



Progress Towards TB Elimination: An Eight-Year Retrospective Analysis of Key Performance Indicators for TB Control in Plateau State, Nigeria, 2016

Luka Mangveep Ibrahim^{1,*}, Gonen Mato Lakda¹, Samuel Ogiri², Phillip Patrobas², Danjuma Maku Aboki³

¹Department of Public Health, Ministry of Health, Jos, Nigeria

²Tuberculosis Control Cluster, World Health Organization, Abuja, Nigeria

³Department of Public Health, Ministry of Health, Lafia, Nigeria

Email address:

lukaimangveep@yahoo.com (L. M. Ibrahim)

*Corresponding author

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Abstract: Tuberculosis is a major public health concern in Nigeria. It had been targeted for elimination using the directly observed treatment short Course strategy. Plateau state started implementing the strategy since 2001. The key performance indicators towards achieving elimination targets was evaluated. Data from the routine surveillance records and reports from 2008 to 2015 were extracted. Patients' enrollment, sputum conversion, treatment outcomes and TB/HIV co-infection was analyzed using epiInfo software. Of the 23,532 registered cases, only 34% were new sputum smear positive. The introduction of XpertMTB/Rif technology in 2013 increased the proportion of patient with pulmonary TB diagnosed bacteriologically by 11%. Majority (89%) of the smear positive cases were in the productive age group of 15 – 54 years. TB/HIV co-infection was 39.6%, with more female than male (OR 2.41, 95% CI: 2.22 – 2.63). The cured rate increased from 57.3% in 2008 to 70.1% in 2014. The overall treatment success and death rates were 83.0% and 6.6% respectively. Deaths and treatment failure rates were lower among new pulmonary smear positive patients (OR 0.68, 95% CI 0.52 – 0.88 and OR 0.47, 95% CI 0.29 – 0.77) respectively. The deaths were higher among TB/HIV compared to HIV negative patients (OR 2.23, 95%: 1.84 – 2.70). Despite the improvements in the performance indicators, the state is yet to achieve the elimination targets. Expansion of the use of Xpert technology, Community awareness, patient education and prompt defaulter retrieval will ensure early detection and enrollment of cases, improve quality of diagnosis and outcomes of TB treatment in the state.

Keywords: Tuberculosis, Case Notification, Diagnosis, XpertMTB/Rif, Treatment Outcomes

1. Introduction

Tuberculosis (TB) whose causative agent was discovered over 100 years ago and effective drugs for its treatment had been in use for over 50 years is still one of the leading cause of death globally. In 2014, about 10 million people became sick of the disease with 1.5 million deaths. It was also responsible for the death of 400,000 people living with HIV/AIDS (PLWHA). Developing countries especially sub-Saharan Africa accounts for about 80% of TB/HIV co-infection and deaths among the HIV positive TB patients.

Nigeria occupies the 4th position among the global TB burden countries and has the highest burden in Africa with an estimated incidence of 322 per 100,000 [1-3]. The country adopted the World Health Organization (WHO) recommended Directly Observed Treatment Short Course (DOTS) for TB control using the 8-month regimen since 1996. The treatment regimen had been modified to 6 months while the 8 months' regimen was reserved for patients with previous exposure to anti TB drugs [4 – 6]. The main principle for detection of TB under the DOTS strategy is bacteriology using sputum microscopy and drug

susceptibility test [1]. However, patient could be diagnosed clinically with support of chest radiology where resources for sputum microscopy and culture are limited [7]. Patients diagnosed through chest radiograph or clinical assessment do not have definitive proof of having the disease. The introduction of a new tool called the XpertMTB/Rif (GeneXpert) which is based on molecular method had revolutionized the diagnosis of TB. The method shortens the time delay for diagnoses and increases the sensitivity to detect TB among sputum smear negative patients including susceptibility of the bacilli to rifampicin [8].

At the end of treatment, the patients have six mutually exclusive outcomes as follows: 1) cured, 2) treatment completed, 3) failure, 4) loss to follow up, 5) died, and 6) not evaluated [6, 9, 10]. These outcomes of treatment are the major performance indicators for the TB control program. The target for TB control in Nigeria which is in line with the STOP TB Partnerships targets is to achieve a cure rate of at least 85% of the smear positive (infectious cases) detected implying that other outcomes account for less than 15% [11]. A combination of cured and those who completed treatment but without bacteriological prove (treatment completed) is called treatment success is also an important performance indicator [12]. Low cured rate with high treatment success indicate programmatic issues affecting follow up sputum examination. It also indicates lack of bacteriologically confirmed evidence that the patients are cured and no longer infectious. This is one of the critical issues in the TB control program because the uncured patients form a pool of the infection that will continue to transmit the disease [13]. Furthermore, patients who fail to get cured under the DOTS strategy are potential sources of multi-drug resistant TB [14].

