Addressing the drug resistant tuberculosis challenge through implementing a mixed model of care in Uganda, 2012- 2017

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Abstract

Background Worldwide, Drug resistant Tuberculosis (DR-TB) remains a big problem; the diagnostic capacity has superseded the DR-TB clinical management capacity thereby causing ethical challenges. In Sub-Saharan Africa, treatment is either inadequate or lacking and some diagnosed patients are on treatment waiting lists. In Uganda, various health system challenges impeded scale up of DR-TB care in 2012; only three treatment initiation facilities existed, with only 41 of the estimated 1010 cases enrolled on treatment yet 300 were on the waiting list and there was no DR-TB treatment scale up plan. To scale up care, National TB/Leprosy Program (NTLP) with partners rolled out a DR-TB mixed model of care. In this paper, we share achievements and outcomes resulting from the implementation of this mixed Model of DR-TB care. Methods Routine NTLP DR-TB program data from 2013 to 2017 cohorts was collected from all the 15 DR-TB treatment initiation sites and analyzed using STATA version 14.2. We presented outcomes as the number of patient backlog cleared, DR-TB initiation sites, cumulative patients enrolled, percentage of co-infected patients on co-trimoxazole preventive therapy (CPT) and antiretroviral therapy (ART) as well as the six, twelve interim and 24 months treatment outcomes as per the Uganda NTLP 2016 Programmatic Management of drug Resistant Tuberculosis (PMDT) guidelines. Results Over the period 2013-2017, DR-TB treatment initiation sites increased from three to 15, cumulative patient enrollment rose from 41 to 1,311 and the 300-patient backlog was cleared. Treatment success rate (TSR) of 73% was achieved above the global TSR average rate of 50%. Conclusions The Uganda DR-TB mixed model of care coupled with early application of continuous improvement approaches, enhanced cohort reviews and use of multi-disciplinary teams allowed for rapid DR-TB program expansion, rapid clearance of patient backlog, attainment of high cumulative enrollment and high treatment success rates. Sustainability of these achievements is needed to further reduce the DR-TB burden in the country. We highly recommend this mixed model of care in settings with similar challenges.

Background

Worldwide, Drug resistant Tuberculosis (DR-TB) a form of tuberculosis (TB) where TB organisms continue to grow in the presence of one or more anti-TB drugs still remains a big challenge with Multi-drug resistant TB (MDR-TB) and extensively drug resistant TB (XDR-TB) being the worst forms. MDR-TB is defined as TB that is resistant to the two most powerful first-line medicines (Rifampicin and Isoniazid) while XDR-TB is a form of TB where in addition to being resistant to Rifampicin and Isoniazid, it is resistant to any Fluoro-quinolone and at least one of the injectable second-line drugs (1-3). In 2015 alone, about 580,000 people developed MDR-TB and about 9.7% of these cases had XDR-TB (4) while an estimated 250,000 people died of MDR-TB (1, 4). Notable causes of DR-TB among others include; poor adherence to TB treatment, inappropriate or incorrect use of anti-TB drugs, and use of poor quality medicines (5). Again, due to the growing availability of rapid diagnostics (Xpert MTB/Rif assay), detection and diagnosis of DR-TB patients is on the increase. However, in most settings, the diagnostic capacity has superseded the DR-TB clinical management capacity thereby causing ethical challenges (6, 7). DR-TB fuels the generation and subsequent transmission of highly resistant strains of TB termed XDR-TB (2) and incident cases are predicted to increase (8). In this regard, the emergence of drug-resistant TB (DR-TB) continues to threaten global efforts to eliminate TB and threatens to reverse the global progress made in TB control (9-12).

In Sub-Saharan Africa, a resource limited setting, the true burden of drug resistant TB is unknown as most countries have not conducted drug resistant surveys (DRSs). To make matters worse, treatment of patients with DR-TB is either inadequate or lacking (2, 13). This precedent has resulted into DR-TB patients diagnosed being put on treatment waiting lists as affected countries try to establish or scale up PMDT treatment programs. The outcome of this is that most DR-TB patients are delayed to start treatment resulting into high morbidity and mortality (14-17).

Uganda is one of the “30 high burden TB/ Human immunodeficiency virus (HIV)” countries (HBC) that collectively account for 90% of the global TB burden(18). While the World Health Organization (WHO) had scrapped Uganda off the HBC list in 2015 (20), a recent Uganda population based TB prevalence survey suggests that incidence and prevalence rates in the country are far higher than previously believed(19, 20), and that notification rates for drug-susceptible (DS) and drug

resistant (DR) TB represent only a small proportion of actual cases(20). In 2012, the Uganda National TB and Leprosy Programme (NTLP) had encountered several challenges in implementing TB control activities in the country, for example, there was limited capacity to rapidly clear the 300 DR-TB patient backlogs. Consequently, in 2013, the NTLP was supported to overcome such challenges(20, 21). Partners provided both logistical and technical support to NTLP central unit, treatment sites and played a coordination role. Therefore, the objective of this descriptive review was to assess and share resulting from achievements of the implementation of the Uganda mixed Model of DR-TB care.

