EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 6
Issue: 7
64-71
Year: 2019

# A COMPARATIVE STUDY OF DIAGNOSTIC TECHNIQUES FOR MYCOBACTERIUM TUBERCULOSIS INFECTION IN PORT HARCOURT, RIVERS STATE

**Ibiju Wariboko*[1], Uche Uchegbu[2] and Udijih Helen[2]**

[1]South-South Tuberculosis Zonal Reference Laboratory, Department of Medical Microbiology & Parasitology, University of Port Harcourt Teaching Hospital, Nigeria.
[2]Department of Medical Laboratory Science, Imo State University, Nigeria.

***Corresponding Author: Ibiju Wariboko**
South-South Tuberculosis Zonal Reference Laboratory, Department of Medical Microbiology & Parasitology, University of Port Harcourt Teaching Hospital, Nigeria.

**Article Received on 07/05/2019** **Article Revised on 27/05/2019** **Article Accepted on 17/06/2019**

## ABSTRACT
The re-emergence and increase in the prevalence of tuberculosis cases and multidrug resistant strains is of public health concern. The aim of this study was to compare some diagnostic techniques for *Mycobacterium tuberculosis* infection in Port Harcourt, Rivers State. A total of one hundred and eighty-two (182) sputum samples were collected from patients including children, teenagers and adults suspected to be infected with *tuberculosis* (TB) who were visiting the University of Port Harcourt Teaching Hospital, Choba. The samples were transported in cold chain with triple packaging system to be processed in a biosafety level two with level three practices laboratory in South-South Tuberculosis Zonal Reference Laboratory in Port Harcourt using Acid Fast Bacilli microscopy, Rapid Diagnostic Technique (RDT) and GeneXpert MTB/RIF assay. Whole Blood samples were also collected from participants for RDT. The present study showed a prevalence of 31.5% MTB positive cases among the studied population using AFB or GeneXpert. Positive MTB with rifampicin resistance was 65% while rifampicin sensitive was 35%. AFB microscopy of 20.3% showed scanty MTB positive (+) while 10.1% were moderately MTB (++) positive and, 1.1% of the tested population showed a heavy MTB (+++) infection. The positive predictive value of Ziehl-Neelsen microscopy from this study stood at 100% as against 8.0% for RDT. The results showed higher TB prevalence in males than in females. Conclusively, GeneXpert MTB/RIF assay is highly sensitive and specific in the detection of MTB and Rifampicin Resistance. The short turnaround time enhance prompt patient management and controls the transmission of the disease. It is therefore recommended that the MTB/RIF assay be emphasized as point of care test over RDT and AFB microscopy.

**KEYWORDS:** *Mycobacterium tuberculosis*, Tuberculosis, GeneXpert, Ziehl-Neelsen Staining and Rapid Diagnostic test.

## INTRODUCTION
*Mycobacterium tuberculosis* is specie of pathogenic bacteria in the family of Mycobacteriaceae and can cause the disease known as tuberculosis (Ryan and Kenneth, 2004). Robert Koch discovered the causative agent of tuberculosis in 1882. It's typical physic-structural characteristic is the presence of a waxy coat on the surface as a result of their acquisition of mycotic acid. This makes the cell surface impervious to gram staining but rather acid-fast stains like Ziehl-Neelsen or fluorescent stains like auramine are used instead for distinctive diagnosis of *Mycobacterium tuberculosis* in the laboratory (Fu-Liu, 2002). Currently, the most popular diagnostic tests for tuberculosis includes GeneXpert, Tuberculin Skin test, acid fast stain, sputum culture, and polymerase chain test (Caudaly, 2016).

In history, tuberculosis is one of the oldest diseases affecting humans. However, untill today, it's still recorded as one of the biggest killers among infectious diseases despite the global use of attenuated vaccine for tuberculosis as introduced by Calmette and Guerin in Paris in early 1920s (Waaler, 2002). Nevertheless, *Mycobacterium tuberculosis* the causative agent of tuberculosis has transformed to acquire a high rate of virulent strains and resistant genes (Bloom, 1994) which can attack soft tissues as well as bones and can cause deformities. Thishard tissues like bone can preserve TB infection for many years after death (Stead, 1997). Over time, modern diagnostic methods had aided the distinctive DNA sequencing of both human and animal TB pathogens like *Mycobacterium africanum*, *Mycobacterium microti*, *Mycobacterium canetti*, *Mycobacterium bovis*, and *Mycobacterium tuberculosis.* This forms the *Mycobacterium* complex (Cole, 2002; Sreevatsan, *et al*., 1997; Haas, 1996). To reach the global TB target by 2030 of reducing deaths from TB,

substantial rapid effort, with high levels of detection, diagnosis and treatment provision are needed.

