Diagnostic Network Optimization & Laboratory Information Management Systems in Cameroon

Integrated Diagnostic Consortium Meeting
Washington D.C
September 12-13 2019

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Laboratory Director
CDC-Cameroon
90-90-90 Results from CAMPHIA

* The CAMPHIA began fieldwork in June 2017 and concluded in January 2018.
90-90-90: One Year After CAMPHIA

Cameroon 90-90-90 as of January 2019 (1 year after PHIA)

- 1st 90: 68%
- 2nd 90: 90%
- 3rd 90: 82%
HIV Prevalence by Region

Among adults ages 15-64 years, HIV prevalence among adults varies by region, ranging from 6.3 percent in the South Region to 1.5 percent in the Far North Region.

<table>
<thead>
<tr>
<th>Region</th>
<th>HIV Prevalence (%)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adamawa</td>
<td>4.9</td>
<td>3.1-6.7</td>
</tr>
<tr>
<td>Centre</td>
<td>5.8</td>
<td>4.8-6.8</td>
</tr>
<tr>
<td>Douala</td>
<td>3.3</td>
<td>2.5-4.0</td>
</tr>
<tr>
<td>East</td>
<td>5.9</td>
<td>4.5-7.3</td>
</tr>
<tr>
<td>Far North</td>
<td>1.5</td>
<td>1.0-2.1</td>
</tr>
<tr>
<td>Littoral</td>
<td>3.1</td>
<td>1.2-4.9</td>
</tr>
<tr>
<td>North</td>
<td>1.6</td>
<td>1.0-2.1</td>
</tr>
<tr>
<td>North West</td>
<td>5.1</td>
<td>3.4-6.7</td>
</tr>
<tr>
<td>South</td>
<td>6.3</td>
<td>5.4-7.3</td>
</tr>
<tr>
<td>South West</td>
<td>3.6</td>
<td>2.4-4.9</td>
</tr>
<tr>
<td>West</td>
<td>2.7</td>
<td>1.8-3.6</td>
</tr>
<tr>
<td>Yaounde</td>
<td>4.4</td>
<td>3.2-5.6</td>
</tr>
</tbody>
</table>

HIV Burden and Unmet Need by Region

*All numbers in the table are both adults and children; the prevalence rates in the map are adults only*
Updates on TB and Healthcare Services

**TB situation**

- Incidence of **95/100,000** in 2018
- **84% (1069/1272)** of pre-treatment cases tested on GeneXpert in 2018 are MDR cases
- TB Lamp is used as primary TB diagnosis for children and adults, presumed TB with negative microscopy

**Health Care Services**

- ART services are offered at **379 facilities**
- There are over **5,000 health facilities** in Cameroon
- PMTCT and EID services are offered at **2,060 facilities**
- **254 facilities** offer TB testing (including microscopy and treatment centers) 10 of which are MDR TB centers

Source: *Cameroon DHS 2018, **Spectrum projections 1NACC 2017 Annual report; 2Cameroon National TB program 2018*
PART II: DNO UPDATES
Objectives and Processes for Diagnostic Network Optimization

Main Objectives
1) Ensure existing and newly procured devices are strategically placed to maximize utilization
2) Optimize the referral network to reduce TAT and generate efficiencies.

Specific objectives
- Identify and map all the existing laboratories (conventional platforms and POC devices) for the 10 Regions;
- Strengthen integrated testing on existing platforms for HIV (EID/VL), TB and Hepatitis
- Provide guidance to MOH for deployment of new devices
- Improve on the existing quality assurance network

Who is involved in the process

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Lead</th>
<th>Verification</th>
<th>Notes</th>
<th>Coordination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master Data Compilation</td>
<td>GHSC-PSM</td>
<td>CHAI &amp; EGPAF</td>
<td>Components for the data have been contributed by NACC, GHSC-PSM, CHAI, EGPAF, CIS</td>
<td>NACC/NPHL/DLMEP/CDC</td>
</tr>
<tr>
<td>Master Data Cleaning</td>
<td>EGPAF</td>
<td>GHSC-PSM &amp; CHAI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visualization from cleaned data</td>
<td>CHAI</td>
<td>GHSC-PSM &amp; EGPAF</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision making process