Methods

Study s*etting*

Uganda is a land locked country, located in East Africa with a total population of 34.6 million and over 111 districts and one City (22). Uganda is among the 30 high TB/HIV burden countries(18) with a TB prevalence and incidence at 253 cases per 100,000 and 234 cases per 100,000 respectively (19, 23). The burden of MDR-TB is estimated at 1.4% among all new and 12.1% among previously treated TB cases (9) (11). In 2012, Uganda was only notifying about 310 DR-TB cases with only 41 out of the estimated 1,010 DR-TB cases being enrolled on treatment and about 300 DR-TB patients were on the waiting list (17) (21). Lack of treatment for most DR-TB patients perpetuated an ongoing transmission of drug resistant TB strains thereby posing a major threat to the community around these patients. During the same period, NTLP was still grappling with lack of a nationally agreed DR-TB scale up plan coupled with a weak health care system. There was limited access to drug sensitivity test (DST), unreliable second line drug (SLD) management system, with no contact tracing of contacts of index DR-TB cases besides limited expertise in DR-TB management and poor access to DR-TB treatment. More still, the country only had three DR-TB treatment initiation facilities(21, 24) and thus health workers often referred DR-TB patients to these few treatment initiation sites. Furthermore, there were low levels of sputum follow up examinations; loss of specimens during transportation; drug stock outs; lack of appropriate isolation spaces as well as limited funding at both NTLP central unit and district levels. Due to high stigma towards DR-TB patients and high mobility of populations, DR-TB patient loss-to-follow-up was high(21).

Service delivery through a mixed DR-TB model of care

Due to the above challenges and the high political pressure to expand the Programmatic Management of drug Resistant Tuberculosis (PMDT) program as well as the need to clear the big number of patient backlog led to a paradigm shift in the way the NTLP and partners (USAID funded TRACK TB Project, SUSTAIN and GFATM) designed and scaled up DR-TB service delivery (21). Therefore, a locally appropriate Uganda-specific mixed model of DR-TB treatment was designed and rolled by NTLP and partners to rapidly absorb the DR-TB patient backlog so as to save lives and to curtail the ongoing DR-TB transmission (25). This DR-TB mixed model of care involves brief periods of hospitalization (in-patient) followed a long period of ambulatory/clinic-based care. Patients who are severely ill or not within immediate catchment area of the treatment initiation hospital are admitted for a short period of 1- 8 weeks and thereafter are transferred for ambulatory care at a prepared peripheral directly observed therapy (DOT) follow up facility nearest to patients' homes.

Therefore, in this paper we share experiences, implementation approach, achievements and lessons/good practices from the implementation of the Uganda mixed DR-TB treatment model of care over 2013-2017 period that may be important for both current and future PMDT programs.

Interventions, innovations and roll out of the DR-TB mixed model

Before the DR-TB program was scaled up, a baseline analysis was conducted that informed the DR-TB minimum package of interventions that were applied. These interventions included strengthening of health care provider skills, implementation

of quality improvement and use of standard operating procedures, improving access to patient investigation/treatment monitoring tests, management of TB commodities, strengthening of data management, performance of enhanced cohort reviews, improving TB Infection Control practices, facilitation to implement ambulatory care (Home visiting, contact tracing, follow up facility training/mentorship and drug delivery), general hospital administrative support and provision of patient psychosocial economic support including food and transport (incentives and enablers). This direct patient socio-economic support is reported to be associated with better treatment outcomes through enhancement of nutritional status, patient adherence and compliance (26, 27).

NTLP was supported with logistical and technical support at both its central unit and at all DR-TB facilities. Human resource (HR) capacity and partner coordination at NTLP central unit was strengthened through secondment of technical staff to lead NTLP continuous quality improvement (CQI) campaigns and overall partner coordination. Early implementation of continuous quality improvement campaigns through peer to peer mentorships, coaching, holding learning sessions contributed to improved quality of care and the building of multi-disciplinary teams of DR-TB experts in sites where few experts existed. Therefore, these teams of experts provided the day to day advisory services at both the national and regional levels. More still, initially, a toll-free helpline was established to support linkage of peripheral regional site teams to the National DR-TB Panel for specialized advisory services until an Echo platform which a learning network, established by the Project ECHO (University of New Mexico) was introduced.

