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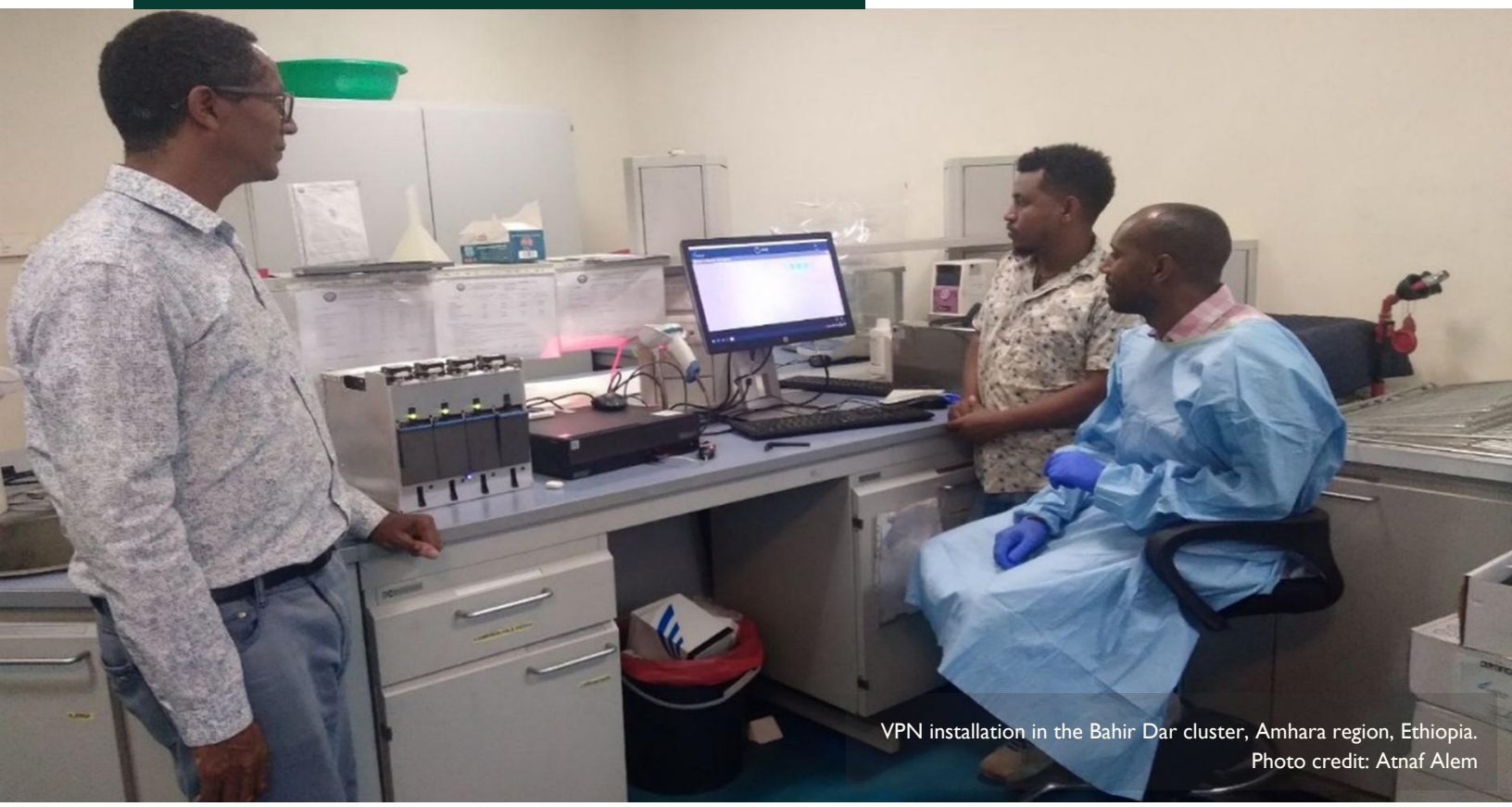

VPN installation in the Bahir Dar cluster, Amhara region, Ethiopia.
Photo credit: Atnaf Alem

