

TECHNICAL BRIEF

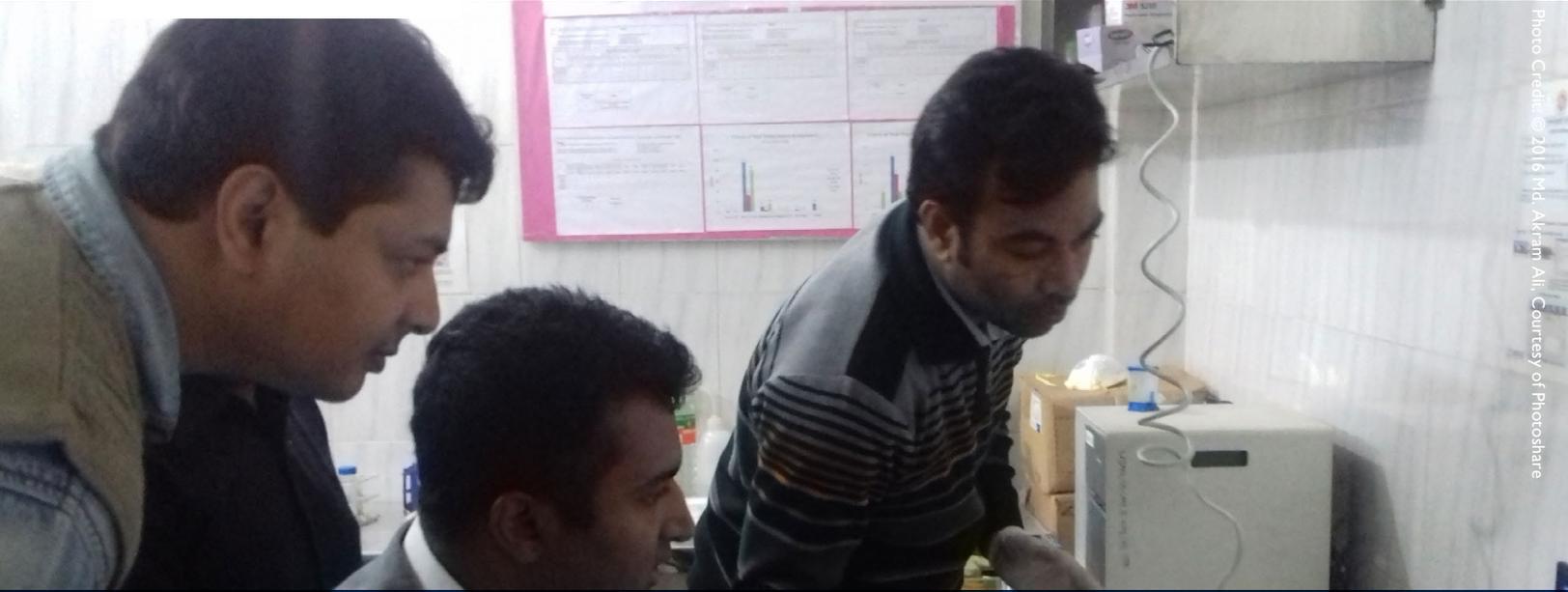


Photo: Challenge TB 2016. Md. Akram Ali. Courtesy of Photoshare

GxAlert for Real-time Management and Strengthening of Remote GeneXpert Network in Bangladesh

PROJECT CONTEXT

The USAID-funded Challenge TB (CTB) Project has supported 39 GeneXpert sites in Bangladesh since March 2015. At the beginning of the CTB Project, many machines were down, there was a high percentage of errors and nonfunctional modules, cartridge stocks-out were frequent, and low uptake of the Xpert network was prevalent. There were no structured monitoring mechanisms to report the need for maintenance of GeneXpert machines or for logistics management, optimal utilization, understanding error codes, or timely enrollment of drug-resistant TB (DR-TB) patients to treatment. All of these were major bottlenecks to the effective and efficient management of the Xpert network.

In addition, there was a lack of quality supervision and skilled human resources to monitor the machines across sites. Increasing the number of GeneXpert machines to 615 by 2022, a goal set by the National Tuberculosis Control Program (NTP) following the national GeneXpert scale up and implementation plan, was not feasible. However, many of the challenges could be resolved through the introduction of a real-time monitoring system called GxAlert. CTB introduced the system to connect GeneXpert machines and allow for remote monitoring and improvements in inventory management, maintenance, and utilization of the machines.

