Diagnostic Network Optimization (DNO)

Overview of the DNO Analysis in Zambia for TB/HIV testing Integration

Powell Choonga
Laboratory Advisor, Ministry of Health (MOH)

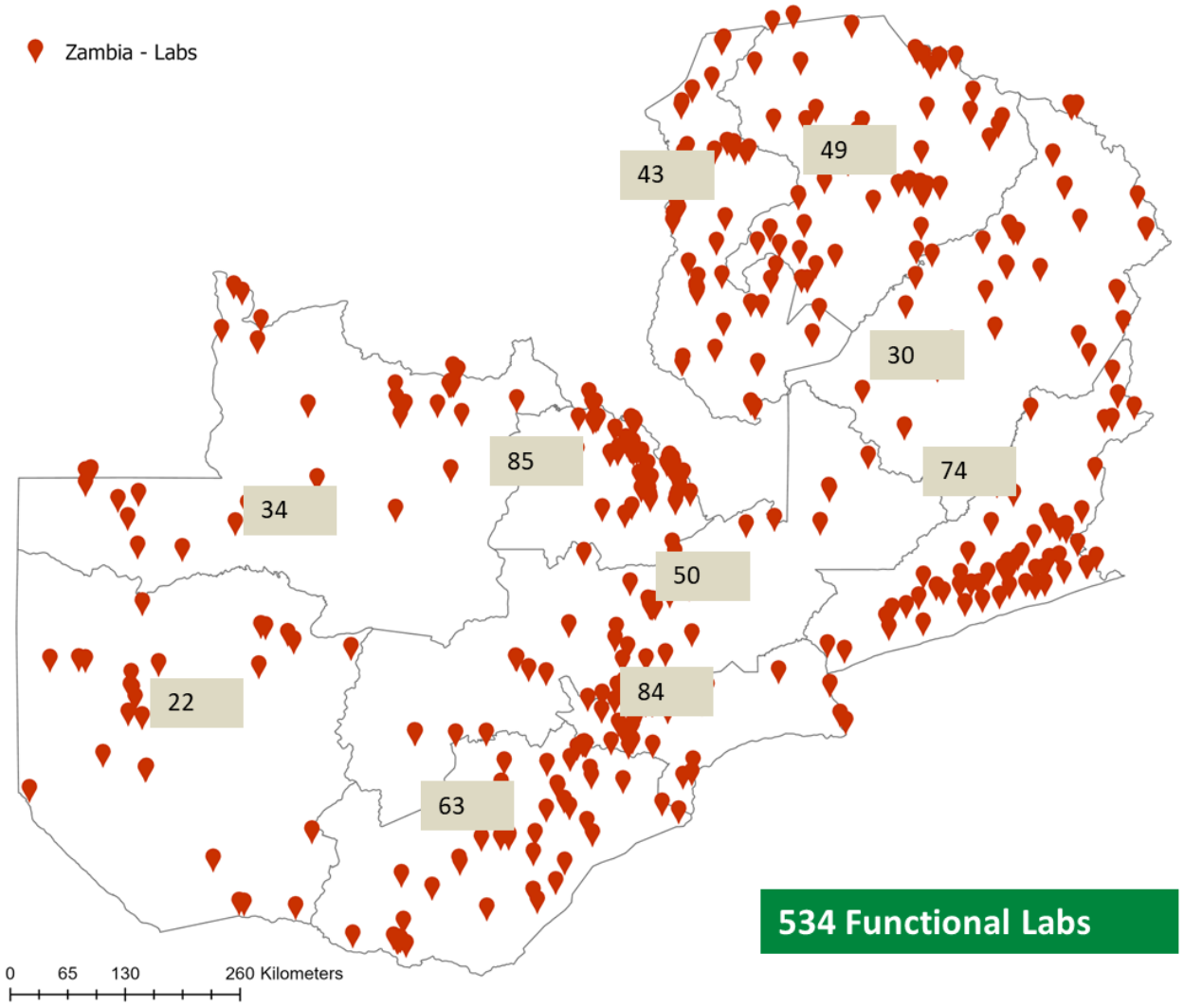
Trevor Machila
Monitoring & Evaluation Manager, Centre of Infectious Disease Research in Zambia (CIDRZ)

Strategic Direction- Pathology & Laboratory Services

To have a functional and sustainable laboratory services for all Zambians.

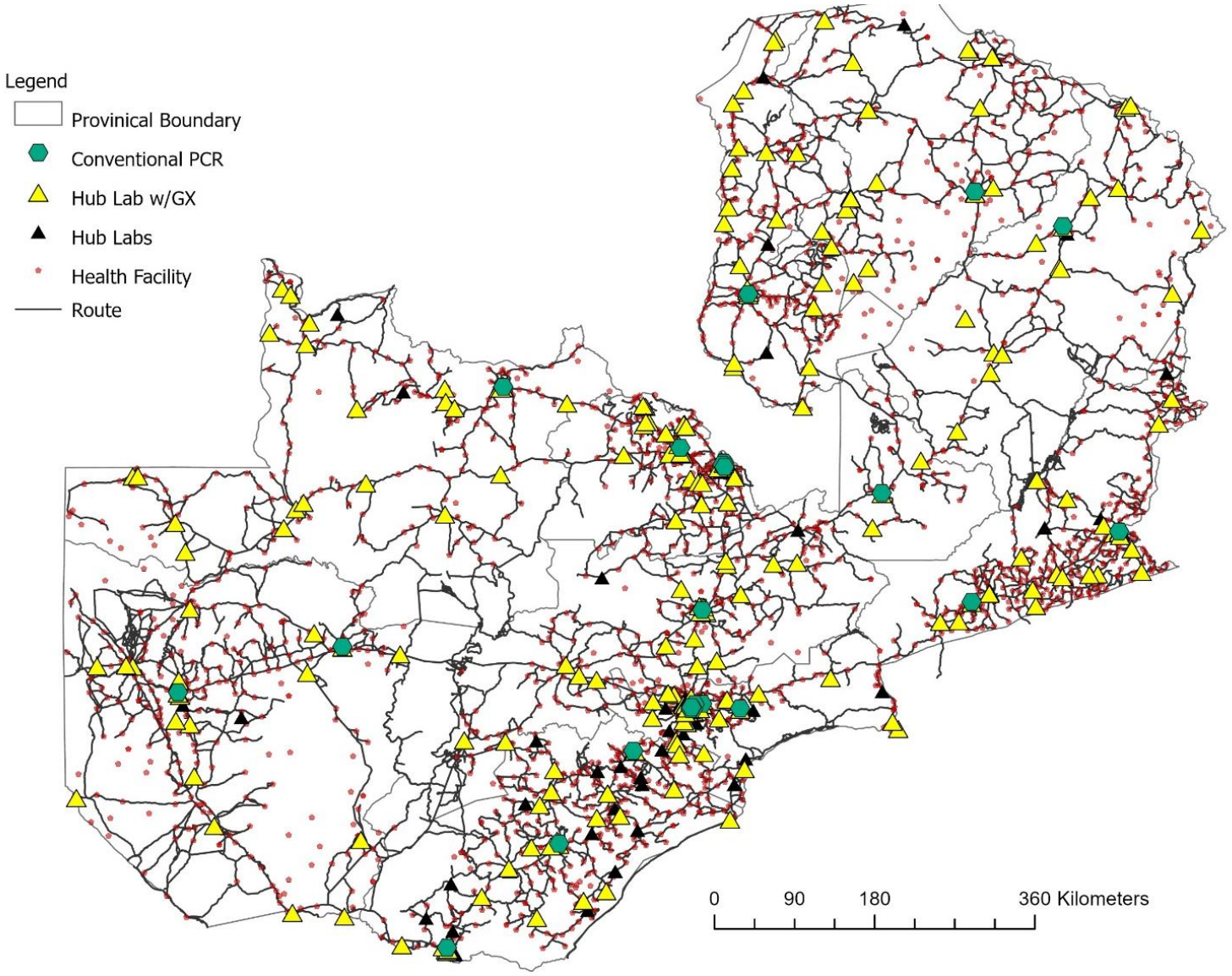
To provide Zambians with high quality, accurate, timely, cost effective and appropriate laboratory services at all levels of care and as close to the family as possible.