TECHNICAL HIGHLIGHT

INTRA-CONFLICT RESPONSE: VIRTUAL PRIVATE NETWORK, A LOCAL SOLUTION FOR REAL-TIME GENEXPERT DATA SHARING AND USE

December 2024

BACKGROUND: PRIOR TO CONFLICT

Improving tuberculosis (TB) diagnostics to ensure access to highly sensitive rapid diagnostics is a priority to improve TB case finding and provide quality of care. GeneXpert is a rapid molecular TB diagnostic tool that transformed the effort of TB case finding for both drug-sensitive and drug-resistant (at least for rifampicin) strains. Microscopy, a less sensitive test, has been used for decades to diagnose highly infectious forms of pulmonary TB. The Ethiopian National TB Program (NTP) introduced GeneXpert in 2013 and rapidly increased the number of machines to 1,000 across the country, aiming to reach one machine per district. The US Agency for International Development (USAID) has contributed to about 60% of the installed GeneXpert machines in the country. The Amhara region—the second-most populous region in the country—saw progressively increasing numbers of machines and ensured high coverage (figure 1).

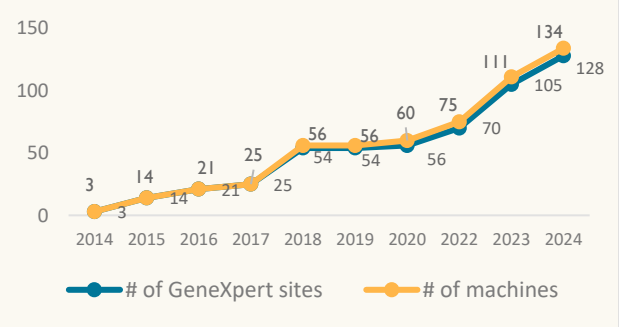

Figure 1. Trend of GeneXpert machine expansion, Amhara region, 2014–2024

Over the past 10 years, the utilization of GeneXpert as the primary rapid molecular diagnostic tool in the Amhara region has contributed to an increase in the proportion of bacteriologically confirmed pulmonary TB cases (BCPTB), from 21% to 30% (figure 2). While the BCPTB proportion is increasing with the use of GeneXpert, the clinically diagnosed pulmonary TB (CDPTB) proportion is declining because of the higher sensitivity of GeneXpert compared to acid-fast bacilli tests.

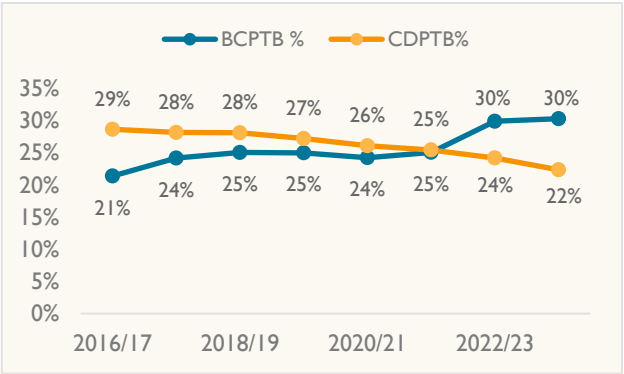

Figure 2. Contribution of GeneXpert expansion on BCPTB and CDPTB diagnosis in Amhara region, 2016–2023

The NTP has been using GxAlert connectivity—a global tool that requires regular payment per test and for continuous development needs to a third party according to the contract agreement—to provide performance data to the national program. Due to the limitation on including contextual needs, the payment per test, and ownership by an external entity, the Ministry of Health, USAID, and the Ethiopian Public Health Institute (EPHI) decided to implement an alternative and local solution. USAID supported the NTP and EPHI and funded the development of a local solution called LabXpert, which is customized from the Ugandan NTP. The GxAlert connectivity solution has been replaced by the locally led LabXpert connectivity solution. This change is part of the introducing New Tools Project, a collaboration between the Stop TB Partnership and USAID with the aim to deploy a suite of cutting-edge innovations in diagnostics, treatments, and digital health technologies to enhance TB care in high-burden countries. The LabXpert connectivity solution was piloted by REACH Ethiopia and scaled up and implemented by the MSH-led USAID Eliminate TB Project in Ethiopia.

