Data Management, Dashboard & Connectivity Solutions
Agenda

- Data utilization overview
- Dashboard & Data sources
- Ethiopia experience on health data management
Why does test data matter?

For fast result delivery back to facility and patient for immediate clinical management, contact tracing, and tracing of patient status

Test outcome monitoring to quickly identify potential hotspots and guide national program decision making

Diagnostic commodity monitoring to inform future procurement and mitigate risk of stock outs

Test Data visibility is key for optimizing health/Laboratory activities and decision making process
Dashboard – Visual Thinking

- Data visualization is the process of converting raw data/information into easily understood pictures of information that enable fast and effective decisions.
Dashboard – Benefits

- Allows users see several different perspectives of the data.
- Makes it possible to interpret vast amounts of data.
- Offers the ability to note exceptions in the data.
Dashboard – Benefits

- Allows the user to analyze visual patterns in the data.
- Exploring trends
- Translate data patterns into insights, making it a highly effective decision-making tool.
Based on infrastructure and capacity available, a single or combined solution can be used to optimize health/Laboratory data for decision making process.

The main output of ANY laboratory, serving ANY purpose, in ANY industry, is information.
Data Sources - LIMS

- Specialized application of information technology to optimize and extend laboratory operation
  - Manage laboratory data from sample log-in to reporting
  - Interfaces with diagnostic instruments
  - Sort and organize data into various report formats
Data Sources - LIMS

- Management of the data explosion
- Enhance business processes/workflow
- Quality assurance and control
- Error reduction
- Fast sample turnaround
- Easy access to information

Most Common LIMS

- BIK, BLIS, DISA Labs, OpenELIS, CHAI EID/VL System, OpenLIS
Data Sources - Dx Device Connectivity Solutions

- Connectivity is the ability of a device to transmit data to another device or system to allow for remote monitoring

1. A testing device that initiates data transmission
2. Tools to transfer data from the testing device, such as embedded WiFi capability, an external modem with a SIM card or Ethernet cord
3. A network that data passes through, such as a mobile phone network or fibre broadband connection
4. A system that receives the data, such as a local server at the MOH, or cloud-hosted servers
5. A front-end application to aggregate and visualize the data, which can be desktop, web or mobile-based

- Real time data from remote laboratories across platforms
- Consumption data
- Information on uptime
- Quality information
- Forecasting
- Service and Maintenance
- Procurement
- Supply Chain
Data Sources - Dx Device Connectivity Solutions

- We can group existing solutions in three categories:
  - Integrated solutions (providing data aggregation & data transmission)
  - Data aggregation and
  - Data transmission

<table>
<thead>
<tr>
<th>Product</th>
<th>Manufacturer</th>
<th>Components</th>
<th>Associated Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Integrated Solutions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alere Connectivity Pack</td>
<td>Alere</td>
<td>Samba 3G-E or CT63 terminal, USB extension cord, external FME antenna,</td>
<td>PIMA, AlereQ HIV 3% (connecting one device at a time) + local SIM</td>
</tr>
<tr>
<td>GxAlert/Aspect with Connectivity Pack</td>
<td>SystemOne</td>
<td>Router, mobile SIM, antenna, user interface, and mobile data</td>
<td>GeneXpert + laptop&lt;br&gt;BD M/GIT, Abbott m2000, Roche COBA (connecting one device at a time)</td>
</tr>
<tr>
<td><strong>Data aggregation</strong></td>
<td></td>
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</tr>
<tr>
<td>Aegis POC</td>
<td>Alere</td>
<td>Software platform</td>
<td>PIMA, AlereQ HIV 3% (and other compatible devices) + laptop + modem</td>
</tr>
<tr>
<td>Aspect Reporter</td>
<td>SystemOne</td>
<td>Software platform</td>
<td>GeneXpert, BDU M/GIT, Abbott m2000, Roche COBA + modem</td>
</tr>
<tr>
<td>C360</td>
<td>Cepheid</td>
<td>Software platform</td>
<td>GeneXpert + laptop + modem</td>
</tr>
<tr>
<td>Connected Diagnostics Platform (CDP)</td>
<td>BlueFrontier</td>
<td>Software platform</td>
<td>GeneXpert + laptop + modem (and intended as a platform for recording patient data from multiple devices)</td>
</tr>
<tr>
<td><strong>Data transmission</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>USB Dongles</td>
<td></td>
<td></td>
<td>Offered by most major telecom companies/SIM card enabled modem + Simple internet connection (no device tailoring)</td>
</tr>
<tr>
<td>Mobile Network Routers</td>
<td></td>
<td></td>
<td>Aliya, Netcomm Wireless (M2M Router), Sierra Wireless (Airlink), Vodafone (machinelink) etc.</td>
</tr>
</tbody>
</table>