Laboratory Network

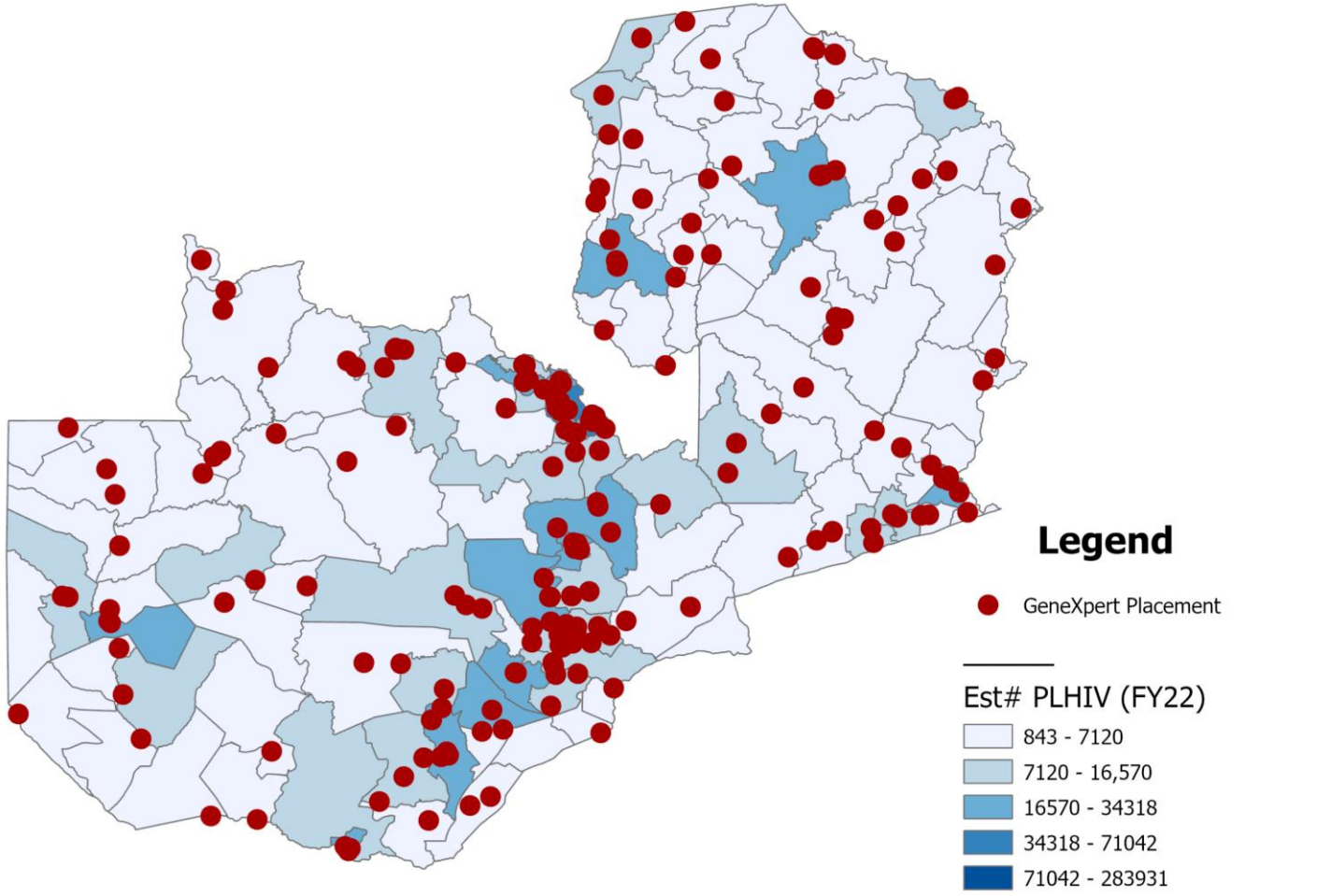


534 Functional Labs

VL/EID Testing network



Equipment Footprint- GeneXpert



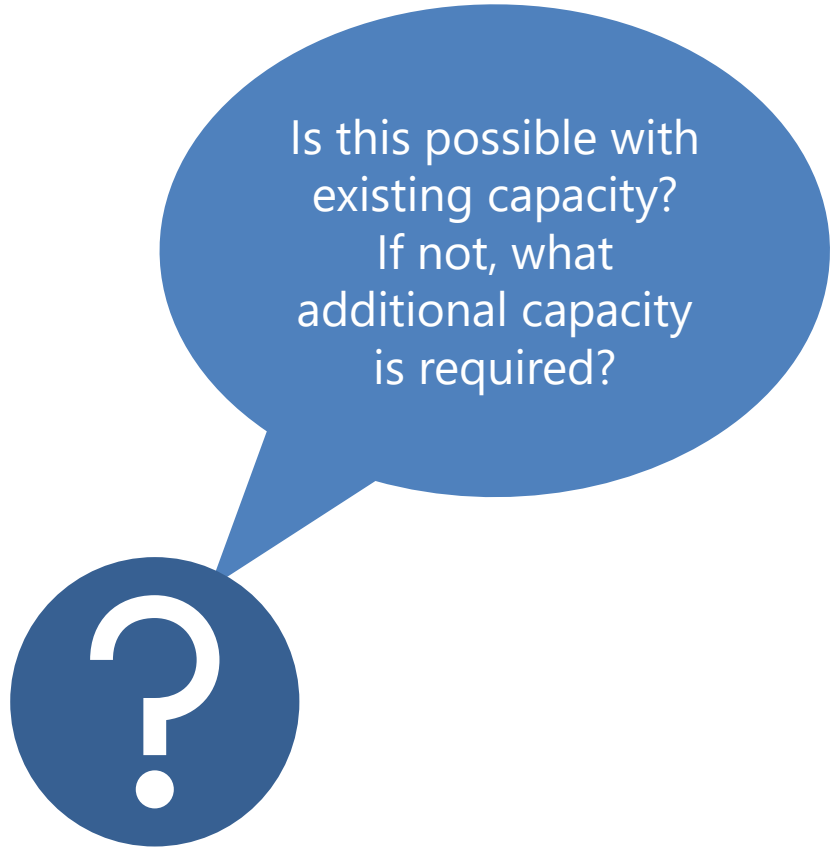
Data Sources:

> PLHIV: COP22 Data Pack
> GeneXpert Install base: National TB Program

Disease programme objectives

- **Expand TB programme – full coverage**
  - Increase testing demand by **200%** from **230,000** GeneXpert tests to **450,000** GeneXpert tests
  - Increase the number of sites referring samples from **500** to >**2000**

- **Improve access** to EID and priority HIV viral load testing for Pregnant and Breastfeeding Women(PBFW) and Paediatric.
  - Shift testing from conventional centralized devices to GeneXpert
  - Increase onsite testing (especially, same-day diagnosis for EID)



Diagnostic Network Optimization (DNO)

Diagnostic network optimization (DNO) is a geospatial analytics approach to

- Analyse the current diagnostic network
- Recommend the optimal type, number and location of diagnostics and an associated sample referral network to achieve national health goals

Why DNO?