The locally developed and led LabXpert connectivity solution is essential as it provides real-time notification of results to clinicians and referring sites to track patients with positive results in a timely manner, initiate treatment and care, and report machine functionality, thereby significantly reducing the turnaround time (TAT) for result notification. It also provides notification to

patients if their mobile telephone number is entered into the system.

Prior to the start of current conflict in the Amhara region, all 103 GeneXpert machines were LabXpert connected and 81% (83) had active connectivity status using internet connectivity.

PROBLEM STATEMENT

Due to internal conflict, internet connectivity has been down since August 2023, mobility in the region has been restricted, and service delivery in general has been compromised (table 1).

The disruption to internet access significantly affected the LabXpert connectivity solution, limiting access to GeneXpert testing data in general and positive GeneXpert tests in particular, both of which are necessary for timely patient tracking for treatment and care. This has resulted in prolonged TAT, delayed initiation of patient linkage to treatment, and compromised capacity to monitor machines status and provide maintenance.

In addition, even though internet access was restored after a year of interruption, the running cost is expensive, and data access did not cover GeneXpert machines. Obtaining data remains challenging, and the situation is unsustainable.

Table 1. LabXpert active connectivity status, Amhara region

Month	GeneXpert		LabXpert connectivity		Conflict status
	Number	LabXpert installed	# Active	% Active	
Jul 2023	111	103	83	81	Pre-conflict
Aug 2023	111	103	0	0	Intra-conflict
Sept 2023	111	103	0	0	
Oct 2023	111	103	0	0	
Nov 2023	111	103	0	0	
Dec 2023	111	103	0	0	
Jan 2024	111	103	0	0	
Feb 2024	111	103	0	0	
Mar 2024	111	103	0	0	
Apr 2024	134	103	0	0	
May 2024	134	103	0	0	
Jun 2024*	134	103	6	6	

** VPN pilot began.*

INTERVENTIONS AND RESULTS

In May 2024, after a year-long disconnect, connectivity was re-established but linked only two GeneXpert sites. To address the needs, the USAID Eliminate TB Project piloted the use of virtual private networks (VPNs) in collaboration with REACH Ethiopia. This has shown the potential of VPNs to advance the use of the LabXpert connectivity solution in conflict-affected areas.

Despite the restoration of internet connectivity, accessing data in real time continues to be a challenge as the use of the internet is restricted in scope and geographic reach. To address this, the USAID Eliminate TB Project worked with EPHI and REACH Ethiopia to introduce virtual private networks (VPNs), which securely extend a private network, at five sites in Bahir Dar in June 2024.

To offset the cost of this intervention and improve access and sustainability, the USAID Eliminate TB Project scaled up the use of VPNs by integrating with the cluster-based GeneXpert maintenance approach that it had also introduced during the conflict. These approaches are low cost and easy for the government to sustain.

Maintenance of GeneXpert Machines: When it became difficult to provide on-site medical equipment maintenance services due to the conflict, the USAID Eliminate TB Project initiated and coordinated the GeneXpert clustering activity for maintenance and related interventions, including calibration, module replacement, and software maintenance. The project identified places where there is relative peace and easy access for health facilities and technical collaborators and then worked with the health facilities to transport the machines in a geographic cluster to the identified site (figure 3).