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**Legend**
- **Dx Device Connectivity Solutions**
- **Alere™ Data Point**
- **GxAlert**
- **Aegis POC**
- **Cepheid C360**
- **PocLAB**
- **Centralized Data Management System**
Common deployment Option – In house (MoH) Server

Countries will be responsible for the purchase of modems. Data enabled Local SIM will be used. SIM card purchase and data transmission cost will be covered by respective countries.

Data transmission happen over the existing mobile network.

Server will be located inside MoH countries, MoH will have access to the testing data through an application developed by CHAI.

This application will be installed and maintained from MoH central server.

The application organize and present analyzed POC testing information.

The application can also be accessed remotely via internet if valid credential is given.
Focus on commodities, quality & Availability of tests
Data availability in real time saves lives

Real time data from remote laboratories across platforms

- Consumption data
- Information on uptime
- Quality information

Consumption data is availed in real time across all analyzers in a country by platform
Throughput and down time of each equipment
Internal QA/QC data for each test performed

Forecasting
- Service and Maintenance

Consumption based forecasting is precise
Service and maintenance is easily monitored

Procurement
- Supply Chain

Procurement and supply chain planning is straight forward
Elimination of lab commodity stock outs

Assured availability of quality diagnostic testing
Patient monitoring hence longevity on first line therapy saving vital resources
Identification of toxicities early hence better clinical management hence reduced morbidity
Lives saved!!!
Establishing Data Management Systems, Dashboards and Data Triangulation for Program Monitoring

Ethiopia’s Experience in Implementing EID/VL Data Systems
Out line

- Background
- EID/VL Database Basic Features
- EID/VL Database Details
- Major Accomplishments
- Data Synchronization
- Regional Access Dashboard
- Electronic Test Order and Result Reporting System - ETORRS
- GxAlert
Computerized systems facilitate and enhance the efficiency of data capturing and utilization processes.

In collaboration with CHAI, EPHI has developed integrated HIV VL & EID Database System based on the nationally implemented test request and result reporting forms.

Currently, 21 testing centers have the system installed and use it for systematic and easy data capturing, storage, transfer and report generation.

Successfully synchronized the system installed at testing centers to a Central Server located at EPHI for real-time flow of data to the national level.

System enabled to allow RHBs, pertinent agencies and concerned departments of the FMOH to access data from the Central Dashboard.

System is featured with capabilities for easy generation of reports in various formats including that of CDC / DATIM.
Data management systems for informed decision making

- Which patients are not virally suppressed?
- How much is the viral suppression rate?
- How much is the sample rejection rate?
- Which patients are in First Line/Second Line treatment?
- How do I generate reports?
- How can I send test results electronically?
EID/VL Database Basic Features

✓ **Data capturing tool**: Electronic registration of request forms

✓ **Worksheet preparation**: Providing details on samples on process

✓ **Result Registration and approval**: Filling test result and approval

✓ **Patient data tracking**: Tracking of patient data for subsequent viral load tests

✓ **Electronic result delivery**: Delivering result via SMS

✓ **Customizable report**: Periodic report generation

✓ **Raw data for analysis**: Data exportable in excel format

✓ **Automatic dashboard**: Graphic and numerical summary on key indicators
EID/VL Database Details

Input
- Region/Facility
- Client Information
- Sample Information
- Lab related information
- Results

Process
- Register Sample
- Prepare worksheet
- Register Result
- Approve

Output
- Electronic Results
- Raw data for analysis
- Summary Report
- Archive
Major Accomplishments

Implementation Phases

1. **1st Phase Scale up**
   - 1.1 Application development
   - 1.2 User Manual Preparation
   - 1.3 Pilot at EPHI, Harari and Adama RL

2. **2nd Phase Scale up**
   - 2.1 Evaluation of pilot phase
   - 2.2 Clearing field validations
   - 2.3 Scale up to Jimma Univ, Nekemte RL, Hawassa RL

3. **3rd Phase Scale up**
   - 3.1 Integrating Electronic Result Delivery
   - 3.2 Install database on ICAP provided computers
   - 3.3 Scale up to Dessie RL, Bahirdar RL, GUH, Deberberhan HL, Debremarkos HL, Black Lion HL, ALERT HL, Police HL, Armed Forces HL