- Optimize laboratory network through diagnostic integration

- Maximize utilization of existing resources

Stakeholder Engagement

Stakeholder	Role in the DNO Exercise
Ministry of Health	Provide oversight, coordination, defining high level objectives and alignment to **both programmatic constraints as well as longer-term goals**
PEPFAR/CDC	Funding and project scoping
CIDRZ	Support project scoping, data preparation and Analysis
FIND	External technical assistance, capacity building of country Team
Implementing Partners (NTP, APHL, JSI, CIDRZ & EQUIP)	Collation of data inputs
Technical Working Groups (Laboratory and HIV)	Provided insight into the scope of analysis, and refined assumptions and validation of results from the DNO analysis.

Core Project Team

Position Title	Organization	Role
Laboratory Advisors	Ministry of Health (MOH), FIND & CIDRZ	Provided insight on the diagnostics network and refinement of the project scope
Data Analysts	CIDRZ	Support data preparation and Analysis
Supply Chain Analyst and Health Economist	FIND & HEERO	Technical support, analysis, and building Capacity of MOH and in-country IPs to ensure sustainability of the DNO

Objective

- Optimizing the diagnostic network to ensure **priority** HIV viral load testing for PBFW, paediatric and EID can be tested **onsite** or shifted from conventional platforms to **GeneXpert** whilst ensuring TB diagnostic testing is not negatively impacted.

How can the network be optimized to improve access to EID and VL testing for PBFW & Paediatric?

Is there enough capacity for this if we close all Roche CAP/CTMs?

Is there enough capacity for SARS-CoV-2 and HPV testing?

Methods

OptiDx
OPTIMIZING DIAGNOSTIC NETWORKS

- Using OptiDx software, we first established the **baseline diagnostic network** based on 2020 testing demand, referral linkages, testing sites, platforms, and costs for the HIV and TB programmes respectively.

- Next, we incorporated **future testing demand** and programme expansion targets.

- To improve access, we integrated priority HIV testing, including EID, on **GeneXpert platforms**, historically only utilized by the TB programme; and closed CAP/CTMs.

- We then calculated the annualized device **cost**, variable cost/test, and sample transport cost for each scenario.

- Lastly, we assessed how adding **additional devices** would impact results.

Key take-away messages

1. We can expand the TB programme and improve HIV testing access within current capacity **but** a number of sites are operating over-capacity.

2. Closing all Roche CAP/CTMs +shifting EID/priority VL on GX results in **large access benefits** in terms of shorter sample transportation distances (10-fold decrease).

3. Placement of GX-XVIs at higher volume laboratories results in **cost savings of 4%** from reduced reagent prices as can meet minimum tests per device requirement for rental agreement.

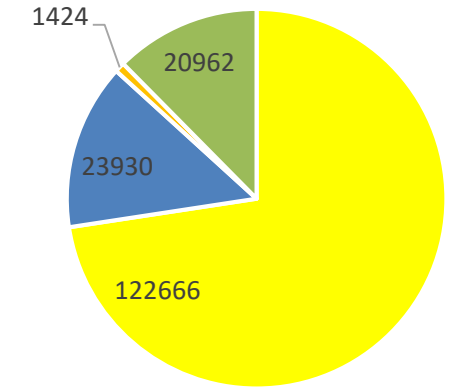
4. **Recommend** placing GX-16s at high demand sites, and/or extending shifts of GX-IV devices.

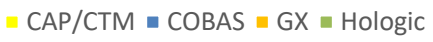
Can we expand the TB programme AND improve HIV access with current capacity?

YES There is available GeneXpert capacity to accommodate priority HIV testing

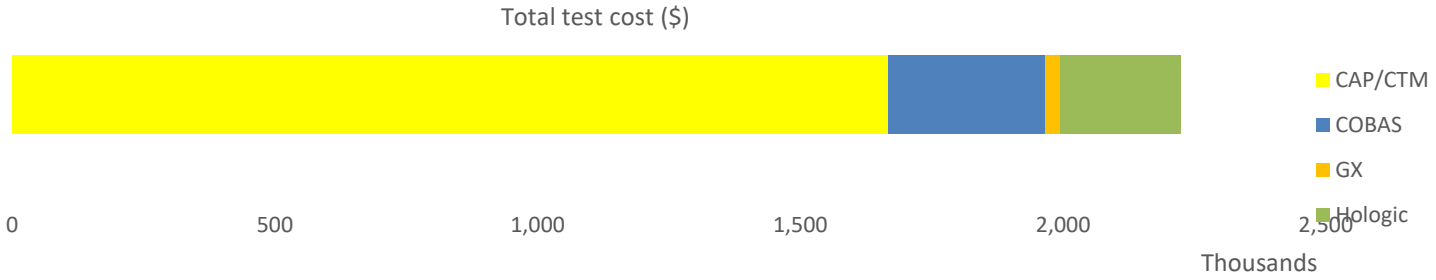
Historical Baseline

Number of priority VL/EID tests by device

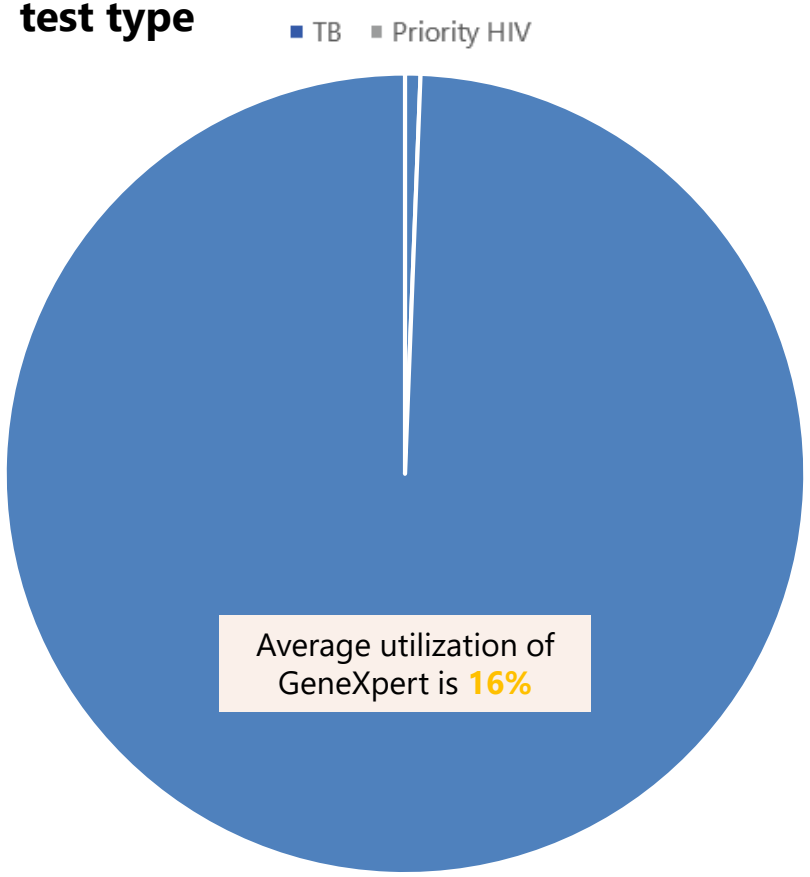




Majority of Priority VL/EID tests performed on CAP/CTM at baseline – reflected in test cost distribution