To ensure standardized DR-TB program implementation, DR-TB treatment guidelines and other tools were developed and disseminated through National coordination committee (NCC) meetings at central level while at subnational level, this was achieved through performance and cohort review meetings. Conduction of enhanced cohort reviews also helped to validate program data, identify performance gaps and best practices. Therefore, these enhanced cohort reviews served as a vehicle for capacity building and programmatic implementation of continuous quality improvement (CQI) campaigns.

More human resource capacity at DR-TB treatment initiation was built based on a standardized curriculum and training materials including at Follow up health facilities (FUFs, defined as any health facility identified and accepted to offer DOT to DR-TB patients). Remodeling/construction of DR-TB wards to both expand admission ward space as well as improve TB infection control was supported. Community linkage facilitators (CLF) and district teams supported adherence enhancement through provision of patient and family education on DR-TB disease, tracking of patients lost to follow-up as well as linking of diagnosed patients. DR-TB program monitoring and evaluation system was strengthened through development of an electronic web-based recording/reporting management system (DR-TB Management Information System). To strengthen the DR-TB drug and commodity supply chain, the QUAN TB tool was used (31) to improve ordering as well monitoring of utilization of DR-TB commodities. Again, installation of GeneXpert machines while ensuring internet connectivity to improve access to rapid DST (drug susceptibility testing) and to facilitate real time transmission of GeneXpert results through the GxAlert information system was done. To ensure a high DR-TB program quality, NTLP's central DR-TB core committee that is part of the national technical committee that oversees implementation, policy formulation, resource mobilization, implementation science and overall coordination of the PMDT program was set up and facilitated to hold regular coordination meetings during which action plans were drawn. For Treatment Initiation Sites (TISs) and, FuFs' roles see *table 1.*

Data collection and analysis

We used routine DR-TB program 2013 - 2017 data collected by NTLP using NTLP recording and reporting tools from all the 15 sites to describe the achievements and outcomes of implementing the DR-TB mixed model in Uganda. Data on the following variables was collected; treatment initiation site, DR-TB patients enrolled, sex, age, patient categories, disease type, HIV status, HIV integration, culture and smear results, six, twelve and 24 months (final) treatment outcomes based on Uganda NTLP guidelines. Cohort data from 2013 to 2017 for all the 15 treatment initiation facilities was collected and analyzed using STATA version 14.2 (Stata Corp. 2015. Stata Statistical Software: College Station, TX: Stata Corp LP).

Continuous data were summarized using medians while categorical data were computed as proportions. We presented the data in text, tables, and graphs. Results were presented at p-value < 0.05 level of significance and 95% confidence interval. We took achievements and outcomes to be number of patient backlog cleared, increment in number of DR-TB initiation sites, cumulative number patients enrolled, percentage of HIV integration interventions as well as six, twelve months interim and 24 months final treatment outcomes among 2013 - 2017 cohort. The outcome measures were defined according to the Uganda NTLP 2016 PMDT guidelines.

Results

In this paper we share experiences, implementation approach, achievements, lessons learnt as well as good practices from the implementation of DR-TB mixed model in Uganda over five years (2013-2017) that may be important for both current and future PMDT programing.

The operationalization of the Uganda DR-TB mixed model allowed for the rapid expansion of the DR-TB treatment and care program from three treatment initiation sites at baseline in 2012 to 12 in 2013 and then 15 in 2014 up to 2017 (figure 2). The backlog of 300 DR-TB patients who were on the treatment waiting list was cleared by end of 2014. The DR-TB cumulative patient enrollment increased from 41 in 2012 to 1311 patients *(Figure 1)*in 2017 due to improved GeneXpert coverage (there were 24 GeneXpert machines in 2012, 39 in 2013, 72 in 2014, 111 in 2015, 112 in 2016 and 131 in 2017,*Figure 2)* and linkage to care.

Characteristics of patients enrolled for MDR-TB treatment

The characteristics of DR-TB patients enrolled for treatment from 2013 to 2017 are shown in *Table 2* below. In this period, a total of 1,311 DR TB patients were enrolled; 64.4% (844/1311) were male although sex was not statistically significant in influencing patient enrollment (p=0.85). Age was a major factor in enrollment (p=0.04) with the majority of enrolled patients (47.2% (619/1311) being in the young and productive age group of 15-34 years, followed by 41.7% (547/1311) in 35-54 years, 7.6% (100/1312) who were older than 54 years and 3.3% (43/1311) who were under 15 years. The median age was 34 years, with a mean of 35.53 ± SD 12.78 years. Although most patients (98.5% (1291/1311) had pulmonary DR-TB disease; disease classification was not statistically significant in driving enrollment (p=0.449), but then HIV status was (p=0.01). Almost half of the patients (52.6% (690/1311) were HIV co-infected.