Treatment of TB infection had evolved over the recent centuries since introduction of Streptomycin for TB treatment by Schatz and Waksman in the early 1940s. This was followed by the use of other antibiotics like isoniazid, rifampicin and pyrazinamide (Ryan, 1992). However, Dubos (2002) cautioned that medical solution alone would not work to cure and prevent or achieve TB eradication because several factors are responsible for the distribution of TB infection globally (Dubos, 2002). Performing drug susceptibility testing (DST) can be done from the growth of *Mycobacterium tuberculosis* in culture and this can take up to six (6) week and needs high biological safety level laboratory which is expensive. Isoniazid and rifampicin are two fundamental anti-TB drugs in use until recently when high resistance set in hence performing drug susceptibility testing became very important. In many countries multi-drug-resistant tuberculosis (MDR-TB) is greatly increasing and its treatment is very challenging as it takes longer time with the use of several anti bacterial agents that are expensive (Small and Pai 2010).

The Expert MTB/RIF assay technique was introduced in the United States by Cepheid Company and was declared fit for use in December 2010 by the World Health Organization as a major tool for Tuberculosis diagnosis world-wide. This declaration was made after about eighteen (18) months of continuous effective field assessment of its use in Tuberculosis, Multi drug Resistance-TB and TB/HIV con-infection diagnosis (Van Rie, *et al*., 2010).

This test has similar sensitivity to culture, specifically detects *Mycobacterium tuberculosis* as well as rifampicin resistance via the *rpoB*gene concurrently (WHO 2013). It can be used in low-death rate which is usually associated with delayed diagnosis and mistreatment (Fred, 2009). The GeneXpert MTB/RIF (GeneXpert) is a cartridge based nucleic acid amplication test, an automated diagnostic test that can identify mycobacterium tuberculosis DNA and resistance to rifampicin (RIF) by nucleic acid amplification test (NAAT). It was developed by the laboratory of Professor David Alland at the University of Medicine and Dentistry of New Jersery (UMDNJ) CDC, 2009).

The Ziehl-Neelsen (ZN) staining technique is an acid fast technology used to stain *Mycobacterium tuberculosis* and other species of Mycobacterium. It was fondly used by most developing countries before now as point of care test for the diagnosis of TB before the advent of the GeneXpert technology. It has the ability of providing the bacteriologic evidence needed to establish TB infection in clinical specimen like sputum. As a result of the mycolitic nature and ability to resist alcohol and acid (acid fast) by the cell wall of the bacterium, ZN stain was preferred to stain the TB bacilli (Mac-Fiberesima *et al*., 2018).

The Rapid Diagnostic Test (RDT) Kit was introduced by WHO in 2016 in Geneva to speed up detection and improve the management of multidrug resistant tuberculosis. It is cheaper, faster, and easy to manipulate with little or no expertise. It provides results within 24-48 hours as against the three months period needed for culture results. It's use is geared towards reducing the morbidity and mortality rate of TB bringing the public health burden of TB to a barest minimum. The aim of this study is to compare some diagnostic techniques for *Mycobacterium tuberculosis* infection in Port Harcourt, Rivers State.

## MATERIALS AND METHODS

### Study Area

This study was carried out at the Tuberculosis Reference Laboratory (TBRL) University of Port Harcourt Teaching Hospital (UPTH) located along East West Road between Rumuosi and Choba town in Obio/Akpor Local Government Area of Rivers State Nigeria. The Hospital shares a common boundary with the University of Port Harcourt, Abuja campus in Alakahia town. It is located in the Niger Delta region, lying along the Bonny River, 66 kilometers upstream from the gulf of Guinea (Britannica, 2007) Geographically it lies on the coordinates, latitude $4.75^0$N and longitude $7^0$E. The climate of Port Harcourt is temperate almost throughout the year with daily temperature averaging $30^0$C and rainfall measuring an average of over 210mm, the rains are heaviest between June and September (Britannica, 2007) The cite is sprawling in nature and building constructions are poorly regulated. This adds to flooding and sanitation problems since proper drainage system is lacking, parts of the cite floods during heavy rains. The inhabitants in Port Harcourt city depend mainly on drinking water from boreholes while most people have the habit of eating outside their homes.

### Patient Characteristics

Those enrolled for this study were patients between ages <10 — 70 years.

### Sample Size

$N=Z^2P(1-P)/d^2$ (Araoye, 2004)

Where N=sample size, P=Prevalence rate (12%: Z= confidence interval (95% CL= 1.96), d=degree of accuracy.

Therefore, $N=(1.96)^2(0.12)(1-0.12)/(0.05)^2$

N=176

One hundred and eight two (182) sputum and blood samples were received from the individuals enrolled and analyzed accordingly.