Plateau state, began implementing TB control services using the WHO recommended DOTS strategy in 2001 [15]. It also began using the GeneXpert in the TB control in 2013 in one center and expanded to seven centers in 2016. The state employs mixed method for direct observation of treatment involving a combination health care workers and community members. The concept of the community based TB care was to ensure accessibility and acceptability of the services [16]. Reports on patients' enrollment, sputum conversions and outcomes of treatment are collated at the end of each quarter from all local government areas (LGAs), the basic management unit (BMU) into a summary form for the state. Validation and harmonization of the reports is done during quarterly review meetings with all LGA supervisors. However, apart from the annual reports produced by the state program, the progress relating to the performance indicators had not been evaluated since inception of the DOTS strategy in the state. This study was conducted to evaluate the key performance indicators of the control program towards achieving elimination targets in the state. The findings of the study will help the TB control program focus interventions on the gaps identified in the performance indicators for the state.

2. Method

2.1. Study Setting

Plateau state is one of the thirty-six states in Nigeria, located in the north central geopolitical zone of the country. It has a land mass of 22,410 square kilometers and an estimated population in 2014 of 3.9 million people. Majority of the populace live on subsistent farming. It is one of the states with high burden of HIV in the country [17]. The state is divided into seventeen Local Government Areas (LGAs) for ease of administration. It has a total of 964 (756 publics and 208 registered private) health care facilities, only 189 of the health facilities offer TB control services [18, 19]. TB control services using the WHO recommended DOTS strategy had been going on since 2001. In line with the National control program to improve diagnosis especially drug resistant TB and management of TB cases, the GeneXpert technology was introduced in the state in 2013. The state uses a mixed method of both health care workers and community members for the direct observation of treatment (DOT) for the TB patient [20].

2.2. Definition of Terms

The state control program uses the standard WHO classification to register patients for treatment. The two broad categories are category 1 (Cat 1) which refers to patients receiving TB treatment for the first time or patient who had received the treatment for less than 4 weeks (New) and category 2 (Cat 2) refers to those who had previous exposure (Retreatment) to anti TB drugs. The Cat 1 include the extra pulmonary, new pulmonary TB patients. The cat 2 includes the relapses, treatment failures, returned after defaults and the others [5, 11].

Patients are evaluated at the end of treatment under six mutually exclusives classes as follows; Cured; refers to a patient who was initially smear positive at start of treatment, had completed the full course of treatment and has remained smear negative at the end of the seventh month and at least on one other occasion. Treatment completed; is a patient who completes the full course of anti-TB treatment but does not meet the condition of cured. Failure; is a patient who still remained sputum smear positive at the end of the fifth month or later during treatment. Returned after loss to follow up (returned after default); applies to a patient whose treatment was interrupted for at least 2 months. Died; are patient who died for any reason during the course of TB treatment. Not Evaluated (transferred out); refers to a patient who has been transferred to another treatment center in another state and whose treatment result is not known [9, 11, 21].

2.3. Data Collection and Analysis

Data for the study was extracted from the routine surveillance records and reports of the state TB control program for 2008 to 2015. Data on patients enrolled for treatment, sputum conversion at end of intensive phase and outcome of treatment including HIV co-infection among the

patients were evaluated. The impact of application of the GeneXpert technology on the quality diagnosis of the disease among patients with Pulmonary TB was also assessed. The data was entered in excel spread, cleaned and analyzed for proportions. Bivariate analyses were done using epiInfo software version 3.5.4 to determine association between categorical variables.

3. Ethical Considerations

Permission for the evaluation of the surveillance data was

obtained from the Plateau State Ministry of Health. All measures to ensure confidentiality of patients and data was ensured.

4. Results

A total of 23,532 TB cases were diagnosed enrolled for treatment between 2008 and 2015. About half 11,963 (51%) of the cases were new sputum smear negative, 7925 (34%) were new sputum positive while 3,646 (15%) had previous exposure to anti TB drugs (Table 1).

Table 1. Distribution of TB cases registered for treatment in Plateau state 2008-2015.

