

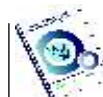
## Prevalence of Tuberculosis Using Xpert MTB/RIF Assay in a Tertiary Hospital Northwest Nigeria

Jimoh O\*, Aliyu S, Giwa FJ, Opaluwa AS, Ega B, Odugu J, Mikail MB, Umar LW

Ahmadu Bello University Zaria, Nigeria

### Article Metrics

Date submitted: 15/06/2021  
Date Accepted: 21/06/2021  
Date Published: 20/08/2021



### ABSTRACT

**Background:** A major impediment in the management and control of tuberculosis is the time frame required for accurate diagnosis. Routine microscopy has low sensitivity while culture, which is the gold standard, has a longer turnaround time and biosafety challenges. The Xpert MTb/Rif (Cepheid), on the other hand, is a newer molecular technology aimed at rapidly improving the diagnosis of tuberculosis (Tb), by being used as the initial test in individuals suspected of having multidrug resistant Tb or HIV associated Tb. The assay is able to amplify the DNA in mycobacterium and detect genetic mutations associated with resistance to the drug rifampicin within two hours. This study aimed to determine the prevalence of tuberculosis in a tertiary hospital in Northwestern Nigeria using Xpert MTb/Rif assay.

**Methodology:** This was a retrospective laboratory based study conducted at the Ahmadu Bello University Teaching Hospital, Zaria, Nigeria, from July 2015 to July 2017 on one thousand and forty seven (1047) body fluid specimen submitted at the medical microbiology laboratory for processing using the Xpert MTB/Rif assay. Data was recorded and analysed using Microsoft Excel and SPSS version 20.0. Descriptive statistics was done and results represented in charts and tables.

**Results:** Of the one thousand and forty seven (1047) patients' specimens tested using Xpert MTB/RIF, 94(9%) were positive for Mycobacterium tuberculosis. 19 (20.2%) had HIV/TB co-infection while 4/ (4.3%) had rifampicin resistant tuberculosis.

**Conclusion:** The prevalence of tuberculosis and Rifampicin resistant tuberculosis as obtained from this study were 9.4% and 4.3% respectively. Xpert MTB/RIF assay is a valuable alternative for diagnosis of drug sensitive and MDR-TB which will enhance early detection and prevent transmission at all levels of health care.

**Keywords:** Xpert MTB/RIF, Tuberculosis, Diagnosis, HIV, MDR

\*Correspondence: Dr Jimoh O, Ahmadu Bello University Zaria, Nigeria. Email: [drwritelanrej@yahoo.com](mailto:drwritelanrej@yahoo.com)

### Access to the article



website: <http://www.jmbsr.com.ng>

doi: <https://doi.org/10.46912/jmbsr.68>

Find our articles on Google Scholar, fully indexed

### How to cite this article:

Jimoh O, Aliyu S, Giwa FJ, Opaluwa AS, Ega B, Odugu J *et al.*, Prevalence of Tuberculosis Using Xpert MTB/RIF Assay in a Tertiary Hospital Northwest Nigeria. J Med Bas Sci Res 2021;2(2):1-8.

## INTRODUCTION

Tuberculosis remains a major public health problem in Nigeria and a significant cause of morbidity and mortality as an infectious disease. World over, it accounts for 1.5 million deaths in 2014 and the proportion of people who develop Tb and die of the disease was 16% in 2016.<sup>[1,2,3,4]</sup> Early and rapid diagnosis is therefore essential to prevent complications that may arise from the disease. However, the use of routine microscopic examination, though rapid and inexpensive, has poor sensitivity and specificity and is unable to differentiate between tuberculous and non-tuberculous mycobacteria (NTM).<sup>[5]</sup> Another shortcoming of routine microscopy is the inability to test for drug resistance; patients with MDR Tb require prompt second line treatment to prevent morbidity or mortality and the creation of a continuous pool of multi drug resistant Tb in the population.<sup>[6,7]</sup> Culture, which is the “gold standard” for detection of *Mycobacterium tuberculosis* (MTb) is slow, requiring 4 to 8 weeks for visible growth.

