UNITAID end-of-project evaluation: TB GeneXpert – Scaling up access to contemporary diagnostics for TB

January – March 2017

EXECUTIVE SUMMARY

CONTEXT

Tuberculosis (TB) is one of the top ten global causes of mortality and poses a particularly acute threat to developing countries. Of the estimated 1.8 million TB-related deaths in 2015, more than 95% occurred in low- and lower-middle- income countries, due to weak case detection and treatment systems. Drug-resistant TB also represents a growing threat to poor populations that frequently lack access to the expensive and time-consuming culture tests required to identify drug resistance.

Modern genome-based diagnostic tools, such as the GeneXpert MTB/RIF molecular assay, have the potential to transform field-based TB diagnostics. Conventional TB tests – including sputum smear microscopy, chest x-rays, and solid or liquid culture – suffer either from low sensitivity, or from high cost and cannot be used at lower health system levels. Modern molecular tools offer a highly sensitive test for TB and rifampicin resistance with a turn-around time of two hours, offering the ability to test in primary-care facilities. UNITAID's TB Xpert project aimed to shape the market for this new technology and increase access in low- and lower-middle- income countries. UNITAID did this via a buy-down agreement for 145 countries combined with procurement in 21 targeted grantee countries.

RELEVANCE

The TB Xpert project impact and outcomes were well aligned with UNITAID's overall mission, and activities directly contributed to UNITAID's Strategic Objective 1. The project was well positioned to address country-level challenges in accessing the Xpert market. Activities aimed to reduce barriers to commodity procurement and encourage adoption in national guidelines and diagnostic algorithms.

EFFICIENCY

The program achieved full budget utilization, mostly focused on commodity procurement. Over the full grant period the program utilized 98% of commodity funding and 100% of non-commodity funds. This success was due in part to the Year 4 NCE, which allowed for an additional four-month procurement period to compensate for the slow start in cartridge uptake.

Program budget allocation was focused on commodity procurement, with 13% of expenditure on technical assistance (TA) and implementation support. This aligned with the Project Plan. In line with its general approach, UNITAID did not fund supportive activities such as training (and retraining) of machine users, policy reform, or demand generation. At country-level, funding for these critical activities was often not pre-arranged from alternative sources and this created some funding gaps. Data are not available to measure the effect, but this likely delayed programmatic implementation and reduced commodity usage rates.

UNITAID and WHO effectively managed and supported implementing partners, but some tensions existed within the Coordinating Partner group around UNITAID administrative processes. Grantees were unanimous in their praise of the support provided by UNITAID, WHO, and TBP during the program period. Regular meetings and teleconferences ensured

project-wide alignment on progress and goals, and the WHO-led Xpert forecasting initiative improved global alignment on Xpert production and delivery. WHO HQ and CO efforts to introduce external implementing partners to domestic stakeholders effectively facilitated strong working relationships. However, members of the Coordinating Partner group noted challenges with UNITAID's administration processes, citing issues with slow decision making, labour-intensive reporting requirements, perceptions of insufficient HQ-level funding support for program management and reporting, and confusion regarding respective roles and responsibilities. Stakeholders noted that these issues created strains on coordinating partners, which inhibited the efficient implementation of the program.

Program delivery was done in a streamlined and affordable manner, designed to minimize financial risk. The commodity buy-down arrangement allowed UNITAID to obtain Xpert commodities at the best available price. By leveraging the Stop TB Partnership (TBP) as a centralized procurement agent for the grant, UNITAID also reduced transaction costs and facilitated the efficient delivery of commodities to grantee country port-of-entry. From there, countries were responsible for independently delivering commodities to recipient health centers. Program financial risk was mitigated by keeping all commodity funding at the global level – once country commodity orders were placed, UNITAID transferred funds directly to TBP for procurement, and only the physical commodities were delivered to grantees.

EFFECTIVENESS

Output 1: Timely procurement of Xpert MTB/RIF commodities

The program achieved cumulative procurement targets, despite initial manufacturing and delivery delays. Greater-than-expected global order volumes and manufacturer difficulty in scaling up production resulted in delays to product delivery during Year 1. Meanwhile, cartridge procurement in grantee countries failed to meet initial targets, due to the slow project start and limited early demand (see Output 2).

However, after these challenges, TBP oversaw an effective procurement mechanism with steadily increasing demand. Machine delivery finished on schedule, cartridge procurement lead times improved, and grantees tailored delivery schedules to ensure appropriate national stock levels. Ultimately the project achieved cumulative targets for forecasting accuracy and procurement volume. In total, the project delivered 1.46 million cartridges.

Output 2: Rapid testing for TB and drug-resistance in at-risk populations available at lower health service levels

Decentralized machine placement brought gains to patients, despite installation challenges and weak demand. Per the Project Plan, 98% of machines were installed outside central reference laboratories, expanding patient access to testing in lower-level facilities and remote locations. The rapid Xpert test brought the time between test administration and result delivery to an average of just one day, while previous tests could take days or even weeks to complete. As a result, it is also likely that patients made fewer trips to the health centre and had an increased likelihood of starting treatment[1].

[1] The project did not collect data to measure these effects, so we rely on stakeholder perspectives for these points.

Initially, some health facilities were ill-equipped to accommodate Xpert machines. Some required additional air conditioning or improved power supply. These costs were borne by the NTP or other donors in grantee countries. Overall, this led to machine installation delays.

The project did not meet total testing targets, due primarily to a lack of demand. The failure to meet cumulative targets for patient testing stemmed from low demand for services in remote areas, in combination with insufficient focus on demand generation activities. Machine utilization in some grantee countries remained low across the project period with significant idle time between tests, though the annual number of tests performed showed broad improvement in Years 2 and 3. However, leftover cartridges were likely to have been used in facilities after the project closure due to their relatively long shelf-life. The establishment of patient referral networks with local healthcare providers proved to be an effective method of generating demand for testing in some countries.

Output 3: Effective use of procured commodities

Effective stock management and low wastage rates offset commodity losses from inconclusive tests and machine failures. With support from other donors, the program developed effective stock management methods. Regular communication with central stores and redistribution of cartridges between facilities resulted in expiry rates well below the one-percent project target and no national stock-outs. These gains were mitigated in part by higher-than-expected rates of indeterminate test results, which required patient samples to be re-tested. Inconclusive results were caused predominantly by facility power outages during a testing cycle, though overdue machine calibration, poorly prepared samples, and dust in the machines also contributed to the problem. Also, grantees noted that machine failures due to extreme temperature were common, and required attention from the manufacturer or local service providers. Approaches to machine servicing varied across countries, with some leveraging local knowledge to address issues while others depended upon remote services from the manufacturer – which were reported to sometimes result in long lag times.

The funding gap for supportive activities likely reduced commodity utilization rates. The gap in non-commodity funding required NTPs to seek support from other donors for many activities central to the success of the program. Such activities included the preparation of facilities prior to machine installation (e.g. improve access to stable electricity, air conditioning, and dust control), user training, and stock management. NTPs had often not mobilized sufficient funds before machines arrived and so health facilities could not begin using machines immediately. Reliance on other funders to support key activities, without formal coordination with UNITAID, grantees, and recipients, represented a risk to the timely use of commodities and effective diagnosis of target populations.

Output 4: Increased market penetration of Xpert MTB/ RIF in the private and public non-NTP sector

The social business models (SBM), and other public-private mix schemes, achieved some success in reaching under-served populations in a more financially sustainable manner.

Grantees in three countries[2] aimed to establish self-sustaining social businesses to provide TB diagnosis and treatment to local patients. These facilities offered patients high-quality care in places where the public sector provided poor or insufficient services, while offsetting donor costs through a mix of paid and free-of-charge services. Demand generation activities, combined with collaboration with local care providers, enabled teams to address unique challenges in each setting and generate revenue. The TB REACH SBM projects in Pakistan and Bangladesh, which received commodities support from UNITAID, will be scaled up through continued donor funding.

Beyond the three SBM countries, other public-private mix (PPM) models in nine countries[3] demonstrated methods of reaching under-served high-TB-burden populations to supplement public-sector services. For example, programs targeted prison inmates (Tanzania), garment factory workers (Bangladesh), children (Swaziland), HIV centers (Moldova), and mobile clinics (Cambodia and Nepal). This was achieved through the combined efforts of TB REACH programmatic funding totalling US$ 18 million, and UNITAID commodities support.

Output 5: Strengthened country coordination with other technical agencies and donors

Program coordination was generally strong, with a shift toward consolidation of Xpert activities. The evaluation showed generally strong linkages between UNITAID implementers and local TB programs. Strong leadership from many national TB programs supported the installation of Xpert machines in public hospitals, ensured coordination among the numerous donors active in the countries, and encouraged the inclusion of Xpert in national policy. At the end of the grant, broad commitment from GFATM for continued procurement suggested a move from a fragmented Xpert donor landscape toward a more consolidated approach to future support.

Output 6: Transitioning out to ensure continued use of instruments after project conclusion

All grantee countries have secured funding for continued Xpert operation but cartridge affordability might prevent transfer to domestic funding sources in the long term. National policies in 93% of high-TB-burden countries have incorporated Xpert as the primary diagnostic test for MDR-TB in at-risk populations, and 80% recommend it as the primary test for PLWHIV. These changes reflect the institutionalization of the technology in grantee countries, and ensure continued machine use after the grant period. All countries have secured funding for continued Xpert operation and procurement in the near-term, in most cases using GFATM support. The social business models in Dhaka and Karachi are also planned for expansion – in Bangladesh to two addition cities, and in Pakistan to more broadly serve two provinces. However, the grantee transition plans include little to no domestic funding for Xpert testing, and concerns remain regarding the long-term affordability of the technology without donor support.

[2] Bangladesh, Indonesia, Pakistan

[3] Belarus, Cambodia, India, Malawi, Moldova, Nepal, Philippines, Swaziland, Tanzania

IMPACT

Public Health Impact

The scale-up of Xpert testing resulted in significant public health impact in grantee countries. Commodity users in grantee countries voiced strong support of the new technology, citing significant impact in time and human resource savings, simultaneous RR detection during TB testing, and reduced volume requirements for sputum samples. Countries benefitting from widespread Xpert investment experienced large increases in bacteriologically positive case detection rates, while those with more limited inventories cited the increased visibility to MRD-TB burden as a primary benefit of the program. Overall, the program resulted in 201,748 detected cases of TB, including 18,853 cases in HIV+ patients and 45,278 cases of MDR-TB.

Trade-offs between cost savings and case detection, and lack of linkage to treatment, may have limited project impact. Remaining concerns in some grantee countries regarding the cost of Xpert commodities and the affordability of the technology without donor support led to implementation of varied cost-saving measures. While some approaches – such as focusing Xpert tests on smear-negative cases, or on presumptive TB cases following a chest x-ray – do not appear to negatively impact case detection, others – such as narrowing Xpert testing exclusively to HIV+ patients – have likely been detrimental to diagnosis rates and limited the overall project impact. Further, the project scope was intentionally limited to diagnosis, and therefore did not address linkages to patient treatment. This may have limited the impact on TB prevalence[4] as improved diagnostic testing is most valuable when patients are effectively treated. The program purposefully relied upon existing country systems in this regard.

Market Impact

UNITAID procurement demonstrated proof-of-concept for market acceleration and expanded access in remote areas. The grant successfully established functioning Xpert ecosystems in countries with minimal previous investment. In countries with previous Xpert experience, the program supported the expansion of testing services to less-served populations beyond major population centres, especially where RR testing was previously inaccessible. All grantee countries have institutionalized the technology and have plans for continued operation and scale-up. Meanwhile, global market support has likely incentivized product innovation and Cepheid has announced the future release of two new Xpert products[5]. Some grantees voiced concerns regarding the establishment of a monopolistic market as a result of support to a single manufacturer. However, the impact of this development is yet to be seen.

The buy-down arrangement had a strong impact on increasing public sector purchasing power and accelerating global cartridge uptake. The UNITAID-negotiated buy-down reduced Xpert cartridge prices by 41%. Grantee country procurement at concessional pricing in 2015 was 7.4x above pre-buy-down 2012 levels, and non-grantee countries procured at 4.0x

[4] It is important to note that the project did not collect data to monitor loss-to-follow-up, post diagnosis, so it was not possible to estimate links to treatment.

[5] GeneXpert Ultra and GeneXpert Omni

baseline levels. Total global savings during the project period are estimated at US$ 109.9M (see main report for details).