### Inclusion Criteria

Individuals having cough for two (2) weeks or more (Cough $\geq$ weeks), retreatment cases (PTB within the last year or non converting PTB case), symptomatic contacts

of DR-TB cases, persons that are in contact with individuals that have been recently treated of PTB, symptomatic presumptive TB cases with AFB negative results, those diagnosed to confirm MDR – TB, patients returning after loss to follow up and people living with HIV (PLHIV) with symptomatic tuberculosis were included in the study (Boehme & Sutherland, 2009).

**Patients Exclusion Criteria**
Individuals producing bloody sputum (haemoptysis) and sputum specimens with obvious food particles or other solid particulates were not accepted as these could interfere with the desired result. Persons on anti-TB drugs according to Boehme & Sutherland, 2009 and Individuals with in-complete data according to Vanspall, 2007 were also excluded.

**Study Design**
A cross sectional study was conducted in June 2018 and all eligible participants who fill the questionnaire who gave a written informed consent for the study period were sampled.

**Specimen Collection in Adult Patients**
Sputum specimens were collected in duplicate; one part was used for smear making and the other for GeneXpert. Patients were given two sterile wide mouthed containers each, they were told to rinse their mouth twice with water in the morning, unscrew the lid on the sputum collection container, inhale deeply and cough vigorously, expectorate the sputum into the two containers. They were advised to avoid spills or soiling the outside of the container, secure the lid on the collection device sample container labeled with name, age, sex, and date of collection (Fred, 2009). Sputum specimen were held at 2-8°C whenever possible as they got blocks of pure water and safely put the samples in between the blocks in sellable bags. The bags were three for each sputum specimen, with the form being placed on the third bag to avoid being soiled in case of any spillage. Both oral and structured questionnaire helped in accessing further details about individuals enrolled.

**Specimen Collection in Children**
Sputum specimen collection in children is quite difficult since they tend to swallow the sputum rather than expectorate it unlike in adults, therefore induced sputum specimen were collected especially from minor - age 5. Nebulization technique using hypotonic saline was used to collect the sputum by inhaling a nebulizer 3% sodium chloride mist for 5 - 15 minutes and then encouraging them to cough and expectorate the sputum into a wide mouth container. Chest or abdomen massages technique was also applied. Chest percussion, vibration and active breathing were also used for sputum collection in minors (Grant, 2012).

**Ethical Approval**
Approval for this research was given by the ethical committee of University of Port Harcourt Teaching Hospital.

**Specimen Processing**
Specimens collected were processed by microscopic method, serological method and GeneXpert MTB/RIF Assay, in a biosafety cabinet. In addition appropriate safety gadgets were worn due to the hazardous nature of the samples.

**Microscopy (Ziehi-Neelson Staining Technique)**
The specimens were arranged after being numbered accordingly, slides were labeled on the frosted end with pencil accordingly. The recommended size is 2 X 3cm or 1 X 2cm (Toyosi, 2012). The smear was placed on the flat surface with smear facing upward. It was allowed to air dry for at least 1 hour, and thereafter fixed by passing 3 times through a blue flame, ensuring that the smear face upward. This was done for all smeared samples.

Fixed slides were arranged (in batch of 12) including controls on a processing rack, making sure that smeared samples were separated from each other before staining Slides were flooded with strong carbol fuchsin, and heated to steam, allowed to stain for 5 minutes (Heating helps to melt the wax and opens up the mycolic cell wall to take in more stains, as the heat is removed they close up to retain the primary stain). Slides were rinsed in flowing tap water until no more color runs off. Left over rinsing water was tipped off. Slides were thereafter flooded with acid alcohol for 3 minutes to decolorize and washed with running tap water to stop decolourization. Thereafter they were flooded with methylene blue (which serves as counter stain), for 1 minute and rinsed with tap water, drained and dried (Obasanya *et al.*, 2013). Slides were viewed using oil immersion, and under X100 objectives.

**GeneXpert MTB/RIF Techniques**
Sputum specimens with blood, obvious food particles or other solid particulates were not accepted as these could interfere with the desired result. Two milliliter sputum sample on the original tube was mixed with the four milliliter sample reagent (which constitute of NaOH and Isopropanol, Isopropanol breaks down the mycolic cell wall of MTB while NaOH decontaminates the sputum samples) (i.e. 4mls of sample reagent to 2mls of sputum specimen, the ratio is 2:1 v/v) except in cases where the sputum is too mucoid, more of the sample reagent can be added as this will help to liquefy the mucous sputum specimen easily. After the addition of the sample reagent, the mixture was shacked vigorously for 10 - 20 times and incubated for 5 minutes at room temperature and then shacked again for 10 - 20 times and incubated at room temperature for 10 minutes. Each Gene Xpert MTB/RIF cartridge was labeled with the sample identification (ID) on the slides of the cartridge, and using the sterile transfer pipette provided in the package

of the cartridge packs, 2mls of the liquefied sample was aspirated and transferred into the open port of the cartridge after opening the lid of the cartridge, this was done slowly to minimize the risk of aerosol formation. At this point hands on stops while the machine automatically processes the samples with result displayed at the end of 1 hour 45 minutes on the computer screen (Fred, 2009).