Treatment outcomes

Six-month interim treatment outcomes for DR-TB patients enrolled from 2013 to 2017

Although the culture conversion rates initially improved significantly (p< 0.05) at month six from 48.8% (20/41) in 2012 to 55.2% (112/203) in 2013 and then 67.8% (139/205) in 2014, there was a drop off to 58.0% (145/250) in 2015 and 47.6% (180/378) in 2016 cohorts *(Table 3)*. Similarly, the culture conversion rates at 12 months initially improved from 29.3% (12/41), to 51.7% (105/203) in 2013 and 63.9% (131/205) in 2014 but again dropped to 48% (120/250) in 2015 *(Table 4)*. Therefore, the six- and 12-months interim treatment outcomes are part of the ongoing DR-TB program challenges.

Final treatment outcomes for DR-TB patients enrolled in 2013 and 2014

The original small cohort of 41 patients in 2012 cared for by partner organizations achieved a high level of treatment success of 78% (32/41), but the notable achievement under this NTLP led MDR-TB mixed model is that NTLP managed to maintain high treatment success rates of 74.0% among both 2013 and 2014 cohorts and then 70.1% in the 2015 cohort in the face of large rise in enrollment and rapid expansion to multiple sites across the country, within the public health system (Table 5). Evidence from other settings show similar outcomes when patients are hospitalized for a brief period followed with ambulatory care so long as patient support and monitoring is done (28).

The proportion of cured DR-TB patients increased substantially from 48.8% in 2012 to 60% and above in 2013 to 2015 (p=0.03), with significant reduction in treatment completion rates from 29.3% to 3.3% (p< 0.05) which points to improved quality of care. Overall, 1.1% (7/649) failed on treatment, with a slight increase in failure rate from 0% in 2012 to 1.7% in 2015 but this was not statistically significant (p=0.57). Out of the 52.1% (338/649) HIV co-infected patients, 100% (338/338) were on both CPT and ART. However, HIV co-infection rates soared up from 31.7% in 2012 to 57.3% in 2015 (p<0.05), see *table 5*.

Discussion

The notable achievement under this NTLP led DR-TB mixed model is that NTLP managed to maintain high treatment success rates (TSR) of 74.0% among both 2013 and 2014 cohorts and 70.1% among 2015 cohort compared to 78% that was achieved among the original small cohort of 41 patients cared for by partner organizations under research setting in 2012. The achieved TSR was well above the global TSR average rate of 50% (4) and was achieved in the face of high number of DR-TB patient backlog (of 300 patients), large rise in enrollment and rapid expansion to multiple sites across the country within the public health system(24). These high treatment success rates in both 2013 to 2015 were made possible because there was early implementation of continuous quality improvement campaigns through peer to peer mentorships, coaching, holding learning sessions. These quality improvement campaigns contributed to improved quality of care and the building of multi-disciplinary teams of DR-TB experts. In addition, there was conduction of enhanced cohort reviews which helped to validate program data, identify performance gaps and best practices. The quickly built DR-TB capacity through enhanced cohort reviews and early application of CQI approaches allowed for rapid expansion of the DR-TB treatment initiation sites from three in 2012 to 12 in 2013 and subsequently to 15 since 2014 up to 2017. The significant rise in enrollment rates and in the proportion of cured DR-TB patients over those who completed treatment attests to this built capacity and improved quality of DR-TB care. Again, treatment models that embrace

This rapid expansion in number of DR-TB treatment initiation facilities and ambulatory care led to rapid clearance of the 300 DR-TB patients who were on the waiting list since 2009 and the attainment of a cumulative DR-TB enrollment of 1311 patients over a five year period (2013-2017) up from 41 enrolled in 2012. More still, wide spread availability of GeneXpert machines enabled the identification of the 1311 DR-TB cases despite a low GeneXpert utilization standing at an average of 6 tests per machine; there were 24 GeneXpert machines in 2012, 39 in 2013, 72 in 2014, 111 in 2015, 112 in 2016 and 131 in 2017. GeneXpert implementation is reported to improve early detection and to promote early treatment of DR-TB (29-31).

According to Uganda PMDT guidelines, all newly diagnosed DR-TB patients are started on a standard regimen - 6Km-Lfx-Cs-Eto-Z/14Lfx-Cs-Eto-Z until their DSTs are available at which point, their treatment becomes individualized based on observed resistance and side effects profiles (32). Most patients respond well on this regimen; for example, among the 1036 patients who were evaluated for interim treatment outcomes at 6 months, generally, culture conversion rates improved significantly over the years 2013 to 2015 compared to 2012 baseline (p< 0.05); 55.6% (576/1036) had achieved culture conversion with only 0.9% (9/1036) still being culture positive. At 12 months, 54.1% (356/658) of the evaluated patients were culture negative with only 0.5% (3/658) remaining culture positive. The high proportion of patients with no culture results at both six and 12 months outcome analysis across all the years is attributed to patient deaths, LTFU, and failures in sample referral system as well as failure to return culture and smear results to health facilities (21, 33). Again, although these challenges were picked up by CQI, addressing them could not be solved at once in a public health system.