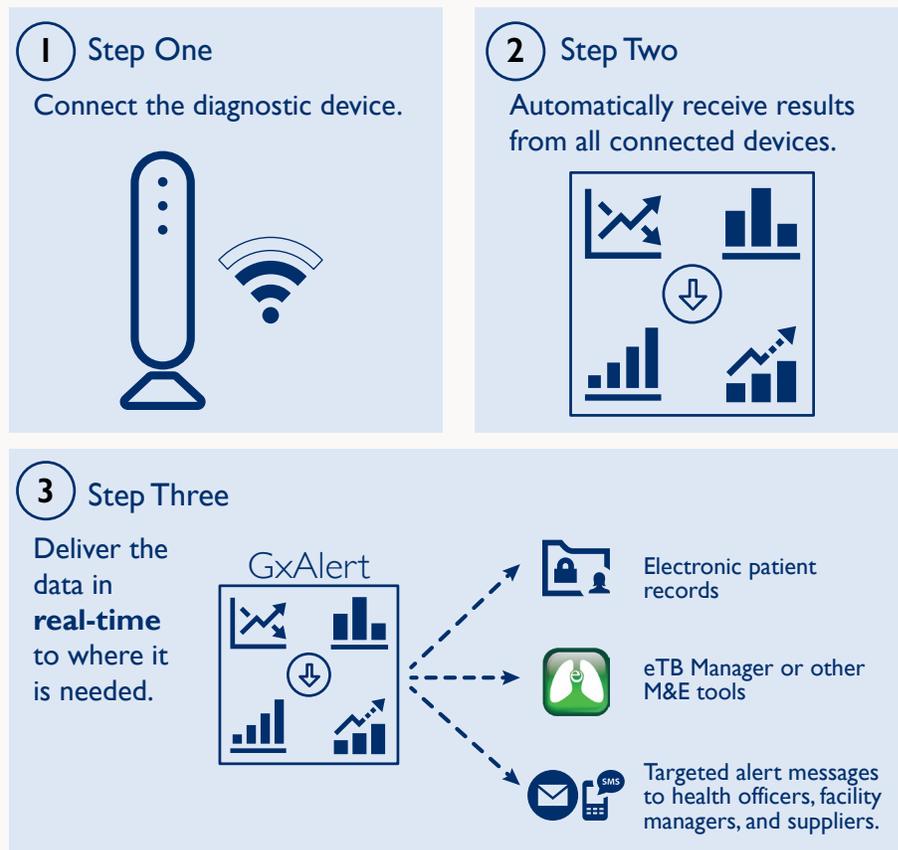
STRATEGIC APPROACH

GxAlert is a web-based open-source data connectivity application that includes a system for data management designed to work with any diagnostic device that can connect to the internet or a mobile network. It allows for detailed monitoring of:

- Device offline notifications
- Critical instrument error notifications
- Devices with automatic reporting for frequent errors (>5%)
- National multidrug resistant (MDR) case identification notifications
- Automatic monthly MDR case reports
- Modules marked as “do not use”

Results from GeneXpert are automatically sent to the GxAlert server, which provides robust and clear documentation to connect existing monitoring and evaluation systems (e.g., e-TB Manager) and eliminates the need for manual reporting and recording of any transcriptions or submission of results (figure 1).

FIGURE 1. Process of GxAlert connection



PROJECT IMPLEMENTATION

Implementing GxAlert to improve the monitoring system of the 39 GeneXpert machines in Bangladesh required careful planning to ensure a smooth procurement process, identify the implementation team, ensure that software was installed and configured properly, and train lab attendees to use the system as intended to achieve desired results. CTB took a phased approach to the implementation (figure 2) by first carrying out a landscape assessment. CTB conducted a series of meetings with all major

