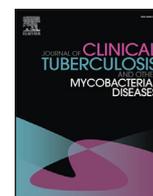




Contents lists available at ScienceDirect

# Journal of Clinical Tuberculosis and Other Mycobacterial Diseases

journal homepage: [www.elsevier.com/locate/jctube](http://www.elsevier.com/locate/jctube)

## The experience of scaling up a decentralized, ambulatory model of care for management of multidrug-resistant tuberculosis in two regions of Ethiopia



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### ARTICLE INFO

#### Article history:

Received 8 November 2016

Revised 13 February 2017

Accepted 3 March 2017

### ABSTRACT

Strong strategies, including proven service delivery models, are needed to address the growing global threat of multidrug-resistant tuberculosis (MDR-TB) in low- and middle-income settings. The objective of this study was to assess the feasibility and effectiveness of the nationally approved ambulatory service delivery model for MDR-TB treatment in two regions of Ethiopia. We used routinely reported data to describe the process and outcomes of implementing an ambulatory model for MDR-TB services in a resource-limited setting. We compared percentage improvements in the number of MDR-TB diagnostic and treatment facilities, number of MDR-TB sputum samples processed per year, and MDR-TB cases ever enrolled in care between baseline and 2015. We also calculated interim and final treatment outcomes for patients who had completed at least 12 and 24 months of follow-up, respectively. Between 2012 and 2015, the number of MDR-TB treatment-initiating centers increased from 1 to 23. The number of sputum samples tested for MDR-TB increased 20-fold, from 662 to 14,361 per year. The backlog of patients on waiting lists was cleared. The cumulative number of MDR-TB patients put on treatment increased from 56 to 790, and the treatment success rate was 75%. Rapid expansion of the ambulatory model of MDR-TB care was feasible and achieved a high treatment success rate in two regions of Ethiopia. More effort is needed to sustain the gains and further decentralize services to the community level.

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### Introduction

Multidrug resistant tuberculosis (MDR-TB) is a global public health challenge. In 2015, of over half a million people estimated to have developed MDR-TB, national TB control programs (NTPs) notified only 20% [1]. Moreover, only 52% of those treated successfully completed the recommended regimen. While these data suggest the presence of critical challenges in the scale-up of MDR-TB services, they also highlight a tripling in case detection and enrollment in care compared with the 2009 baseline [1].

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Further scale-up of MDR-TB services in resource-limited settings requires consensus on the best model of service delivery, since the hospitalized model of care used in developed settings is not sustainable [2]. Cost-effectiveness studies suggest that MDR-TB treatment can be cost-effective, but the model of care is the main influencer of costs, with ambulatory care being more cost-effective [3]. There is also clear evidence from other infectious disease programs that decentralized service delivery improves treatment outcomes. Lessons from decentralized management of HIV programs are particularly relevant for scale-up of MDR-TB services, although important differences between the care needs of MDR-TB patients and those of HIV patients should be taken into consideration [4–6].

Earlier experience from resource-limited settings in Asia, Eastern Europe, and Latin America demonstrated the effectiveness of

standardized MDR-TB treatment approaches, but treatment outcomes varied significantly among countries because of differences in the mode of service delivery. Higher loss-to-follow-up rates, for example, were reported from countries that provided services at a single centralized site compared with countries that implemented a more decentralized approach [7]. The degree of decentralization also varied considerably across countries and regions, with varying degrees of success in treatment outcomes [8–12]. More data are needed, especially from sub-Saharan Africa, to support the ongoing efforts to strengthen the decentralized ambulatory model of care for low- and middle-income settings.

Ethiopia is among the MDR-TB high-burden countries that have achieved an MDR-TB treatment success rate (TSR) exceeding 70% [13]. However, there is limited data on the TSR following the rapid expansion and decentralization of services. In this paper, we describe the processes and outcomes of a decentralized, ambulatory approach to MDR-TB treatment in two large regions of Ethiopia. The two regions cover over half of the country's population. Also, more than 50% of the country's MDR-TB treatment centers are located in these two regions. Our objective was therefore to describe how a decentralized, ambulatory model of MDR-TB treatment, if coupled with appropriate quality assurance strategies, could improve access to and quality of MDR-TB services without compromising treatment outcomes in a setting with limited resources. We also highlighted some of the challenges encountered during this progress and suggested practical solutions based on field-level implementation experience.