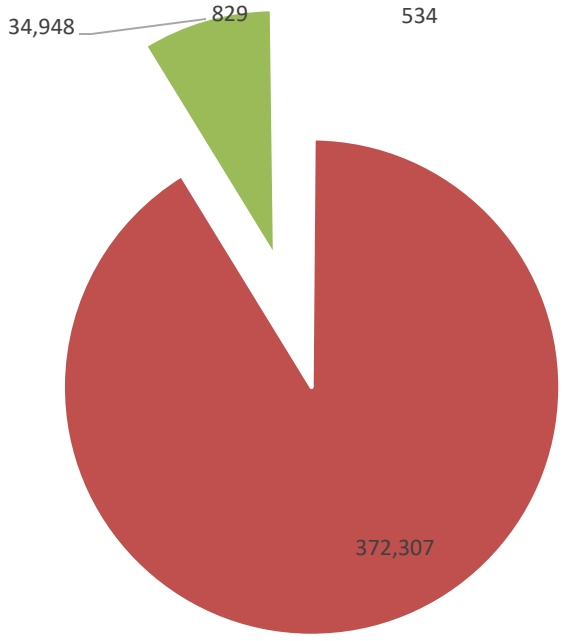
Proportion of tests on GeneXpert by test type



YES There is available GeneXpert capacity to accommodate priority HIV testing

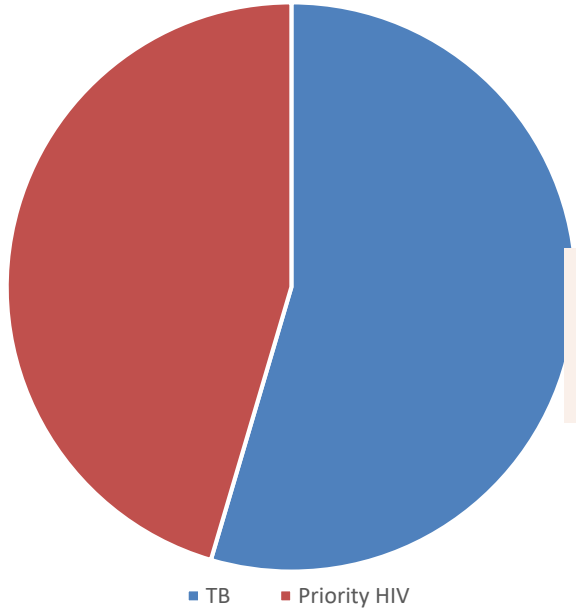
Future demand scenario

Number of priority VL/EID tests by device

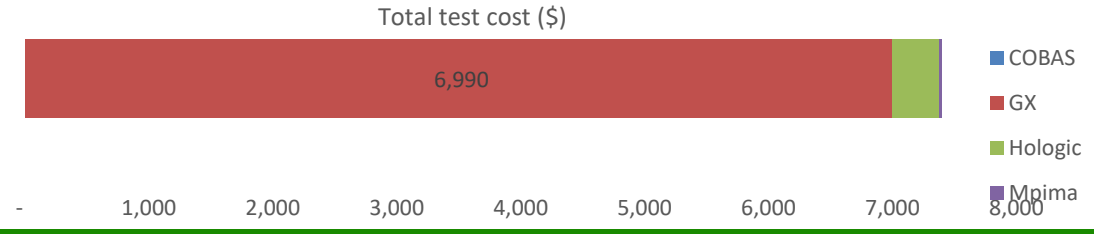


Shift to GX for Priority VL/EID

Proportion of tests on GeneXpert by test type



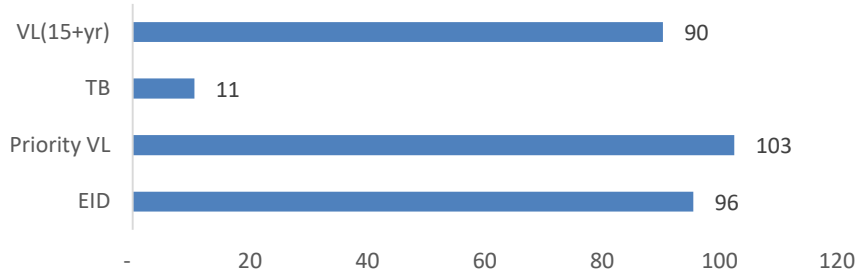
Average utilization of GeneXpert is **48%**