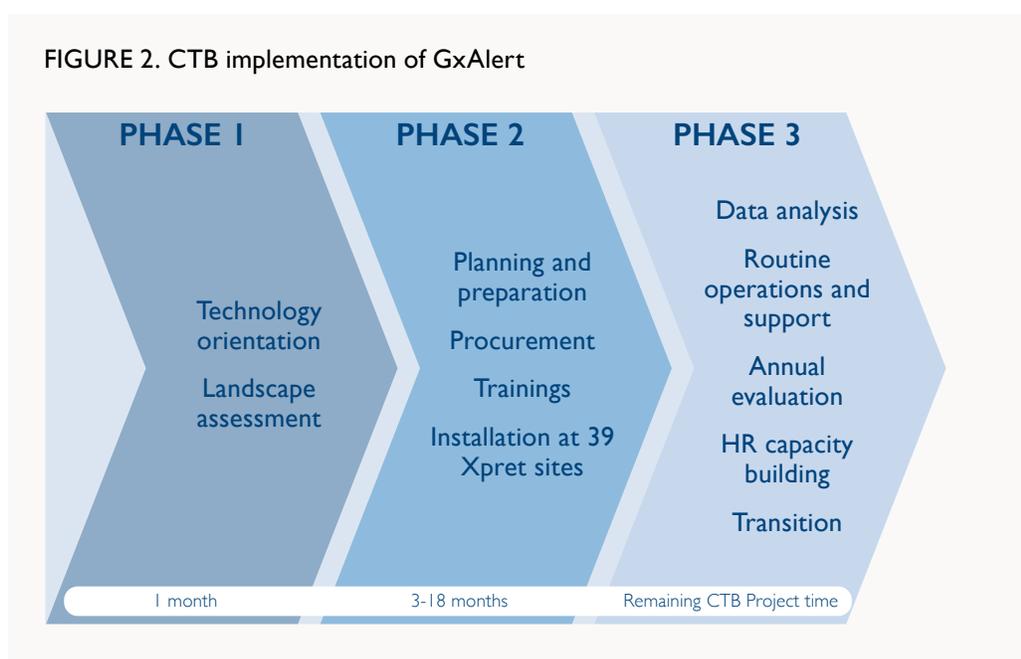
stakeholders (i.e., BRAC, Damien Foundation) under the leadership of the NTP to pave the way for systematic implementation of GxAlert. CTB trained 11 core group members to complete the installation, data analysis, and troubleshooting of the system in November 2016 through System One, a South Africa-based IT solutions firm with expertise in the GxAlert system. All required instruments, including routers, wi-fi dongles, and SIM cards and multi-plugs for the 39 GeneXpert machines, were procured. Software

was also purchased, including Team Viewer, Twilio SMS, Tableau Desktop Professional, Jira Helpdesk, and Confluence Knowledge Base.

To ensure local buy-in, two teams were created. Each consisted of two people from the NTP and two from CTB who provided technical support, oversaw installation, and coordinated with stakeholders. These teams received in-depth training from System One on all aspects of the software, including administrative issues and troubleshooting.

In Phase I, CTB provided training workshops to NTP staff and other key stakeholders on the technology and its functionality. In March 2016, CTB conducted the landscape assessment using the GxAlert Implementation Toolbox to identify strengths and weaknesses of the GeneXpert network. The results of the assessment were used as a foundation for the next steps in the implementation.

In Phase 2, CTB contracted with System One and procured all necessary routers and SIM cards. Through concerted advocacy efforts with the NTP, the products were cleared through the Bangladesh Telecommunication Regulatory Commission with the support of System One. CTB organized several trainings of trainers for the core technical team (comprising representatives from the NTP, CTB, other nongovernmental organizations, and Cepheid) in 2016. CTB successfully installed the GxAlert



system on all 39 GeneXpert machines and oriented operators and field and central-level staff during field visits and trainings throughout 2017.