**Rapid diagnostic test (RDT)**

This one step TB test is a chromatographic immunoassay for the qualitative detection of antibodies to *M. tuberculosis* in human whole blood. It is intended for professional use as an aid in the detection of antibodies against *M. tuberculosis* in human whole blood. Specially selected TB recombinant proteins were used in test band as capture materials and gold conjugates. These enable the Rapid TB test to identify antibodies to TB in human whole blood, with a high degree of accuracy. Whole blood specimen, collect fresh blood specimen just prior to using the assay. Specimens must be fresh. Whole blood collected by venipuncture should be stored at 2-8$^{o}$c if the test if to be run within 2 days of collection.

**Test Procedure**

By opening a pouch containing a cassette, the cassette was laid using the plastic pipette provided, 30ul whole blood was drawn into the sample well of the cassette. Then a drop of whole blood buffer was added into the sample well as well. Results were read within 10 – 15 minutes. Results must not be read after 20 minutes.

**Negative**

Only one colored band appears on the control (c) region. No apparent band on the test (T) region.

**Positive**

In addition to a pink colored control (c) band a distinct pink colored band will also appear in the test (T) region.

**Invalid**

A total absence of color in both regions is an indication of procedure error and/or the test reagent has been deteriorated.

**Statistical Analysis**

The data generated from the results were entered into a Microsoft excel spreadsheet. All data using the Statistical Package for Social Sciences (SPSS) version 21. Descriptive statistics were computed using simple frequency tables and charts. Spearman's chi-square test ($x^2$-test) or the Fisher's Exact Test (FET) of significance was used to determine statistical significance. The confidence interval (CI) was set at 95% and a p-value of less than 0.05 was considered statistically significant.

**Conflict of Interest**

The Authors did not declare any conflict of interest**.**

**RESULTS**

**Table 1: Comparison of Ziehl-Neelson and Rapid Diagnostic test against GeneXpert for TB Detection.**

| Number Tested (%) | Negative result (%) | Ziehl-Neelson Positive (%) | RDT Positive (%) | GeneXpert Positive (%) |
|---|---|---|---|---|
| 182(100) | 145(79.67) | 29 (15.93) | 8(4.40) | 37(20.3) |