4. **4th Phase Scale up**
   - 4.1 Upgrading all previous installations
   - 4.2 Scale up to Mekelle RL, Gambella RL, Metu Karl HL, Afar RL, Arbamich HL

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Training | Supervision | Technical Support | System Upgrade
Data Synchronization

- VL database systems are installed at each testing site on locally configured computers.
- These systems can work in off-line mode, no internet connection is required to access the system.
- Users can get access to the system only on local area networks available in regional labs and hospitals.
- It was recommended to work on database synchronization to EPHI server to enable central repository of data for easy access by all stakeholders.
Synchronization Status

Sync Implementation By Regions

**Amhara**
- Amhara Public Health Institute Lab
- Dessie Regional Lab
- Debre Berhan HL
- Debre Markos HL
- Gondar University HL

**Addis Ababa**
- EPHI HIV Molecular Lab
- Addis Ababa Regional Lab
- TASH
- Alert Center
- Armed Forces Hospital
- Federal Police HL

**Oromia**
- Adama RL
- Nekemte RL
- Jimma Univ.HL

**Tigray**
- Tigray Health Research Institute Lab

**SNNPR**
- Hawassa RL

**Harari**
- Harari RL

**Gambella**
- Gambella RL

**Afar**
- Afar RL

**Sync Service**

**EPHI Server**

Not Connected Labs

**Oromia**
- Metu Karl HL
The regional access dashboard is a system built on synchronized data.

Enables regions to monitor VL testing across multiple labs available in their region.

Regional access dashboard provides varieties of graphical visualizations and reports that help in informed decision making not only for regions, but for FMOH and all its agencies and partners.
Regional Access Dashboard Details

Graphical Visualization

Different Reports

Regional testing summary

Lab Testing Summary

DATIM Report

Raw Data
The regional access dashboard has different options to customize reports.

- Enables exporting raw data and reports to excel format.
- Individual client data is also accessible from the system.
ETORRS is a system that enables ordering of VL test requests and delivery of results electronically by developing interoperability between EID/VL data system installed at testing lab and Smart Care ART available at referring sites.

**Viral load test request and result delivery process**

- ART clinic of the referring facility fills out test request form and sends the client to laboratory at the same facility for sample collection.
- The facility lab collects sample and sends it together with request form to the testing lab (regional lab) via courier service.
- Receiving regional lab checks the quality of sample at reception, registers request form on EID/VL data system and sends it for testing.
- Once testing is completed, data clerks register test result for specimens.
- Regional lab sends results back to referring facility via courier service.
Enhanced EMR-ART
- ICAP with CDC and FMOH developed an enhanced EMR-ART
- It incorporates all changes related to HIV preventive and treatment programs
- (Tracing, ICT, ASM, CB tracking/reporting, Re-test, scheduled visit, PEP, etc.)
- Support ART-Clinic activities including data capturing and management
- Has Report module that produces HMIS, DATIM, Line list & custom reports
- Rolled-out in more than 470 health facilities

VL & EID Database System
- Developed by CHAI in collaboration with EPHI
- National standards, guidelines, test request and result reporting forms and procedures for VL testing
- Supports Testing facility’s activities & meets national and partners’ report data need including DATIM
- Implemented in 21 testing centers in the country
Challenges Encountered

- Poor VL Data Quality
- Long TAT
- Delayed Clinical Intervention
ETORRS

Proposed Solution

✓ Developing electronic data exchange platform (interoperability) between the systems at testing lab and referring facilities found to be a technology solution.

Enhanced EMR-ART
- Implemented by ICAP with CDC and FMOH
- Support ART-Clinic activities including data capturing and management.
- Rolled-out in more than 470 health facilities

VL & EID Database System
- Developed by CHAI in collaboration with EPHI
Proposed Solution

- ART clinic fills out the test request form
- Data clerks capture the test request electronically into Smart Care ART
- Send test request electronically to testing lab
- Update medical record on receiving results

- Receives test request electronically and wait for the sample
- Upon arrival of sample, quality is checked, if rejected referring facility is informed electronically
- Once testing is completed, data clerks register result
- Quality officers approve test results
- Approved results automatically delivered to Hf
4. Criteria for Technology Selection

**Why Web-API:**
- **Prior experience** with the technologies.
- **Meets basic technical requirements** for an interoperability service and data exchange.
- **Limited investment** to build capacity in short period of time.
Collaborative Approach