To overcome this challenge of delay in diagnosis and treatment, the World Health Organization introduced GeneXpert MTb/Rif (Cepheid, Sunnyvale, CA, USA) assay. It has the ability to detect *Mycobacterium tuberculosis* complex from clinical specimens in approximately 2 hours.<sup>[5]</sup> The assay also has the capacity to identify rifampicin resistant Mycobacteria in the clinical specimens.<sup>[7]</sup>

GeneXpert assay is based on molecular technology that uses real time PCR. It requires minimal training of the laboratorian and less stringent biosafety facilities.<sup>[8]</sup> It is not affected by cross-contamination. The GeneXpert is highly sensitive compared to microscopy and culture. The rapid detection of *M. tuberculosis* and rifampin (RIF) resistance in infected patients is

essential for early case management, selecting treatment regimens and infection control decisions thereby helping to prevent further transmission of tuberculosis. Sensitivity and specificity of 98.2% and 99.2% have been reported respectively.<sup>[7,9]</sup> The study was therefore conducted to determine prevalence of tuberculosis using Xpert MTB/RIF Assay in a Tertiary Hospital, Northwestern Nigeria

## MATERIALS AND METHODS

This was a two year retrospective, laboratory based study conducted from July 2015 to July 2017 in a tertiary hospital in Zaria, Northern Nigeria. Results of samples processed for tuberculosis using Xpert MTB/RIF assay were extracted from laboratory record. Specimens were received from different wards and service points within the hospital and from peripheral clinics outside the facility for routine diagnostic testing at the Medical Microbiology laboratory within the study period. Patients that were on any form of anti-tuberculosis and follow up were excluded from the study. Data on socio-demographic characteristics, sample site and retroviral status were also extracted from the laboratory record. Descriptive statistics and bivariate analysis were used to analyze variables of interest. Ethical approval (ABUTHZ/HREC/F14/2021) was obtained from Ahmadu Bello University teaching hospital health research ethics committee.

### Sample processing:

The MTB/RIF assay was performed as described by Cepheid 2010. The body fluid processed within the period include; sputum, urine, ascitic fluid, pericardial fluid, pleural fluid, gastric washout, lymph node aspirate and others. All body-fluid samples, collected from sterile sites did not receive

any pre-treatment except for mechanical homogenization (where necessary). Sample reagent (SR) was added to the sample at a ratio of 2:1, except for CSF (usually <1 ml), which was raised to 2 ml by the addition of SR buffer. The treated sample was incubated at room temperature for 15min and then transferred to the test cartridge which was loaded into the GeneXpert instrument.<sup>[5,10]</sup> Patients with indeterminate Tb results were excluded from the analysis.

**RESULT**

Specimens from a total of 1047 patients were processed over a two year period. The male: female ratio was 1:1.1. Mean age of study population was 30.2 years and standard deviation of ±20.4 years. Majority of the specimens received were from children <10 years (28.3%) and sputum specimen constituted the most frequent specimen, (64.3%) Table1 and Figure 1).Majority of the patients were HIV negative (Figure 2).

Ninety four (94) specimens were positive for *Mycobacterium tuberculosis* out of 1047 specimens processed giving a prevalence of 9.0%. Of the ninety four (94) positive specimens, four (4) were rifampicin resistant giving a prevalence of 4.3%.

Of the 558 male specimens processed, 58(10.4%) were positive for MTb, while in 489 females 36(7.4%) specimens were positive for MTb. Age group 21-30 had the highest prevalence rate of 17.5% while age group 10 years and below had the least prevalence of 1.2%. Of the 94 Tb confirmed cases, 68.1% were HIV negative while 20.2% had TB/HIV co-infection. Majority of the MTb isolates detected from sputum specimens were rifampicin sensitive 87.2% (figure 3)