Unfavorable treatment was observed in 27.4% (178/649) of the patients with minimal failure rate of 1.1% (7/649) and lost to follow up of 10.9% (71/649). However, from 2013 and 2015, there were high death (17.7%, 14.6% & 14.1%) than they were lost to follow up (7.4%, 10.7% & 14.1%) and failed treatment (1.0%, 0.5% & 1.7%). Being a category 1 treatment failure was a strong predictor of death (OR 2.66 (CI: 39-5.06), *p*=0.003) unlike HIV co-infection (OR=0.58 (CI: 0.34-0.99), *p*=0.050) despite the high TB-HIV co-infection rate of 52.1% (338/649) which is highly associated with mortality in other settings (17). However, the high deaths and LTFU among the 2013 to 2015 cohorts could in addition be attributed to; firstly, enrollment of critically ill patients as a result of being on a treatment waiting list for long before the expansion of PMDT in 2013 (20) and secondly, rapidly expanding PMDT program to DR-TB sites that had limited capacity and prior experience to manage MDR-TB patients in the bid to rapidly clear the patient backlog and save lives (20).

Of the 1,311 DR-TB patients enrolled on treatment since 2013 up to 2017, 64.4% (844/1311) were males. This finding of a higher DR-TB burden among males is also reported in other settings and the available epidemiological literature suggests that this differential burden may be due to environmental and biological factors (34-39). However, in Uganda, whether this observation is due to environmental, biological, social determinants or increased male's health seeking behavior remains to be fully established. In addition, most of the patients were in the reproductive years, with pulmonary DR-TB disease and were co-infected with HIV. This indicates a pressing need to identify and effectively manage DR-TB patients with Pulmonary TB disease with a gender focus among men.

To reduce DR-TB related mortality and DR-TB transmission, there is a need for early detection and prompt treatment of DR-TB patients. Again, the regularity of patient incentives and enablers under Global fund needs to be improved to lead to further improvement in DR-TB treatment outcomes. Provision of socio-economic support is reported to improve treatment outcomes and quality of life (12, 16, 40). Efforts to improve transportation of sputum samples, the turnaround time of results and logistical challenges are needed(20, 21, 23). Therefore, more support should be given to monitoring and evaluation to ensure that all data pertaining to baseline investigations, treatment monitoring including sputum smear and culture results as well as treatment outcomes are promptly and completely entered the DR-TB registers.

The strategies and approaches employed under this model are useful to most countries battling with the same problem of clearing backlog and expanding patient enrollment (25). Available studies suggest that such DR-TB treatment models that embrace CQI approaches and decentralization of management of patients near or at home, are not only socially acceptable (27, 41) but are associated with favorable treatment outcomes; even among HIV co-infected and extensively drug resistant TB patients (42).

Due to the inherent nature of retrospective studies, this descriptive review had some limitations; some important study variables e.g. smear and culture monitoring results were unknown for a significant number of patients. Therefore, during study analysis, outcomes were assigned based on only records and monitoring data variables that were available in the DR-TB register. This has potential of introducing a selection bias into our results, therefore, there is need to strengthen data documentation especially now with the introduction of web-based DR-TB management system.

Conclusions

In conclusion, this descriptive review indicates that the NTLP led DR-TB mixed model of care achieved high TSRs of 74.0% among both 2013 and 2014 cohorts and 70.1% among 2015 cohort in the face of high number of DR-TB patient backlog (of 300 patients), large rise in enrollment and rapid expansion to multiple sites across the country within the public health system. These achievements are attributed to early implementation of CQI campaigns which contributed to improved quality of care and the building of the capacity of multi-disciplinary teams of DR-TB experts. In addition, conduction of enhanced cohort reviews helped to validate program data, identify performance gaps and best practices. Use of this experience to foster national PMDT expansion as well as sustainability of these achievements is needed to further reduce

the DR-TB burden in the country. However, due attention should be paid to the identified performance gaps for improvement. We highly recommend this model of care in similar settings with similar challenges.

List Of Abbreviations

ART Antiretroviral therapy

CQI Continuous quality improvement

CPT Co-trimoxazole preventive therapy

CLF Community linkage facilitators

DR-TB Drug resistant Tuberculosis

DR Drug resistant

DST Drug sensitivity test

DS Drug-susceptible

DOT Directly observed therapy

DRSs Drug resistant surveys

FUFs Follow up health facilities

HIV Human immunodeficiency virus

HR Human resource

HBC High burden TB/HIV” countries

MDR-TB Multi-drug resistant TB

NCC National coordination committee

NTLP National TB/Leprosy Program

PMDT Programmatic Management of drug Resistant Tuberculosis

SLD Second line drug

TB Tuberculosis

TSR Treatment success rate

TISs Treatment Initiation Sites

USAIDUnited States Agency for International Development

WHO World Health Organization

XDR-TB Extensively drug resistant TB

Declarations

Ethical considerations

Our study used routine NTLP program (23)(24)(19) with no patient interaction, therefore, the authors did not seek further ethical approval. The study did not use any patient identifying information so patient consent was a requirement for this study. There was no anticipated risk or benefit to the patients in the analysis of this information.