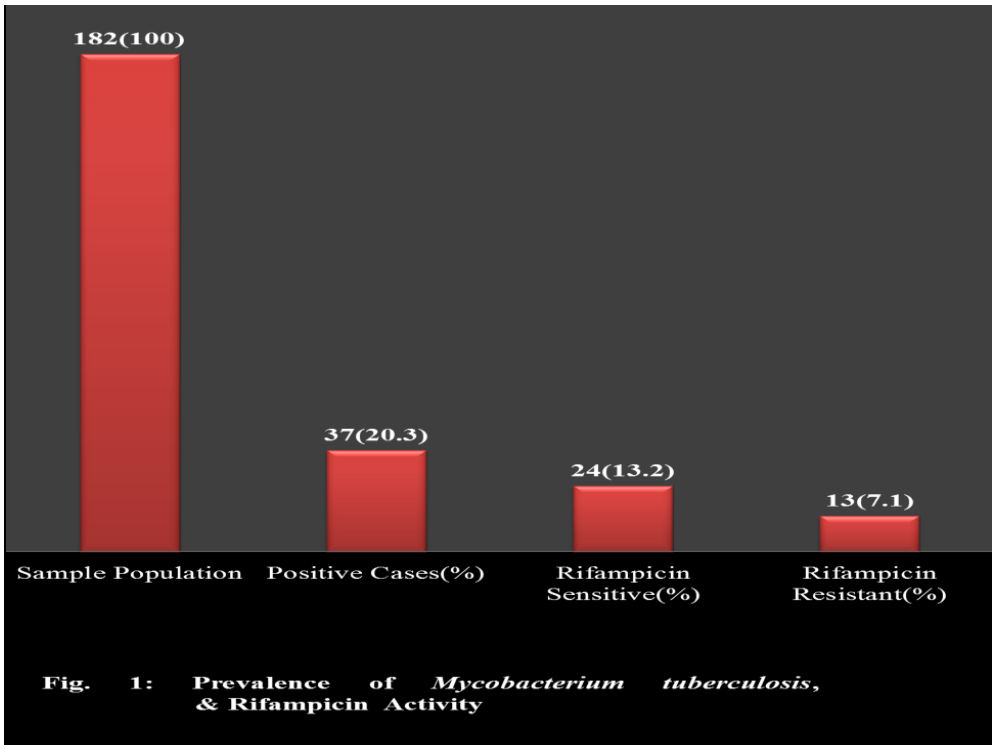


**Fig. 1: Prevalence of *Mycobacterium tuberculosis*, & Rifampicin Activity**

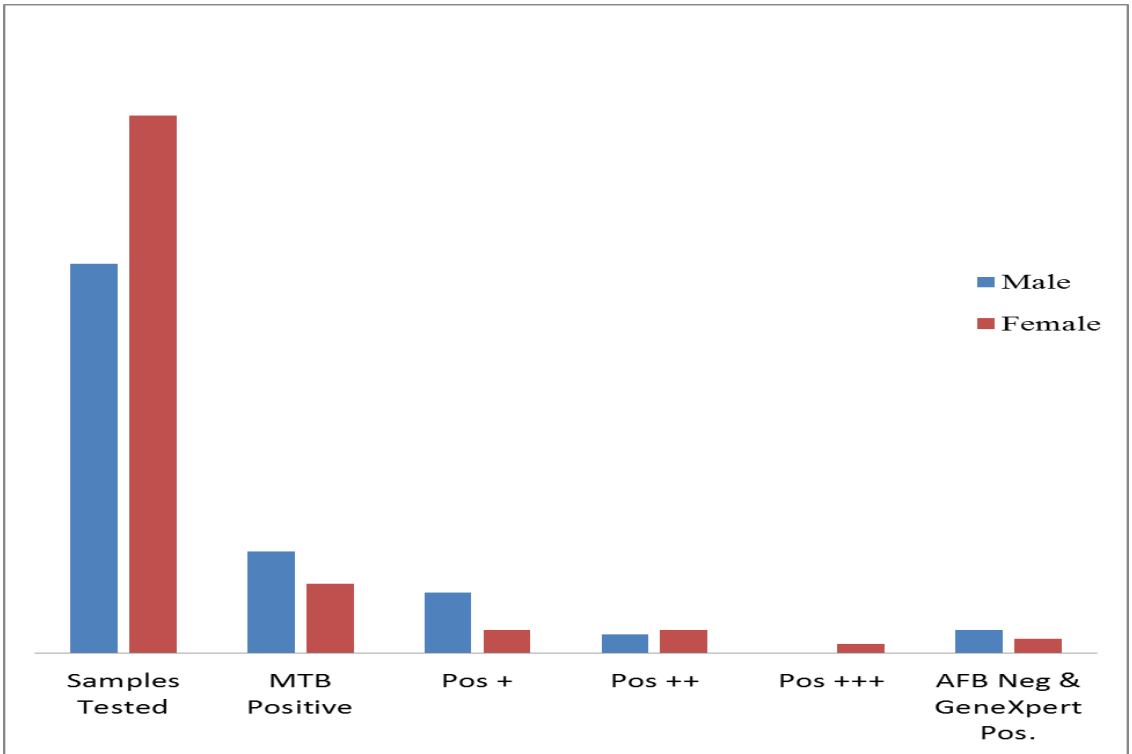


**Fig 2: Sex Related Prevalence of *Mycobacterium tuberculosis* among Subjects**

**Table 2: Age related prevalence of *Mycobacterium* tuberculosis.**

| Age Group | Number of Samples Tested (%) | MTB Positive (%) | +(%) Low | ++(%) Moderate | +++(%) High |
|---|---|---|---|---|---|
| 0-15years | 28(15.4) | 5(2.70) | 3(1.60) | 0(0.00) | 0(0.00) |
| 16-30years | 38(20.4) | 10(5.50) | 5(2.70) | 2(1.10) | 1(0.55) |
| 31-45years | 50(27.5) | 14(7.70) | 4(2.20) | 5(2.70) | 1(0.55) |
| 46-60years | 40(22.0) | 4(2.20) | 2(1.10) | 2(1.10) | 0(0.00) |
| 60+years | 26(14.3) | 0(0.00) | 4(2.20) | 0(0.00) | 0(0.00) |
| Total | 182(100) | 29(15.93) | 18(9.90) | 9(4.95) | 2(1.10) |