Year	New smear Negative n (%)	New smear positive n (%)	Retreatment (Cat 2) n (%)	Extra pulmonary TB n (%)	Others n (%)	Total cases
2008	1,591 (56.0)	940 (33.1)	100 (3.5)	160 (5.6)	52 (1.8)	2,843
2009	1,825 (57.5)	943 (29.7)	131 (4.1)	181 (5.7)	95 (3.0)	3,175
2010	1,628 (56.0)	833 (28.6)	119 (4.1)	189 (6.5)	139 (4.8)	2,908
2011	1,342 (49.0)	957 (35.0)	151 (5.5)	164 (6.0)	124 (4.5)	2,738
2012	1,543 (49.4)	1,077 (34.5)	129 (4.1)	240 (7.7)	133 (4.3)	3,122
2013	1,709 (49.8)	1,107 (32.3)	156 (4.5)	296 (8.6)	161 (4.7)	3,429
2014	1,257 (44.5)	1,039 (36.8)	108 (3.8)	299 (10.6)	121 (4.3)	2,824
2015	1,068 (42.8)	1,029 (41.3)	84 (3.4)	299 (12.0)	15 (0.6)	2,493
Total	11963 (50.8)	7925 (33.7)	978 (4.2)	1828 (7.8)	840 (3.6)	23,532

The introduction of the XpertMTB/Rif technology improved the quality of TB diagnosis in the state. Its introduction in 2013 led to reduction in the proportion of

patients diagnosed clinically from about 60% to 49% with corresponding increase in patients diagnosed bacteriologically (Figure 1).

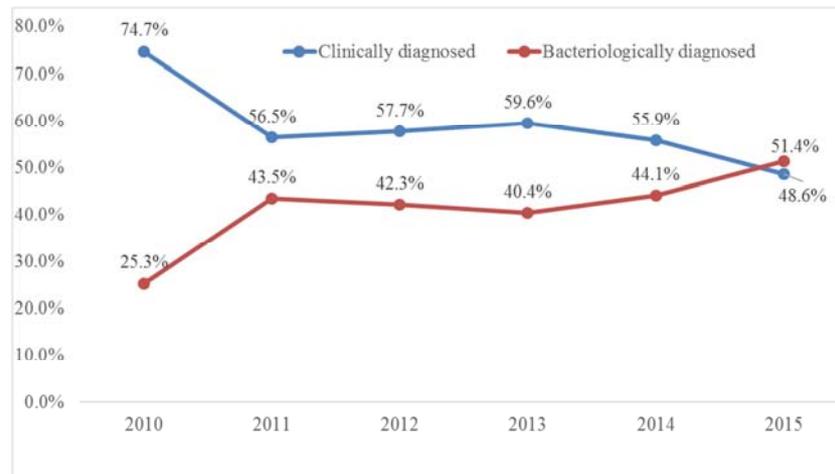


Figure 1. Proportion of Pulmonary TB cases diagnosed clinically and bacteriologically in Plateau state 2008 – 2015.

Among the 8024 smear positive patient, 89% (7171) were in the productive age of 15 – 54 years and 67% (5396) were males. Of the 11,758 TB patients counseled for HIV test, 9802 (83.4%) accepted the test and 3879 (39.6%) were co-infected with HIV (Male 31.2%, female 52.3%). Female

were more likely to have TB/HIV co-infection than male (OR 2.41, 95% CI: 2.22 – 2.63) also patients diagnosed clinically were more likely to be HIV positive (OR 1.97, 95% CI 1.81 – 2.15) compared to patients whose diagnoses were based on bacteriology (Table 2).

Table 2. HIV co-infection among TB Patients in Plateau state 2008 – 2015.

Category	Counseled			Tested			HIV Positive		
	M	F	Total	M	F	Total	M	F	Total
New sputum smear positive	2826	1414	4240	2407	1226	3633	537	525	1062
New sputum smear negative	3434	2519	5953	2689	2113	4802	1054	1258	2312
Extra pulmonary TB	504	382	886	408	317	725	96	101	197
Retreatment cases (Cat 2)	435	244	679	411	231	642	160	148	308
Total	7199	4559	11758	5915 (82.2%)	3887 (85.3%)	9802 (83.4%)	1847 (31.2%)	2032 (52.3%)	3879 (39.6%)

The sputum conversion rate was 79.3%; there was no significant difference in sputum conversions, default and death rates between the new and re-treatment cases. The cured rate increased from 57.3% in 2008 to 70.1% in 2014. The overall treatment success was 83.0% (New sputum smear positive 85.5%, new sputum smears negative 82.0%, Extra-pulmonary TB 78.0% and retreatment 79.2%). Of the 7,790 sputum smear positive patients evaluated, 1703 (21.9%) were co-infected with HIV and 6894 (88.5%) were new sputum smear positive patients. The treatment success

among this group of patients was 84.9% (HIV negative 86.1%, HIV Positive 80.7%). The death rate was 6.6% (HIV Negative 5.4%, HIV positive 11.2%). The new smear positive TB patients were less likely to die (OR 0.68, 95% CI 0.52 – 0.88) and to fail treatment (OR 0.47, 95% CI 0.29 – 0.77) compared to those with previous exposure to anti TB drugs also patients who were co-infected with HIV were more likely to die (OR 2.23, 95%: 1.84 – 2.70) compared to HIV negative TB patients (table 3).