RECOMMENDATIONS

Dalberg makes the following recommendations to UNITAID for consideration in future project planning and implementation:

1. Consider how to formally coordinate with national or global partners to build strong program linkages to the broader health system – including peripheral commodity requirements and linkages to effective patient treatment
2. Tailor support to countries during implementation to maximize commodity uptake, and where possible, provide support or formal coordination with countries and partners to ensure strategic machine placement and sufficient demand generation
3. Consider longer-term sustainability issues as part of transition process, including feasibility of gradual government ownership in place of donor support, and signalling affordability issues to relevant partners

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

ASLM	African Society for Laboratory Medicine
Bac+	Bacteriologically positive case
BMGF	Bill and Melinda Gates Foundation
CEPA	Cambridge Economic Policy Associates
CHS	Community Health Solutions
CTRL	Central TB Reference Laboratory
DALY	Disability-adjusted life year
FIND	Foundation for Innovative New Diagnostics
GFATM	Global Fund for AIDS, TB, and Malaria
HIV	Human Immunodeficiency Virus
HF	Health facility
icddr,b	International Centre for Diarrheal Disease Research, Bangladesh
IRD	Interactive Research and Development
ISI	Innovait Sehat Indonesia
LOA	Letter of Agreement
MDR-TB	Multi-drug resistant tuberculosis
MOU	Memorandum of understanding
NCE	No-cost extension
NTP	National TB Program
PLWHIV	People living with HIV
POC	Point-of-contact/ Point-of-care
PPM	Public-private mix
PTP	Provincial TB Program (e.g. Sindh, Pakistan)
RR	Rifampicin resistant
SBM	Social business model
TA	Technical assistance
TB	Tuberculosis
TB+	TB-positive (patient)
TBP	Stop TB Partnership
USAID	United States Agency for International Development
VfM	Value for Money
WHO (CO)	World Health Organization (Country Office)
XDR-TB	Extensively drug-resistant tuberculosis

INTRODUCTION

Context

Tuberculosis (TB) is one of the top ten global causes of mortality, and poses a particular threat to developing countries. There were an estimated 10.4 million new cases of TB in 2015, only 59% of which were diagnosed and notified to WHO[6]. Sixty percent of all cases are concentrated in just six countries[7], and 95% of TB mortality in 2015 occurred in low- or lower-middle- income countries[8]. HIV-positive patients are particularly susceptible to infection, and 35% of all deaths attributed to HIV in 2015 were caused by TB. Drug-resistant TB prevalence has also increased in recent years, with 580,000 incident cases in 2015[9].

Effective screening and diagnosis are key to reducing the global TB burden. Up to one third of the global population carries latent TB. Disease transmission and infection will continue as long as these cases remain undiagnosed and untreated. An infectious TB+ patient will spread the disease to an average of 10-15 additional people during each year the disease is active, and TB mortality in untreated (non-HIV-associated) cases is approximately 50%[10]. Incorrectly treated cases can also contribute to the growing threat of drug-resistant TB strains, by allowing those bacteria not susceptible to standard first-line antimicrobial treatments to grow and continue to spread. By accurately identifying and effectively addressing all TB cases, MDR-TB circulation can be minimized and patients can make a full recovery in as little as six months.

Conventional diagnostic tools lack effectiveness in resource-constrained settings. Sputum smear microscopy, the traditional field test for TB based on the examination of a sputum sample under the microscope, has a sensitivity ranging from 20-60%[11] in field-based settings, and cannot detect drug resistance. Liquid or solid culture, the gold standard of TB diagnosis which requires allowing a bacterial sample to grow in the lab, requires advanced biosafety equipment and can take three weeks to produce a result. Traditionally, this has been the only method for determining the susceptibility of TB bacteria to standard treatment, but has been inaccessible to most patients. For these reasons, clinical (non-bacteriological) diagnoses by healthcare providers are the chosen method for up to half of all TB diagnoses. This allows patients to begin treatment without waiting for lengthy test confirmations, during which time the disease may rapidly progress.

Modern genome-based diagnostic tools, such as the GeneXpert MTB/RIF assay, have the potential to transform TB diagnostics. Xpert testing has 98% overall sensitivity, and can

[6] WHO, Global TB Report 2016

[7] India, Indonesia, China, Nigeria, Pakistan, and South Africa (WHO)

[8] WHO, Tuberculosis Fact Sheet, http://www.who.int/mediacentre/factsheets/fs104/en/

[9] WHO

[10] WHO, TB Fact Sheet

[11] Steingart, Karen R., Vivienne Ng, Megan Henry, et al. "Sputum Processing Methods to Improve the Sensitivity of Smear Microscopy for Tuberculosis: A Systematic Review." The Lancet 6.10 (2006): 664-74. The Lancet - Infectious Diseases.

correctly identify up to 70% of smear-negative TB cases. It can also detect rifampicin resistance during the same test cycle, allowing caregivers and patients to catch these dangerous cases early and treat them appropriately. As the full test cycle takes only two hours, and is hands-off for the lab technician after initial sample preparation, it offers significant time savings to patients and lab technicians over conventional culture.

However, the early lack of market scale and high resultant cost of Xpert commodities made them inaccessible for most low- and lower-middle-income countries. At product launch, Xpert cost $35,000 per module (multi-use) and an additional $17 per test performed. With per-test costs four to five times higher than conventional sputum smear, low- and lower-middle- income countries have struggled to introduce these advanced diagnostic tools. The manufacturer was also unable to assist countries with scale-up due to the limited market for Xpert goods. Further, as countries were heavily invested in conventional testing practices, and given the high up-front costs of shifting to a new algorithm (including machine procurement, site preparation, and user training), such a shift was prohibitively expensive without external support.

Pictured: Four-module GeneXpert machines located in the laboratory of Indus Hospital in Karachi, Pakistan

To expand access to rapid testing for TB, HIV-associated TB, and MDR-TB, UNITAID negotiated a cartridge price reduction and procured commodities for 21 countries. Following the previous success of the FIND-negotiated buy-down for Xpert machines and cartridges, UNITAID led the creation of a second-round buy-down completed in partnership with BMGF, USAID, and PEPFAR. This brought cartridge prices down to $9.98 for public-sector buyers in 145 countries to improve general access to the technology. UNITAID also utilized a total budget of US$ 25.9 million over three and a half years for the procurement of additional machines and cartridges in 21 grantee countries. This was intended to catalyse local Xpert ecosystems and encourage broader use of the tool at lower-level health centers. The WHO Global TB Program served as the lead grantee for the program, working with the Stop TB Partnership. The project consortium also included TB

REACH, ASLM, IRD, EXPAND-TB, and GLI. (See Efficiency section and Figure 2 for details on consortium member roles and responsibilities.) In addition to the UNITAID project budget, TB REACH supplied US$ 10 million in supplementary funding across 14 grantee countries during the project period for related activities.

Evaluation objectives and methodology

The evaluation team was commissioned by UNITAID to assess the TB Xpert project through the UNITAID grant evaluation framework (see Annex 1). The team considered the project through the lenses of relevance, efficiency, effectiveness, dissemination of learnings, and impact. The evaluation aimed to determine whether the grant met its objectives and had the intended impacts in target countries within the specified project timeframe.

The evaluation was conducted in three phases:

1. **Desk review** of relevant UNITAID and partner documentation and reports, including (but not limited to) program proposals, budgets, legal agreements, annual programmatic and financial reports, the mid-term evaluation, and other publicly available materials. This allowed the team to gain a broad understanding of the grant progress and develop initial hypotheses.

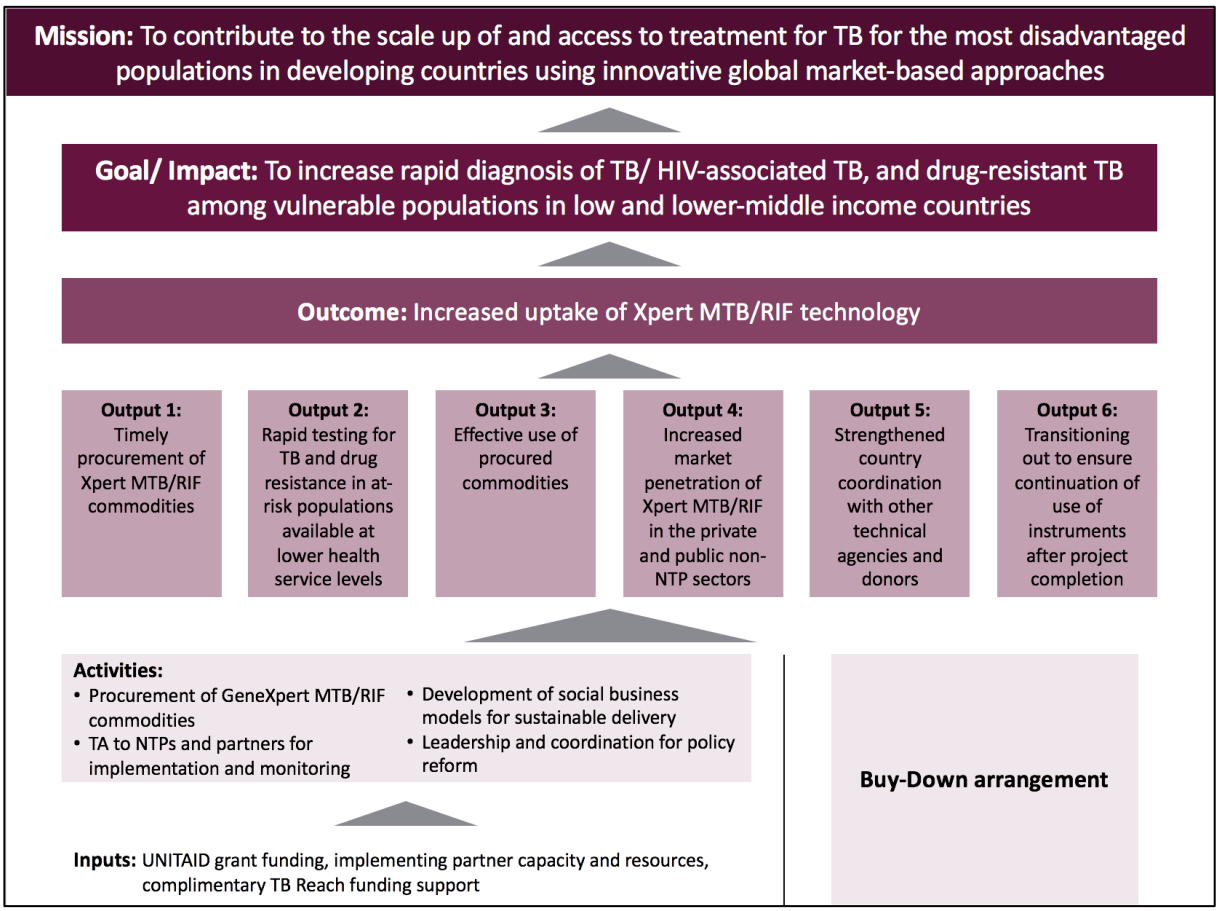
2. **Interviews** with a broad range of more than 35 stakeholders, spanning six grantee countries and 16 agencies and national TB programs involved in Xpert rollout at both the global and country levels, to gather experiences and lessons learned from their engagement with the UNITAID TB Xpert project or the introduction of Xpert technology more broadly.

3. **Country visits** to Pakistan and Tanzania, allowing the evaluation team to speak first-hand with grant implementers and Xpert users to gain a richer understanding of the program successes and challenges. This included a detailed look at the social business delivery model in Karachi, which was supported by a joint effort between UNITAID and TBP's TB REACH initiative.

Dalberg analysed these findings to identify common themes and lessons from across grant countries. The team reconciled evidence from varying sources and drew conclusions regarding the grant's lasting impact in grantee countries and on the broader Xpert market. Lastly, the findings and insights were consolidated into this final report. The remainder of the report is a presentation of those findings followed by a series of recommendations and considerations for future UNITAID project planning.

THEORY OF CHANGE OF THE PROGRAM

Figure 1: TB Xpert Theory of Change



The TB Xpert Theory of Change is shown in Figure 1, demonstrating the intended linkages between grant inputs and impacts as described in the project plan and log-frame. UNITAID worked to achieve its goal of increasing rapid diagnosis of TB among vulnerable populations through the increased uptake and use of Xpert technology. The project was developed to address one of the key barriers to the scale-up of a new diagnostic technology – the high initial cost of investment. UNITAID aimed to shape the market for future growth by assisting countries to install the machines through the buy-down arrangement and targeted procurement in the grantee countries. The push for improved diagnostics was targeted at increasing the share of TB+ patients on treatment and driving down general disease prevalence, with specific focus on leveraging the advantages of Xpert to improve detection of HIV-associated TB and MDR-TB.

This Theory of Change excluded two elements central to achievement of the intended impact. First, though the Xpert machines are considered easy-to-use and require little training, the project did not anticipate the full need for ongoing user training. (See Output 3 for more on lack of training.) The project also relied on existing treatment systems or the actions of other donors to create linkages to broader health systems. This risked systems being unable to accommodate the added TB+ patient burden, or significant patient loss-to-follow-up.

RELEVANCE

Key evaluation questions:

- *Are the outcomes and impacts of the grant aligned with UNITAID's overall mission to contribute to the scale up of and access to treatment for TB for the most disadvantaged populations in developing countries using innovative global market-based approaches?*
- *How did the grant contribute to one or more of UNITAID's six strategic objectives?*

The TB Xpert project goals were well aligned to UNITAID's overall mission. The buy-down price-reduction agreement significantly increased the ability of donors and national TB programs to procure Xpert commodities for the benefit of disadvantaged populations. In addition, UNITAID-funded procurement targeted high-TB-burden developing countries with the aim of creating or supplementing functional GeneXpert ecosystems.

TB Xpert directly contributed to UNITAID's Strategic Objective 1, to increase access to POC diagnostics for TB and HIV-associated TB. By encouraging grantee countries to place UNITAID-procured machines outside of central reference laboratories, the grant successfully expanded patient access to advanced TB testing in local healthcare facilities. Grant implementers in some countries also built effective patient referral networks, through which primary care providers would send suspected TB patients to a diagnostic centre for testing.