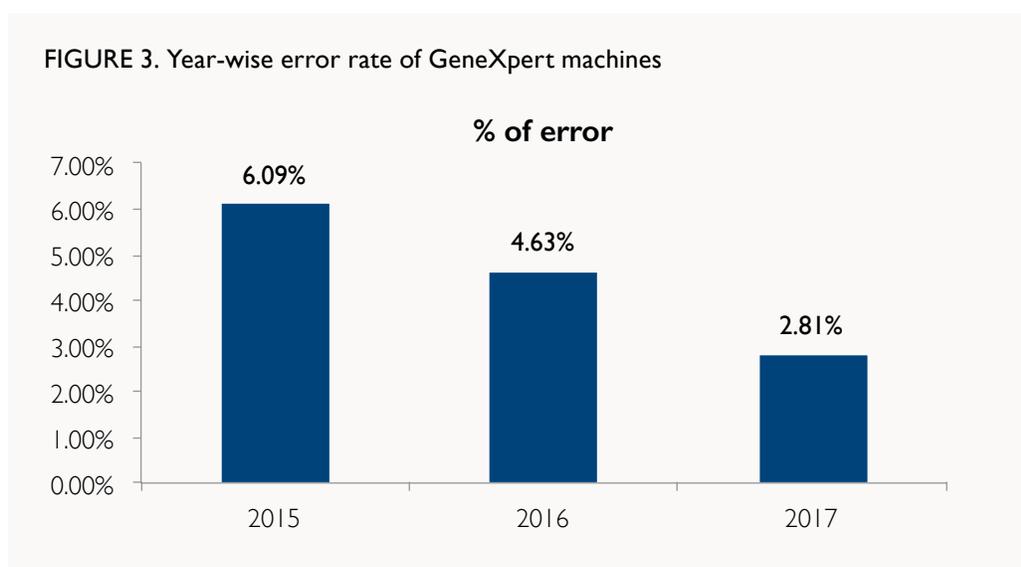
In Phase 3, CTB conducted a deep dive analysis to generate evidence on the effectiveness of this system to strengthen the GeneXpert network overall. Based on encouraging findings, CTB initiated dialogues with

the NTP to hand over the system and scale up to other GeneXpert machines across Bangladesh. The NTP secured funding and initiated communication with the Global Drug Facility and the Global Fund to procure and introduce the system. CTB is currently working with the NTP and other stakeholders to scale up and sustain the GxAlert system.

RESULTS AND ACHIEVEMENTS

The analysis of GeneXpert data through GxAlert showed that the most common GeneXpert instrument and Xpert MTB/RIF test errors were due to incorrect sample processing. A high error rate (in particular of errors 2008, 5006, and 5007) spread across all modules suggests that operator error may be a cause; onsite retraining of staff may be necessary.

Figure 3 shows a downward trend in error rates over time as sites gained expertise and supervision (from 6.09% in 2015 to 2.81% in 2017). This



downward trend represents important progress of the GeneXpert network in Bangladesh when compared to many other countries (>10% error rates in some field settings).

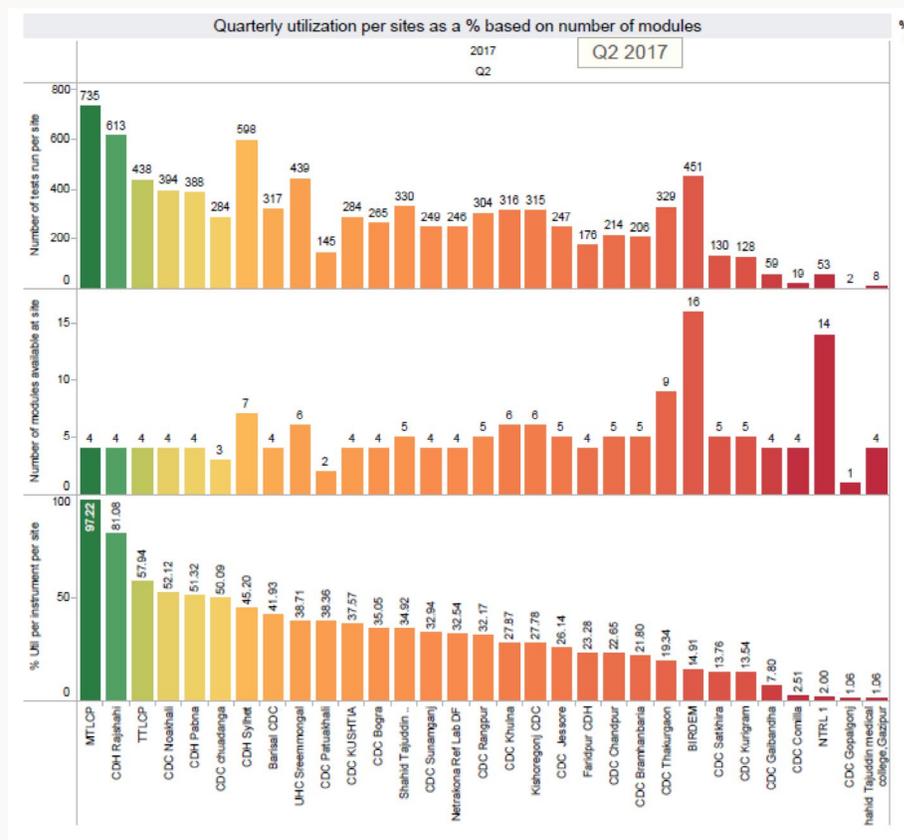
The trend of unsuccessful tests is decreasing each year. Among the three categories of unsuccessful test results—invalid, error, and no result—error is the most common. The most frequently error type codes are 5006 and 5007, which relate to incorrect specimen volumes being added to the cartridge. After getting results from sites through GxAlert, the NTP used that information to tackle frequently reported error test results from the 39 machines. The regular site-level feedback to the lab reduces both errors and cost.