P=0.33($X^2$=2.9464), P>0.05=Not Significant, P<0.05=Significant

**Table 3: Prevalence of *Mycobacterium tuberculosis* Related to Questionaire Response**

| Marital Status | AFB Pos (%) | GeneXpert Pos (%) | RDT Pos (%) | $X^2$ | Pvalue 0.05 | Fishers Exact P-value | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | $X^2$ | 0.05 | 0.01 |
| Living in crowded rooms | 22(12.1) | 28(15.4) | 6(3.3) | 17.6 | 0.0002 | 1 | * | * |
| Living in un-crowded rooms | 7(3.7) | 9(4.9) | 2(1.1) | 5.89 | 0.0150 | | | |
| Seldom coughing for less than two weeks | 2(1.1) | 3(1.6) | 0(0) | 3.33 | 0.068* | 1 | * | * |
| Frequently coughing for more than two weeks | 27(14.8) | 34(18.7) | 8(4.4) | 21.3 | 0.0004 | | | |
| Experiencing chest pain, fever, and headaches | 23(12.6) | 29(15.9) | 7(3.8) | 6.63 | 0.0100 | 1 | * | * |
| Not experiencing chest pain fever and headaches | 6(3.3) | 8(4.4) | 1(0.55) | 179 | 0.0000 | | | |
| Vaccinated against TB | 0(0) | 0(0) | 2(1.1) | 0.00 | 1.000* | 1 | * | * |
| Not vaccinated against TB | 29(15.9) | 37(20.3) | 6(3.3) | 27.1 | 1.400* | | | |
| Engage in self medication | 17(9.3) | 22(12.1) | 4(2.2) | 15.9 | 0.0001 | 1 | * | * |
| Do not engage in self medication | 20 | 15 | 24 | 6.87 | 0.0240 | | | |
| Frequently visits a health facility | 12(6.6) | 15(8.2) | 4(2.2) | 2.76 | 0.142* | 1 | * | * |
| Seldom visits a health facility | 27 | 22 | 24 | 20.4. | 0.0005 | | | |

*Not Significant (P>0.05).

**DISCUSSION**

This study revealed an overall prevalence of MTB infection of 20.3% Fig 1. This was in tandem with the 20% reported by Wachukwu *et al*., (2017). This number could have been due to the socioeconomic factors such as low-income people with large families, living in densely populated urban communities with inadequate housing conditions, people living in congregated institutions such as prisons, nursing homes for elderly people, social shelters, day nurseries and internally displaced persons camps (IDP). However, in this study, age group 31-45years had the highest prevalence (7.7%) of MTB detection among the studied population with the least prevalence observed among age group 46-60 years and 61 years and above which had 2.2% each Table 1. It is heartwarming to note that the youthful population still has the highest population of MTB positive cases. A phenomenon also noted by Wachukwu *et al*., (2017) with their study's highest prevalence observed among age group 21-30 years and 31-40 years.

The study showed a negative predictive value for AFB microscopy of 95% as against 85.5% for RDT kits Table 1. According to Bradley *et al*., (1996), in Argentina and in many other developing countries like Nigeria, the main approach for TB diagnosis is still the Ziehl-Neelsen staining direct observation. Acid Fast bacilli (AFB) smear observation has a very poor sensitivity and a low negative predictive value in addition to exposing testing personnel to bacillus Fig 2. As a result of the features, currently many patients are misdiagnosed and the epidemic deepening. However, Non-respiratory specimens, apart from sputum, like early morning clean-catch urine specimens, cerebrospinal fluid, pleural fluid, pericardial fluid, and synovial fluid may be collected on 3 consecutive days for MTB culture (CLSI, 2008). In addition to cell size (1–10 µm in length), a beaded staining appearance is suggestive of AFB. The overall clinical sensitivity of sputum AFB smear is 22–80% depending on the burden of *mycobacteria*, the type of AFB stain used, and experience of the laboratory scientist, while the positive predictive value for *mycobacteria* is > 95% (Caulfield and Wengenack, 2016). However, acid-fast stains are not specific for MTB as they cannot differentiate between *mycobacteria* species. Smear sensitivity varies greatly based on AFB burden within sputum with 1000–10,000 CFU/ml required for reliable detection (Mac-Fiberesima *et al*., 2018). These higher AFB concentrations correlate with the severity of infection and positive sputum smears suggest a higher likelihood of infectivity for patients with pulmonary tuberculosis (Caulfield and Wengenack, 2016; Wachukwu *et al.*, 2017). Thus, proper training and personnel control is needed to improve result sensitivity and specificity.