The project was well positioned to address the challenges that countries faced in accessing the Xpert commodity market. UNITAID recognized that the costs of technology procurement, installation, and start-up were primary barriers to the scale-up of the global market. As a result, the project was designed to lower the barrier to procurement and accelerate uptake of the tools in high-TB-burden regions. UNITAID and TB REACH also leveraged the opportunity to pilot innovative social business delivery models in three countries[12]. These tested sustainable delivery methods geared towards benefiting low-income patients in settings with an active private healthcare market.

Project impact on overall patient treatment rates could have been magnified by coordination with other donors for complementary activities addressing loss to follow-up. The Xpert grant had significant impact on the market for modern TB diagnostics. (See Impact section for details.) However, in accordance with UNITAID's business model, this commodities-centric grant did not include a focus on linking identified TB+ patients to treatment – a core aspect of UNITAID's mission. Rather, the program relied on partner organizations to provide countries with support in this area. TB REACH provided support for this totalling US$ 18 million to partners receiving UNITAID commodities in 14 countries, while the others worked with USAID, GFATM, and other donors. A greater coordination role from UNITAID during the planning stages of the program to ensure complementary donor action could have increased the effect of the grant.

[12] Bangladesh, Indonesia, Pakistan

EFFICIENCY OF THE PROGRAM

Key evaluation questions:

- *Were grant funds allocated, disbursed, and utilized in a way to maximize project impact?*
- *Are the grantee implementation arrangement and coordination mechanism for co-implementers, national, and sub-national authorities efficient?*

Budget and reporting

The program budget allocated most funds to commodity procurement. Actual expenditures for the full grant period show that 87% of total funding was used for commodities, with the remainder going to technical assistance and program staff costs[13]. While this focus aligns with the stated intentions of the project – to engage in a market intervention to accelerate uptake of a new technology – grantees found that it did not adequately support associated activities critical to the efficiency of such an intervention such as user training and facility preparation. As a result, installation and commencement of diagnoses were not as rapid as it could have been. (See Output 3 for more description of the non-commodity funding gap.)

Over the full grant period – including the Year 4 NCE – grantees achieved near-full budget utilization. Despite early lags in cartridge procurement and disbursement delays, the program ultimately utilized 98% of commodity funding and 100% of non-commodity funds. This reflects the program's ability to scale up procurement in the second half of the period, and the value of the extension in allowing time for complete budget spend on commodity procurement. Activity funding for Output 2 (supporting lower-level testing availability) saw an 8% under-spend of grant funds, but this was compensated by a 9% over-spend in funds for Output 3 (promoting effective use of commodities). All other non-commodity activities saw 100% utilization.

UNITAID reporting requirements were perceived to focus heavily on commodity usage and identified patients. Though the grant log-frame and indicators were mutually agreed by UNITAID and its grantees prior to project start, evaluation interviews reflected concerns regarding the narrowness of the monitoring framework. Grantees noted that while the purpose of the program was to expand diagnosis and ultimately treatment for TB+ patients, UNITAID materials and reporting forms emphasized the usage of commodities and the numbers of patients identified. Some stakeholders made comparisons to TB REACH's reporting approach, wherein patients are not "diagnosed" until they can also be proven to have received effective treatment. This provides a stronger incentivize for grantees to support system linkages than a strict commodity focus. (See Impacts section for more on program linkage to treatment.) The commodity focus in reporting also risks creating a perverse incentive for implementers to use tests on patients without a clinical suspicion of TB in order to improve absolute utilization rates, though evidence of this effect was not found during the evaluation of the Xpert grant. Future programs may consider including a broader

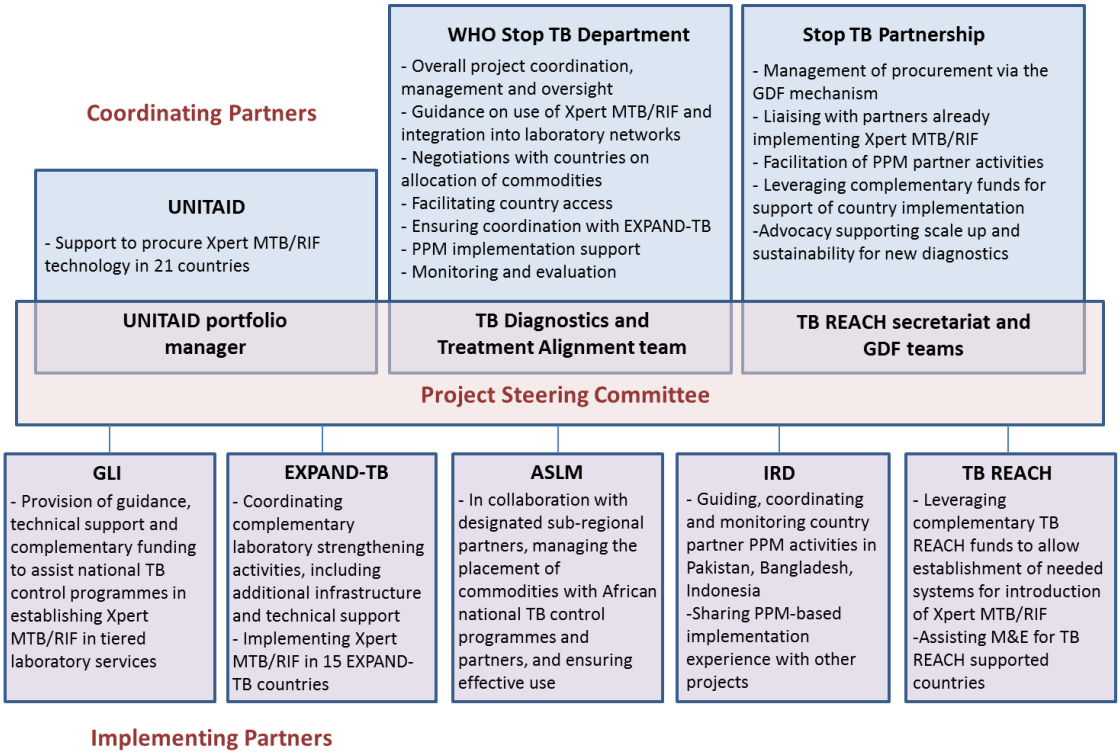
[13] UNITAID 2016 Annual Report Annex II, Financial Report

range of indicators, in addition to those used in this grant, to capture a more holistic view of progress and impact.

Partner coordination

Overall global coordination between UNITAID, WHO, and TBP was strong at the country level. Interviews with stakeholders in all grantee countries reflected positive experiences with the global grant management structure. Grantees cited readily available support and productive responses to issues from WHO and TBP as important contributors to efficient implementation. The Project Steering Committee engaged in regular meetings throughout the grant, and WHO organized calls among the implementing partners to ensure coordination[14]. In response to early procurement challenges, WHO also initiated a global Xpert commodity forecasting initiative to improve forward planning for the manufacturer and recipients. (See Output 1 for details on procurement delays and forecasting.) In grantee countries where TB REACH provided co-financing for activities, UNITAID benefitted from its support for TA provision and grant integration into the national Xpert program. In these cases, TB REACH frequently took the lead in program implementation, incorporating UNITAID-procured commodities into ongoing activities. Meanwhile, countries also relied upon WHO for ongoing TA support.

Figure 2: Summary roles and responsibilities of TB Xpert project partners[15]



[14] UNITAID annual reports

[15] Source: UNITAID (2013), TB Xpert Project Plan

Disagreement over the extent of grantee responsibility led to tensions among Coordinating Partners. In a deviation from typical arrangements, UNITAID signed contracts directly with sub-grantees (IRD and ASLM) to facilitate financial arrangements. Meanwhile, per its standard implementation model and brief mention in project agreements, UNITAID expected that the other Coordinating Partners would remain responsible for managing these fund recipients during the project. However, interviews with grantees during the evaluation reflected disagreement or misunderstanding, and a concern that UNITAID's expectations – particularly regarding partner management – had extended beyond legal agreements. Review of the relevant documentation confirms that UNITAID's expectations were within the bounds of the legal agreements.

Partners were positive in their overall summary of UNITAID leadership on this grant, but some interactions around program management created challenges for implementing partners. Interviewees were unanimous in their praise of the project aims and general UNITAID leadership in the Xpert space. However, project partners reported at times encountering challenges working within the project management structure. Interviewees stated that they experienced long lag times on decision making and at times unconstructive feedback, which challenged their relationships with UNITAID[16]. Interviews with TBP also unearthed tensions within the Coordinating Partner group regarding the level of assistance partners were expected to provide to project roll-out. In-country, sub-grantees and other partners faced challenges in knowing whether to focus on implementing TB REACH-specific programs, or lend additional support to local UNITAID projects focused primarily on commodities consumption. Making these implementation arrangements and expectations explicit at the start of the grant would potentially have avoided challenges later. Additional direct attention to the grant from UNITAID may have broadly benefitted the grant by accelerating decision-making timelines and providing an efficient central management process to address concerns.

WHO supported implementing partners to build effective relationships. In specific countries, implementing partners contracted additional agencies to provide assistance. ASLM, for example, obtained the support of MSH and FIND in eastern Africa to supply experienced TA. When those agencies were externally based (e.g. South Africa-based MSH working in Congo Rep), WHO HQ and COs played a valuable role in introducing the agencies to local stakeholders. This facilitated the start of each partner's work and built trust among the project implementers, while allowing for the engagement of the best available resources – whether local or external.

Insufficient funding to grantees for HQ administrative support created strains on resources during implementation. UNITAID allocates administrative funding to Coordinating Partners by designating a "lead grantee," which is responsible for general grant oversight, monitoring, and reporting. WHO was assigned this role for the Xpert grant, taking a programmatic lead for the project. For this reason, WHO received the majority of administrative funding to support its responsibilities during the grant. Meanwhile, TBP oversaw the expenditure of 85-

[16] Independently verifying the timing and quality of communications between partners was beyond the scope of this evaluation

90% of program funds through its role as the commodities procurement agent, which resulted in significant regular reporting requirements. Information gathered through interviews suggests that this caused a substantial strain upon TBP resources, given the limited administrative support available. Interviews with TBP reflected that significant unanticipated in-kind donations of TBP staff time were made to the project as a result, which were critical to ensuring completion of required tasks.

Roles and responsibilities of SBM implementing partners were not always clearly differentiated. Interviewees involved with the SBM pilots spoke of ambiguity in the management structure between IRD and the country-specific actors[17]. Though IRD was formally set out to manage the SBM projects and received UNITAID funding on the sub-grantees' behalf, it had limited practical oversight of the programs. Country-specific implementers retained the freedom to work directly with TB REACH, and IRD faced challenges to play more than a general guiding role. Interviewees voiced concerns that the lack of clarity in the management structure resulted in unclear accountability for project outcomes.

[17] icddr,b (Bangladesh), ISI (Indonesia)

EFFECTIVENESS OF THE PROGRAM

Key evaluation questions:

- *Were the outputs of the project for the evaluation period fully achieved within the timeframe and budget specified in the original project plan?*
- *What are the main factors influencing the achievement or non-achievement of the outputs or overall outcomes across all countries?*

Output status classifications:

- Achieved: 100% of associated indicator targets were met (including both intermediate and cumulative targets)
- Partially achieved: More than 50% of associated indicator targets were met (including both intermediate and cumulative targets)
- Not achieved: Less than 50% of associated indicator targets were met (including both intermediate and cumulative targets)

Output 1: Timely procurement of Xpert MTB/RIF commodities

Table 1: Performance against log-frame targets, Output 1

Indicator	2013-2015		2016		Cumulative	
	Target[18]	Actual[19]	Target	Actual	Target	Actual
O1.1 Number of Xpert modules procured within Project framework	892	898	N/A	N/A	892	898
O1.2 Number of Xpert MTB/RIF cartridges procured within framework of Xpert Project	1,211,210	1,195,210	253,350	264,850	1,464,560	1,460,060
O1.3 Median number of days between planned delivery of Xpert instrument order at port of entry and date of actual delivery	15	12	N/A	N/A	15	12
O1.4 Median number of days between planned delivery of Xpert MTB/RIF cartridge order at port of entry and date of actual delivery	15	27[20]	15	13	15	20.5
O1.5 Percent difference in actual procurement of Xpert MTB/RIF cartridges vs forecasted procurement	+/- 13%	-18.6%	+/- 10%	+7%	+/- 12.5%	-14.8%

[18] Note that in some cases across all log-frame performance tables, targets shown reflect mid-grant revisions following early implementation learnings, and may not be the targets initially set out at the project start.
[19] Indicators across all log-frame performance tables have been marked as "achieved" with green shading if the actual value was within 5% of the respective target.
[20] In some countries, deliveries were intentionally rescheduled to avoid over-stock situations or cartridge expiry. These adjustments of delivery schedules are reflected as delays against the original shipment plans.