It is possible to expand the TB programme AND improve TB/HIV access

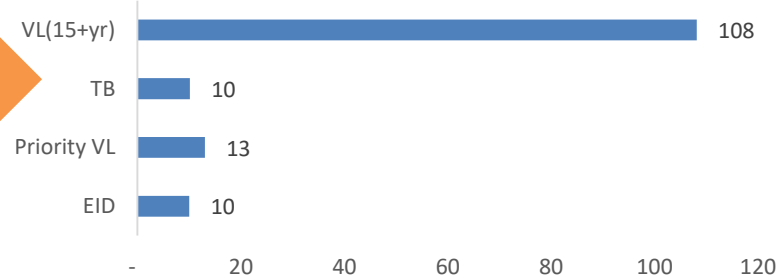
YES

Baseline - Avg km travelled/sample

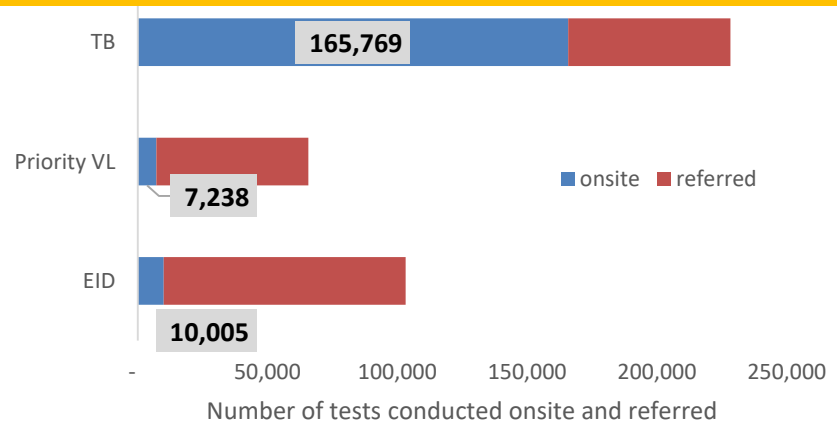


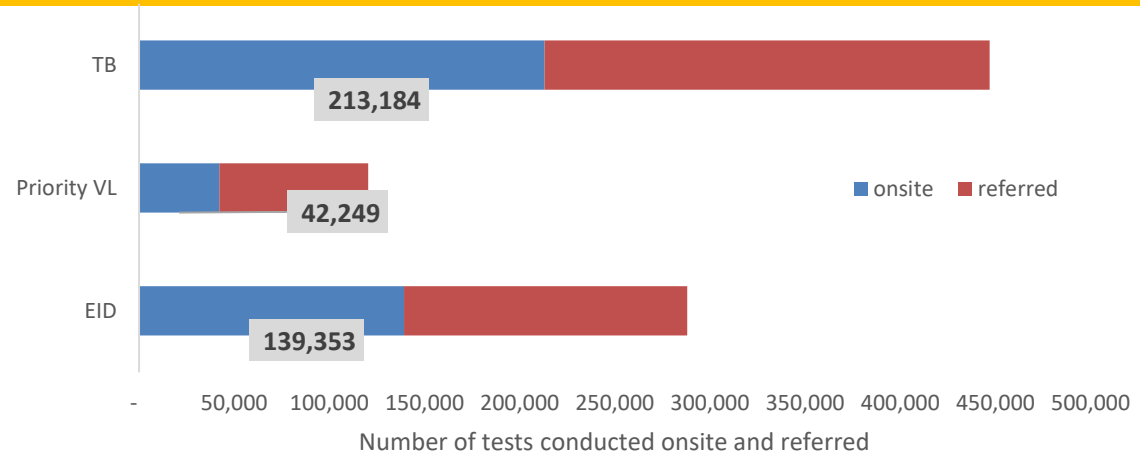
Avg km/sample decreases for samples (except Adult VL). **10-fold for EID/priority VL**

Future - Avg km travelled/sample



Number of tests performed onsite increases for TB and HIV despite large programme expansions



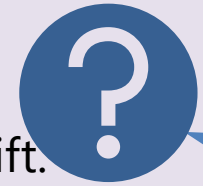


Whilst average utilization is below 50%, a number of sites are operating over-capacity

But

Decentralization of both the TB and priority HIV programme and closing CAP/CTM platforms places pressure on a number of smaller laboratories with GeneXpert IV instruments:

- **10 sites operating over 100% capacity**
  - 9/10 are GeneXpert IV where the majority of tests are TB (>75%)
- **84 sites are operating at >80% capacity**.
  - Largely GeneXpert IV devices operating 1 shift.

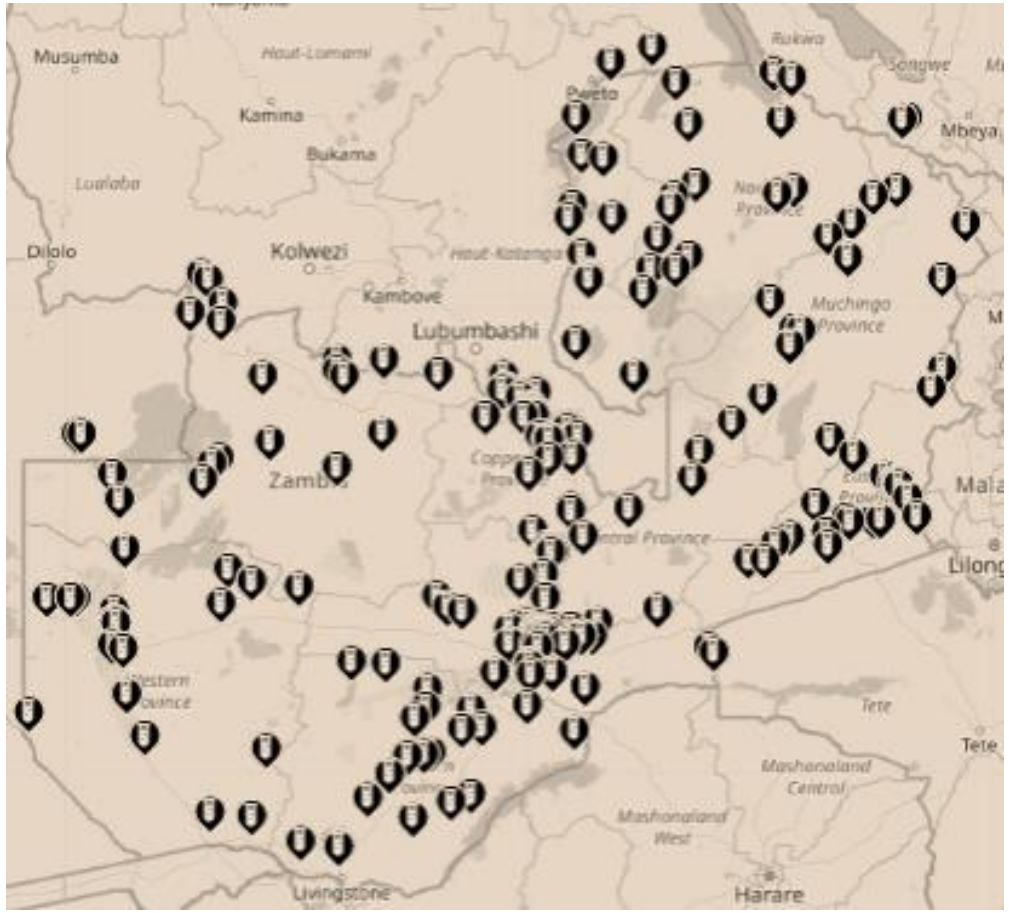


Solutions?

1. Add more GeneXpert devices
2. Re-locate under-utilized devices
3. Extend shifts

Recommendations

- **Recommendation 1:** Place GX-XVIs at high demand facilities to ensure minimum test requirements are met (and lower reagent rental prices).
- **Recommendation 2:** Re-locate devices that are underutilized to sites with expected high utilization or sites that are overwhelmed when distance constraints are enforced.
- **Recommendation 3:** Extend shifts of 1-shift GX-IV devices where possible to accommodate increases in demand and reduce utilization from > 80%.



Next steps

- Implementation of recommendations


Implementation

In FY 22, 123 sites were adopted to begin POCT

All Correspondence should be addressed to the
Permanent Secretary
Telephone: +260 211 253040/5
Fax: +260 211 253344

In reply please quote:
MH/101/23/6
No.....

REPUBLIC OF ZAMBIA
MINISTRY OF HEALTH

NDEKE HOUSE
P. O. BOX 30205
LUSAKA

25th March, 2022

TO: Provincial Health Directors
District Health Directors
Senior Medical Superintendents
Medical Superintendents
Implementing Partners

SUBJECT: USE OF POINT OF CARE (POC) FOR VIRAL LOAD TESTING IN CHILDREN BELOW 15 YEARS AND IN PREGNANT AND BREASTFEEDING WOMEN.