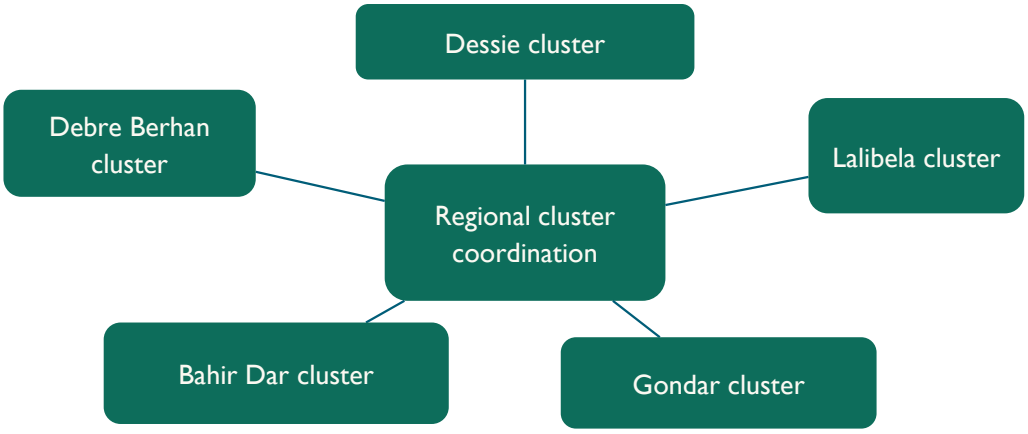

Figure 3. Cluster sites for GeneXpert maintenance and VPN installation

Testing VPN: The project coordinated the intervention and provided technical and financial support to conduct the identification and testing of the viability of VPNs in the conflict-affected areas of the region.

Integrated installation of VPN during cluster-based GeneXpert machine maintenance: Because GeneXpert machines were already being transported to safe sites by cluster, it was efficient to install a VPN on the machines already there for maintenance (table 2).

Stakeholder coordination to schedule VPN installation: The USAID Eliminate TB Project facilitated the coordination of stakeholders (EPHI, Amhara Public Health Institute, GeneXpert sites, REACH Ethiopia, and Delta) and conducted the scheduled VPN installation.

VPN solution scale up: Knowing the VPN solution worked successfully at six pilot sites, the USAID Eliminate TB Project immediately started expansion to other GeneXpert sites by replacing the normal SIM card with a VPN in the region (table 2, figure 4).

Table 2. Cluster-based maintenance and VPN installation, September 2024

Cluster	VPN installation		GeneXpert module maintenance			
	Target	# Installed	# Calibrated	# Passed	# Failed	# Replaced
Gondar	27	15	5	4	1	11
Bahir Dar	38	36	36	26	10	22
Lalibela	11	9	4	3	1	1
Dessie	31	29	NA*	NA*	NA*	18
Debre Berhan	3	1	8	6	2	10
Total	110	90 (82%)	53	39 (74%)	14 (26%)	62