Status: Partially achieved

Slow manufacturing scale-up led to delivery delays in Year 1. Due to a combination of, i) unexpectedly high non-UNITAID order volumes, and ii) challenges in scaling up production to meet accelerating demand, the manufacturer faced cartridge shipping delays during Q1-Q2 2013. This led to a worldwide cartridge shortage and shipment delays of approximately two months, pushing back the start of testing at health facilities until mid-2013. As a result, countries showed significantly below-target rates of cartridge procurement, testing, and case detection in the 2013 Annual Report. It is challenging to assess how this could have been avoided. It is possible that improved market forecasting prior to project start may have assisted the manufacturer in anticipating demand – including both grantee countries and others intending to leverage the buy-down price. To address this gap, WHO launched a global forecasting initiative during Year 1 to improve future market coordination. This initiative has continued to function after the close of the grant to facilitate ongoing procurement planning.

Cartridge procurement in grantee countries over Years 1 and 2 remained below forecasted levels, though countries with supplemental TB REACH support performed better. Numerous issues at the start of the grant, as described in the CEPA Mid-Term Evaluation, resulted in lower cartridge procurement and utilization rates than expected for the first two years. These included administrative start-up delays, the above-mentioned manufacturing interruptions, challenges with commodity clearance through customs, and the preparation of sites prior to machine installation. The deviation between forecasted and actual demand was more than 10% of forecasted volumes for the first half of the project – failing to meet forecast accuracy targets. However, supplementary support from TB REACH appeared to have a significant impact on countries' commodity uptake rate, despite many sites rolling out new testing services instead of simply replacing smear with Xpert as part of an existing algorithm. Countries receiving TB REACH support were able to scale up commodity usage faster than other grantee countries[21].

After initial manufacturing challenges, Stop TB Partnership coordinated timely procurement, showing improvements in average procurement times. Country interviews reflect general satisfaction with the TBP procurement model. Stakeholders cited positive experiences with the straightforward annual ordering process, and prompt responses to requests for support from the global team. Module procurement was completed on schedule in Year 2 with the total procurement of 898 GeneXpert MTB/RIF modules, exceeding the initial plans for 892 modules[22]. Meanwhile, TBP oversaw steady increases in annual cartridge order volumes and significant reductions in delivery time. The median time between planned delivery to country port of entry and actual delivery improved from 27 days in Year 1 to just 13 days in Year 4, due primarily to improved familiarity with project procurement systems

[21] See UNITAID semi-annual reports from project period

[22] Three additional two-module machines were procured on behalf of India, at the country's request.

and coordination between grantees and TBP. The project achieved annual delivery timeliness targets in 2014 and 2016 (see below regarding Year 3).

Countries tailored delivery schedules to suit local needs and ensure appropriate stock levels. NTPs and project implementers communicated with TBP and Cepheid to delay deliveries in cases of slow in-country utilization to avoid over-stock or cartridge expiry situations. These intentional delivery postponements also impacted the delivery timeliness measures for 2015, which appear as severely delayed shipments in the 2015 Annual Report. This communication between country implementers and TBP reflects an evolving procurement relationship that effectively managed national stock levels to account for initially slow uptake and avoid stock-out.

By project close, annual targets regarding procurement volume and forecast accuracy were achieved. The project achieved all annual targets for Output 1 in 2016, showing a steady improvement in performance after initial challenges. The increase in cartridge procurement volumes also resulted in the achievement of the cumulative procurement target by the end of the project period, reaching a total of 1.46 million cartridges procured across the 21 grantee countries.

Output 2: Rapid testing for TB and drug resistance in at-risk populations available at lower health service levels

Table 2: Performance against log-frame targets, Output 2

Indicator	2013-2015		2016			Cumulative	
	Target	Actual	Target	H1 Actual[23]	Full-year extrapolation[24]	Target	Actual[25]
O2.1 Percentage of instruments procured through project framework for use at sites outside of central-level TB reference laboratories	90%	98%	N/A	N/A	N/A	90%	98%
O2.2 Number of Xpert MTB/RIF tests performed using TB Xpert Project commodities	1,016,700	926,065	372,860	214,313	463,495	1,389,560	1,389,560
O2.3 Number of individuals tested with Xpert MTB/RIF using TB Xpert Project commodities	965,865	854,385	342,274	201,438	430,794	1,308,139	1,285,179
O2.4 Median number of days between date of specimen collection and availability of TB testing results for patient	1	1	1	1	N/A	1	1

[23] Denominator for Indicator O2.8 in Year 4 includes only the 12 countries benefitting from the four-month procurement NCE

[24] Based upon remaining in-country stock at end of 2016 reporting period and previous testing and case detection rates, mid-year performance was extrapolated to predict full-year performance against targets

[25] Actuals include 2016 full-year extrapolation, where applicable

O2.5 Median number of days between date of specimen collection and availability of rifampicin susceptibility testing results for patient	1	1	1	1	N/A	1	1
O2.6 Median number of days between date of GeneXpert instrument order receipt at port of entry and delivery to site	17	23	N/A	N/A	N/A	17	23
O2.7 Median number of days between date of Xpert MTB/RIF cartridge order receipt at port of entry and delivery to site	15	17	12	7	N/A	14	16
O2.8 TB Xpert Project countries with Xpert MTB/RIF roll-out plans, including diagnostic algorithms	21	16	12	12	N/A	N/A	N/A

Status: Partially achieved

Machines were predominantly installed in lower-level facilities, building upon previous donor work. Of the 237 machines procured through the grant, 232 were installed outside of central reference laboratories (98%). This exceeded the project target of 90%, and reflects the focus of many grantee countries on using the UNITAID-funded machines to expand patient access to TB testing. While most countries leveraged the opportunity to reach more remote populations, some grantees placed machines in health centres within major cities, near to central laboratories[26]. This succeeded in increasing the diagnostic capacity of the region, but failed to expand the geographic coverage of Xpert testing. The project's success in expanding testing beyond central laboratories also requires acknowledgement of its reliance upon other donors working in grantee countries. While UNITAID aimed to be catalytic in its early support of the technology, other donors were also actively seeding the market. The value of UNITAID's approach to decentralized testing is supported by the prior installation of Xpert in reference labs through other donors.

Installation challenges and facility readiness concerns caused delays in bringing machines online in some locations. Country methods of site selection and assurance of facility readiness prior to machine delivery varied. Drawing on previous learnings, India took a strong approach in developing a national checklist for facility preparation and requiring site visits prior to machine arrival. This succeeded in ensuring that machines could be installed promptly and in a suitable environment for long-term functioning. Other recipients, such as Tanzania, did not initially conduct reviews prior to site selection. After machine allocation, the NTP

[26] This was particularly the case in the three countries working under IRD on the social business models – Bangladesh, Indonesia, and Pakistan. These countries focused their machines in the capital cities, without significantly expanding the domestic reach of Xpert testing.

found sites to be lacking necessary equipment such as air conditioning and steady power supplies. This prompted a subsequent national site review, further delaying installation.

The funding gap for technical assistance required grantee countries to seek support for site selection and preparation from other donors. While ultimately successful in most cases, greater effectiveness may be found through improved forward planning and support at the start to ensure full country readiness.

GeneXpert's rapid turnaround time enabled patients to save time and money. As soon as Xpert testing launched in grantee countries, the typical wait for patients to receive results improved – with particularly large gains in RR testing time. While sputum smears could traditionally be done with relatively short turn-around times, determination of drug resistance would take up to three weeks. However, Xpert allowed patients to receive full results – including TB and RR status – in an average of one day, and maintained this performance through the project period. This allowed for improved patient contact and reduced risk of not returning to the health facility to collect results or begin treatment. In low-demand remote locations which allowed for same-day testing (given the two-hour test cycle), patients could save an entire trip to the facility by waiting for results instead of returning on another day. This potentially represented significant savings for these patients, in averted transportation costs or in opportunity costs such as missed time at work or school.

GeneXpert machine usage rates varied across grantee countries. While some countries – particularly India – showed strong ability to absorb grant commodities, machine utilization varied across grantee countries. Select health centres in Pakistan noted that any module failure would result in the development of patient backlogs until servicing was completed due to high demand. However, at the other extreme, Congo Republic was reported in 2012 to be running its Xpert machines at only 15% capacity[27], and interviews with implementers in the country indicated that utilization had not significantly changed during the UNITAID grant. Interviewees in other countries also noted that machines frequently experienced idle time between tests[28].

Failure to reach testing targets stems primarily from lack of demand for services, rather than lack of testing availability. Despite the acceleration in commodity procurement, the number of tests performed remained below targets throughout the program. Stakeholder interviews suggest that this was due primarily to low demand in some countries, as opposed to stock-outs or lack of capacity to process demand.

[27] A. N. Umubyeyi, F. Bonsu, R. Chimzizi, S. Jemal, M. Melese, E. Ruttoh, C. Mundy. The role of technical assistance in expanding access to Xpert MTB/RIF: experience in sub-Saharan Africa. Public Health Action, 2012.
[28] The project did not collect data on machine idle time, so this observation is based on stakeholder anecdotes, rather than quantitative data per se

The establishment of local referral networks among private health providers was a key success factor in some grantee countries. Pictured (center) is a local primary care doctor in Karachi who participated in the SBM referral network.

Low machine utilization is a natural trade-off with decentralized placement. The push to install machines at low-level health facilities frequently resulted in placement in rural regions which experience less demand for services. For example, Kyrgyzstan placed their UNITAID-procured machine in a remote city with poor access to transportation for samples and bacteria culture. This was a meaningful expansion of testing coverage for the regional population, but due to the size of the TB population, demand for testing did not reach the machine's full capacity. Other countries, such as Kenya and Tanzania, experienced similar constraints.

Greater focus on demand generation may have increased utilization. More effective demand generation activities may have boosted testing rates, as seen in Pakistan through the support of IRD and TB REACH. In response to early challenges, they built a network of local primary-care providers to refer suspected TB patients for Xpert testing. Similarly, health worker sensitization sessions in Tanzania were used to boost rates of patient referral based on observation of TB symptoms.

Output 3: Effective use of procured commodities

Table 3: Performance against log-frame targets, Output 3

Indicator	2013-2015		2016		Cumulative	
	Target	Actual	Target	Actual	Target	Actual
O3.1 Number of site stock-outs of cartridges	< 10	11	< 3	2	< 13	13
O3.2 Median number of days of site stock-out duration	14	9	14	22	14	12
O3.3 Proportion of Project-procured cartridges expired, at country level	1%	0.25%	1%	0%	1%	0.2%
O3.4 Proportion of Xpert MTB/RIF tests with indeterminate results	< 6%	7%	< 3%	7%	< 5%	7%

O3.5 Number of TB Xpert Project sites which have provided "evidence for scale-up" data to WHO[29]	N/A	N/A	N/A	N/A	N/A	N/A
O3.6 Fraud and Loss report submitted to UNITAID biannually	Yes	Yes	Yes	Yes	N/A	N/A

Status: Partially achieved

Seven percent of tests were inconclusive or resulted in errors, exceeding annual and cumulative targets. While annual targets anticipated gradual improvement over the grant period, test errors remained constant and exceeded the project's cumulative target of 5%. Indeterminate test results were caused most often by cuts to a facility's power supply during a testing cycle, which interviewees indicated was a common problem at many remote health centres. Other donors invested resources in backup power supplies and UPS (uninterruptible power source) devices for at-risk facilities, but this appeared to have little impact on the level of indeterminate results throughout the project. Other challenges included:

- Poor sample preparation: While sample preparation was a straightforward process, occasional mistakes or a failure to collect sufficient sputum from a patient would result in a failed test. User training was the primary method of reducing these errors.
- Dust in the machines: Health facilities in India and Pakistan noted challenges with dust affecting test results. High concentrations of dust combined with ineffective ventilation systems resulted in frequent module failure and test errors. Cepheid addressed the problem during Year 2 by developing improved dust filters and cleaning equipment for the machine ventilation systems, which could be purchased for use at additional cost. Interviewees indicated that this solution was effective.

Machine failure posed a risk to the availability of Xpert testing. While grantees generally found Xpert machines to be reliable and faced few long-term breakdowns, occasional failures impacted testing capacity at select sites. Interviewees cited the machines' high sensitivity to temperature as the greatest cause of failure, as many grantee countries experience seasonal heat changes. Some users also noted that indoor labs would often warm to above the recommended operating temperature during use, causing failures. Inadequate servicing and preventative maintenance also led to machine downtime. In one example, a feasibility study for Xpert scale-up in India published in 2014 found that 28% of modules assessed required servicing or replacement. Similarly, a mapping of Xpert commodities by the Indonesian NTP at the end of the grant found that 20% of all modules needed servicing or recalibration. However, the modular nature of the machines was cited as an advantage in these cases, as the failure of one module in a machine still permitted the use of others while awaiting servicing.

Countries experienced varying levels of quality in local service providers. Cepheid provided direct servicing in countries where they had a presence, while contracting local providers to cover other grantees. Most grantees portrayed positive experiences with machine servicing

[29] Indicator O3.5 was removed following a change in WHO guidance and end to associated data collection

during the project, describing Cepheid and local providers as responsive and helpful. However, IRD-supported sites faced some significant delays in servicing and would resort to contacting Cepheid's Program Director for Asia to expedite the process. Implementers in Indonesia also faced challenges with the local non-profit service provider, who had limited experience in government work and lacked presence in many areas. In an effort to improve response times, Cepheid began offering a mobile service option, to troubleshoot and offer support via skype. However, grantees noted that this had limited value, as modules still frequently needed to be sent in for replacement after the remote consultation.