1. Present the current and optimized outputs scenarios to the Lab Task Force
2. Lab Task Force (LTF) validates/endorse output to MoH
3. MoH/NACC and LTF uses the output to guide revision of the National Deployment Plan
<table>
<thead>
<tr>
<th>Region</th>
<th>Conventional Platform</th>
<th>Point of care platform</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Type of platform (Number)</td>
<td>Positioning and functioning (F or NF)*</td>
</tr>
<tr>
<td>Adamaoua</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Centre</td>
<td>Abbott m2000rt (7)</td>
<td>CPC (F), CIRC (F),</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HGOPY (F) Nkolondom (F), CHE (NF), CRESAR (F) LNSP (F)</td>
</tr>
<tr>
<td></td>
<td>Qiagen (3)</td>
<td>CHU (NF), HGOPY (NF),</td>
</tr>
<tr>
<td></td>
<td>Biocentric-Diasorin (2) Applied Biosystem (2)</td>
<td>CPC (F), CRESAR (F), LNSP (F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extreme-North</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Littoral</td>
<td>Abbott m2000rt (2)</td>
<td>HLD (F), Lab Tag (F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LC 96 (Roche) (2)</td>
<td>HLD (F), HGD (NF)</td>
</tr>
<tr>
<td></td>
<td>Sysmex</td>
<td>Litto Labo (F)</td>
</tr>
<tr>
<td></td>
<td>Qiagen</td>
<td>Biopharma Douala (F)</td>
</tr>
<tr>
<td>North</td>
<td>LC 96 (Roche)</td>
<td>CPCAG (F)</td>
</tr>
<tr>
<td></td>
<td>ABI 7500</td>
<td>CPCAG (F)</td>
</tr>
<tr>
<td>North West</td>
<td>Abbott m2000rt (1)</td>
<td>TB-Ref Lab (F)</td>
</tr>
<tr>
<td></td>
<td>Biocentric-Diasorin (1)</td>
<td>TB-Ref Lab (F)</td>
</tr>
<tr>
<td>West</td>
<td>Abbott m2000rt (1)</td>
<td>St Vincent Dschang (F)</td>
</tr>
<tr>
<td>South</td>
<td>Abbott m2000rt (1)</td>
<td>EID Lab Mutengene (F)</td>
</tr>
<tr>
<td>South West</td>
<td>Abbott m2000rt (1)</td>
<td>EID Lab Mutengene (F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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</tr>
</tbody>
</table>
### EID and VL Testing Footprint

#### Number of Platforms

<table>
<thead>
<tr>
<th></th>
<th>Abbott</th>
<th>OPP</th>
<th>m-Pima</th>
<th>GX-4</th>
<th>TB-Lamp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>10</td>
<td>05</td>
<td>25</td>
<td>29</td>
<td>27</td>
</tr>
</tbody>
</table>

#### Number of Testing Labs

<table>
<thead>
<tr>
<th></th>
<th>EID</th>
<th>VL</th>
<th>TB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>04</td>
<td>10</td>
<td>254*</td>
</tr>
</tbody>
</table>

---

**Low Coverage for EID and VL**
- Long TAT
- Limited Access to Testing
- Stock Outs of Test Kits
- Equipment Down Time
- Platform Distribution

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*Source: National molecular mapping for integrated diagnostics 2018 (pending validation), maps developed from labEQIP; CHAI EID TAT analysis Jan2016—Feb 2017. *There are 254 diagnosis (including microscopy) and treatment centers in the country, CHAI has successfully mapped out and defined a mini hub and spoke referral network for 10 hubs covering 183 spokes.
Outcome of 2018 DNO exercise - Impact on Laboratory Network and Supply Chain

DNO has also generated information to complete an in-depth mapping of Health facilities -> reference labs and ref. labs -> ref. labs defining back up labs

We have determine the actual utilization rates of platforms and through this we continuously optimize our national quantification and supply plan

DNO next steps

1. Organize a workshop in September 2019 to endorse scenario mix for both conventional and POC arrangements
2. Develop framework to inform scale up of additional devices for continuous
Network of Viral Load Reference Laboratories