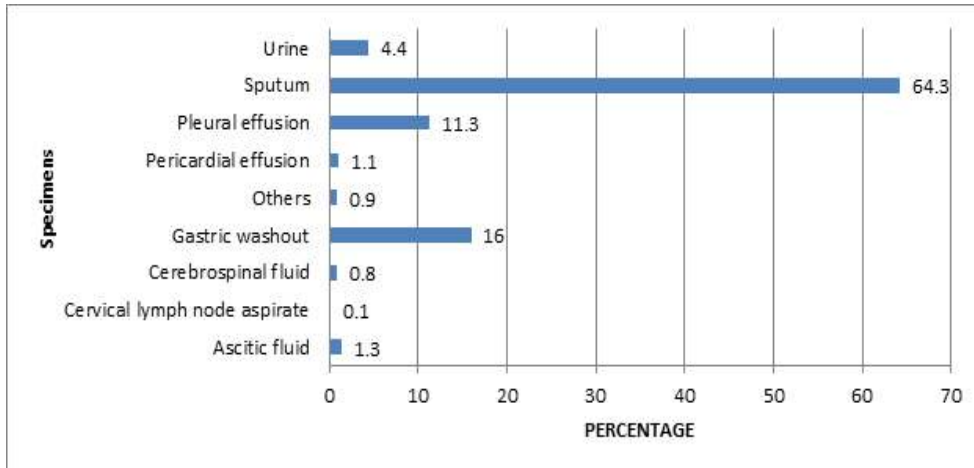
**Table 1: Demographic profile of the study population**

Variable	Frequency	Percentage (%)
<b>Age</b>		
<10	242	23.1
11-20	117	11.2
21-30	206	19.7
31-40	187	17.9
41-50	123	11.7
51-60	93	8.9
>60	79	7.5
<b>Sex</b>		
Male	558	53.3
Female	489	46.7
<b>Address</b>		
outside Zaria	257	24.5
unknown	77	7.4
Zaria	713	68.1
<b>Hiv Status</b>		
Negative	761	72.7
Positive	196	18.7
Unknown	90	8.6

**Table 2: Age -sex-location related prevalence of Tuberculosis**

Age	MTB detected	Not detected	Total
<10	3(1.2)	239(98.8)	242
11-20	13(11.1)	104(88.9)	117
21-30	36(17.5)	170(82.5)	206
31-40	23(12.3)	164(87.7)	187
41-50	10(8.1)	113(91.9)	123
51-60	7(7.5)	86(92.5)	93
>60	2(2.5)	77(97.5)	79
<b>Sex</b>			
Male	58(10.4)	500(89.6)	558
Female	36(7.4)	453(92.6)	489
<b>Location of patient</b>			
outside Zaria	21(8.2)	236(91.8)	257
unknown	9(11.7)	68(88.3)	77
Zaria	64(9.0)	649(91.0)	713
Total	94(9.0)	953(91.0)	1047(100)

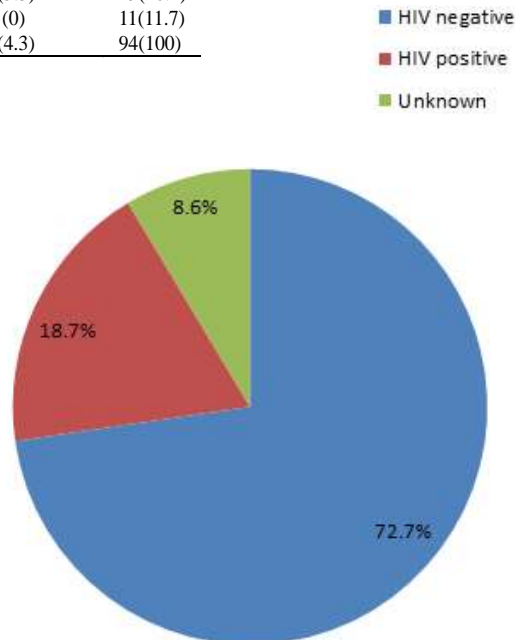
\*Numbers in parenthesis are in percentages



**Figure1: Distribution of specimens tested for tuberculosis using Xpert MTB/RIF**

Table 3: HIV status of MTB/Rif positive patients in study population

HIV Status	Rif sensitive	Rif Resistant	Total
HIV Negative	61(95.3)	3(4.7)	64(68.1)
HIV Positive	18(94.7)	1(5.3)	19(20.2)
HIV unknown	11(100.0)	0 (0)	11(11.7)
Total	90(95.7)	4(4.3)	94(100)