Cartridges were largely used in a timely and effective manner, avoiding wastage or expiry. In general, cartridge use and stock management was effective and timely across grant countries. Of the 1.46 million cartridges procured through the grant framework only 0.2% were lost to expiry, well below the 1% target for the project period. This was the result of active stock monitoring and effective planning by national programs and grant implementers, including shipment planning (as discussed in Output 1) and efficient redistribution of cartridges across sites as needed. Exceptionally, interviewees noted that the Republic of the Congo experienced expiry of 26.5% of its Year 2 stock due to slow initial service uptake, through a weak referral system and low patient demand. This was addressed in Year 3 through an adapted procurement schedule for the country, and no additional cartridges were lost.

Effective commodity use and stock management resulted in zero national stock-outs during the project period. Regular shipments and communication with TBP ensured that all countries maintained cartridge stocks throughout the grant. There were, in total, 13 instances of site-level stock-out, of which eight were in India. This concentration of stock-outs may reflect either the particularly high cartridge utilization rate in the country, or some weakness in local stock management systems.

Non-commodity funding gap forced countries to identify alternative sources of implementation support. Eighty-seven percent of the TB Xpert project budget was spent on commodity procurement, with non-commodity funding available only in Year 1. This resulted in a dependence on other actors – such as TB REACH, CDC, USAID, and IRD – to support the operation of UNITAID-procured machines in parallel to their own activities surrounding Xpert. Grantee reliance on other actors for key activities without formal coordination with UNITAID was a risk to the project success, spanning such activities as:

- **Facility preparation:** After selecting sites to receive Xpert machines, some countries found that the facilities lacked appropriate equipment to ensure sustainable operation of the machines. While some sites could make the necessary corrections – e.g. installation of air conditioning, room ventilation, back-up power supplies – with the support of other donors, others were unable to do so prior to the launch of Xpert testing. This resulted in higher rates of machine failures, interruptions in testing availability, and additional servicing costs.
- **Training:** Frequent staff turnover at health facilities is a widespread problem in developing countries, and was described by interviewees as a key challenge to regular operation of the Xpert machines. Stakeholders described the role of a machine

operator as one with limited room for growth, and so employees were likely to seek alternative work within the health sector when possible. Further, users that had attended extensive training on machine operation were more likely to be selected for promotion within facilities. While some support for user training was provided at the start of the grant, UNITAID does not provide support for recurrent training to address the on-boarding of new hires. Therefore, countries relied on other donors working in the Xpert area to fund supplemental trainings – TB REACH, CDC, FIND, and USAID were particularly active.

- **Stock redistribution:** Interviews with TB REACH grantees in Tanzania described engaging in significant work in stock management and redistribution. They communicated between facilities receiving Xpert commodities to arrange for near-expiry cartridges to be moved to sites with sufficient demand to ensure timely use. This was a key factor to ensuring that Tanzanian facilities minimized the loss of cartridges when faced with low demand.

"Super-users" were an innovative method of reducing operating costs and retaining technical knowledge within grantee countries. Kenya and Tanzania each implemented a network of highly trained domestic Xpert users to address the lack of TA funding and support, called Xpert "super-users". These were lab technicians who were identified at standard training sessions as having exceptional understanding and ability to operate Xpert machines, and were invited to attend further advanced training. If successful, they were certified to conduct their own training sessions, and perform basic machine servicing and calibration. This system effectively reduced the countries' reliance on costly external support, improved servicing times by contracting local super-users, and retained domestic knowledge on Xpert machine operation.

Output 4: Increased market penetration of Xpert MTB/RIF in the private and public non-NTP sector

Table 4: Performance against log-frame targets, Output 4

Indicator	2013-2015		2016		Cumulative	
	Target	Actual	Target	Actual	Target	Actual
O4.1a Number of people tested via implementation of project social business models in Bangladesh	61,750	52,438	24,250	31,384	86,000	83,822
O4.1b Number of people tested via implementation of project social business models in Indonesia	47,500	41,795	33,950	36,900	81,450	78,695
O4.1c Number of people tested via implementation of project social business models in Pakistan	85,500	77,580	48,500	49,526	134,000	127,106
O4.2 TB Xpert project countries (other than BGD, IDN, PAK) in which PPM schemes have been established using project commodities	4	9	4	9	4	9

Status: Partially achieved

Social business models demonstrated the potential to create self-sustaining service delivery mechanisms, despite challenges to growth. Three countries[30], with joint support from UNITAID and TB REACH, piloted the creation of social business models (SBM) for service delivery. These were modelled after traditional private-sector health facilities, offering paid services to cover operational and procurement costs. In many countries, interviewees described a preference among patients for private-sector care if able to pay, due to perceptions of increased quality and efficiency. The SBM sites aimed to leverage the low-cost end of the private-care market to offer more sustainable and equitable service delivery.

By generating revenue through a range of paid services, the SBM sites could offer selected services to patients free of charge. Initial project plans intended to offer only chest x-rays for TB screening at a cost to the patient, after which suspected TB+ cases would move to a no-cost Xpert test for confirmation. Those referred by a doctor but unable to cover the cost of a chest scan would be offered an Xpert test directly.

Sites in all three countries faced significant early challenges to scale-up. Test provision was well below targets, and revenue generation was minimal. This was due in part to initial project planning, which expected all three countries to implement identical models of delivery. However, subsequent adjustments to the respective models and adaptations to local circumstances allowed all three countries to approach cumulative testing targets by the project end.

Pakistani sites learned from early challenges and adapted to boost growth. Limited early demand for testing and inadequate cash flows for continued operation in Karachi forced the SBM sites to re-evaluate their models. Having faced difficulty in generating sufficient revenue through chest x-rays alone, sites expanded to offer paid ultrasounds and blood tests to increase cash flow. Centres leased equipment to minimize capital investment costs, and outsourced blood testing services. Having proven the model's potential in Karachi, CHS has been awarded future funding from the Global Fund for a sizable scale-up across Pakistan.

CHS found that a robust network of local primary care providers was key to their increasing success. Local doctors would refer presumptive patients for testing, in exchange for a small referral fee. Management of the referral network required only one "Medical Representative" per city region to manage the relationships, and effectively generated demand. This was a significant improvement over the early model of using many screeners to check patients at other facilities and recommend TB testing, which was costly and failed to generate interest in testing.

Bangladeshi SBM sites show significant promise through targeted approach. Unlike the SBM sites in Karachi, icddr,b and IRD opted to focus exclusively on TB screening in Dhaka. Finding that x-ray screening was an inadequate source of revenue for sustainability, sites also began serving as collection centres for other TB tests offered through icddr,b diagnostic centres.

[30] Bangladesh - through icddr,b; Indonesia - through Inovasi Sehat (ISI); and Pakistan - through Interactive Research and Development (IRD) and Community Health Solutions (CHS)

Total revenue grew steadily over the project period, due to increasing test volumes and expansion of services, and icddr,b projected the SBM sites to break even in Q1 2017[31]. (Information not available to confirm at time of evaluation.) Key challenges were seasonal fluctuations in demand, and political unrest in Year 3 impacting patient movement.

Persistent problems in Indonesia resulted in limited project success. At the start of the project, ISI faced challenges surrounding the importation and registry of the x-ray machines intended to generate revenue in the SBM sites. These delays prevented the establishment of any independent SBM screening or treatment centres. Consequently, ISI decided to pursue a three-pronged approach of screening, targeted sputum-negative sample re-testing, and partnership with local hospitals for Xpert testing. Though these strategies achieved varying levels of success, none were revenue-generating or independently sustainable, as the SBM principle had intended.

The Sehatmand Zindagi Lab ("Healthy Life") brand was developed for the Pakistani social business sites

Further, the Indonesian sites faced challenges with transition to treatment – at the end of Year 2, only approximately 50% of identified patients were receiving treatment[32]. The implementation of a national health insurance scheme in 2014 also dissuaded many patients from engaging in paid health services not covered by the scheme, and further undermined demand for ISI services. Finally, partners in Indonesia voiced concerns during interviews regarding the effectiveness of ISI project management, describing failures of the team to communicate effectively or coordinate with the NTP and others[33].

[31] UNIATAID 2015 Annual Report

[32] UNITAID 2014 Annual Report

[33] These issues were not identified during an interview with ISI, which focused more heavily on the approach to active case finding and follow-up.

SBM sites offer donors an attractive method of service delivery, under appropriate conditions. Even when unable to generate sufficient revenue to cover all operational costs, the social business model offers a method of steeply discounting the cost of program delivery for donors. Meanwhile, it promotes entrepreneurial local business and allows donors and national programs to monitor the quality of care provided – something which is not possible in most private care facilities. However, the success of such a model relies upon the existence of an active private health sector and a willingness of patients to pay for services.

Key lessons learnt on SBM development gathered from interviewees and grant implementers include:

- A **referrals-based demand generation** model was more effective than a screen-based model. This approach was also more cost-effective, as it required only one "Medical Representative" per region to build a network of doctors, rather than many screeners posted at health facilities.
- An **effective network of healthcare providers** was a primary key to success. Using them to generate patient referrals and build confidence in the SBM sites within the local community was valuable.
- SBM sites need to be **run like businesses**, not just health centers, to move towards sustainability. Patient experience is key to ensuring a positive reputation within the community. Timeliness of service, doctor presentation, customer treatment, availability of trained care providers, and more are all key to creating a positive patient experience.
- **Lease-based models for equipment** were an effective method of keeping capital investment costs low while allowing for expanded service offerings at facilities during the early stages of the program. However, as the health centers become better established and revenue streams stabilize, the direct purchase of equipment may be a more sustainable long-term arrangement.

Other innovative public-private mix (PPM) models showed a broad range of potential application for Xpert technology and creative methods of reaching at-risk populations. In addition to the three countries piloting social business models, nine countries implemented PPM delivery models to reach underserved populations[34]. The UNITAID annual reports describe these programs in detail, which included mobile clinics (Cambodia and Nepal), mission hospitals (Malawi), HIV centres providing TB testing (Moldova), and services targeting garment factory workers (Bangladesh), children (Swaziland), and prison inmates (Belarus, Moldova, Philippines, Tanzania).

Tanzania provides an illustrative sample of this work. Prison populations are widely noted for having exceptionally high TB burdens, due to the close living quarters and inadequate health services. For example, interviews with grant implementers noted that prisons in Tanzania before the project start were found to have TB prevalence rates of more than 4%. TB REACH, with on-the-ground support from the University of Maryland Global Initiatives program, arranged for five UNITAID-procured Xpert machines to be placed in prisons across the country

[34] All programs except those in Belarus and the Philippines were supported by TB REACH initiatives

to improve case detection in these settings. The programs experienced great success, identifying large numbers of patients and triggering effective treatment for infected inmates. Through these improved screening practices and early case detection, TB prevalence in the five selected sites fell to below 1% by the project end, in line with prevalence rates in the general population.

Output 5: Strengthened country coordination with other technical agencies and donors

Table 5: Performance against log-frame targets, Output 5

Indicator	2013-2015		2016		Cumulative	
	Target	Actual	Target	Actual	Target	Actual
O5.1 Project countries in which NTPs and partners have provided semi-annual updates on sites and plans for rolling-out Xpert MTB/RIF	21	21	N/A	N/A	N/A	N/A
O5.2 Number of annual meetings of Xpert MTB/RIF implementers organized	3	6	1	2	4	8
O5.3 Number of quarterly coordination teleconferences with major implementers and partners organized and action steps documented	12	5	2	0	14	5

Status: Partially achieved

Country-level coordinating mechanisms were generally strong. Most countries showed strong linkages between UNITAID program implementers and local TB programs. Machines were frequently placed in public-sector facilities with strong local buy-in and support, and NTPs led the site selection and stock management processes. However, public sector support for the program varied across countries. Three specific country examples of grantee-government coordination are:

- **Kenya:** Stakeholders described particularly strong leadership from the NTP as key to program success. It took the lead in identifying national priorities and developed a donor roadmap, effectively coordinating the work of agencies across counties to ensure all needs were met.
- **Pakistan:** Interviewees cited political difficulties between the private sector implementers and public sector stakeholders as a challenge to broad Xpert uptake in public hospitals. Scepticism regarding the new technology and concerns over the increased cost of Xpert testing drove reluctance to embrace the rollout. However, the sharp increase in drug-resistant case detection during the project improved NTP buy-in.
- **Indonesia:** Broad challenges in the coordination of project activities between implementers and the government hampered implementation throughout the grant (see Output 4 for detail).

At times, the project handover process lacked clarity for health workers. Plans for the transition of Xpert commodities at the end of the UNITAID grant varied widely, based upon country circumstances and arrangements for continuing support. GFATM took a leading role in future funding support (see Output 6), but approaches to the logistical handover of commodity management were inconsistent. For example, Kyrgyzstan received coordinating support from WHO and experienced no gap in service provision. However, a TB REACH sub-grantee in Tanzania continued to receive requests for support from health facilities months after the program end, to aid in stock redistribution. These activities were not formally handed over and the transition not communicated to the facility level, resulting in confusion among health workers.