Currently 14 National VL Ref labs. Others not shown include: CHE(CNPS); CRESAR & HR Bertoua
<table>
<thead>
<tr>
<th>Instrument Platform-FY 17</th>
<th>QTY (A)</th>
<th>Specimen Type</th>
<th># of Staff</th>
<th>Est. Max. Throughput /8hrs (B)</th>
<th>Est. # Days/yr (250 dys-WHO rec.) (C)</th>
<th>Estimated Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abbott sp/rt</td>
<td>6</td>
<td>Plasma</td>
<td>2</td>
<td>138</td>
<td>240</td>
<td>198720</td>
</tr>
<tr>
<td>Abbott rt/manual</td>
<td>3</td>
<td>Plasma</td>
<td>2</td>
<td>93</td>
<td>240</td>
<td>66960</td>
</tr>
<tr>
<td>roch fluoro 96</td>
<td>4</td>
<td>Plasma</td>
<td>2</td>
<td>126</td>
<td>240</td>
<td>120960</td>
</tr>
<tr>
<td>ABI</td>
<td>3</td>
<td>Plasma</td>
<td>2</td>
<td>126</td>
<td>240</td>
<td>90720</td>
</tr>
</tbody>
</table>

Estimated Annual Capacity for Viral Load Testing \((A \times B \times C) = 477,360\)

Est. % Utilization Capacity= FY17 VL tested/Capacity = 47,397/477,360 = 9.9%

Est. Un-Utilized Capacity = 90.1%
### Viral Load and EID Equipment Utilization Rate - 2018

<table>
<thead>
<tr>
<th>Test Sites (Reference Laboratories)</th>
<th>Projected testing per year based on current average testing/day</th>
<th>Total Testing Potential per year based on potential capacity (throughput of machine)</th>
<th>Current equipment utilization rate for VL Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 CIRCB</td>
<td>12096</td>
<td>26784</td>
<td>45.16%*</td>
</tr>
<tr>
<td>2 CPC (Abbott)/OPP</td>
<td>18756</td>
<td>108960</td>
<td>17.21%</td>
</tr>
<tr>
<td>3 Nkolondon (Abbott)</td>
<td>2568</td>
<td>44640</td>
<td>5.75%</td>
</tr>
<tr>
<td>4 Laquintinie (Abbott)/OPP</td>
<td>12396</td>
<td>64320</td>
<td>19.27%</td>
</tr>
<tr>
<td>5 CPCAG (OPP)</td>
<td>5796</td>
<td>19680</td>
<td>29.45%</td>
</tr>
<tr>
<td>6 TBRL B'da (Abbott)/OPP</td>
<td>22596</td>
<td>21792</td>
<td>103.69%*</td>
</tr>
<tr>
<td>7 NEIDRLab Mut. (Abbott)</td>
<td>33300</td>
<td>35712</td>
<td>93.25%*</td>
</tr>
<tr>
<td>8 Dschang (Abbott)</td>
<td>3468</td>
<td>44640</td>
<td>7.77%</td>
</tr>
<tr>
<td>9 LNSP / CHEssos (Abbott)***</td>
<td>0</td>
<td>44640</td>
<td>0.00%</td>
</tr>
<tr>
<td>10 CRESAR (Abbott)</td>
<td>4428</td>
<td>44640</td>
<td>9.92%*</td>
</tr>
<tr>
<td>11 Hôpital Regional Bertoua**</td>
<td>0</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>12 Hôpital Central Yaounde**</td>
<td>0</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td><strong>115404</strong></td>
<td><strong>455808</strong></td>
<td><strong>25.32%</strong></td>
</tr>
</tbody>
</table>

| POCTest sites                      |                                                              |                                                                                  |                                               |
| 1 Hôpital Regionale de Bafoussam   | 396                                                           | 1920                                                                             | 20.63%                                        |
| 2 Hôpital Regionale de Ngoundere    | 396                                                           | 1920                                                                             | 20.63%                                        |
| 3 Hôpital de District d'Ambam       | 396                                                           | 1920                                                                             | 20.63%                                        |
| 4 Hôpital Regionale Annexe de Yagoua** | 0                                                             | 1920                                                                             | 0.00%                                         |
| **Sub-Total**                      | **1188**                                                      | **7680**                                                                         | **15.47%**                                    |

| Grand-Total                        |                                                              |                                                                                  |                                               |
|                                   | **116592**                                                    | **463488**                                                                       | **25.16%**                                    |