## Methods

### The setting

Ethiopia is located in the horn of Africa. The country is subdivided into nine administrative regional states and two city councils. Each regional state is further subdivided into administrative zones, which in turn comprise woredas (equivalent to districts). Oromia is the largest regional state, with an estimated population of over 34 million, followed by Amhara Region, which has a population of over 20 million [14]. The current national TB incidence and prevalence estimates per 100,000 population are 200 and 207, respectively [1]. The proportion of MDR-TB cases among new and previously treated cases is estimated to be 1.6% and 11.8%, respectively [15].

Under the guidance of the Ministry of Health of Ethiopia (FMOH) and the Regional Health Bureaus of Amhara and Oromia regions, the Help Ethiopia Address the Low Tuberculosis Performance (HEAL-TB) Project has provided comprehensive TB program support to the two regions since July 2011. HEAL-TB, funded by the United States Agency for International Development (USAID) and implemented by Management Sciences for Health, prioritized MDR-TB as one of the key technical areas for support. We selected the two HEAL-TB-supported regions for this analysis because we were able to obtain complete data through project activities, which allowed us to thoroughly document the processes and outcomes of the program.

### Service delivery models

FMOH recommends two models of care for management of MDR TB patients [16,17]. In the **inpatient model of care**, all eligible patients that are ready to start treatment with second line drugs (SLDs) are admitted to treatment initiating centers (TICs) with designated MDRTB wards for four to eight weeks till the patient turns sputum smear negative. Upon discharge from the TICs, patients are referred to treatment follow up centers (TFCs) for outpatient follow up. Prior to 2011, only two tertiary hospitals pro-

vided MDR TB treatment to patients from all over the country using the inpatient model of care (Fig. 1). However, with the growing need to improve access to MDR-TB services, the FMOH developed a decentralized, ambulatory model of care for rapid expansion of the services [16].

In the **ambulatory model of care**, patients are treated at outpatient level at TFCs from day one. The multidisciplinary panel team at TICs may recommend temporary admission at TICs based on clinical or social criteria. At TFCs, patients received daily injections six times per week for the initial 8–9 months (intensive phase) and attended daily follow up during the continuation phase. The patients received their medications under direct observation and strict follow up by health workers both at TICs and TFCs. Table 1 describes the roles and responsibilities of TICs and TFCs in the ambulatory model of care.

All newly diagnosed MDR-TB patients received a standardized treatment regimen, per the national guidelines [18]. Accordingly, the recommended regimen of choice was eight months of Pyrazinamide (Z)- Capreomycin (Cm)- Levofloxacin (Lfx)-Prothionamide (Pto)-Cycloserine (Cs) for the intensive phase followed by 12 months of Pyrazinamide (Z)-Levofloxacin (Lfx)-Cycloserine (Cs) abbreviated as **8 Z-Cm<sub>6</sub>-Lfx-Pto-Cs, 12 Z-Lfx-Cs**.

### Interventions and innovative approaches

Some of the challenges identified at baseline and anticipated to be encountered in the longer-term necessitated prompt innovative interventions. Less organized clinic appointment systems and consequent poor adherence to treatment and follow up; limited experience of the clinical team; and irregularities in laboratory monitoring systems were some of the key challenges identified at baseline.

Strengthening the national and regional level program coordination capacity was the initial step in enabling the operationalization of the decentralized, ambulatory model of care. This was followed by specific capacity building efforts for health care providers and program managers through trainings on clinical and programmatic management of MDR-TB. To ensure ongoing learning and skills improvement we prepared, printed and distributed provider support tools including pocket guides, clinician desk references, cohort monitoring charts, and wall charts adapted from national guidelines. Since most health facilities did not have adequate space and were not infection control friendly, we supported renovation of three major MDR-TB treatment centers, and improved the functionality of facilities renovated through other projects by providing furniture and equipment. Strengthening the laboratory capacity was another area which required significant investment. This included supplying laboratory equipment and consumables and building human resource capacity on their use through training, on-site demonstration, and by providing job aids.

While clearing the backlog of patients in waiting list, we focused on improving case finding. As part of this effort and in addition to strengthening the overall human resource and laboratory capacity, we sensitized the community through mass communication by organizing orientation sessions for health program managers and community workers, with a focus on presumptive case identification and contact investigation.

