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Sensitivity and Synergism of Tuberculin Skin Test (TST), Smear microscopy and GeneXpert in Diagnosis of Overt and Latent TB Infection in Mixed Population

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Abstract:- The study consisted of a cross sectional examination of infection profile focusing more on screening overt and asymptomatic (latent) TB infections in Correctional facilities (CF) in Cross River State. All tuberculosis cases (overt and latent) were screened using Tuberculin Skin Test, Smear microscopy and GeneXpert (GXPT) respectively. Inmates' positive for TST, AFB and GXPT were also screened for Human Immuno-deficiency virus (HIV) antibodies. The study population was 248 symptomatic and asymptomatic inmates; 166 from Afokang Correctional facility (ACF) and 82 from Ogoja Correctional facility (OCF). 92 (86 males and 6 females) enrolled for TST, 28 (30.4 %) were TST^+ male and 4 (4.4 %) TST^+ female in ACF and 17 (27 %) TST^+ all male from OCF with significant difference at P = 0.05. 14 TST^+ with 6 mm produce 5 AFB^+, 6TST^+ having 7-9 mm, 4 became AFB^+ while 7 individuals having 10-12 mm all tend out to be AFB^+, finally, 13-15 mm produced 2 AFB^+ from 5 TST^+ individuals. Induration diameter had no statistical influence on the AFB or GXPT positivity, but its result interpretation gave better prediction of AFB outcome. Acid fast bacilli detected 20 % AFB^+ while GXPT confirmed 22 % TB^+ from the 34.8 % TST^+ in ACF. There was no AFB nor GXPT positive cases from all TST^+ individuals in OCF. We report for the first time that, the synergistic diagnostic relationship of TST, AFB and GXPT in TB diagnosis in high-risk population as justify in their ability to detect 22 % TST^+GXPT^+, 7 % TST^-GXPT^+, 17 % TST^+ AFB^- $GXPT^+$ and 4 % TST^- AFB- $GXPT^+$ from 34.8 % TST^+ is encouraging and recommended for further investigation as an innovative model for identification of asymptomatic TB cases in mixed and highly -risk population.

***Keywords*:-** *Mycobacterium Tuberculosis, Sensitivity, Synergism, TST, AFB, GXPT, Afokang and Ogoja Correctional Facilities.*

I. INTRODUCTION

Tuberculosis (TB) is a contagious infectious disease seriously implicated in affecting the lungs and other organs of the body. The causative agent of TB is *Mycobacterium tuberculosis*_(MTB). It is a gram positive, slow growing, non-motile, non-spore forming obligate aerobic bacteria belonging to the family *Mycobacteriaceae* [1]. This family is divided into Mycobacterium tuberculosis complex (MTB) where the causative agent of TB belongs, non-tuberculosis mycobacteria (NTM) and mycobacterium leprae (causative agent of leprosy) [2].

According to WHO report 2022, 1.6 million people died from TB in 2021 of which 187 000 where co-infected with HIV. It is estimated that 10.6 million people felt sick of TB worldwide comprised of six million men, 3.4 million women and 1.2 million children. TB is the 13th leading cause of death and the second leading infectious killer after COVID-19 above HIV/AIDS. TB is present in all countries and age groups but is curable and preventable.

Factors such as HIV, malnutrition, young age, diabetes, indoor air pollution, alcohol, use of immunosuppressive drugs, population level, socioeconomic behavioral pattern are some of the predisposing factors to TB infection [3].

Globally, according to latest national TB patient cost survey data, every one in two TB-affected households face loss higher than 20% of their household income.

Before now, successful clinical intervention for TB diagnosis was based on Sputum culture, AFB staining (microscopy) and Tuberculin Skin Test (TST) techniques. Some of these techniques particularly culture is time consuming, while others are not sensitive enough to detect latent TB cases. This results in delayed commencement of treatment of positive cases, hence, further increase the mortality rate.

The introduction of Cepheid GeneXpert in 2015 for diagnosis of TB and detection of rifampicin resistance was the beginning of a new era in clinical management of TB. However, the present and popularly known TB diagnostic methods lacks the capacity of diagnosing asymptomatic (latent) TB infection, hence, the present study seek to explore the working synergy of TST, smear microscopy and GeneXpert in identifying overt and latent TB infection in mixed population using Correctional facilities as a case study.

II. MATERIALS AND METHODS

A. *Sample Collection and Preparation*

A total number of two hundred and forty-eight (248) inmates participated in the exercise. One hundred and sixty-six (166) from Afokang Correctional facility (ACF), eighty-two (82) from Ogoja Correctional facility (OCF). Out of this number, two hundred and thirty-four (234) were male and fourteen (14) females.