Table 3. Outcomes of treatment of TB patient registered for treatment 2008 – 2014 in Plateau state.

Category of patients	Total enrolled	Cure	Treatment Completed	Died	Failed	Defaulted	Treatment success
New sputum smear positive	6896	4996	901	436 (6.3%)	85 (1.2%)	339 (4.9%)	5897 (85.5%)
New sputum smear negative	10893	0	8931	971 (8.9%)	0	731 (6.7%)	8931 (82.0%)
Extra-pulmonary	1529	0	1193	161 (10.5%)	0	93 (6.1%)	1193 (78.0%)
Relapses	470	333	54	38 (8.1%)	10 (2.1%)	25 (5.3%)	387 (82.3%)
Treatment failure	154	94	25	13 (8.4%)	11 (7.1%)	9 (5.8%)	119 (77.3%)
Return after default	270	161	50	30 (11.1%)	2 (0.7%)	19 (7.0%)	211 (78.1%)
Others	827	42	612	85 (10.2%)	8 (1.0%)	54 (6.5%)	654 (79.1%)
Total	21039	5626	11766	1734 (8.2%)	123 (0.5%)	1263 (6.0%)	17392 (82.7%)

5. Discussion

This study showed that significant progress had been made towards the key performance indicators for TB control although the state is yet to achieve the optimum targets set for the national program. The goals of the TB control in Nigeria are to reduce mortality, morbidity and transmission of the disease until it no longer poses threat to public health. The gauge for achieving these goals starts with the enrolment of patients. Contrary to evidences in developed countries where TB affects mostly the extreme of the ages (the very young and old) due to lower immunities, it affects mostly the productive age groups in developing countries as seen in this study. These findings are corroborated by other studies in Nigeria [22, 23] and contribute significantly to worsening effects of the medical and socio-economic burden of the disease. The types (categories) of patients at enrolment are proxy indications of the effectiveness of TB case detection and patients' management in the program. For example, a high number of the retreatment (patients with previous exposure to anti TB drugs) cases especially the returned after default and the treatment failures indicate poor management of the patient in the first instance. Failure to address the major cause for the initial failure may lead to failures in subsequent treatment. Potential multi-drug resistant TB (MDR-TB) patient could be identified at patients' enrollment and steps taken to avert it. A patient with previous exposure to anti TB treatment should be counseled to first identify the cause for the initial failure. The reasons for initial failure of treatment should be identified and addressed before the patient is started on the new treatment. The patient drug history and treatment including family supports system should be evaluated. Similarly, patients returning after default should also be counseled to identify and address the

cause of the default. These types of patients should be scrutinized more in-depth because of the risk of MDR-TB among them [24, 25]. A promising tool to curb the emerging threats of the TB control is the XpertMTB/Rif technology that provides correct and early diagnosis for MDR-TB. The introduction of the XpertMTB/Rif technology in the state in 2013 led to significant improvement in the quality of diagnosis and reduced significantly the number of non TB patients on anti-TB medication. The technology also contributes to early diagnosis of MDR-TB in the state. The national targets for the TB control is to achieve a cure of at least 85% among smear positive patients in the first instance. These are the main source of infection, achieving cure among them will reduce the number of retreatment cases at enrolment to less than 15% (11). HIV is a major public health concern in the state as in other states in north central Nigeria. The HIV infection among the TB patients is also high compared to other parts of the country. The reported prevalence in Nigeria were 12.3% in south-west, 1.42% in south-east, 41.2% in North-central 5.9% in southern 32.2% in North- east Nigeria and 31.3% in other African countries [26-31]. The higher rate in this study might be a result of the high background HIV sero-prevalence in the state. The results of the sentinel survey among pregnant women attending ante natal care (ANC) showed remarkable increase from 2.6% in 2008 to 7.7% in 2010 in the state placing it in the sixth position in the country. The co-morbid condition has negative effect on incidence of mortality among the TB patients [21, 32].