- As of August 31, 2018, the current VL test trend shows, only 25.32% (115404 tests) and 15.47% (1188 tests) of the potential throughput (capacity) of the conventional test platforms (reference laboratories) and POC sites respectively will be used by December 31, 2018, despite the platforms having a potential (based on maximum throughput) to test 463,488 tests.
- The 2018 ART population (PLHIV) stands at 283,471 while the VL test target (49% of the PLHIV) is 137,584 tests.

*These labs equally test for EID on the same platform, and the final utilization rate of the equipment for VL and EID testing will be a combination of the testing rate and testing potential for both tests, as this sums up to the monthly coverage of 22 working days. This is summarized in Table 3 below.

**Sites to begin testing by close of FY2018**

***NPHL and CHEssos are separate labs, but with CHEssos to take over the commodity allocation and test volumes/targets of NPHL**
Situated in the Grand North along side the Far North and North regions respectively. There are approx. 179 health facilities in the region of which 150 offer PMTCT services, and EID has expanded from < 20 sites in 2012 to 68 sites in 2017. The region has no conventional testing capacity and relies solely on CIRCB for EID testing services and CPCAG for VL. In 2017 MOH procured and installed a GeneXpert device at the RH used at the time only for TB testing. Following MOH approval in 2018 the Xpert device was fully integrated to include EID/VL testing. In addition an Alere q device was installed in Meiganga DH used for EID. There is a great need to further expand access to testing via POC diagnostics in the region.

**Region Snapshot: Adamawa Region**

**Brief Overview**

- Situated in the Grand North along side the Far North and North regions respectively. There are approx. 179 health facilities in the region of which 150 offer PMTCT services, and EID has expanded from < 20 sites in 2012 to 68 sites in 2017. The region has no conventional testing capacity and relies solely on CIRCB for EID testing services and CPCAG for VL. In 2017 MOH procured and installed a GeneXpert device at the RH used at the time only for TB testing. Following MOH approval in 2018 the Xpert device was fully integrated to include EID/VL testing. In addition an Alere q device was installed in Meiganga DH used for EID. There is a great need to further expand access to testing via POC diagnostics in the region.

**Priority Areas**
- Improve access to diagnostics using POC
- Operationalize TB/HIV integration
- Optimize the lab network

**Current Challenges**
- Currently underserved in terms of devices
- Adhoc ST system, which is inefficient over long distances

**Health Facilities**

<table>
<thead>
<tr>
<th>Sites collecting EID samples</th>
<th>68</th>
</tr>
</thead>
<tbody>
<tr>
<td>PMTCT sites</td>
<td>150</td>
</tr>
</tbody>
</table>

**Number of Platforms**

<table>
<thead>
<tr>
<th>Number of Platforms</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Abbott</td>
<td>00</td>
</tr>
<tr>
<td>OPP</td>
<td>00</td>
</tr>
<tr>
<td>GX-4</td>
<td>01</td>
</tr>
<tr>
<td>Alere Q</td>
<td>01</td>
</tr>
<tr>
<td>Samba</td>
<td>00</td>
</tr>
</tbody>
</table>

**Funding**

- GF for conventional, Unitaid and GF for POC and near POC
- PEPFAR for EQA

**Source:** PMTCT Progress report No 12; NACC 2017 Annual report

**Source:** National molecular mapping for integrated diagnostics 2018 (pending validation), maps developed from labEQIP
Current Scenario of TB, EID and VL Lab referral network: Adamawa Region

**TB referral network.** Map showing sites referring samples to HD Ngaoundere for processing on GeneXpert. Only portion of sites are currently collecting and referring TB samples to Testing lab.

**VL referral network.** Currently most sites continue to send samples to CPCAG in Garoua for processing apart from the RH Ngaoundere which provides onsite POC VL testing on the GeneXpert device.