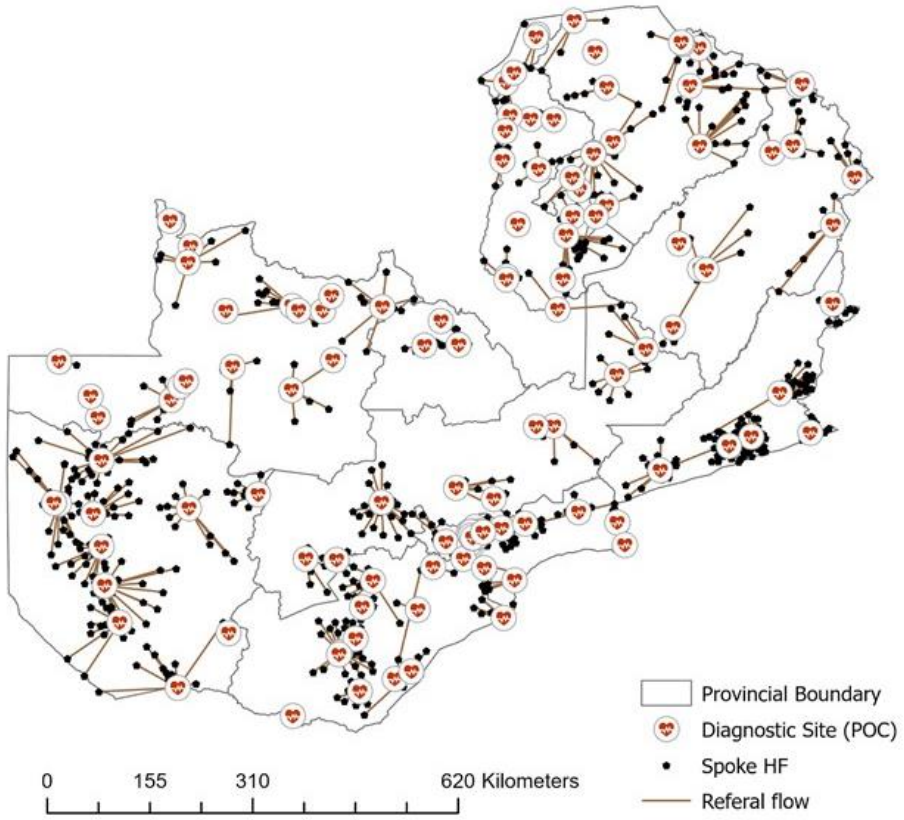
Reference is made to the above stated subject matter.

The Ministry of health has made great progress towards epidemic control of HIV in Zambia, with over 1,200,000 individuals on Antiretroviral therapy (ART).

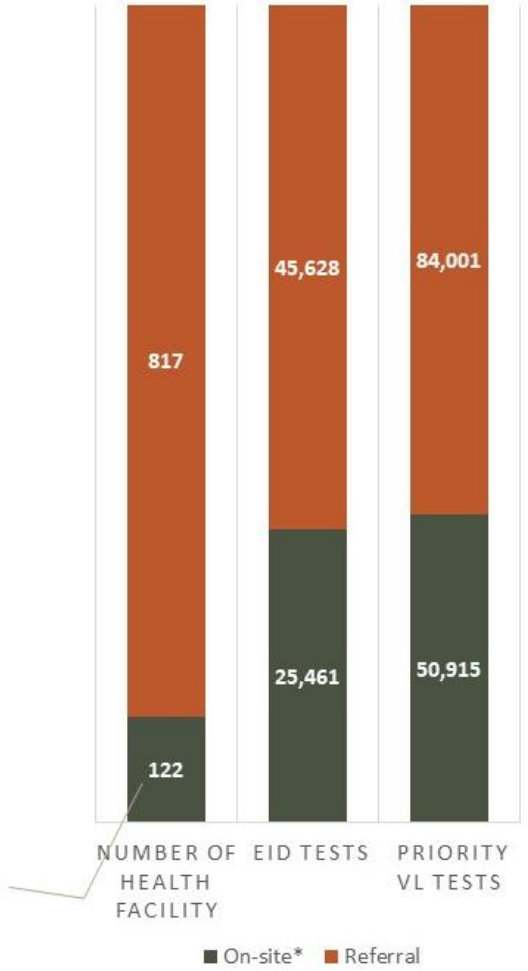
The HIV program has prioritized Viral Load (VL) testing to monitor treatment success. Currently, HIV VL testing technologies are restricted to centralized laboratory testing, which requires substantial infrastructure and training.

Reagent stock outs, shortcomings in cold-chain management, plasma collection and sample transport often result in long turnaround times of several days to weeks, which can negatively impact the HIV treatment cascade by affecting patient retention.

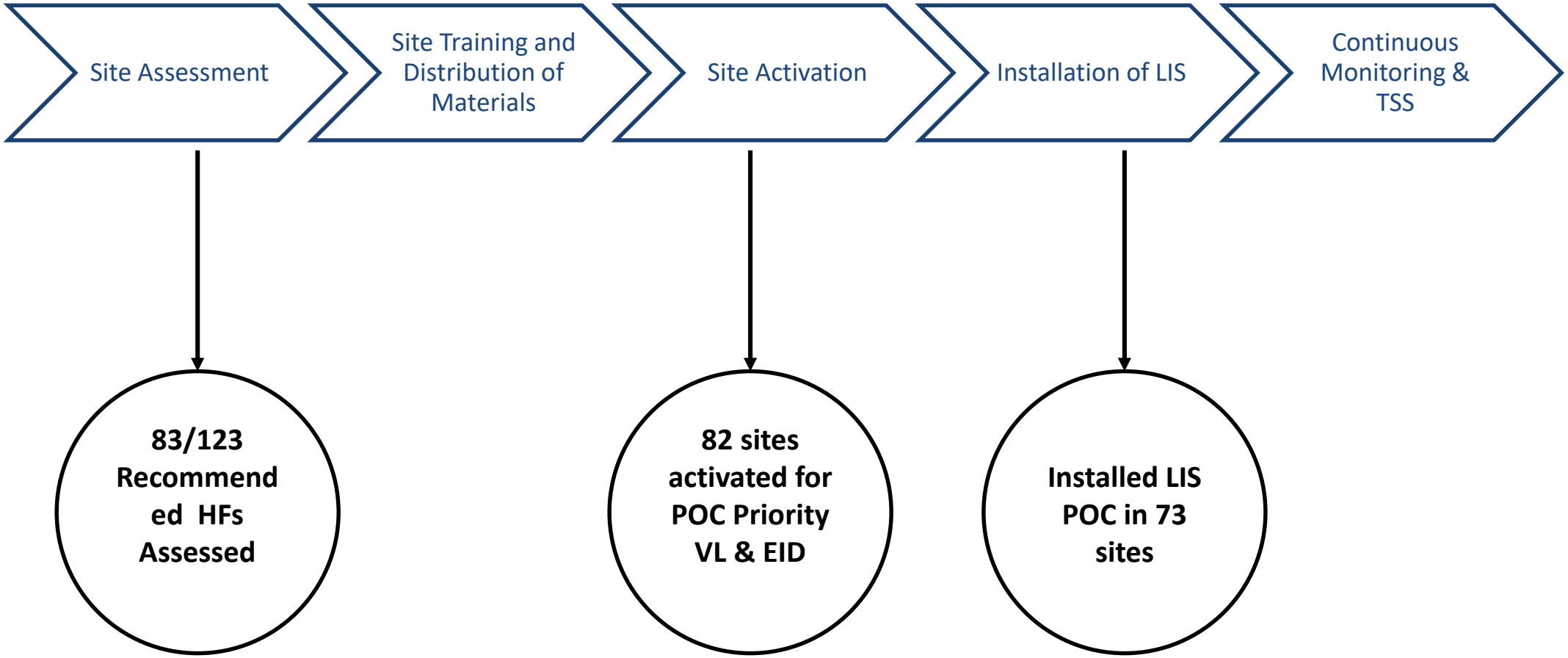
The Ministry in the year 2020 implemented the use of POC platforms for qualitative HIV diagnosis (Early Infant Diagnosis) for HIV-exposed infants, which has been successful in achieving same-day results return, increased efficiency and overall improved service quality for patients. As a result, the Ministry will expand use of POC platforms for VL testing for priority populations, namely, **children below the age of 15** and **pregnant and breastfeeding women.** This will be implemented in a phased approach with the initial facilities listed below:



*Excludes CHAZ Complex Laboratory



Process for implementation



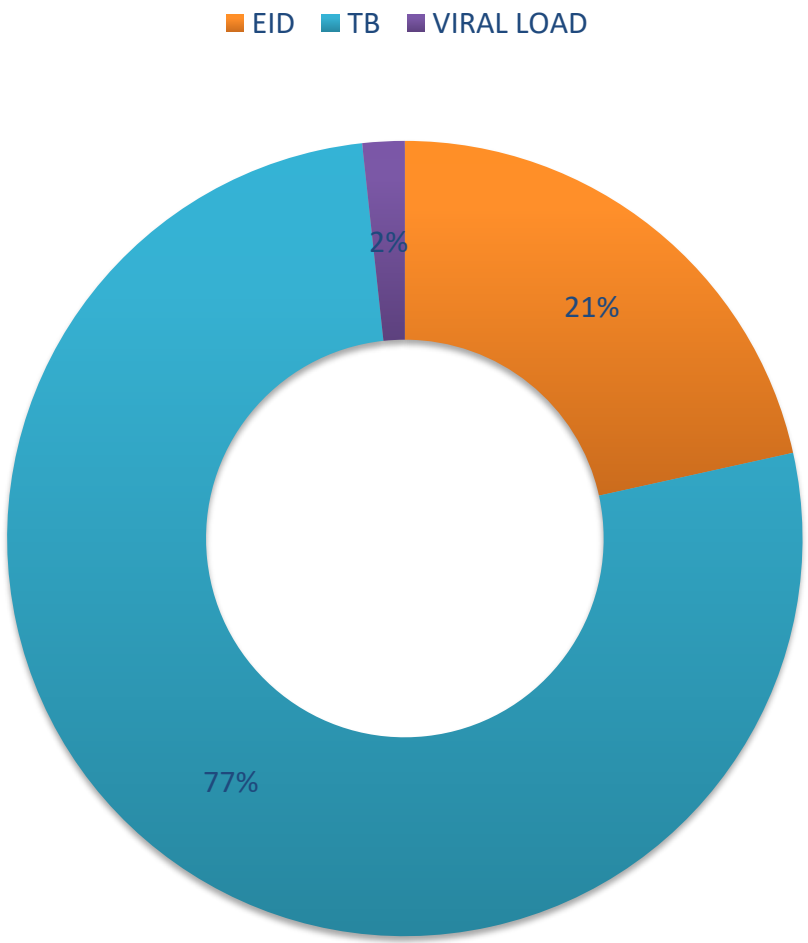
Routine Implementation Monitoring

- LIS on POC platforms have been activated

- Monthly National Multi-disease update meetings held to monitor progress towards integration

Impact evaluation

2022 Testing Operations



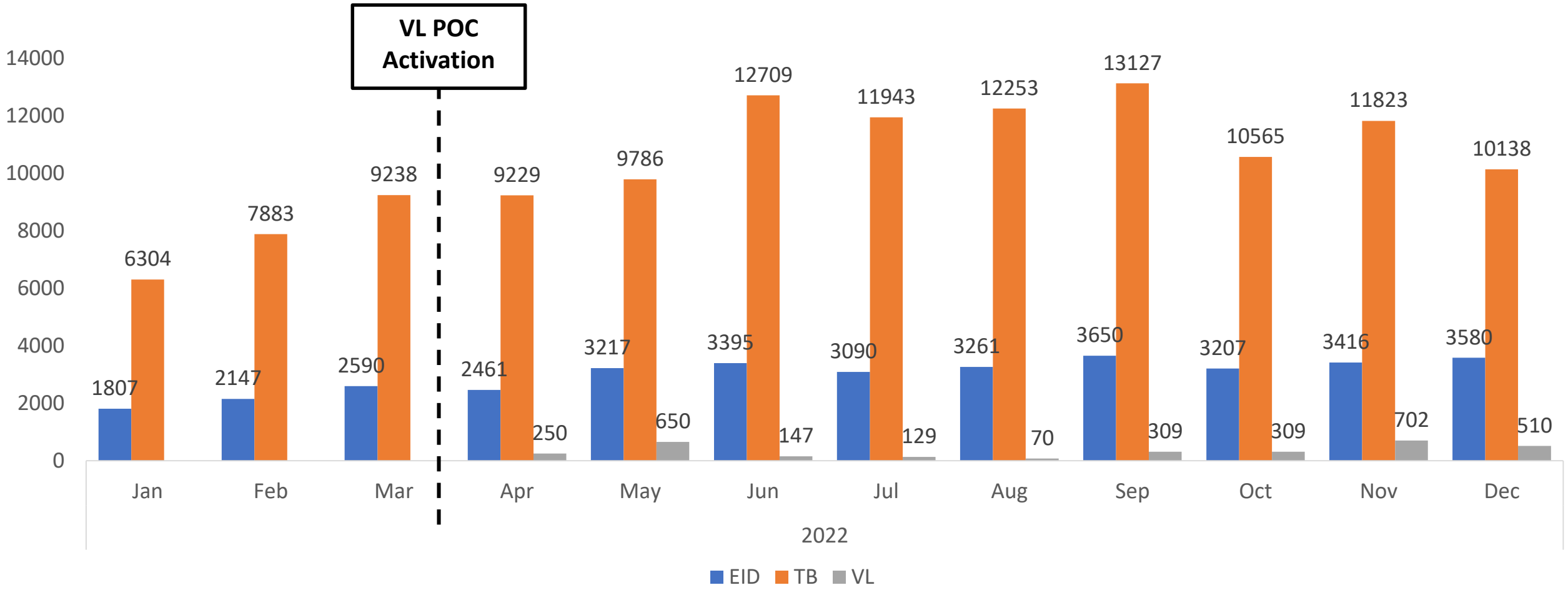
In **2022**, 32,241 EID tests, 114,860 TB tests and 2566 viral load tests, were conducted on the GeneXpert platform.