Sputum conversion reflects the quality of the medication and patients' managements; hence an important rate determining step towards achieving good treatment outcomes. Patients who are not consistent on taking their medication are likely not to convert at the end of the intensive phase of treatment. They are also likely to fail the

treatment. Inconsistency on treatment also poses danger of the bacilli mutating into resistant strains. The sputum conversion rate of 79.8% in this was below the national target of a minimum of 95% [33].

The outcomes of treatment are some of the key determinants of the effectiveness of the TB control program. Prominent among the outcomes is the cure rate. The results of this study showed that although the overall treatment success rate was 85.3% among the new cases, the cured rate of 71.5% was relatively sub-optimal to the national target of at least 85%. Also, 14% of the new patients did not have their bacteriological status evaluated at the end of treatment. The implication of the latter is that these groups of patients did not benefit maximally from the expected quality of care, which is to establish cure at the end of treatment. The control program expectation is that at least 85% of the smear positive TB patients should be cured when treated in the first instance. Patients who fail to achieve cure at the first instance of their treatment pose danger to the success of the entire TB control program because they become potential carriers of mutant bacilli that are likely to be resistant to the conventional first line anti tuberculosis drugs. According to the WHO indicators for Program outcomes, retreatment or patients with previous exposure to anti TB drugs is an indication of ineffective treatment, incorrect administration of medication or non-adherence to the direct observation of treatment (DOT) either on the part of the patient or the service providers [34]. One of the key factors that ensures adherence of patients to treatment is the patient–health care workers relationship. The quality of the information on the disease and treatment from the health care workers to patient is important. On the side of the health care workers the quality of the information to the patient is a proxy indicator of their own knowledge of the disease, their skills of counseling and attitude towards their patient and work. Deficiencies of the health care workers in these essential elements will lead to non-adherence to treatment and non-compliance to the follow up sputum examination. Studies have shown that people who had history of failing to adhere to treatment in the first instance are more likely to fail subsequent treatments since the first failure might have been due to unresolved cause of poor compliance to treatment of drug resistance [35, 36]. Similarly, patients who were lost to follow up might continue to interrupt their treatment if the cause for the initial interruption was not addressed. A study in Malaysia [37] showed that people who were non-compliant to their anti TB treatment were more likely to be white collar workers; this could be true considering that majority of patients in this study were in the most productive age group. This is a wakeup call for the health care workers who handle patients to do more to address causes of the interruption to ensure adherence to the treatment by adapting patient specific counseling approaches.

This study had the following limitations that are common with the use of secondary data because it was not designed for the study as many important variables were not included in the data. Firstly, the design of the data reporting tool

limited the age and sex data to only smear positive patients as such we could not evaluate the contribution of sex and age to the outcomes of treatment for all the patients. Secondly the data on the ‘others categories’ did not include their smear results though some were evaluated as cured in the outcomes of treatment. Thirdly the surveillance data did not evaluate patients’ outcomes of treatment by age and sex.

6. Conclusion

This study revealed that although significant progress had been made towards elimination of the TB scourge, the state is yet to achieve the target for TB control on key indicators such as the case detection and cure rates. The XpertMTB/Rif, technology is an important tool for effective and efficient TB diagnosis. Community awareness for detection of cases, patient education with prompt defaulter retrieval will improve treatment outcomes and reduce continuous spread of TB infection

Recommendations

The National TB control program in collaboration with the Plateau State TB and Leprosy Control Program and other partners should train all health workers involved in management of patients on patients’ education on the duration of treatment to identify and address causes of loss to follow up and failure among all patients.

The TB control program should include critical evaluation of all patients who failed or defaulted from treatment to identify and address the cause (s) before commencing next treatment. The program should follow up on bacteriologically diagnosed patients who complete treatment without bacteriological evaluation to ascertain the rate of relapse. More so, the patient-centered approach should be promoted with a view to involving patients before and during treatment in all critical decisions concerning their management.

The National TB control program should strategically deploy the Xpert MTB/Rif technology in all parts of Nigeria to improve the effectiveness and efficiency of TB diagnosis and hence appropriateness in the enrollment of patients on treatment.

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Conflict of Interest

We wish to state that there was no conflict of interest in this study

Authors’ Contributions

Luka Mangveep Ibrahim: Conception, design, writing of protocol of the study, acquisition of data, analysis,

interpretation and wrote the manuscript. Gonen Mato Lakda: Acquisition of data, read and approved the final manuscript. Samuel Ogiri, Philip Patrobas and Danjuma Aboki: Literature review, read and approved the final manuscript.

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