Future funding arrangement shows a gradual move toward consolidation of Xpert activities and improved coordination. Many grantee countries described a crowded marketplace for Xpert procurement and rollout, with numerous donors and agencies engaged in the area. While beneficial for the recipient countries to receive such widespread support, there is a risk of disjointed programming without strong leadership from the local TB program or other coordinating bodies. At the UNITAID project end, GFATM was moving to take over most Xpert commodity funding and continued scale-up. However, other agencies were continuing to act as project managers and providers of TA in some countries. As the UNITAID project-specific coordinating fora have ended, the leading role of the GFATM and its interaction with local TB programs will be key to ensuring alignment in ongoing Xpert work.

Output 6: Transitioning out to ensure continuation of use of instruments after Project conclusion

Table 6: Performance against log-frame targets, Output 6

Indicator	2013-2015		2016		Cumulative	
	Target	Actual	Target	Actual	Target	Actual
O6.1 Project countries with a transitioning-out plan with identified sources of funds	21	21	21	21	21	21
O6.2 Proportion of GeneXpert instruments with planned funding available for cartridges in 2016	100%	100%	100%	100%	100%	100%
O6.3 UNITAID transition status tool submitted to UNITAID biannually, with transition status for 21 beneficiary countries up-to-date	N/A	No	N/A	No	N/A	N/A

Status: Partially achieved

Funding has been secured to ensure the continued operation of all UNITAID-procured Xpert machines in grantee countries. Through engagement with project partners and other agencies active in TB diagnostics, UNITAID ensured that all grantees secured full funding for continued operations. End-of-grant letters were sent on behalf of grantee countries to GFATM focal points containing complete forecasts of future costs. GFATM has since taken up

a leading role, offering funding to all grantee countries for machine procurement per national plans and ongoing provision of cartridges. The SBM projects in Bangladesh and Pakistan have also been awarded support to continue and expand the delivery model.

Xpert inclusion in national guidelines and diagnostic algorithms will encourage continued use in the near-term. Ninety-three percent of all high-burden TB countries have indicated that national policy will recommend Xpert as the primary front-line test for those at risk of MDR-TB, and 80% of high-burden countries will prioritize Xpert for HIV+ patients. Some countries with adequate donor support for cartridge procurement, such as Tanzania, have even moved to adopt Xpert as the standard front-line test for all suspected TB cases where available. Continuing machine procurement will allow the country to offer this in all secondary and tertiary health facilities.

Despite government ownership of the commodities, little to no domestic funding has been committed to Xpert operation. Almost all grantee countries will rely heavily upon donor funding for the continued operation of their Xpert commodities – mostly via GFATM support. While this ensures that the UNITAID-funded machines will continue to operate, it does not ensure very-long-term sustainability. National TB programs are often heavily supported by donor funding, which can impede the domestic adoption of new strategies. The notable exception to this concern in the Xpert project was India, which focused from the start on ensuring local financial support for the technology and has already taken on a large share of the recurring operating costs.

High cartridge costs continue to threaten the long-term sustainability of Xpert as a default diagnostic test for all patients. Despite the impact of the buy-down arrangement on cartridge price, many countries voiced continuing concerns regarding the affordability of Xpert commodities. Representing a two- to three- fold increase over the cost of conventional sputum smears, grantees voiced concerns that without donor funding it will not be possible to continue Xpert testing. To address this concern, many countries have opted to continue using chest x-rays and sputum smears as front-line screening tests for low-risk patients (e.g. HIV- or those in low-MDR-TB-burden areas), progressing to Xpert only in smear-negative cases. This allows for significant cost savings in the smear-positive cases, while still leveraging the increased sensitivity of Xpert in smear-negative TB+ cases.

IMPACT

Key evaluation questions:

- *Has the grantee been able to report on impact as originally framed in the project plan and log-frame?*
- *Can the grantee attribute UNITAID's financial support for diagnostic tools purchased to patients tested or treated in each grantee country?*

Purpose (Outcome): Increased uptake of Xpert MTB/RIF technology.

Table 7: Performance against log-frame targets, Purpose (Outcome)

Indicator	2013-2015		2016		Cumulative	
	Target	Actual	Target	Actual	Target	Actual
P1.1 Rate of public sector cartridge procurement at concessional prices in Project countries (beyond UNITAID procurement) – average ratio above baseline procurement	1.4x	2.1x	---	---	1.4x	2.1x
P1.2 Rate of public sector cartridge procurement at concessional prices in 124 non-project countries – average ratio above baseline procurement	1.3x	1.7x	---	---	1.3x	1.7x

Status: Achieved

Market impact

The project demonstrated proof-of-concept in accelerating demand for a new product in developing countries. This grant proved to be an effective method for the rapid scale-up of a technology through the combination of price negotiation/ demand pooling and assisted implementation. By reducing one of the primary barriers to market scale-up through the buy-down arrangement, UNITAID showed that coordinated effort to expand a market could meaningfully impact uptake. Further procurement support to specific high-burden, low- or lower-middle- income countries also assisted in ensuring equitable global access to the new technology.

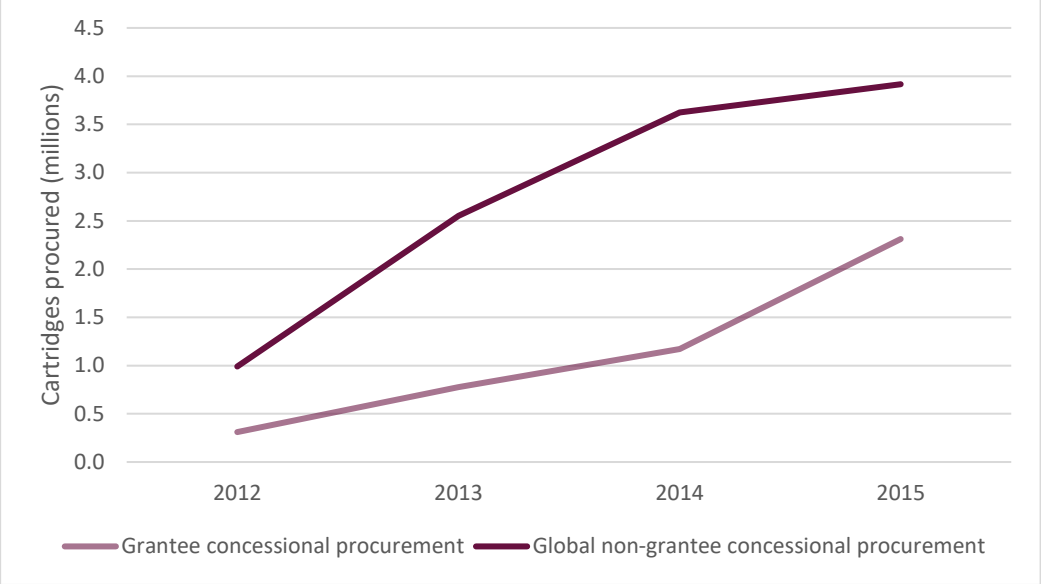
Countries with small pre-project Xpert inventories saw the creation of domestic ecosystems for machine operation. Given the small scale of UNITAID's procurement in most grantee countries, one of the major impacts of the commodities was the establishment of complete systems for the operation of the machines. Creating or expanding domestic capacity for procurement, registration, distribution, training, stock management, and revision of diagnostic protocols was key to promoting sustainable use of the technology. Even with limited patient reach through the commodities themselves, the secondary effects of this procurement could have far-reaching impacts.

Grantees with pre-existing Xpert markets benefitted from the expansion of patient access to testing. In those countries with previously active Xpert markets, the UNITAID grant often represented a relatively small share of the national inventory. However, these countries nevertheless benefitted from expanding access to Xpert testing to more remote regions, as was done in Kenya and Tanzania. This promoted broader use of the technology outside of central health centers, and contributed to demonstrating the utility of advanced case detection at national scale. The geographic expansion of testing and more standardized implementation into diagnostic algorithms may also have influenced the revision of national policies to adopt Xpert as a standard tool.

The catalytic impact of UNITAID procurement on Xpert market growth remains uncertain. Most grantee countries had pre-existing Xpert programs of some scale, funded by previous donor engagements. Therefore, assessing the isolated impact of UNITAID's module procurement on broader market growth is challenging. In countries in which UNITAID-funded machines were placed in more remote areas without previous Xpert coverage – such as Kyrgyzstan and Tanzania – the grant may have supported the establishment of effective supply chains for Xpert goods, and facilitated machine roll-out in the region (see above for more on establishing domestic ecosystems). However, the evaluation team did not find evidence of this effect. Meanwhile, countries with little to no Xpert experience before the grant, such as the Republic of the Congo, saw little growth in cartridge procurement during the grant period.

The UNITAID-negotiated buy-down had a significant global impact, increasing the cartridge purchasing power of governments and donors. Global procurement at concessional pricing (procurement with non-UNITAID funds) significantly outpaced expectations and targets for the project period. The 124 non-grantee countries showed a rapid acceleration in procurement after the buy-down announcement, as seen in the sharp procurement increase between 2012 and 2013 in Figure 3. Meanwhile, grantee countries initially experienced a more gradual acceleration in procurement, for reasons discussed above. However, subsequent uptake across the 21 countries has risen steadily, showing a growing cartridge market. Procurement in 2015 at concessional pricing in grantee countries was 7.4 times higher than pre-buy-down levels. Further, all countries secured donor or domestic funding for continued Xpert use and scale-up – in line with UNITAID's new KPI 5.1. (See Output 6 for more on transition.)

Figure 3: Annual cartridge procurement at concessional pricing[35]



In the medium and long runs, further scale-up may continue to incentivize product innovation. Cepheid indicated that the project provided added incentive to continue creating products for the TB diagnostic market. The impact of this work has already been seen in the announcements of next-generation Xpert products. In direct response to learnings gained through this grant, Cepheid has developed two new products – a redesigned cartridge providing further increased sensitivity (Xpert Ultra), and a battery-operated, tablet-controlled module for use as a true POC test (Xpert Omni). These new tools address challenges frequently encountered by countries during the grant, and show promise to further increase case detection rates. As the market continues to adopt these tools and generate learnings during implementation, ongoing innovation can address gaps and ensure that the tools are well suited to varying country contexts.

GeneXpert Omni module (Source:

Grantees voiced concerns regarding the potential effects of the project focus on a single manufacturer. Due to the grant's focus on a single innovative manufacturer, interviewees were concerned that alternative firms may be dissuaded from entering the market. The significant investment in Xpert systems over the project period, plus additional funding already secured for continued scale-up, creates a challenging environment for the entry of competing products. Countries that have already invested in Xpert commodities and related training may be reluctant to take up similar products requiring additional up-front installation costs. The long-term impacts of this potentially monopolistic arrangement remain to be seen,

[35] Source: UNITAID log-frame reporting

but could result in suboptimal pricing for countries or limit future innovation from other manufacturers.

Public health impact

Grant implementers and health facility users described several advantages of the technology. After using the Xpert machines for the full project period, grantees voiced unanimous support of the technology as a positive step in TB diagnostics. In particular, they noted the following benefits:

- **Time and human resource savings:** Test operators found the time savings produced by the two-hour automatic Xpert test, over hands-on sputum smears or several-week-long cultures, to be a dramatic improvement. It allowed for a greater volume of tests to be processed and could be done by minimally-trained health workers rather than formal lab technicians. These time savings also benefitted the patients, as the rapid availability of results allowed, in some locations, for same-day testing. This was a dramatic improvement over previous performance, and may have saved patients in remote settings from making additional trips to the health centre. This may have led to further second-order savings in travel costs, such as less time missed from work and/ or school.
- **Simultaneous RR testing:** The ability to assess drug resistance during a rapid first-line TB test was described by many grantees in high-MDR-TB-burden areas as one of the primary benefits of the new technology. It facilitates the identification of dangerous TB strains without the traditional three-week delay, is less costly than culture, and does not require the same advanced biosafety measures. Further, the short turnaround time for testing may increase the odds that patients follow up promptly for treatment.
- **Reduced sputum requirement:** Xpert testing requires a smaller sputum sample from patients than conventional smear testing. This is an advantage for all patients, as they frequently have trouble producing adequate samples. However, this is especially valuable for paediatric patients, whose sputum is known as “precious sputum” due to the particularly acute challenges associated with obtaining it. Xpert testing allows these limited samples to be successfully examined.

Project brought visibility to the MDR-TB burden in grantee countries. Even in those countries for which UNITAID procurement was relatively small, or who failed to achieve broad scale-up of the technology, stakeholders highlighted the attention brought to MDR-TB as a significant impact. Implementers in the Republic of the Congo noted the numbers of MDR-TB cases found using the one machine in Brazzaville as valuable in bringing the problem to the forefront of discussion amongst local actors and mobilizing resources for continued action.

Goal (Impact): To increase rapid diagnosis of TB, HIV-associated TB, and drug-resistant TB among vulnerable populations in low and lower-middle income countries.