Nevertheless, the sensitivity of Ziehl-Neelsen (ZN) for the detection of *Mycobacterium tuberculosis* among the studied population was observed to be 78.4% with 100% specificity as against 21.6% sensitivity and 98.9% specificity observed for rapid diagnostic test (RDT) as against 100% for Genepert MTB/RIF assay. This is similar to Boehme and Sutherland (2009) report with a sensitivity of 98% for patients classified as smear negative; culture positive and for culture positive samples Xpert gave 100%. Scott *et al.* (2011) also had similar result in a clinical study conducted, with the sensitivity of MTB/RIF test on just one sputum sample was 92.2% for culture positive TB and 98.2% for smear positive TB which also agrees with the present study. In the same vein, results from this study were also in agreement with Small and Pai (2010) reports in relation or reference to a pooled sensitivity of 88 and 98% specificity. However, no significant difference was observed for the detection of MTB among the different age groups in this study using GeneXpert, AFB and RDT. Scott *et al*. (2011) in their study found out that the Xpert MTB/RIF non laboratory based molecular assay has potential to improve the diagnosis of tuberculosis (TB) especially HIV infected population through increased sensitivity, reduced turnaround time and immediate identification of Rifampicin (RIF) resistance. MDR-TB also known as Vank's Disease as a form of TB infection caused by bacteria that are resistant to treatment with two of the most powerful first line anti-TB drugs such as isoniazid (INH) and Rifampicin (RIF). With the Xpert, MTB/RIF test MDR-TB diagnosis can be accomplished in fresh sputum samples and in prepared sediments within 2 to 3 hours, microscopy cannot be used to detect tuberculosis that are resistant to drugs hence treatment is delayed. The quick detection of *M. tuberculosis* and Rifampicin resistance using Gene Xpert assay helps the medical personnel to make critical patient management decisions concerning treatment (Lalloo *et al*., 2006).

It is also important to prevent co-infection because critically for patients who have TB co-infection with HIV or HBsAg, as co-infection has been shown by Umasoye *et al*., (2018) to influence disease mortality, causing electrolyte imbalance. Therefore, there is need for adequate awareness among health care providers and the public on the effect of the spread of these viral infections, the consequence of their co-infection and their modes of prevention (Umasoye *et al*., 2018; Ayodele *et al*., 2016).

Perhaps, occupation, marital status, education and living indices are important Predisposing factors to infection risks as well as disease predisposing factors in MTB prevalence (WHO, 2013). Fig 3 of this present study had shown that frequent coughing up to two weeks or more, had the highest prevalence of 14.8% for AFB microscopy and 18.7% for Xpert Gene assays. Thus, indicating that in overcrowded homes where more than two persons live, the release of cough droplets in aerosols could be important vehicle for transmission. Also, considering that, higher MTB infection prevalence were observed among the less educated and people with meager income, transmission could be attainable due to

unhygienic practices and communal lifestyle. In the same vein, according to Aaron *et al*., (2017), economic gains could also prompt impoverished individuals to loose or ignore their sense of hygiene and safety, to indulge in risky behaviors that can predispose them to MTB infection most especially in our harsh economic realities.

## CONCLUSION

Control of Tuberculosis can best be achieved by applying the appropriate technology to diagnose, finding new cases fastly, separating actively, and treating effectively. The Rapid Diagnostic Test Kit is not a reliable technology for TB diagnosis. The findings of this study therefore support the GeneXpert technology as a point of care test for TB diagnosis.

