 tests			√	√
Cobas Integra 400 - ISE (Reference) 200 tests			√	√
Cobas Integra 400 - ISE Direct 200 tests			√	√
Cobas Integra 400 - ISE Indirect 200 tests			√	√
Cobas Integra 400 - Potassium ISE 2 500 tests			√	√
Cobas Integra 400 - Precinorm U 4x5 ml			√	√
Cobas Integra 400 - Precipath U 4x5 ml			√	√
Cobas Integra 400 - Sample Cups pack of 1000 cups			√	√
Cobas Integra 400 - Sodium ISE 1 500 tests			√	√
Cobas Integra 400 - Total Bilirubin			√	√
Cobas Integra 400 - Total Protein			√	√
Cobas Integra 400 - Urea 500 tests			√	√
Cobas TaqMan (CTM48) - 1ml Tips - Filtered (100)			√	√
Cobas TaqMan (CTM48) - Ampliprep Wash Buffer 5L			√	√
Cobas TaqMan (CTM48) - K Tips (432)			√	√
Cobas TaqMan (CTM48) - K Tubes (1152)			√	√
Cobas TaqMan (CTM48) - SPU 24x12			√	√
ILAB 300 Plus - Alanine aminotransferase (ALT) 696 tests	√		√	√
ILAB 300 Plus - Alkaline Phosphatase (ALP)	√		√	√
ILAB 300 Plus - Aspartate aminotransferase (AST) 696 tests			√	√
ILAB 300 Plus - Chloride 200 tests			√	
ILAB 300 Plus - Cleaner 1 liter			√	√
ILAB 300 Plus - Control 15 ml/vial			√	√
ILAB 300 Plus - Creatinine 640 tests	√		√	
ILAB 300 Plus - Cuvette Cleaning Solution	√			
ILAB 300 Plus - Cuvettes 20 x 1000 microcuvettes			√	√
ILAB 300 Plus - Gamma Glutamyl Transferase (GGT or γ- GT)	√		√	
ILAB 300 Plus - Glucose 700 tests	√		√	
ILAB 300 Plus - ISE Calibrator A	√			
ILAB 300 Plus - ISE Calibrator B	√			
ILAB 300 Plus - ISE Cleaning Solution	√			
ILAB 300 Plus - Potassium 200 tests			√	
ILAB 300 Plus - Printer paper roll 5ml			√	√
ILAB 300 Plus - Probe Rinse	√			
ILAB 300 Plus - Sample Cups pack of 1000 cups			√	√
ILAB 300 Plus - Sodium 200 tests			√	
ILAB 300 Plus - Total Bilirubin	√		√	
ILAB 300 Plus - Total Protein	√		√	√

ILAB 300 Plus - Urea 640 tests		√	√	
Pipette Tips - Blue Pipette Tips 1000μL			√	
Pipette tips - White tips			√	
Pipette tips - Yellow tips			√	
<b>Histology</b>				□
Brushes, Cervix	√	√	√	
Cassettes			√	
Cytological Fixative		√	√	
Eosin powder			√	
Harris Haematoxylin			√	
Microtome blades High profile			√	
Microtome blades Low profile			√	
Mounting Media			√	
Papanicolaou Solution EA 50			√	
Papanicolaou Solution Orange G			√	
Paper Roll, Blue			√	
Paraffin wax			√	
Speculum - Disposable speculum	√			
Xylene			√	
<b>Microbiology</b>				□
Agar - Blood Agar base			√	
Agar - Columbia Agar		√		
Antibiotic Disc Methicillin		√	√	
API 20E Kit		√	√	√
BACTEC MGIT 960 PZA kit				√
BACTEC MGIT 960 PZA tubes				√
BACTEC MGIT 960 S.I.R.E kit				√
BBL MGIT 7ml tubes barcoded				√
Centrifuge tubes 15ml				√
Distilled water			√	
Falcom centrifuge tubes			√	
Glycerol			√	
Gram Negative Discs (single discs)			√	
Gram Positive Discs (single discs)			√	
Gram stain			√	
Indole				√
Kahn tubes			√	
Lancets	√	√		√
LJ media				√
Malachite Green (Oxalate)			√	
Methanol Fixative	√			
Orange stick	√			
Oxalic Acid			√	
Panel Cells			√	
Phenol			√	
Stool discs (single discs)			√	
TB Culture - HCL				√
TB Culture - Microtubes-2ml				√
TB Culture - plastic pipettes individually wrapped and sterile-1ml				√
TB Culture - plastic pipettes individually wrapped and sterile-20ml				√
TB Culture - Potasium permanganate				√
Throat swabs			√	
Urine dipstick -9 parameters,			√	
Urine dipsticks - 5 parameters	√	√		
<b>Virology</b>				□
Apheresis Blood bags				√

DBS Protein Saver card				√
Dessicator				√
DNA/PCR Kit v 1.5				√
Sarstedt Tube				√
Sterile, DNase, RNase free 1000ul filtered				√
Sterile, DNASE, RNase free 200ul filtere				√
Sterile, DNase, RNase free 20ul filtered				√
ViroSeq Kit				√
<b>General Consumables</b>				<input type="checkbox"/>
Alcohol pads				√
Alcohol Swabs				√
Applicator Sticks - 500 sticks		√	√	√
Biohazard Bags	√			√
Bleach (10% Hypochloride)				√
Cover Glass(22x22)		√		
Disinfectant	√			√
Disposable Centrifuge Tubes		√		√
Ethanol 70%		√		√
Gloves - Disposable, latex, powder-free gloves, Large / Extra Large		√		
Gloves - Disposable, latex, powder-free gloves, Small / Medium		√		
Gloves, powdered			√	√
Needle 21G	√			√
Needle 23G	√			√
Paper Rolls - Jumbo				√
paper towel				√
Petri dishes		√	√	√
Pipette Tips 0-20mcl - filtered		√		
Pipette Tips 20-200mcl - filtered		√		
Pipette Tips 300-1000mcl - filtered		√		
Pipettes - fine tipped				√
Sharps container (1000 sharps capacity)	√	√	√	√
Slides cut edge		√	√	
Slides frosted end		√	√	√
Slides plain	√		√	√
Specimen Containers - Urine/Stool/sputum Containers	√	√	√	
Specimen Storage Bags				√
Troughs Disposable Troughs				√
Tubes - Blood tubes	√			
Tubes - EDTA Tubes		√	√	√
Universal Specimen Collection Bottles				√
Vacutainer Needles		√		
Vacutainer Tubes	√			√
Xylene resistant/nitrile gloves			√	