Table 8: Performance against log-frame targets, Goal (Impact)

Indicator	2013-2015		2016			Cumulative	
	Target	Actual	Target	H1 Actual	Full-year extrapolation[36]	Target	Actual[37]
G1.1 Number of incident TB patients detected using project commodities	142,872	161,190	64,174	40,559	83,793	233,213	244,983
G1.2 Number of incident HIV-positive TB patients detected using project commodities	19,868	15,753	6,087	3,100	5,793	25,955	21,546
G1.3 Number of incident rifampicin-resistant TB patients detected using project commodities	31,997	37,080	17,151	8,198	16,714	60,937	53,794
G1.4 Percentage increase in number of incident bacteriologically-positive TB patients detected (among sites recording necessary data from project start)[38]	+10%	+29%	---	---	---	+10%	+29%
G1.5 Percentage increase in number of incident bacteriologically-positive HIV-positive TB patients detected (among sites recording necessary data from project start)[39]	+10%	+134%	---	---	---	+10%	+134%
G1.6 Percentage increase in number of rifampicin-resistant TB patients detected (among sites recording necessary data from project start)	+100%	+379%	---	---	---	+100%	+379%

Status: Partially achieved

The project showed significant public health impact through numbers of patients identified and expansion of patient access to testing at lower health service levels. Over the full implementation period, the project diagnosed 201,748 cases of TB, including 18,853 cases in HIV+ patients and 45,278 cases of MDR-TB (see Table 8 above for details)[40]. After the start-

[36] Based upon remaining in-country stock at end of 2016 reporting period and previous testing and case detection rates, mid-year performance was extrapolated to predict full-year performance against targets

[37] Note that actuals include full-year extrapolations for 2016

[38] Based on data from only 12 project countries

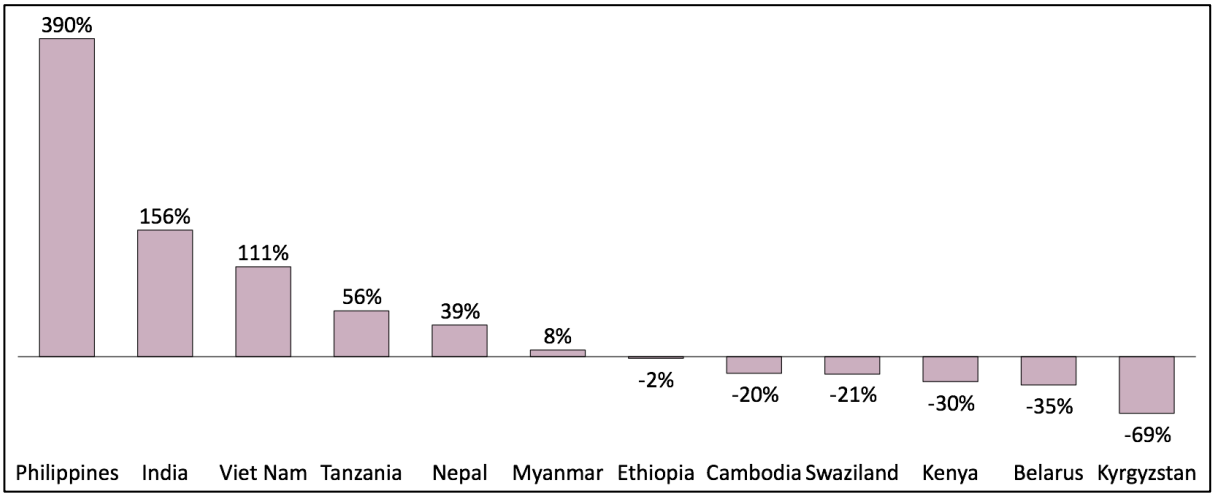
[39] Indicators G1.5-1.5 based on data from only seven project countries

[40] Source: UNITAID log-frame reporting

up delays of Year 1 and the low resulting diagnosis levels, case detection rates increased annually and surpassed cumulative targets through Year 3 for overall detection and MDR detection. HIV-associated-TB detection rates were lower than expected, though still within the lower bound of the project target. The poorer performance in HIV-associated detection may be attributed in part to the difficulty in collecting accurate data – in some testing facilities, patients' HIV status may have been unknown or unreported[41]. Performance against 2016 targets was mixed, due to targets having been set for full-year activities despite reporting only on activities completed in Q1-Q2 2016. When including extrapolated figures based on remaining in-country commodity stocks and previous case detection rates, full-year performance exceeds all annual targets (see above).

Relative rates for bacteriologically positive case detection showed significant increases above the baseline at the global level (see Indicators G1.4-1.6 above), with particular gains in HIV-associated TB and MDR-TB detection. This remained true in most countries supplying necessary data, though outcomes were varied (see Figure 4 below). Note that data was not collected in countries intending to establish referral hub systems around Xpert machines, as the expected change in facilities' geographic coverage area would invalidate comparisons to the baseline. Those countries showing particularly marked gains – such as the Philippines and India – also established referral systems during the project, driving the large increases in case detection shown below. Other countries showing improvement, such as Tanzania and Nepal, reflect the advantages of increased Xpert sensitivity and improved facility capacity for test processing. Lack of data on absolute patient testing rates – including smear, Xpert, and culture – restricts the analysis of those countries failing to show improvements.

Figure 4: Percentage change in bacteriologically positive case detection rates in select countries in 2015, relative to pre-project (2012) baseline[42]



Public health impact projections are limited by insufficient data. Dalberg was unable to project future grant impact due to the complexities of diagnostic programs and the availability of relevant downstream data (see Table 9 for details on data availability). While total case

[41] UNITAID 2015 Annual Programmatic Report

[42] Source: UNITAID log-frame reporting

detection rates using UNITAID commodities are readily available, the impact of procurement on the broader market, including relative increases in patient testing and patient treatment rates, are less clear. Other agencies were also active in the market prior to UNITAID's intervention, and diagnostic algorithms including the use of Xpert testing vary widely across countries. These complications make a valid counterfactual situation difficult to establish. Further, the impacts of UNITAID's procurement on broader national planning cannot be isolated from those of other donor projects. Finally, the impact of the buy-down arrangement on the decision-making of other actors cannot be isolated, despite efforts to estimate global procurement savings (see Value for Money for more on savings). For these reasons, a credible measurement of UNITAID "market catalysis" or "additional lives saved" cannot be made.

Table 9: Summary of project impact data availability

	Machine procurement	**Cartridge procurement**	**Patients tested**	**Cases detected**	**Change in bac+ case detection**	**Treatment initiation**	**Lives saved**
National level	Complete data available for national procurement	Complete data available for national procurement	Data available for Xpert testing only	Data available for Xpert testing only	Data available for select countries	Data not available	Data not available
Facility level	Data available for domestic machine placement	Data not available	Data not available	Limited data available (Owner: WHO)	Limited data available (Owner: WHO)	Data not available	Data not available

Cost-saving measures may affect case detection. Significant concerns persist in grantee countries regarding the cost of Xpert commodities and the feasibility of their use for front-line testing. As a result, countries have implemented a range of strategies to reduce diagnostic costs with an aim to improve the sustainability of the programs. A common approach, as seen in Pakistan, is to retain chest x-rays as a screening measure, with onward referral to an Xpert test for presumptive cases. Similarly, countries such as Indonesia and Malawi have targeted Xpert for use following a negative sputum smear for suspected (non-RR) cases, to utilize Xpert's increased sensitivity only when required. These have proven to be effective cost-saving methods of leveraging the Xpert's advantages and boosting case detection without relying on it as a front-line diagnostic test. However, Malawi experienced a shift in national policy in at the end of 2013 which designated HIV+ smear-negative patients as the priority group for Xpert testing while relying on conventional testing methods for other patients. This resulted in a sharp decline in case detection rates – still above forecasted pre-Xpert levels, but significantly below the previous levels reached with broader Xpert use.

Overreliance on Xpert may reduce impact on overall diagnostic rates. In the past, due to the low sensitivity of smear testing, clinical diagnoses have represented up to one half of all TB diagnoses. These are doctor's assessments of patient conditions, based on non-bacteriological evidence such as presentation of symptoms and chest x-rays. Children and HIV+ patients, who are traditionally hard to diagnose through smear tests, particularly relied

upon this method. Xpert testing represents a significant step in the progression of TB diagnosis, but still only shows approximately 70% sensitivity in smear-negative cases[43]. A typical sputum smear sensitivity of approximately 50% would therefore imply that 12-15% of all TB+ cases may not be identified by Xpert and continue to require clinical diagnosis. However, the presentation of Xpert as a highly sensitive tool may lead some doctors to rely too heavily on the results of Xpert testing, taking a negative Xpert result to rule out any possibility of TB. While data is not available to estimate the magnitude of this effect, there is a risk that it mitigates the otherwise significant impact of Xpert introduction on overall case detection rates – as seen by a TB REACH impact study conducted in Nepal[44]. However, we do note that doctor examinations may also support specificity in patient treatment, avoiding unnecessary distribution of drugs at significant donor cost and potential patient harm.

Stakeholders noted that a lack of focus on linking diagnosed patients to treatment may have limited the downstream health impact of the grant. While the program focused on increasing case detection rates in grantee countries, it relied on existing treatment systems or the activities of other agencies to ensure patient follow-up. Interviewees reflected this as a risk to the grant impact, as increases in patient diagnosis equate to meaningful public health impact only when treatment can result in averted deaths and reduced transmission. Some countries, such as Tanzania and Pakistan, benefitted from health systems which ensured active follow-up and treatment rates above 95% among diagnosed patients. But others, such as Indonesia, suffered from severe challenges in linking grant-identified patients to the existing public health system, which resulted in treatment rates as low as 50%.

WHO and TB REACH grantee countries benefitted from supplementary support in this area, which may have positively impacted the treatment rates for patients diagnosed within UNITAID's program. Programs were designed to improve data sharing between laboratories and care providers, use the GxAlert information system, and trace TB+ patients to ensure treatment follow-up.

UNITAID-supported diagnostics represented relatively limited coverage at the national level, and ongoing support will be needed to achieve full national coverage. UNITAID procurement was intended to support the expansion of Xpert use in grantee countries. However, the short-term health impact was limited by the absolute reach of the UNITAID-procured commodities. These commodities generally represented a small share of the Xpert machines present in countries, and had limited ability to expand testing to remote populations, given the large populations and geographic area of most target countries. In the medium term, UNITAID's efforts to catalyse national Xpert markets will potentially facilitate additional investment to ensure full diagnostic coverage in remote areas – planned procurement through GFATM in coming years will help to address this. (See Output 6 for more on transition.)

[43] Menzies NA, Cohen T, Lin H-H, Murray M, Salomon JA (2012) Population Health Impact and Cost-Effectiveness of Tuberculosis Diagnosis with Xpert MTB/RIF: A Dynamic Simulation and Economic Evaluation. PLoS Med 9(11): e1001347.

[44] J Creswell et al. "Introducing new tuberculosis diagnostics: the impact of Xpert MTB/RIF testing on case notifications in Nepal." The Union, 2015.

LEARNING AND RISK MITIGATION

Key evaluation questions:

- *Have lessons learnt been documented and widely disseminated by grantees and UNITAID?*
- *Have programmatic and financial risks been identified and tracked over the course of grant implementation?*

Project learnings were compiled and shared in annual reports, but capacity for course correction was limited. Following the annual grantee reporting process, UNITAID compiled annual programmatic reports. The reports reviewed performance against grant indicators during the reporting year, and included annexes with country-specific successes and challenges for all grantees. Though containing various levels of detail across countries, these annexes provided a wealth of information regarding best practices, learnings, and ongoing challenges from which all countries could benefit. However, implementing these learnings across countries would have required seeking supplemental funding. The program did not provide for support country experience sharing or provide tailored TA for program adjustments based on mid-term experience. Interviewees voiced a desire for opportunities to share in-country experiences, through online forums or face-to-face meetings, to leverage the learnings of other implementers.

Learnings and recommendations were also gathered through the 2015 CEPA mid-term project evaluation. The report made five recommendations, the details of which are shown in Table 10.

Table 10: Status of CEPA mid-term evaluation recommendations

No.	Recommendation	Status	Comments
1	Arrange for extension of project period	Partially completed	The mid-term evaluation recommended a full additional year of implementation. UNITAID approved an extension of ten months, including four months of additional procurement followed by six months of final installation and reporting.
2	Expedite sustainability planning in all countries	Completed	All countries successfully arranged for continuation of program funding through other donors.
3	Review provisions for TA and supporting costs	Completed	Budget reallocation requests were reviewed by the Project Steering Committee, and decisions on line item approvals were taken by UNITAID. Overall budgets for non-commodity spending remained unchanged through the grant period, despite some fund reallocation between outputs.
4	Critically appraise the PPM/ SBM modes and consider appropriate revisions to targets	Completed	Implementers examined SBM progress and revised final targets accordingly, considering early challenges.

5	Provide support for/ encourage use of remote monitoring tools	Partially completed	The program supported four countries[45] in the introduction of the GxAlert software for remote monitoring and case management. Ten other grantee countries also utilized the technology through the engagement of other donors.

UNITAID procurement may have contributed to the development of sector-wide Xpert lessons-learned and best practices. Numerous studies were conducted during the project period documenting emerging lessons on the implementation and use of Xpert commodities in grantee countries. While not explicitly cited in evidence reviewed by the evaluation team, UNITAID's contributions to the Xpert inventories and expansion of operations in grantee countries likely offered valuable lessons for later program planning.

Programmatic risk was monitored throughout implementation. UNITAID maintained a comprehensive risk register, which was updated during the grant period to assess changes in the risk landscape. The register considered strategic, implementation, and sustainability risks, and prescribed mitigating actions as appropriate. Primary risk areas identified with respect to continued pricing barriers to country commodity access and limited project impact due to poor treatment rates or existing high clinical diagnostic rates. The outcomes of both risk areas are discussed previously in this report. (See Impact section for details.)