**EID referral network.** Majority of sites send DBS samples to CIRCB (approx. > 1000km away) for processing. Major challenge is long TAT for result return. In 2018 CHAI/UNICEF introduced POC testing on the POC (Alere q) and near POC (GeneXpert).

Source: National molecular mapping for integrated diagnostics 2018 (pending validation), maps developed from labEQIP
PART III: LIMS UPDATES
Objectives of putting in place an EID/VL dashboard

- Data Harmonization and coordination at the National Level for Timely Interventions and Decision Making

- To provide real time visibility of key laboratory and treatment indicators as captured in the requisition forms received by the laboratories to generate harmonized reports and provide timely corrective actions and mitigations

- To Enhance Inter- and Intra-Laboratory Sample Tracking From Collection to Return of Results
LIMS? - Flexible, Scalable, Multifunctional and low Cost

- Decentralized GeneXpert
- Decentralized m-PIMA
- Conventional platforms

- Data upload

- Monitor
- Manage
- Results Reporting

- Centralized management
  - Disease analysis
  - Error monitoring
  - Usage analysis

- dhis2

- Result
- Alert
- Alert or result?

- SMS Printer
- Clinician & District coordinator
- Patient
Updates of LIMS in Cameroon

- **2012 – 2014**
  - CDC/PEPFAR support to NACC to setup a national LIMS
  - First round of indicators selection and validation
  - EID and VL Request Forms drafted
  - LIMS Demo presented to MoH and partners
  - Failure to implement

- **2014 – 2016**
  - dhis1 introduced

- **2017 – 2018**
  - dhis2 introduced
  - Revised and harmonize EID/VL Request Forms
  - Validated key indicators to capture on dash board
  - LIMS survey tool developed
  - Assessment of LIMS in reference labs completed

- **2019**
  - Exchange visit to Kenya
  - Restitution meeting at NACC
**LIMS Assessment Outcomes**

### LIMS

**Availability:**
- Yes (Full/Partial)
- None

**Name:**
- DISA at NEID Lab, DREAM LIMS at Nkolondom and Dschang, CIRCB, CRESAR, CPC

**Supported assay:**
- HIV VL, EID, Others

**Interoperability:**
- TBD

**LIMS Type:**
- Open Source One time payment
- Paid-to-service subscription

**POC Connectivity:**
- EID: Data Point

### Centralized Dashboard

**Availability:**
- Yes
- No

**Functional Dashboard:** Q4 2019

**Timelines:**
- 100% VL data visibility on Dashboard: TBD
- 100% EID data visibility on Dashboard: TBD

**Public URL:** N/A

### Laboratories

**Connectivity status**

- **Conventional**
- **POC**
  - Total Labs
  - Automatic data transmission
  - Transmitting to Dashboard

*For POC, bar graph shows number of devices and Automatic data transmission represents devices connected to POC Dashboard*
Challenges in LIMS, Dashboards Implementation

1. No/limited technical capacity
2. Fragmented systems for data management at labs – dhis2, BLIS, DISA, DREAM –LIS, Excel-based: Need for a standard system at all labs
3. There is no connectivity between platforms
4. No link between health facilitates and testing laboratories as such facilities cannot track their samples or results in real time
5. Data is not available or partially available at central level to enable real time to inform policy makers
6. dhis2 captures aggregated data and cannot process large data sets plus it relies on data input by health care providers
LIMS Roadmap for Cameroon - 2019

Q 1
- Study exchange visit

Q 2
- Develop country operational plan
- Set up country coordination and leadership mechanism
- Select and pilot a system in country
- Present pilot results

Q 3
- Systems implementation

Q 4
- Transition
Study exchange visit to Kenya
Kenya Benchmarking: Government Ownership and Strong Support From Partners are Critical to Ensure Successful and Sustained Implementation

PEPFAR supports essentially everything in Kenya
– STS, data management, HR capacity, QA, and recently HIV-DR testing
Next steps: CHAI to Pilot the system across one Ref lab, and CDC/PEPFAR to scale up to the remainder 9 ref labs as well as set up the national server in country to host country data