Consent to publish

Not Applicable.

Availability of data and materials

The datasets used and/or analyzed during the current the study is publicly available by reasonable request to the NTLP.

Competing interests

Authors declare no competing interests.

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Authors' contributions

SK, NKS, DL, RB, CL, HL, ST, EK and PS conceived the idea, designed the study and collected the data. NKS, DK and SK performed the data analysis. SK, NKS, DL, DK, RB, CL, HL, EK and ST wrote the manuscript draft and contributed to interpretation of results and reviewed the scientific content of the manuscript and entire supervision of the study process. PS reviewed the manuscript. All the authors read and approved the manuscript. The views and opinions expressed in this paper are those of the authors and do not necessarily represent official policy or position of the organizations they are affiliated too nor that of the United States Agency for International Development.

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Conflict of interest

The authors declare no conflict of interest.

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Tables

Table1: Roles of Treatment initiation sites and FuFs in DR-TB management

Treatment initiation site (TIS)	Follow up Facility (FuF)
· Initiating and offering "start-to-finish" case management (monthly clinic reviews, monitoring and managing side effects, offering DR-TB expert Panel services, and conducting cohort reviews to assign treatment outcomes) · Training and mentoring FuFs for ambulatory care · Managing and suppling DR-TB commodities to all initiated/active patients	· Providing DOT to DR-TB patients on ambulatory care · Providing adherence counselling and education to patients and families · Conducting patients' home visits for contact tracing, nutrition and infection control assessments.

Table 2: Characteristics of DR-TB patients enrolled for treatment in 2013 and 2017

Baseline characteristics	*2012 Baseline n (%)*	*2013 n (%)*	*2014 n (%)*	*2015 n (%)*	*2016 n (%)*	*2017 n (%)*	*Total (2013-17) n (%)*	*P-values*
Total (N)	41	203	205	250	378	275	1311	
Sex								
Male	26(63.4)	126(62.1)	131(63.9)	168(67.2)	247(65.3)	172(62.6)	844(64.4)	0.85
Female	15(36.6)	77(37.9)	74(36.1)	82(32.8)	131(34.7)	103(37.4)	467(35.6)	
Age (years)								
<15	2(4.9)	5(2.5)	3(1.5)	7(2.8)	12(3.2)	16(5.8)	43(3.3)	0.04
15–34	13(31.7)	97(47.8)	88 (42.9)	132(52.8)	180(47.6)	122(44.4)	619(47.2)	
35–54	24(58.5)	91(44.8)	101(49.3)	96(38.4)	153(40.5)	106(38.5)	547(41.7)	
>54	2(4.9)	10(4.9)	13(6.3)	14(5.6)	33(8.7)	30(10.9)	100(7.6)	
Missing age	0(0.0)	0(0.0)	0(0.0)	1(0.4)	0(0.0)	1(0.4)	2(0.2)	
Type of DR-TB								
Pulmonary	39(95.1)	200(98.5)	201(98.1)	248(99.2)	373(98.7)	269(97.8)	1291(98.5)	0.45
Extra-pulmonary	2(4.9)	3(1.5)	4 (1.9)	2(0.8)	5(1.3)	6(2.2)	20(1.5)	
HIV status								
HIV-negative	28(68.3)	112(55.2)	96(46.8)	107(42.8)	167(44.2)	139(50.5)	621(47.4)	0.01
HIV-positive	13(31.7)	91(44.8)	109(53.2)	143(57.2)	211(55.8)	136(49.5)	690(52.6)	

Table 3: Six-month interim outcomes for DR-TB patients enrolled from 2013 to 2016.

Interim outcomes at 6 months	*2012 Baseline n (%)*	*2013 n (%)*	*2014 n (%)*	*2015 n (%)*	*2016 n (%)*	*Total 2013-2016 n (%)*	*P-value*
Total	41	203	205	250	378	1036	
Culture negative	20(48.8)	112(55.2)	139(67.8)	145(58.0)	180(47.6)	576(55.6)	< 0.05
Culture positive	1(2.4)	2(1.0)	1(0.5)	4(1.6)	2(0.5)	9(0.9)	
Culture unknown	20(48.8)	89(43.8)	65(31.7)	101(40.4)	196(51.9)	451(43.5)	

Table 4: Twelve-month interim outcomes for DR-TB patients enrolled in 2013 - 2015