## REFERENCES


1. Ryan, C. and Kenneth J In Sherris Medical Microbiology: An Introduction to infectious Diseases New York: McGraw-Hill, 2004.
2. Flu-Liu WM, Mei R, Di X, Ryder TB, Hubbell E, Dee S, Webster TA, Harrington CA, Ho MH, Baid J, Smeekens SP *Bioinformatics*, 2002*;* 18: 1593-1599.
3. Waaler, H. T. Tuberculosis and Poverty. The International Journal of Tuberculosis and Lung Disease, 2002; 6(9): 745-746.
4. Bloom B R. Tuberculosis: Pathogenesis, Protection, and Control. Washington, DC: ASM Press, 1994.
5. Stead, W.W. The origin and erratic global spread of tuberculosis. How the past explains the present and is the key to the future. , 1997; 18(1): 65-77.
6. Cole, S. T. Comparative and functional genomics of the *Mycobacterium tuberculosis* complex. Microbiology, 2002; 148: 2919-2928.
7. Sreevatsan, S., Xi, Pan., Kathryn E. Stockbauer, Nancy, D., Connell, Barry, N., Kreiswirth, Thomas, S., Whittam, and James M. Musser. Restricted structural gene polymorphism in the *Mycobacterium tuberculosis* complex indicates evolutionarily recent global dissemination Proceedings of the National Academy of Science, 1997; 94(18): 9869-9874.
8. Ryan F. The forgotten plague: how the battle against tuberculosis was won and lost. Boston: Little, Brown, 1992; 251–261.
9. Small PM and Pai M. Rapid Tuberculosis Diagnosis in Low-Income Countries *New England Journal of Medicine*, 2010; 7(2) 115-116.
10. Van Rie, A., M.G., Alimuddin, Z., Ben, M. and Markus, M. GeneXpert MTB/RIF for point-of-care diagnosis of TB in high-HIV burden, resources-limited countries: Hype or Hope? *Expert Review in Molecular Diagnosis*, 2010; 107(7): 937-946.
11. World Health Organization. Updated WHO Recommendation for Diagnosis of Pulmonary TB, and Pediatric TB, Extra Pulmonary TB and Rifampicin resistance. 2013; www.who.int/tb/publications.
12. Fred, T. Two-hour detection of MTB and resistance to rifampicin. *Invitro diagnostic medical device.* Diseases & Project-Tuberculosis-Xpert MTB/RIF, 2009.
13. Centre for Disease Control and Prevention. A new tool to diagnose tuberculosis. 2009 http: //www.cde.govt/tb/publication/factsheets/testing/xpert-mtb-rif.htm.
14. Mac-Fiberesima, G., Akio, B., Okwelle, S.P.C., Ibiju, W., Wokom, a V., Omakwelle, G.C., Sounyo, I.I., Emuh, F., Karibi B.R.K., Appiah, T., Miebogo, E. & Anyiam, F.E. Utilization of GeneXpert for Point of Care Testing of Tuberculosis: A Bench Mark Approach Over Ziehl Neelson Smear Microscopy. *EC Pulmonology and Respiratory Medicine*, 2018*; 7(2): 65-71.*
15. Araoye, M, O. Sample Size determination. In: Research methodology with Statistics for Health and Social Sciences Ilorin: 2003; Nathadex.
16. Boehme, C.C. & Sutherland, R. Xpert, MTB/RJP Demonstrations for detection of TB and Rifampicin resistance. 2009 www.find diagnostic.org.document(Accessed 20/7/2015).
17. van Spall HGC, Chong A, Tu JV. Inpatient smoking-cessation counseling and all-cause mortality in patients with acute myocardial infarction. Am Heart J, 2007; 154(2): 213–220.
18. Grant, L.R. Procedures for collection of induced sputum specimen from children. *Clinical* I*nfectious Disease Oxford Journal, 2012;* 54: 140-145.
19. Toyosi, R. Update on tuberculosis diagnosis, Medical laboratory eLearning course, 2/4 of series 1, 2012; .http: //rapid intake.(Accessed 8/8/20 13).
20. Obasanya, J.O., Ojika, G.T., Elom, E.U., andEgbom, C. National TB Standard Operating Procedure Manual for laboratory. 2013; Published by American society for Microbiology.
21. Wachukwu, C. K,. Okwelle, S.P., Nwokah, E. G., and Ollor, O. Evaluation of gene xpert assay and microscopic examination for detection of *Mycobacterium* tuberculosis in sputum at Port Harcourt, Nigeria. African Journal of Microbiology Research, 2017; 12(14): 327-332.
22. Bradley, P., Reed, L., Catanzaro, A. Clinical Efficacy of the Amplified *Mycobacterium tuberculosis* direct test for the diagnosis of pulmonary tuberculosis. *American Journal of Respiratory and Critical Care Medicine*, 1996; 153: 1606.
23. Clinical Laboratory Standards Institute (CLSI). Laboratory detection and identification of *mycobacteria*. Document M48-A. Wayne, PA, 2008.
24. Caulfield, A. J. and Wengenack N. L. Diagnosis of active tuberculosis disease: From microscopy to molecular techniques. *Journal of Clinical Tuberculosis and Other Mycobacterial Diseases*, 2016; 4: 33-43.
25. Scott, L.E, McCarthy, K, Gous, N, Nduna, M, Van Rie, A, Sanne, I, Venter, W.F, Duse, A, and Stevens, W. Comparisons of Xpert MTB/RIG with other nucleic acid technologies for diagnosing pulmonary tuberculosis in a high HIV prevalence setting: a

prospective study. *Journal of Public Medicine*, 2011; 8(7): 57-58.
26. Ayodele, M. B. O., Frank-Peterside, N and Wariso, K. T. Serological Markers and Polymerase Chain Reaction (PCR) Detection of HBV DNA in HIV Sero-positive Patients in Port-Harcourt.*Nature Science*, 2016*;* 14(7): 1-5.
27. Aaron, U.U., Azuonwu, O., and Ayodele, M. B. O. Public Health Implication of HIV/AIDS Incidence in Orashi Region, Niger Delta, Nigeria. International Journal of Multidisciplinary Research, 2017; 4(3): 80-87.