Phase 1 - LIMS
- Set up a team of developers to build both software and hardware systems
- Ensure the team understands the sample and laboratory work flow in detail
- Customize CHAI’s LIMSLITE software to Cameroon context
- Get support from CHAI IT team

http://34.253.117.172/limslite/UserLogin.aspx
http://34.253.117.172/LISDashboard

Phase 2 – Pilot 3 months
- Present results of the pilot phase
- Replicate similar systems across the remainder labs without an existing LIMS
- Set up individual servers across each lab
- Create individual IP addresses for remote access
- Develop the facility log in interface and test

Phase 3 Scale up 1st wave
- Set up the national data center – server (create virtual backups) to host country data
- Develop links for labs with existing LIMS (05) to share agreed on data with the dashboard

Phase 4a Scale up 2nd wave
- Set up PocLABS software and operationalize the system
- Install on all POC devices starting with CHAI/UNICEF focus regions

Phase 4b
- Set up NPHL
- HF with logging access
Key considerations for developing a road map for Cameroon

1. Strong Coordination mechanism

2. Strong Systems for Ref. Labs; Health Facilities & Data Storage

Resource Mapping and Partners support

- **USG Team**: Funding support from CDC/OGAC
- **MOH**: Coordination and infrastructure set-up
- **CHAI**: Software and dashboard development and installation set up, technical assistance
- **Other partners**: Global Fund TA
- **Technical and Functional support**: CHAI, USG and MOH
- **Technical staff capacity**: Yes
Key considerations for developing a road map for Cameroon – 2

### 2 Infrastructure resource requirement

<table>
<thead>
<tr>
<th>Reference Laboratory</th>
<th>Infrastructure:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- internet, local network, server, computers</td>
</tr>
<tr>
<td></td>
<td>- Software</td>
</tr>
<tr>
<td></td>
<td>- document lab workflow</td>
</tr>
<tr>
<td></td>
<td>- Manual system in the Lab (HFs)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>National Data center</th>
<th>Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Stable power source</td>
</tr>
<tr>
<td></td>
<td>- cooling system</td>
</tr>
<tr>
<td></td>
<td>- computer system</td>
</tr>
<tr>
<td></td>
<td>Software</td>
</tr>
<tr>
<td></td>
<td>- Web server</td>
</tr>
<tr>
<td></td>
<td>- Database</td>
</tr>
</tbody>
</table>

### 3 Outstanding HR and financial resource requirement

- **Budget required for staffing**
  - CHAI can support TA for set up in one lab that can be replicated to all labs
  - IT/technical lead is required for 12 months full time
  - May require infrastructure (hardware & software)

- **Other requirements**
  - Infrastructure for other labs (hardware and software)
  - Data entry clerks for all labs
  - Internet connection running cost
Similar to Kenya, Cameroon has set out to improve and strengthen their national EID and VL systems and put in place a dashboard whose data is hosted in country on a national server. Each lab has its own server and can operate independently even if the national server system breaks down.

Summary data from dashboard is pushed into DHIS 2.

Virtualize all data and create multiple backups.

Software + Database

02 of the 10 ref labs in Kenya already had an existing LIMS.
Preliminary work to initiate the pilot phase (Phase 1)

**Cameroon Assessment of NPHL Data Center**

- **Server 1 used for PACS** (a system to manage sample sorting)
- **Server 2 used for surveillance in and around the lab**
- **Running diagnostics at a remote workstation computer to test local network through Ethernet**
- **Installation completed successfully at server 1**
- **LIMSlite software installed at NPHL after assessment was completed: initial tests runs by CHAI software engineer**

**Failure to connect with remote workstation** – explaining to NPHL staff error message and possible approach to rectify the error
IV – Immediate Next steps

1. CHAI will customize LIMSlite Software to Cameroon Context

2. Follow up with NPHL to Diagnose local network issues and upload LIMSlite

3. Engage MOH to Endorse Pilot

4. Conduct in-house demo for MOH with CHAI team

5. Train NPHL Team and Start Pilot Effectively

6. Expand to Xpert site 1 month after pilot at NPHL