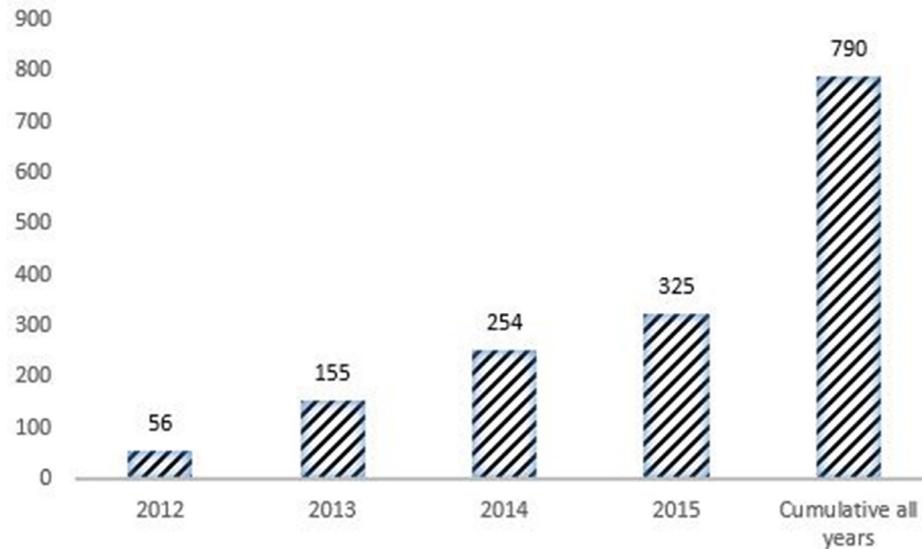
Strengthening the monitoring and evaluation of the MDR TB program performance was a key component of the interventions. We supported the design and implementation of specific indicators for MDR-TB standards of care, for quarterly monitoring and reporting, and trained clinic staff on recording and reporting of MDR-TB data. To support more efficient recording and reporting, we provided desktop computers, an electronic patient data monitoring system, and access to mobile internet services.

At each TIC, MDR-TB panel teams, composed of a multidisciplinary group of personnel, guided patient-level decisions. Typi-



**Table 2**  
Key MDR-TB service expansion indicators, 2012–2015, Amhara and Oromia Regions, Ethiopia.

Indicator	Baseline (2012)	Current (2015)	Percentage Increase
Cumulative number of TICs ever established	1	23	2100%
MDR-TB sputum samples processed per year	662	14,361	1969%
Cumulative number of MDR-TB patients ever enrolled	56	790	1211%



**Fig. 2.** Cumulative and new MDR TB patients enrolled per year, 2012–2015, Amhara and Oromia Regions, Ethiopia.

## Results

### Improvements in service accessibility

Before 2012, MDR-TB service delivery was limited to a single tertiary hospital in one of the regions. In the two regions, the number of TICs had increased from one in 2011 to 23 by the end of September 2015. Similarly, there were only two MDR-TB culture centers and no GeneXpert machine at the beginning of the project. By September 2015, the number of GeneXpert centers had reached 49. There were no liquid culture and DST service at baseline but by the end of August 2015 five labs were equipped. Moreover, the number of MDR-TB sputum samples tested had increased from 662 per year in 2012 to 14,361 by September 2015. The number of MDR-TB cases identified and put on treatment increased from 56 in the first year to 790 by the end of September 2015, and no patient was on the waiting list (Table 2 describes key indicators of service expansion and Fig. 2 shows annual enrollment rates).

### Treatment outcomes

Of 790 patients ever enrolled in care by the end of September 2015, six-month interim results were available for 469 patients enrolled between July 2012 and December 2014, and final results were available for 178 patients enrolled during July 2012–September 2013. Of 469 patients assessed for interim treatment outcomes, 65% had negative culture results at six months.

For 178 patients who completed at least 24 months of follow up, final treatment success rate was 75%, with a cure rate of 65% (Table 3 summarizes interim and final treatment outcomes).

## Discussion

This is the first large scale implementation experience of the ambulatory MDR TB treatment model in Ethiopia, through which

**Table 3**

Six month interim outcome of MDR-TB patients, July 2012–September 2014, Oromia and Amhara Regions, Ethiopia.

Six month interim outcome, July 2012–June 2014 (N = 464)	Number (%)
Culture negative	289 (62)
Culture positive	9 (2)
Died	47 (10)
Lost	27 (6)
Not evaluated	97 (21)
<b>Final outcome, July 2012–September 2013 (N = 178)</b>	
Cured	115 (65)
Completed	17 (10)
Died	27 (15)
Failed	2 (1)
LTFU	15 (8)
Not evaluated	2 (1)

it was possible to achieve rapid expansion of MDR-TB services. Between 2012 and 2015, patient enrollment rate increased twelve-fold while at the same time achieving treatment success rate of 75% and cure rate of 65%. These findings suggest that if adequate resources and robust technical support are put in place, the ambulatory model of care can be implemented successfully in settings with limited resources.