**Figure 2: HIV status of study population**

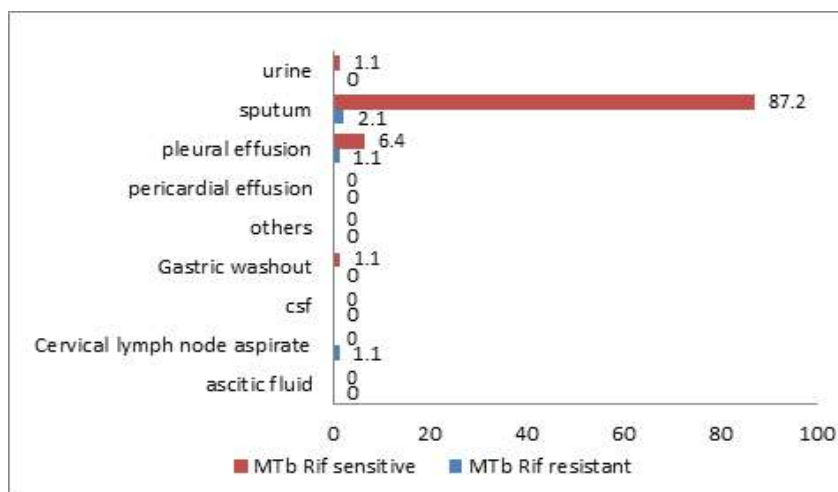


Figure 3: Frequency of *Mycobacterium tuberculosis* isolates in different Specimens.

## DISCUSSION

Nigeria being a high tuberculosis burdened country requires an effective means of diagnosis of the disease in all the component states of the country so as to stem the tide of the disease. The advent of Xpert® MTB/RIF assay is a game changer in the laboratory diagnosis of tuberculosis. A high prevalence of tuberculosis was observed in this study further corroborating the initial statement. However, the value obtained from this centre was lower than the National value reported by another author in Kaduna state where a higher prevalence was found.<sup>[11]</sup> This could be as a result of higher number of patients recruited in comparison to those recruited for this study. A similar study from tertiary health institutions in South East and North Central Nigeria, found a higher prevalence of tuberculosis as compared to our own observations in this study.<sup>[6,12,13]</sup> These differences could be due to the fact that majority of patients recruited for this study were HIV negative as compared to the

other studies where majority were HIV positive and it is a well-known fact that tuberculosis is a HIV defining disease.<sup>[14]</sup> A significant percentage of the patients in this study had multidrug resistant tuberculosis (MDR Tb) since resistance to rifampicin is a surrogate marker for Isoniazid resistance.<sup>[13]</sup> The observed prevalence was lower than the findings of other authors.<sup>[6,13,15]</sup> Early detection of MDR Tb will assist the clinician in prompt decision making in the management of patients.

The observation of a high detection rate of MTb among the age group 21-30 and 31-40 years was comparable to results of previous studies conducted in other parts of the country and elsewhere.<sup>[16,17,18]</sup> These age groups are critical components of any country because these are the productive age group that contribute to the building of the economy of any nation and also commonly engage in unguarded social behaviours such as

smoking, sexual indiscretion thereby predisposing them to tuberculosis. The finding of a lower prevalence rate among paediatric age groups is in agreement with a study done in University College Hospital, Ibadan where a similar finding was observed even though different methods were employed.<sup>[19]</sup> This further supports the belief that detection of *Mycobacterium tuberculosis* in paediatric patients are more difficult because children with TB have closed caseous lesions compared to adults with open cavities and large amounts of Mycobacteria.<sup>[20]</sup>

A higher proportion of MTb detected from sputum samples further supports the fact that pulmonary manifestation is commoner than extra pulmonary tuberculosis. This is in agreement with findings from other retrospective studies conducted in Morocco and Turkey where TB patients studied presented more with pulmonary manifestations of 63.5% and 54.8% respectively.<sup>[21,22]</sup> In addition, an eight year study done in the European union, found the prevalence of newly diagnosed pulmonary tuberculosis to be 75%. This is comparable to our study findings with a prevalence of 64.3%.<sup>[23]</sup> Pulmonary manifestation also makes the patient more contagious.