Interim outcomes at12 months	*2012 Baseline n (%)*	*2013 n (%)*	*2014 n (%)*	*2015 n (%)*	*Total 2013-2015 n (%)*	*P-Value*
Total	41	203	205	250	658	
Culture negative	12(29.3)	105(51.7)	131(63.9)	120(48.0)	356(54.1)	< 0.05
Culture positive	0(0.0)	2(1.0)	1(0.5)	0(0.0)	3(0.5)	
Culture unknown	29(70.7)	96(47.3	73(35.6)	130(52.0)	299(45.4)	

Table 5: Final treatment outcomes for DR-TB patients enrolled in 2013 and 2014

Final Treatment outcome	2012 Baseline *n (%)*	2013 *n (%)*	2014 *n (%)*	2015 *n (%)*	Total *n (%)*	P-value
Total	41	203	205	241	649	
Cured	20(48.8)	122(60.1)	142(69.3)	161(66.8)	425(65.5)	0.03
Completed Treatment	12(29.3)	28(13.8)	10(4.9)	8(3.3)	46(7.1)	<0.05
TSR	32(78.0)	150(73.9)	152(74.1)	169(70.1)	471(72.6)	0.63
Unfavorable	9(22.0)	53(26.1)	53(25.9)	72(29.9)	178(27.4)	
· Lost to Follow up (LTFU)	4(9.7)	15(7.4)	22(10.7)	34(14.1)	71(10.9)	0.16
· Died	2(4.9)	36(17.7)	30(14.6)	34(14.1)	100(15.42)	0.20
· Failed Treatment	0(0.0)	2(1.0)	1(0.5)	4(1.7)	7(1.1)	0.57
· Not evaluated	3(7.3)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	<0.05
Tested for HIV	41(100)	203(100)	205(100)	241(100)	649(100)	N/A
HIV-positive	13(31.7)	91(44.8)	109(53.2)	138(57.3)	338(52.1)	<0.05
Started on CPT	13(100)	91(100)	109(100)	138(100)	338(100)	N/A
Started on ART	13(100)	91(100)	109(100)	138(100)	338(100)	N/A

From 2015 cohort 9 patients were found not RR/MDR patients and thus eliminated from final treatment outcomes

Table 5: MDR-TB performance indicators: 2013 – 2017 against 2012 baseline.

	2012	2013	2014	2015	2016	2017	Target
(%) PMDT annual work plan developed and implemented	0	70%	100%	100%	100%	100%	75%
No. of HCWs seconded to DR-TB sites	0	25	25	25	25	25	25
No. of sites with Audiometry machines	0	12	13	13	13	13	15
No. of sites with a GeneXpert installed	24	39	72	111	112	131	131
National GeneXpert utilization (tests per machine)	unknown	2	3	5	5	6	12
No. of DR-TB sites using electronic registers	0	12	15	15	15	15	15
No. DR-TB sites using DR-TB MIS	0	0	0	0	15	15	15
No. of DR-TB sites conducting quarterly cohort reviews	3	12	15	15	15	15	15
No. of DR-TB sites remodeled/constructed	1	2	3	4	6	6	5
No. of DR-TB sites having a TB IC plan	3	12	15	15	15	15	15
No. of DR-TB sites supported with patient incentives/enablers	3	15	15	15	15	15	15