***NA:** Not applicable as the machines at Dessie cluster were maintained in the previous schedule.*

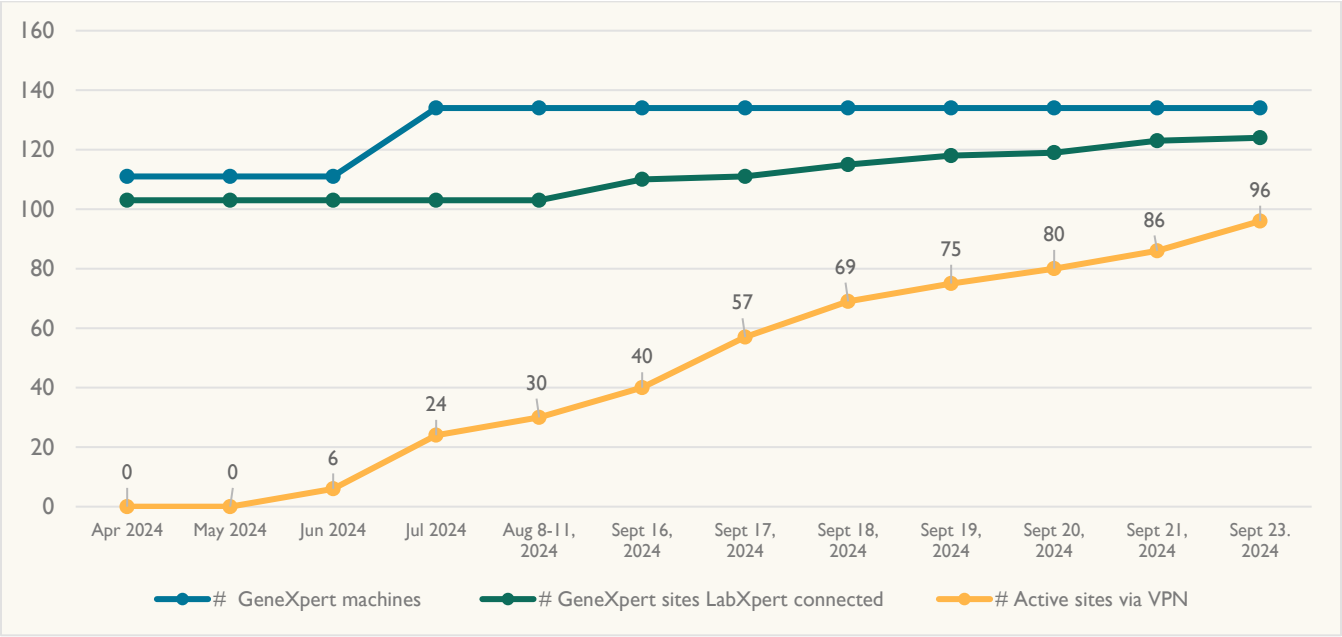

Figure 4. Active LabXpert connectivity trend, April–September 23, 2024

	September 16, 2024	September 27, 2024
GeneXpert Machines Testing	Machines Testing 40/111 GeneXpert	Machines Testing 94/124 GeneXpert
GeneXpert Tests Completed	GeneXpert Tests 3,423 TB	GeneXpert Tests 8,721 TB

Figure 5. Dashboard showing LabXpert real-time connectivity and test status in Amhara, September 2024

Reduced TAT: As a result of automatic rifampicin-resistant (RR) result notification to clinicians and sample referring sites, RR-TB patients were immediately tracked and linked to treatment initiating centers for care and treatment, thereby reducing TAT.

Reduced cost: VPN installation has been integrated with the GeneXpert machine maintenance sessions. This integration has been shown to be highly effective and cost efficient as there is no need to schedule or conduct a separate visit for installing VPNs on the machines.

Motivated health care workers: With the resumption of real-time connectivity, health care workers were able to receive results; share them with regional and national programs; and receive support for supplies and machine maintenance, which motivates health care workers.

Contribute to reduced transmission: Timely access to quality diagnosis and release of results contributes to early case finding and prompt initiation of treatment, which contributes to TB infection prevention.

LESSONS LEARNED AND RECOMMENDATIONS

LESSONS LEARNED:

Opportunity amid conflict: We have learned that in any crisis, there are alternative ways to implement program activities, leverage existing solutions, and apply innovations for sustaining health services and/or limiting adverse outcomes in the health system, including patient-centered care.

Use of digital connectivity solutions: During conflict, existing platforms may become inaccessible and lead to limited access to and use of data. Using VPNs to restore and maintain connectivity can be instrumental to sharing and using data in real time.

Cluster-based GeneXpert maintenance: During conflict, when mobility to multiple health facilities to conduct on-site medical equipment maintenance is limited, identifying locations where medical equipment from a geographic cluster can be transported for maintenance is a viable option. Cluster-based GeneXpert maintenance, calibration, and module replacement are a few examples that helped the NTP sustain services despite the widespread security disruption because of the conflict.

Partnership and coordination: Intraconflict program intervention; timely mapping; communication; sensitizing stakeholders; and creating platforms to harmonize plans, execute activities, monitor progress, guide implementers, and solve encountered barriers have played a pivotal role in ensuring service continuity and patient care during conflict. These interventions have also enhanced the efficiency and effectiveness of concerted effort, reduced duplication of effort, and saved resources. In addition, partnerships with Ethio telecom, EPHI, and other sectors have been important and support successful implementation of other health and multisectoral programs.

RECOMMENDATIONS:

Scaling up digital solutions: Understanding the context and its impact on the ground, scaling up VPN installation as a digital solution is highly recommended for better monitoring and utilization of GeneXpert and other molecular WHO-recommended rapid diagnostic services like Truenat. Other health information systems that have been affected by conflict in the country, such as the drug-resistant TB tracker system, would similarly benefit from this digital solution.

Provide technical assistance to ensure continuity of the digital solutions: Implementing intraconflict interventions requires continued support to health care workers by providing mentorship and conducting regular review meetings.

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