In this study only 20.2% of the patients had HIV/Tb co-infection. There is the possibility that this proportion could have been higher since Tb is a HIV defining disease. However, this was a retrospective study whereby not all the patients' HIV status was known.

Xpert MTB/Rif assay is rapid and the result can be obtained within 2 hours, however, its limitations includes inability to differentiate between living or dead *Mycobacterium tuberculosis* complex resulting in its failure to be used to monitor treatment success, failure or relapse and to detect non tuberculosis mycobacteria.<sup>[24,25]</sup> Furthermore it also requires constant power supply and cold storage facilities.

## CONCLUSION

The prevalence of tuberculosis and Rifampicin resistant tuberculosis as obtained from this study were 9.4% and 4.3% respectively. Xpert MTB/RIF assay is a valuable alternative for diagnosis of drug sensitive and MDR-TB which will enhance early detection and prevent transmission at all levels of health care. The limitation of this study was that we did not have comparative data with AFB microscopy, culture and we had no information on the HIV status of some participants.

## Acknowledgement

We are grateful to Management of Ahmadu Bello University Teaching Hospital Zaria, Department of Medical Microbiology ABUTH, Zaria; NACA, Global fund and National tuberculosis and Leprosy Control Centre, Saye-Zaria.

## Conflict of Interest

No conflict of interest to declare.

## REFERENCES

1. Zeka AN, Tasbakan S, Cavusoglu C. Evaluation of the GeneXpert MTB/RIF Assay for Rapid Diagnosis of Tuberculosis and Detection of Rifampin Resistance in Pulmonary and Extrapulmonary Specimens. *J Clin Microbiol* 2011;49(12):413-41
2. Raviglione M, Sulis G. Tuberculosis 2015: Burden, Challenges and Strategy for Control and Elimination. *Infect Dis Rep* 2016 ;8(2): 6570
3. Caulfield AJ, Wengenack NL. Diagnosis of active tuberculosis disease: From microscopy to molecular techniques. *J Clin Tuberc Other Mycobact Dis* 2016;4:33-43.
4. Gebretsadik D, Ahmed N, Kebede E, Mohammed M, Belete MA. Prevalence of