Figures

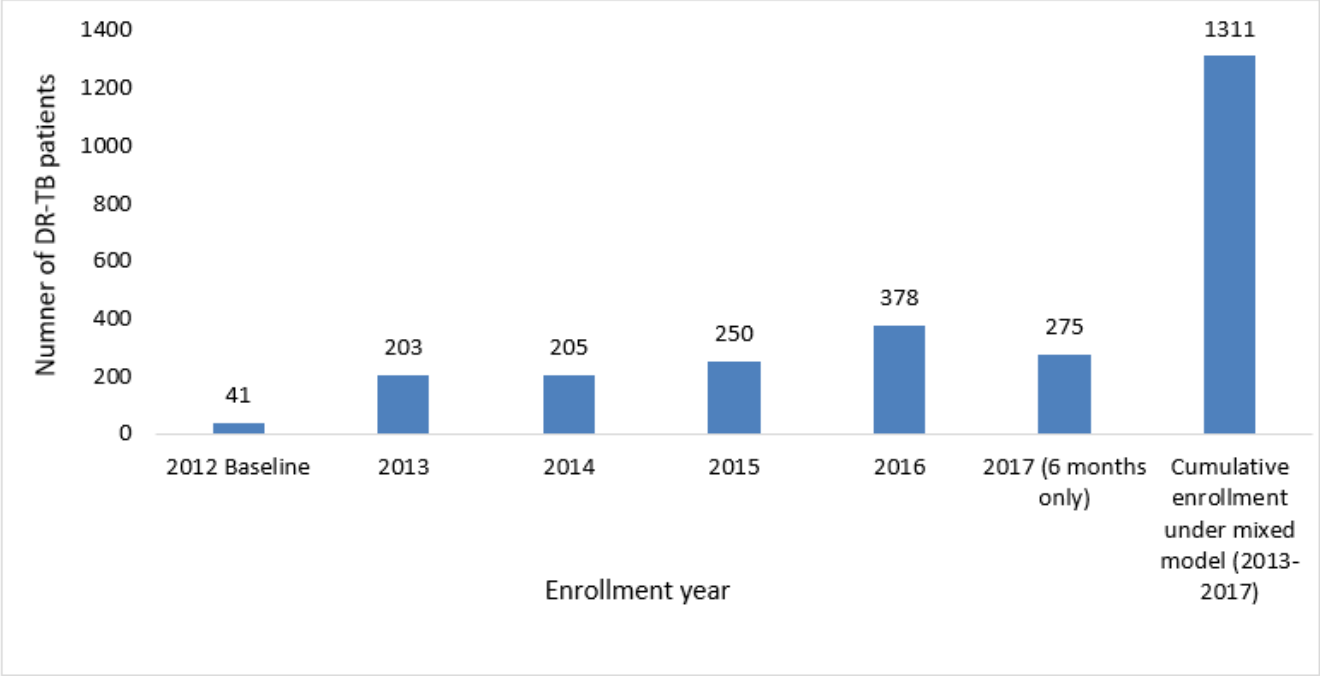

Figure 1

Number of DR-TB patients enrolled by year

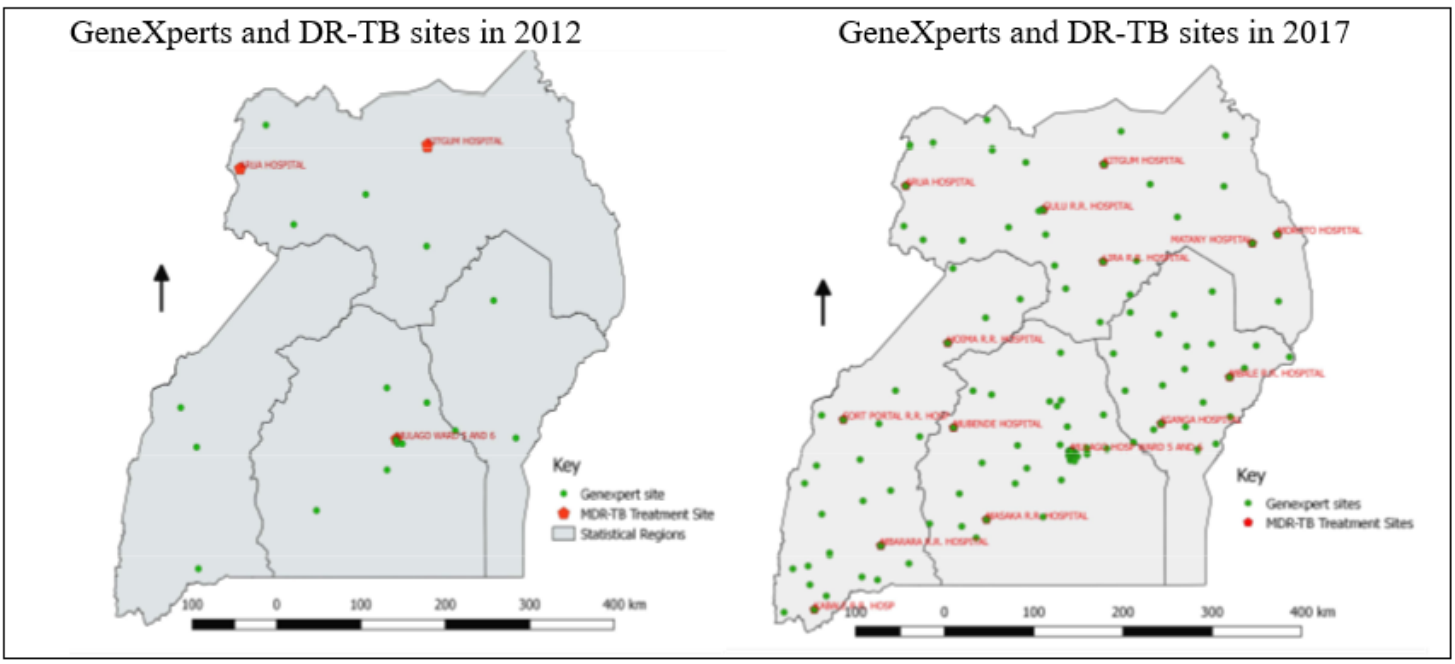

Figure 2

GeneXpert and DR-TB sites in 2012 and 2017