Average Lab TAT= 1 day

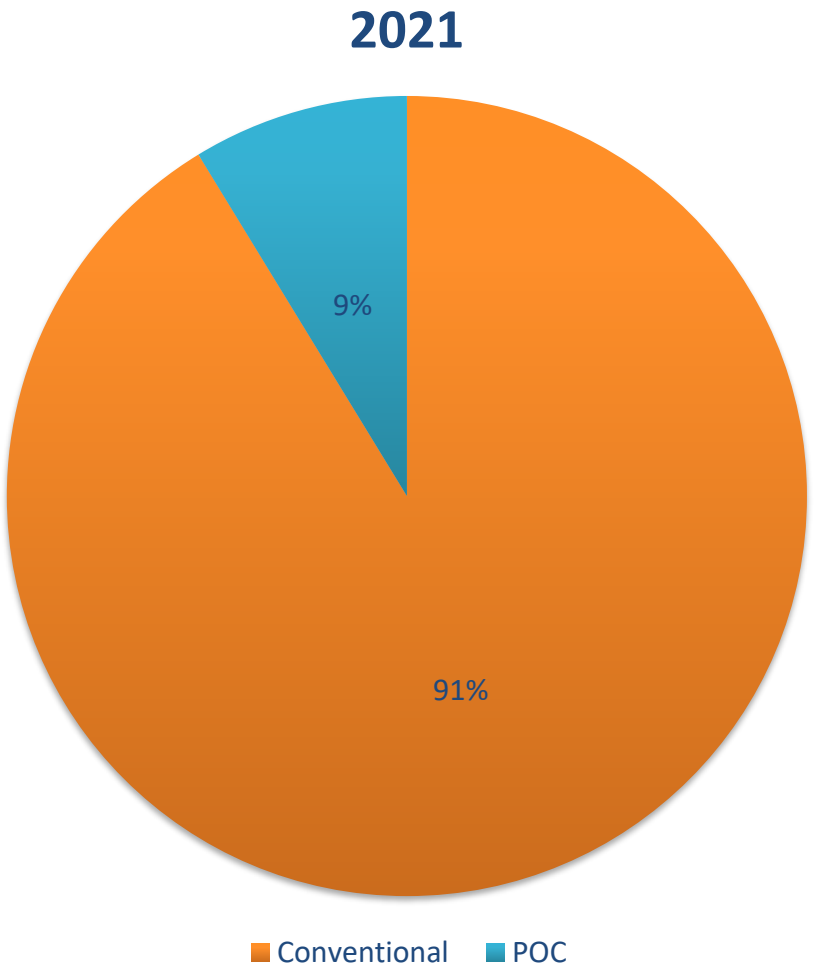
Average Patient TAT= 2 days

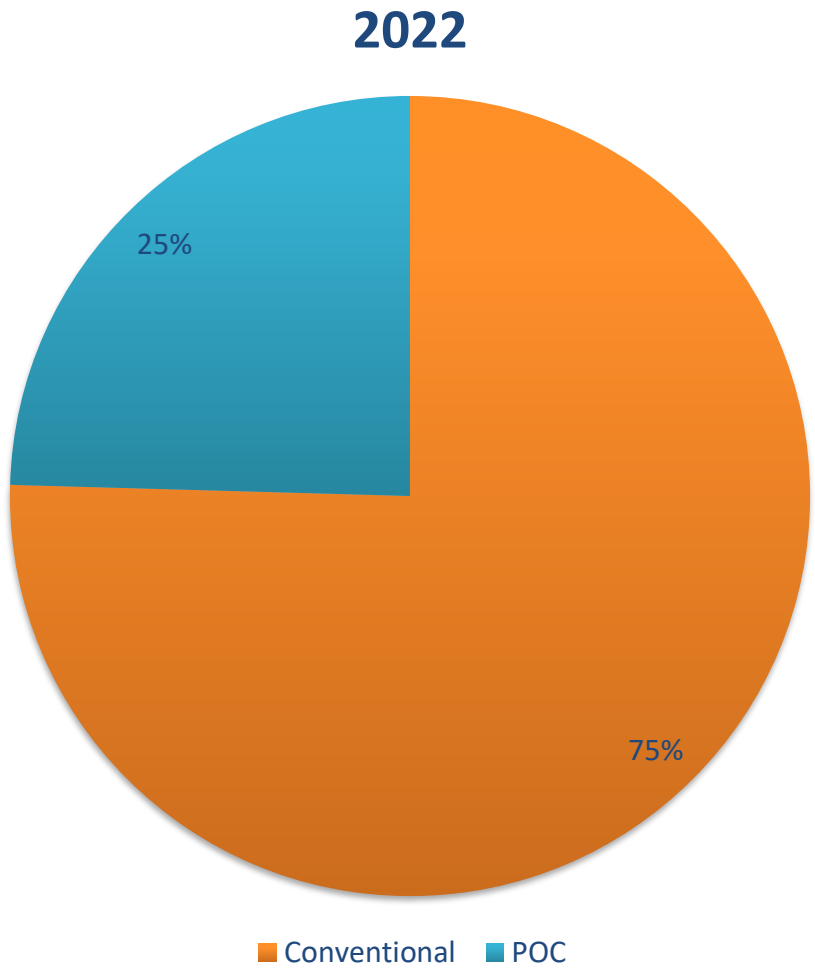
Functional Courier from RHCS to Hubs

Annual VL,EID & TB Testing Trends Review



EID: POC vs Conventional testing





Sustainability of DNO Recommendations

- Access to testing
  - Increased testing capacity – multiple tests can be conducted without additional equipment/HR making it scalable to accommodate increasing demand over time.
- Cost-effectiveness
  - Cost savings through reagent rental agreements
  - Reduced transportation costs **(resulting in long-term cost savings)**
  - Lower training costs
  - Reduced infrastructure costs: GeneXpert POC tests can be performed in decentralized settings
  - Lower maintenance costs compared to conventional platforms
- Supply chain management
  - Easily coordinated and integrated supply chain

Challenges

- DNO is a data driven approach and requires data in specific formats. Challenges include;
  - Data received is in different formats. This delays data collation and preparation
  - Unavailability of data on some test types in formats required for DNO e.g CD4, Chemistry, Heamatology - Data is not routinely collected.

Ongoing works

Project	Status
1. Integration of tuberculosis and HIV testing on GeneXpert	Complete (In the process of rerunning to account for changes)
2. Optimization of CD4, HPV, Heamatology & Chemistry testing?	In progress

Evaluation of the Impact of DNO

- Protocol development under underway

Publications

PLOS GLOBAL PUBLIC HEALTH

OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

The integration of tuberculosis and HIV testing on GeneXpert can substantially improve access and same-day diagnosis and benefit tuberculosis programmes: A diagnostic network optimization analysis in Zambia

Sarah Girdwood, Mayank Pandey, Trevor Machila, Ranjit Warrier, Juhi Gautam, Mpande Mukumbwa-Mwenechanya, Mariet Benade, Kameko Nichols, Lunda Shibemba, Joseph Mwewa, Judith Mzyece, Patrick Lungu, Heidi Albert, Brooke Nichols, Powell Choonga

Published: January 25, 2023 • https://doi.org/10.1371/journal.pgph.0001179

https://journals.plos.org/globalpublichealth/article?id=10.1371/journal.pgph.0001179

Thank you!


ONE ZAMBIA ONE NATION


ZAMBIANS AND AMERICANS
IN PARTNERSHIP TO FIGHT HIV/AIDS
PEPFAR


DEPARTMENT OF HEALTH & HUMAN SERVICES · USA


CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION


CIDRZ
for a healthy Zambia


FIND
Because diagnosis matters


coupa


BILL & MELINDA
GATES foundation


USAID
FROM THE AMERICAN PEOPLE


USAID GLOBAL HEALTH
SUPPLY CHAIN PROGRAM
Procurement and Supply Management


PEPFAR
U.S. President's Emergency Plan for AIDS Relief