- Tuberculosis by Automated GeneXpert Rifampicin Assay and Associated Risk Factors Among Presumptive Pulmonary Tuberculosis Patients at Ataye District Hospital, North East Ethiopia. *Infection and Drug Resistance* 2020;13: 1507–1516.
5. Kn P, Chourasia E. Use of GeneXpert Assay for Diagnosis of Tuberculosis From Body Fluid Specimens , a 2 Years Study. *J Microbiol Biotechnol* 2016 ;1(1):1–4
  6. Okonkwo RC, Onwunzo MC, Chukwuka CP, Ele PU, Anyabolu AE, Onwura CA *et al.* The Use of the Gene Xpert *Mycobacterium tuberculosis*/Rifampicin (MTB/Rif) Assay in Resistant Tuberculosis (MDRTB) in Nnamdi Azikiwe University Teaching Hospital, Nnewi, Nigeria. *J HIV Retrovirus*. 2017, 3:1
  7. Boehme CC, Nabeta P, Hillemann D, Nicol MP, Shenai S, Krapp F, et al. Rapid Molecular Detection of Tuberculosis and Rifampin Resistance. *N Engl J Med* 2010 ;363(11):1005–15.
  8. Heidebrecht CL, Podewils LJ, Pym AS, Cohen T, Mthiyane T, Wilson D. Assessing the utility of Xpert(®) MTB/RIF as a screening tool for patients admitted to medical wards in South Africa. *Sci Rep* 2016;6:19391.
  9. Oluwaseun E, Adeniyi BH, Olatunbosun FM, Akinniyi AP, Afolabi O. Evaluation Of The Analytical Performance Of Xpert Mtb/Rif Assay In The Diagnosis Of Tuberculosis Among Hiv Seropositive And Seronegative Patients In Abeokuta, Southwestern, Nigeria. *Am J Res Commun* 2015 ;3(10).
  10. Center of Disease Control. A New Tool to Diagnose Tuberculosis? The Xpert MTB / RIF Assay. 2013 [cited 2018 Jun 6];2. Availhttps://www.cdc.gov/tb/publications/factsheets/pdf/xpertmtb-rifassayfactsheet\_final.pdf
  11. Gidado M, Nwokoye N, Nwadike P, Ajiboye P, Eneogu R, Useni S, et al. Unsuccessful Xpert® MTB/RIF results: the Nigerian experience. *Public Heal action* 2018 ;8(1):2–6.
  12. Akanbi MO, Achenbach C, Taiwo B, Idoko J, Ani A, Isa Y, et al. Evaluation of gene xpert for routine diagnosis of HIV-associated tuberculosis in Nigeria: A prospective cohort study. *BMC Pulm Med* 2017;17(1):87.
  13. Mbaave TP, Igbudu TJ, Egwuda L, Audu O, Jombo GT. GeneXpert MTB/RIF Sputum MTB Detection and Human Immunodeficiency Virus Seroprevalence among Patients with Presumptive Pulmonary Tuberculosis at a New Teaching Hospital in North-Central Nigeria. *Int J Curr Microbiol App Sci* 2016 ;5(8):564–70.
  14. Bruchfeld J, Correia-Neves M, Källenius G. Tuberculosis and HIV Coinfection. *Cold Spring Harb Perspect Med*. 2015 26;5(7):a017871. doi: 10.1101/cshperspect.a017871. PMID: 25722472; PMCID: PMC4484961
  15. Kalokhe AS, Shafiq M, Lee JC, Ray SM, Wang YF, Metchock B, et al. Multidrug-resistant tuberculosis drug susceptibility and molecular diagnostic testing. *Am J Med Sci*2013 ;345(2):143–8
  16. John S, Gidado M, Dahiru T, Fanning A, Codlin AJ, Creswell J. Tuberculosis among nomads in Adamawa, Nigeria: outcomes from two years of active case finding. *Int J Tuberc Lung Dis* 2015;19(4):463–8.
  17. Nwadike V, Mbata G, Kalu I, Ojide K, Nweke I, Nwokeji I, et al. Sputum smear positive tuberculosis among tuberculosis patients in a tertiary hospital in South Eastern Nigeria. *Sky J Med Med Sci* 2013;1(5):20–4.
  18. Bhat S, Kotian M, Radhakrishna M, Rao S. Drug susceptibility profiles of

- Mycobacterium tuberculosis* isolates at Mangalore. Indian J Med Sci 2010;64(3):99.
19. Rasaki SO, AJibola AA, Musa SA, Moradeyo AK, Odeigah LO, Sule GA et al. Rifampicin resistant tuberculosis in a Secondary Health Institution in Nigeria, West Africa. J Infect Dis Ther 2014;2:139. doi: 10.4172/2332-0877.1000139
  20. Kehinde AO, Okesola AO. Epidemiology of Clinical Isolates of *Mycobacterium tuberculosis* at Ibadan, Nigeria. Nig. J. Physiol. Sci. 25(December 2010) 135 – 138
  21. Guler SA, Bozkus F, Inci MF, Kokoglu OF, Ucmak H, Ozden S et al Evaluation of Pulmonary and Extrapulmonary Tuberculosis in Immunocompetent Adults:A Retrospective Case Series Analysis. Med Princ Pract 2015;24:75–79
  22. Eddabra R, Neffa M.Epidemiological profile among pulmonary and extrapulmonary tuberculosis patients in Laayoune,Morocco.PAMJ 2020;37:56
  23. Natali D, Cloatre G, Brosset C, Verdalle P, Fauvy A, Massart JP, Van QV et al.What pulmonologists need to know about extrapulmonary tuberculosis. *Breathe* 2020;16: 200216.
  24. Arend SM, van Soolingen D. Performance of Xpert MTB/RIF Ultra: a matter of dead or alive. Lancet Infect Dis. 2018; 18(1):8-10.
  25. Lawn SD, Nicol MP.Xpert® MTB/RIF assay: development, evaluation and implementation of a new rapid molecular diagnostic for tuberculosis and rifampicin resistance. Future Microbiol. 2011; 6(9): 1067–1082