Treatment success rate of 75% and cure rate of 65% in our cohort exceeded those reported in recent systematic reviews, and was comparable with results from two tertiary hospitals from Ethiopia which used a predominantly inpatient model of care [18]. In a systematic review conducted in 2009, the treatment success rate for programs that used standardized treatment regimen was 54%, and 64% in individualized treatment models [10]. The treatment success rate was 62% in a study that summarized findings from 36 studies that reported treatment outcomes from 21 countries [9]. A recent review of studies from programs implementing community-based MDR-TB treatment approaches reported a treat-

ment success rate of 65%. No specific factor was associated with successful treatment outcomes in this more recent review [12].

The higher treatment success rate in our cohort could be attributed to the robust technical support provided and the actions taken to address challenges encountered early in the course of service roll-out. Strengthening the technical and infrastructure capacity for early detection and management of patients was a critical step in ensuring a higher treatment success rate. The MDR-TB clinic day was a useful mechanism to improve adherence to clinical appointments and medications.

Ambulatory models of MDR-TB care have been implemented in several countries, but the specific modalities of care have varied considerably across regions and countries. In a poor district in South Africa, for example, a decentralized, home-based care model for MDR-TB and HIV patients, about 77% were reported to have cured or still on follow up but the proportion cured was not clearly described [19]. Analysis of programmatic management of MDR-TB in three different continents suggested the feasibility of a decentralized approach in diverse settings [20]. However, the extent of decentralization varied considerably among countries. In Peru, for example, the initial locus of care was the community; in Russia, a prison/hospital combination was used; and Lesotho followed the combined hospital/community approach. A more recent report from Uganda suggests the acceptability of home-based care [21].

Ethiopia's MDR-TB treatment experience is relatively recent and builds on global experience from similar settings. However, it differs from experiences in other resource-poor settings in several major respects. Treatment and follow up was not yet decentralized to community level as follow up was organized at health center or hospital levels. Decentralization to the community level should be considered as the program matures, and Ethiopia's extensive network of Health Extension Workers (HEWs) could be tapped into to further decentralize MDR-TB services. These HEWs can play a larger role, not only in contact tracing and suspect referral but also in treatment observation and psychosocial support.

Despite considerable progress made in improving access to MDR-TB services, further concerted effort is needed to strengthen the program [22]. The current results were achieved through significant external support. Further technical assistance and close collaboration with the National TB Program should be maintained until the MDR-TB program is fully integrated within the existing TB program at all levels of the health care system. The continuing medical education begun under the current program needs to be continued until a critical mass of national expertise is established. Addressing broader structural barriers such as TB-associated stigma, which, according to anecdotal data, appear to contribute to high rates of loss to follow-up, should be considered a priority. Moreover, the ongoing psychosocial support schemes should be strengthened and more innovative counseling approaches should be devised.

Our results should be interpreted cautiously because of important limitations. Because our report relied on programmatic data reported through routine project management systems, we were not able to do in depth analysis of factors affecting treatment outcomes. Since this relatively high treatment outcome was achieved in the context of strong technical assistance through external funding, it cannot be generalized to settings where such external support does not exist. Moreover, whether such high treatment outcome will be sustained as the program expands to more sites remains to be determined. In conclusion, rapid expansion of an ambulatory model of MDR care was feasible in the Ethiopian setting. The treatment success rate was far better than the recently reported global average of 52% [1]. This was achieved in the context of good collaborative efforts between the National TB Program and robust external technical assistance and program support. More effort is needed to sustain the gains made through

this collaboration. Further analysis of data is required to understand individual factors contributing to treatment outcomes. The impact of further decentralization of services to the community level should be evaluated through implementation research.

## Acknowledgments

We would like to thank the Ministry of Health and Regional Health Bureaus for their guidance during the implementation of this project. The USAID funded TB CARE I project (led by KNCV, in partnership with WHO and MSH) provided critical technical inputs in the preparation of guidelines and training materials, and supported renovation of some of the treatment sites in HEAL TB supported regions. We thank the clinicians and MDR-TB program focal persons for their active role in implementing this project. Barbara K. Timmons edited the manuscript.

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