GxAlert enables users to capture demographic information of presumptive TB and DR-TB patients that will help programs understand disease dynamics across geographic areas and by age groups and gender.

Information on the use of existing GeneXpert machines has helped the NTP plan for the distribution of additional machines. Data showed that some existing sites were demonstrating continuously lower utilization of machines while other sites were performing well. This was an important call for action for the NTP to improve the referral mechanism of those sites, transfer machines to higher-performing areas, or take other appropriate actions.

GxAlert helped the NTP prevent stock-outs and expiration of supplies at GeneXpert sites. In 2017, there

FIGURE 4. Snapshot of GxAlert dashboard with examples of sites with low utilization



were no shortages or expiration of cartridges at those sites, demonstrating important progress in managing inventory successfully.

The real-time monitoring of the performance of machines and modules has resulted in a significant decrease in turnaround time for GeneXpert maintenance support (from 5–14 months to 2 weeks) from 2017 to 2018. The local Cepheid agency can now monitor module status in real time and take preventive actions immediately. NTP Bangladesh is maintaining 90% of functional module rate, which again is a major achievement in GeneXpert maintenance services.

GxAlert helps the NTP understand the mutation pattern of *Mycobacterium tuberculosis (MTB)* by capturing data on mutation probes from routine Xpert tests. Data show that mutation probe E is predominant in Bangladesh, and its distribution throughout the country is almost uniform. The frequency of mutation probes may indicate trends in transmission and circulation of new strains. Ultimately, this will help the NTP establish routine surveillance of MDR-TB and determine the time interval needed to conduct a drug resistance survey.

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LESSONS LEARNED

- Real-time monitoring of GeneXpert machines can contribute to reduced error rates and shorter turnaround times for module replacement and can improve the overall maintenance of the machines.
- NTP laboratory staff now receive emails and SMS alert to speed up treatment initiation. The NTP gets SMS alerts and emails for DR-TB patient enrollment; stock-out and error (>5%) rates; critical module errors; and monthly MDR reports to ensure better connections among diagnosis, enrollment, and treatment.
- GxAlert reports can be used to troubleshoot problems encountered in remote laboratories by targeting the problem type. Site-level interventions as simple as regular cleaning can reduce both the number of unsuccessful test results and the cost.
- GxAlert has strengthened and improve programmatic decision making for cartridge procurement, distribution, and management.

THE WAY FORWARD

There are many operational challenges to be dealt with to realize the full benefit of the GxAlert system, and the following actions need to be taken:

- Deploy a full-time staff person at the central-level NTP to train users, troubleshoot problems, analyze GxAlert data and communicate the findings to program staff, and provide timely support to the field
- The NTP needs to scale up this system to all GeneXpert machines across the country, regardless of ownership
- The NTP needs to secure Government of Bangladesh funding and support to scale up and sustain the system
- The NTP needs to develop its own server and IT laboratory to host the data at the country level
- The NTP should develop a pool of TB data fellows who can produce robust evidence by analyzing GeneXpert data
- Integrate customs field as per national reporting format e.g. 10A and 10B
- Integrate with other systems (e.g., e-TB manager, DHIS 2)

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