Follow up on Assignments & Discussion

Working Together As One
ETORRS

High level Architecture

EPHI SERVER

Create/Update VL requests/responses

ETORRS Custom C# API

Retrieve VL Requests/Results

Interoperability Layer - OpenHIM

Security, channeling, routing and logging

Send VL Requests

Receive VL Results

Submit VL Results

Query VL Requests

EMR-ART

VL Database

Health facilities

Testing Labs
ETORRS Implementation Status and follow-up

- At present 7 testing labs and 50 HF are connected and using the system
ETORRS

Implementation Status and Follow-up

Adama Regional Lab

VL requests and results

- Viral Load reports/results
- VL Requests waiting for responses: 1,843
- VL Results not taken by Facility: 1,742

Addis Ababa Regional Lab

VL requests and results

- Viral Load reports/results
- VL Requests waiting for responses: 1,843
- VL Results not taken by Facility

EPHI HIV Molecular Lab

VL requests and results

- Viral Load reports/results
- Total Viral Load
- VL Requests waiting for responses
- VL test result responses
- VL Results not taken by Facility

ETORRS Facility Supportive Supervision Checklist

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Points to Check</th>
<th>Response</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VL Test Repetition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Number of VL Test requests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Number of VL Test requests not uploaded electronically, if yes, from response 4, why? Please upload</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>VL Test Results Notification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Number of VL Test results returned</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Number of electronically returned to test results captured in database after number varies from 5, why? Please upload</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>VL Test Results Notified</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>List of patients with high viral load not communicated to partner if the number varies from 5, why? Please upload</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

VIRAL LOAD DATA

<table>
<thead>
<tr>
<th>MINU</th>
<th>EAN</th>
<th>Facility Name</th>
<th>Registered</th>
<th>Registered</th>
<th>Duplicate</th>
<th>Result</th>
<th>Result Validity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

Other issues...

System and Issues

1. Internet connection
2. Server availability
3. Power interruption
4. Other...
GxAlert System

• GxAlert, is a web-based system based on the Aspect™ software platform designed to work with the Cepheid's GeneXpert.
• Initially used for MTB/RIF, now upgraded to visualize and report data for GeneXpert HIV1-Qual Result (EID)
• Provides dashboard and information that impact on:
  • Clinical work, through text-messaging to provide real-time alerts about diagnoses to appropriate clinical staff
  • Supply chain management
  • Health policy, allowing ministries of health to understand how disease is moving and where to focus resources in real time.
GxAlert System

Results by Device

- Laboratory
  - High error rate (37%).
  - Go to device dashboard for details.

- High error rate (36%).
  - Go to device dashboard for details.

- High error rate (33%).
  - Go to device dashboard for details.

- Hasn't reported in 823 days.
  - Call and remind them to connect.

- Hasn't reported in 757 days.
  - Call and remind them to connect.

- Hasn't reported in 157 days.
  - Call and remind them to connect.
GxAlert System

Dashboard for [Redacted] Hospital Laboratory

From: 3/31/2020  To: 5/12/2020

Tests per Day

Error Rate by Module

Most Common Errors

Average Time to Upload (weekly)

Utilization Rate

Average Tests Per Day: 0
Lab Hours of Operation: 9:00 AM - 5:00 PM
Average Time per Test: 53.6 minutes
Modules: 1
Average Utilization: 7%
Custom Field Data Capturing

- Following the POC EID scale up, significant number of EID test is done on GeneXpert machines and EID test data is available in two separated dashboards.
- Integration of POC EID data with the national dashboard was recommended by MOH and it is essential for single point of access to data.
- Integration requires complete dataset to be captured both from the POC and convectional testing labs.
- Cepheid’s GeneXpert DX software allows capturing of only limited data sets like patient ID and Sample ID.
- Custom field data capturing is an effort to capture all clinical information's available on the request form using GXConnect software used for sending data to the GXAlert dashboard.
Major Challenges and Responses

Internet connectivity - poor service internet in few testing labs

**Response**
- Discussing with lab heads on availability of usable internet for data sync

**Low capacity server resulting slow response**

**Solution**
- Upgrade the capacity of computers to mid range servers

**Data Backlog**

**Response**
- This is mainly due to staff turnover and lack of follow up on data entry
- Temporary network setup for using multiple station to clear backlog and arrange onsite training to part-time data clerks

**Hardware failure which might lead to loss of data**

**Response**
- and re installation of the system
- Regular back up and troubleshooting and recovery