# Annex 12: Daily Activity Registers

Ref: Draft 0014

**Laboratory Daily Reporting Form  
CD4 Daily Consumption  
FACS Count**

Name of Facility:

Month:

Year:

Date	Valid Tests	Controls	Failures	Initials	Equipment Functioning	Comments
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
<b>Totals</b>						

# Annex 13: LMIS Report

Laboratory Monthly Logistics Reporting Form February												
<b>Name of Facility:</b>			<b>Reporting Period:</b>									
Product Code	Item Description	Unit	Opening Stock	Quantity Received	Quantity Used	Losses / Adjustments	Loans to / From	Closing Stock	Quantity Used Last Month	Quantity Used Last Month	Requisition Quantity	Remarks
			a	b	c	d	e	f	g	h	i=(c+g+h) - f	
	<b>BD FACS Count</b>											
	BD FACS Total CD4 Tests	Each			2				1	12	15	
	BD FACS Count CD3/4/8 Reagent Kit	Each							0	0		
	BD FACS Count-Control Kit	Each							0	0		
	BD FACS Count-FacsClean	Bottle							0	0		
	BD FACS Count-FacsRinse	Bottle							0	0		
	BD FACS Count-FacsFlow	Bottle							0	0		
	BD FACS Count-Thermal Paper	Roll							0	0		
									0	0		
<b>Compiled by</b>			<b>Received by</b>									
<b>Name</b>			<b>Name</b>									
<b>Designation</b>			<b>Designation</b>									
<b>Signature</b>			<b>Signature</b>									
<b>Date</b>			<b>Date</b>									
Test + Equipment Information												
SYSMEX 1800i	FBC											
FACS Calibur	CD4											
EXAVIR CAVIDI	VL											
ILAB 300	ALP											
ILAB 300	ALT											
ILAB 300	AST											
ILAB 300	Cr											
ILAB 300	GGT											
ILAB 300	Glucose											
ILAB 300	Urea											

# Annex 14: Feedback Report

---

## Commodity Report Feedback Form

<b>Facility Name:</b>	<b>Facility Code:</b>
<b>District:</b>	<b>Hub:</b>
<b>Reporting Period (month, year):</b>	

*Thank you for submitting your report*

Date report received (day/month/year):

Your report was received: on time or late

Report check:

	Yes	Complete	No
Opening balance			
Quantity received			
Quantity used			
Losses and Adjustments			
Ending balance			
# Tests conducted			
Equipment Functioning			

Did the closing balance from the last report match the opening balance on this report?

Did the form balance?

*Opening balance + Quantity received - quantity used +/- losses / adjustments +/- loans = closing balance*

From calculations these are the quantities that have been ordered for you:

Product Code	Description	Units of Issue	Quantity Ordered
--------------	-------------	----------------	------------------

Compiled by: \_\_\_\_\_ Name and Title: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

# References

---

1. Department of Technical Support Services, Division of Laboratory Services, Ministry of Health. *Botswana Medical Laboratory Practice Standards*. June 2003.
2. Hannington O. Ahenda II. 2008. *Assessment of ART Laboratory Logistics and Supply Chain Management Systems and Services in Botswana*. August 8 to October 5, 2007. Submitted to the Botswana Ministry of Health by the Supply Chain Management System (SCMS).
3. Idris, R.A., Aboagye-Nyame, F. 2007. *Quantification of Antiretroviral Medicines Requirements for the Botswana Central Medical Stores – 2007 to 2009*. Submitted to the Botswana Ministry of Health by the Supply Chain Management System (SCMS).
4. Mwencha, E.M., Mpfizi, B.I. 2008. *Quantification of Laboratory Commodities in Botswana for the Period July 2008 – June 2009*. Submitted to the Botswana Ministry of Health by the Supply Chain Management System (SCMS).
5. Owens, Richard C., Jr., and Timothy Warner. 2003. *Concepts of Logistics System Design*. Arlington, Va.: John Snow, Inc./DELIVER, for the U.S. Agency for International Development (USAID).
6. Sakyi, B. *et al.* 2008. *Situation Analysis of Causes of Frequent Stock outs of CD4 and Viral Load Reagents in the Botswana National ART Program*. Submitted to the Botswana Ministry of Health by the Supply Chain Management System (SCMS).
7. Sakallah, S., Maribe, M. D. 2009. *Botswana laboratory products specification database*. Submitted to the US Agency for International Development by the Supply Chain Management System (SCMS).
8. USAID | DELIVER PROJECT, Task Order 1. 2008. *Guidelines for Managing the Laboratory Supply Chain: Version 2*. Arlington, Va.: USAID | DELIVER PROJECT, Task Order 1
9. USAID | DELIVER PROJECT, Task Order 1. 2008. *The Supply Chain Implications for Standardizing Laboratory Supplies: Lessons Learned and Practical Approaches*. Arlington, Va.: USAID | DELIVER PROJECT, Task Order 1.