The Xpert project was effectively designed to minimize financial risk. Grant financial risk was primarily mitigated through the procurement structure and fund flow set out in the project plan. By retaining all funds at the global level and conducting procurement operations on behalf of grantee countries, the Coordinating Partners ensured a minimal risk of fund misuse. There was a low risk of commodity misuse or diversion, and the activities of implementing partners were effective in monitoring this risk. Only one case of fraud or misuse was identified during the project period, in the theft of a laptop used for Xpert testing from a facility in Tanzania. This case was documented in the program annual reports.

[45] Ethiopia, Kenya, Mozambique, Tanzania

VALUE FOR MONEY

Dalberg's Value for Money (VfM) analysis examined the project through four lenses, based upon UNITAID's standard VfM framework (as developed by CEPA), and is shown below in Figure 5.

Note that the meaning of the terms used in this section may differ slightly from those used as section headings in other areas of this report. The categories used were:

- **Efficiency:** This represents the ability of the project to transform inputs into outputs, through successful activity execution per the project plan.
- **Cost-efficiency:** Cost-efficiency examines project success in maximizing the conversion of grant funds into outputs. The ability of the implementer to obtain appropriate prices for inputs (such as commodity procurement) and implement them efficiently will impact the outcome of this measure.
- **Effectiveness:** This measure assesses the extent to which outputs were translated into project impact. Following activity implementation, outputs must be well aligned with the intended overarching goals to ensure maximum impact.
- **Cost-effectiveness:** Cost-effectiveness examines the conversion of grant funds into impact, to ensure that the end-to-end grant process achieved the greatest return per resource invested.

It should be noted that the cost-efficiency and cost-effectiveness measures in this assessment account only for the funds spent by UNITAID during the project period. As discussed previously, several activities central to the success of the grant – including facility preparation prior to installation, training facilitation, and stock management – were facilitated by other donors active in grantee countries. The costs associated with the implementation of these activities are not accounted for, as credible estimates of their value could not be obtained.

Figure 5: Value for Money analysis

	Efficiency	Cost-Efficiency	Effectiveness	Cost-Effectiveness
Public health/ systems impact	• Patient testing time reduced from days or weeks to 2 hours – tests returned within 1-2 days • Minimal support was given to machine installation or user training, which may have restricted uptake	• Total Cost to Transfer Cost ratio for program: **1.24** • Cost of test per patient is still significantly above alternatives • Installation and training costs depended upon support of other donors in the Xpert space, which kept UNITAID investment small	• 98% of machines places at lower health service levels • 201,749 TB cases detected • 18,853 HIV+ TB cases found • 45,278 MDR-TB cases found • No work done to strengthen linkage to patient treatment	• Cost per test performed: $23 • Cost per diagnosis: $99 • Impact may have been increased if investment was made in linkage to treatment following diagnosis
Market impact	• Program faced significant procurement delays in Year 1 • Program compensated for initial delays and reached procurement targets • Time to clear customs improved during project	• By consolidating project procurement needs at global level and coordinating with manufacturer on behalf of grantees, kept procurement process lean and efficient	• 898 Xpert modules and 1.46M cartridges procured, reaching initial targets • Supplemented national Xpert inventories and helped spark diagnostic policy revision • UNITAID procurement was small relative to national needs, and relied on other actors to compliment	• Independent impact of UNITAID investment on grantee country uptake of the technology is difficult to isolate, but the cost of commodity procurement was at market standard – including buy-down concessional price
Sustain-ability	• All program countries secured full funding for ongoing support to GeneXpert utilization and continued scale-up – with particular leadership from the Global Fund • Many countries continue to resist use of Xpert as stand-alone front-line diagnostic tool due to concerns of cost, preferring to maintain screening tools (e.g. smear, chest x-ray) to identify likely TB cases which are confirmed by Xpert tests • Next phase of donors should work in increase domestic funding support for long-term Xpert adoption			
Buy-down			• Cartridge price reduced from $17 to $9.98 (59%) • 4.26M supplementary cartridges purchased in program countries • 10.1M cartridges purchased in buy-down-eligible countries	• $109.9M in global savings through concessional pricing • Global savings per buy-down dollar: $9.90 • Global savings per UNITAID buy-down dollar: $34.33

RECOMMENDATIONS

Recommendation 1: Consider how to formally coordinate with national or global partners to build strong linkages to the broader health system – including peripheral commodity requirements and linkages to effective patient treatment

UNITAID could consider supporting linkages to broader health systems wherever possible to significantly increase the scale of project impact. Ensuring that diagnosed patients are connected to treatment and followed up with to ensure compliance could magnify the impact of diagnosis-focused projects. (See Impact section for more on linkages to treatment.)

When selecting countries for future interventions, assessments could be done to identify those places where the benefits of the intervention could be best leveraged for further success through existing systems. Alternatively, grants could consider a more holistic and balanced approach to each intervention, addressing the broader context for an activity rather than a narrow sector.

Flexible grant funding could also be made available to grantees to address unforeseen operational challenges or other costs that arise during a grant. For example, funds for unanticipated recurrent trainings or health facility preparation for machine installation would avert potential delays during implementation. A reliance on other actors to address these issues is a risk to the project's success. That said, it is recognized that this is not UNITAID's typical approach to grant making, and it could make more sense to create a formal structure to coordinate with other partners/donors to ensure health facilities are well prepared and supported.

Recommendation 2: Tailor support to countries during implementation to maximize commodity uptake

UNITAID should consider offering differentiated support to countries based upon size, disease burden, quality of existing health systems, or other factors. Tailored assistance would support the broader success of the intervention. While this was considered in the TB Xpert grant through the engagement of regional implementing partners, the structure of the project was the same for all grantee countries. The availability of flexible grant funding for machine placement, stock management, or linkage to treatment could have amplified the impact of the program in each country and averted potential delays during implementation.

However, there are administrative trade-offs in the planning and implementation phases of a tailored support package. Uniform programs potentially allow for more rapid decision making, while tailored grants may require added upfront planning work and a more complex approval process. The costs of planning and administering a tailored grant would need to be weighed against the expected benefits of adapting to local in-country circumstances.

Recommendation 3: Consider longer-term sustainability issues as part of transition process, including feasibility of gradual government ownership in place of donor support, whilst signalling affordability issues to relevant partners

Beyond UNITAID's existing criteria for project sustainability, it could consider the importance of domestic ownership and funding for impact in the long term. While current UNITAID standards look to ensure that project activities have funding secured by the end of the grant period, there is a risk that relying on other donors may undermine the ability of grantee governments to assume responsibility for the program and its benefits in the near or medium term. It is therefore important to identify potential prohibiting factors to long-term domestic ownership and funding, early-on during a program.

Projected domestic fiscal space and political will to adopt new commodities within a fixed period may be considered as criteria when identifying commodities for support in future UNITAID programs. By assessing, (i) whether the relevant disease burden falls in countries where governments are likely to have available funding, (ii) the relative domestic prioritization of addressing the disease through new approaches, and (iii) the product's likely cost or affordability in the medium and long term, UNITAID can ensure that programs are situated for long-term success from the start. Alternatively, collaboration with other organizations may be considered to support advocacy for domestic resource mobilization in relevant areas to build support for future project ownership.

ANNEX 1 – UNITAID EVALUATION FRAMEWORK

Relevance:

1. Are the outcome(s) and impact(s) of the grant aligned with UNITAID's overall mission to contribute to the scale up of and access to treatment for HIV/AIDS, malaria and TB for the most disadvantaged populations in developing countries using innovative global market based approaches?
2. How does the grant contribute to one or more of UNITAID's six strategic objectives?

Detailed questions

- Has GeneXpert become the new standard for diagnosing TB, MDR TB?
    - Is GeneXpert replacing the existing methods of diagnosing TB and MDR TB or are they complementary to them (i.e. being used for validation)?
    - How has the introduction of GeneXpert changed the target population analysed (move from central labs or national reference labs to more decentralized locations)?

Effectiveness:

1. Are the outputs of the grant consistent with the objectives and expected outcomes as described in the project plan? If changes have been made, has the UNITAID Secretariat been involved in discussions about the changes?
2. Were the outputs of the project achieved within the timeframe specified in the initial project plan?
3. What are the main factors influencing the achievement or non-achievement of the outputs or overall outcomes across all countries and within each beneficiary country?
4. What factors have been considered to ensure that value for money has been achieved?

Detailed questions

- Review the effectiveness of the PPM Business models and in particular
    - Cost to patient
    - Time saved for patient
- What is the outlook for the PPM models for their sustainability after UNITAID funding stops as these are revenue generating sites and should be self-sustaining?
- What is the involvement of NTP managers to support these machines after the end of the project?
- Are other technologies (X-rays) or methods of diagnostic less expensive, which used if upfront can reduce the number of GeneXpert tests needed, and increase the sustainability of the model?

Efficiency:

1. Can the grant Implementers and their partners demonstrate that national authorities are aware and participating in grant activities at the national level?
2. How cost efficient and cost effective is grant implementation?
3. Were challenges raised with the UNITAID Secretariat in a timely manner and did the Secretariat participate in resolving these challenges?
4. Was the grant's procurement model designed to identify and solve procurement-related problems (where applicable)?
5. Were there any issues related to potential diversion of products, counterfeit or quality?
6. Is the grantee implementation arrangement efficient?

Detailed questions

- Have improvements in test turn-around time been achieved?
    - What has been the time from collection to diagnosis with the introduction of this technology?
- Has this new technology reduced the time from analysis to referral of a patient to treatment in comparison with what existed prior to its introduction?
- What have been the problems in implementation of GeneXpert devices and after sales service (maintenance, warranties for TB REACH sites, breakdown/module failure). How has the manufacture response been in these situations?
- Customer satisfaction: Are lab technicians satisfied with the performance of this device (does it require long period of training, user friendly)?

Detailed procurement questions

- Have the procurement processes and activities used for the Projects been consistent with the (i) agreements between the Grantee and UNITAID
- Have procurement processes been efficient and effective in accomplishing the Project's objectives, notably achieving price reduction of products, increasing access to treatment, and encouraging new suppliers to enter the market?
- Has the appropriate expertise and structure required for the procurement activities been in place?
- Have the products procured and dispatched to countries met the quality assurance criteria defined in the projects?
- How well does the process of monitoring of shipments and calculation of lead times of delivery to countries work?
- Does procurement of products correspond to what has been approved and funded by UNITAID?
- Have manufacturer warranties for the product been respected? Do these warranties go far enough in terms of duration and detail?

Impact:

1. Can the grantee report on impact as originally framed in the project plan and Log-frame? If not, has the grant impact been measured in another way?
2. Where relevant, can the grantee attribute UNITAID's financial support for medicines, diagnostics or preventive products purchased to patients tested or treated in each beneficiary country?

Detailed questions

- What has been the improvement in diagnosis of TB, MDR TB in the sites? Has coverage improved?
- Review the Market Dynamics Impact assessment study and check whether the research questions can be used in this evaluation.

Learning & Risk mitigation:

1. Have lessons learnt been documented and widely disseminated by grantees and UNITAID?
2. Have programmatic and financial risks been identified and tracked over the course of grant implementation?
3. Have the findings and recommendations of mid-term evaluations or audits (where relevant) been used to improve grant performance?

ANNEX 2 – LIST OF INTERVIEWEES

No.	Name	Organization
1	Dr Teferi Mekonen	ASLM
2	Dr Optatus Malewo	CDC - TZA
3	Martin Colla	Cepheid
4	Philippe Jacon	Cepheid
5	Frederic Leme	Cepheid
6	Asad Zaidi	CHS
7	Zhi Zhen Qin	GDF
8	Dr Ahsana Nazish	Gori Clinic - Indus Hospital
9	Najam Riaz	IHN-GHD
10	Aditi Awarman	Innovasi Sehat
11	Roy Tjiong	Innovasi Sehat
12	Dr Aamir Khan	IRD
13	Saira Khowaja	IRD
14	Dr Nadeem Rizvi	Jinnah Post-Grad Medical Center
15	Vishnu Mahamba	KNCV
16	Jeremiah Ogoro	MoH - Kenya
17	Dr Gulmira Kalmambetova	MOH - Kyrgyzstan
18	Dr Alaine Nyaruhirira	MSH
19	Dr Nazish Masood	NTP - Pakistan
20	Dr Said Mfarma	NTP - Tanzania
21	Dr Kamara	NTP - Tanzania
22	Dr Amanullah Ansari	PTP - Sindh
23	Dr Ismat Ara	PTP - Sindh
24	Andrew Codlin	Stop TB
25	Jacob Cresswell	Stop TB
26	Dr Abubakar Maghimbi	U of Maryland - Global Initiatives
27	Yamuna Mundade	UNITAID
28	Ombeni Mwerinde	UNITAID
29	Jemmy Dopas	UNITAID
30	Dr Setiawan Jati Laksono	WHO - IDN CO
31	Mikyal Faralina	WHO - IDN CO
32	Achuthan Sreenivas	WHO - IND CO
33	Dr Neema Simkoko	WHO - TZA CO
34	Henriikka Weiss	WHO HQ
35	Wayne van Gemert	WHO HQ