B. *Administration of Tuberculin Skin Test (TST)*

TST was considered in this study as epidemiological tool for latent TB infection (LTBI) surveillance in the experimented environment (Afokang and Ogoja prison). A vial of purified protein derivative (PPD) usually 0.1 Tuberculin unit (TU) (Arkray Healthcare PVC. Ltd India)) was injected intradermal into the forearm of concerted individuals. Previously exposed individual mounts an immune response to *M. tuberculosis* in the skin injected and inoculated with the bacterial proteins within 48-72 hours after injection. Diameter of (a palpable raised, hardened area) of ≥ 5 mm across the forearm perpendicular to the long axis in millimeters after the above-mentioned hours of inoculation was considered positive.

C. *Sputum Smear Microscopy*

All sputum samples from the two facilities were collected at the spot into 60 mL universal container into an ice-cool pack and transported immediately to Infectious Disease Hospital (IDH) Calabar. Sputum sample was divided into two equal portion, one portion mixed with the help of applicator stick and evenly spread over a central area of about 10-20 mm on the slide using a continuous rotational movement. The prepared slide was placed on a dryer with smeared surface upwards, and air dry for about 30 minutes. The slide was heat fixed, allowed to cooled before the addition of carbol fuchsin stain. The smear was heated until vapor begins to rise (i.e., about 60°C) and allowed for 5 minutes. The stain was washed off with a running clean tap water.

Smear was decolorized with 3 % v/v acid alcohol for 2-5 minutes until the smear was sufficiently decolorized, the slide was again washed and excess water tipped off before counterstaining. Slide was flooded with malachite green stain for 1-2 minutes before washing. Thereafter, the back of the slide was wipe clean and place it in a draining rack to air dry. Smeared slide was examined microscopically, using the X-100 oil immersion objective for systematic scanning and affirmation of bacilli.

D. *Gene Xpert Test*

About 4 mL of Xpert MTR/RIF sample reagent (LOT 0047C470) was added to 2 mL of the second portion of the sputum (2:1V/V). A paper towel soaked in hypochloride acid (HCL) was used to shake the wide mount universal cup containing the specimen. The container was shaken vigorously 10-20 times. The shaking was done twice before incubating for 15 minutes. At the expiration of the incubation period, a 2 mL Pasteur pipette was used to aspirate 2 mL of liquid portion of the sample and loaded on the cartridge port slowly to minimized aerosol. The lid of the cartridge was closed, the bar coad of the specimen cartridge scanned using the bar coad scanner (Voyager CG 9540) and loaded into the GeneXpert machine. Sample identification (S-ID) was keyed in, and start test command instructions selected on the computer monitor attached to the GeneXpert machine to begin operation. Positive sample takes 1h :25 minutes while negative result takes 1h :14 minutes to get ready.

E. *Human Immuno-Deficiency Virus (HIV) Screening*

A prolonged state of HIV is responsible for the development of acquired immunodeficiency syndrome (AIDs). This screening was applied in this study to detect the number of inmates that are Sero-positive for immediate commencement of treatment and evaluation of TB co-infection.

The thumb was properly cleaned with 70 % ethanol, lancet (pamoja.co.na) was used to prick the thumb for blood collection unto a sample pad (marked by the arrow symbol), few drops of chase buffer was applied and result read after or within 15 minutes

One red visible bar on control window absence on the patients' window is interpreted as negative result and the latter is interpreted positive. No bar on both windows was regarded as invalid and repeated. All results after the stipulated time were not valid.

➢ *Data Analysis*

The data collected were analyzed using SPSS version 20 for Descriptive statistics, unpaired T-test for comparison of the mean range of TST^{+}, $AFB^{+,}$ and $GXPT^{+}$ cases across the experimented locations.

Minitab 17 software statistical package assisted in determining the correlation between age bracket, period of incarceration and cell number with the positivity of tested parameters. The level of significance was considered at 90% confidence intervals with a P-value of < 0.05 or α- 0.05.

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III. RESULTS

➢ *Percentage Occurrence of TST⁺ Across ACF and OCF in Cross River State*

Of the one hundred and sixty-six inmates that participated in the study in ACF, 92 (86 males and 6 females) enrolled for TST, 28 (30.4 %) were TST⁺ male and 4 (4.4 %) TST⁺ female. Sixty-three (63) of 82 all male from Ogoja enrolled for TST, of which 17 (27 %) were TST⁺ ranged from 6.0 to ≥ 13mm induration diameter. There was a significant different at $P = 0.05$ in the rate of TST⁺ in Afokang compare to Ogoja (Figure 1).

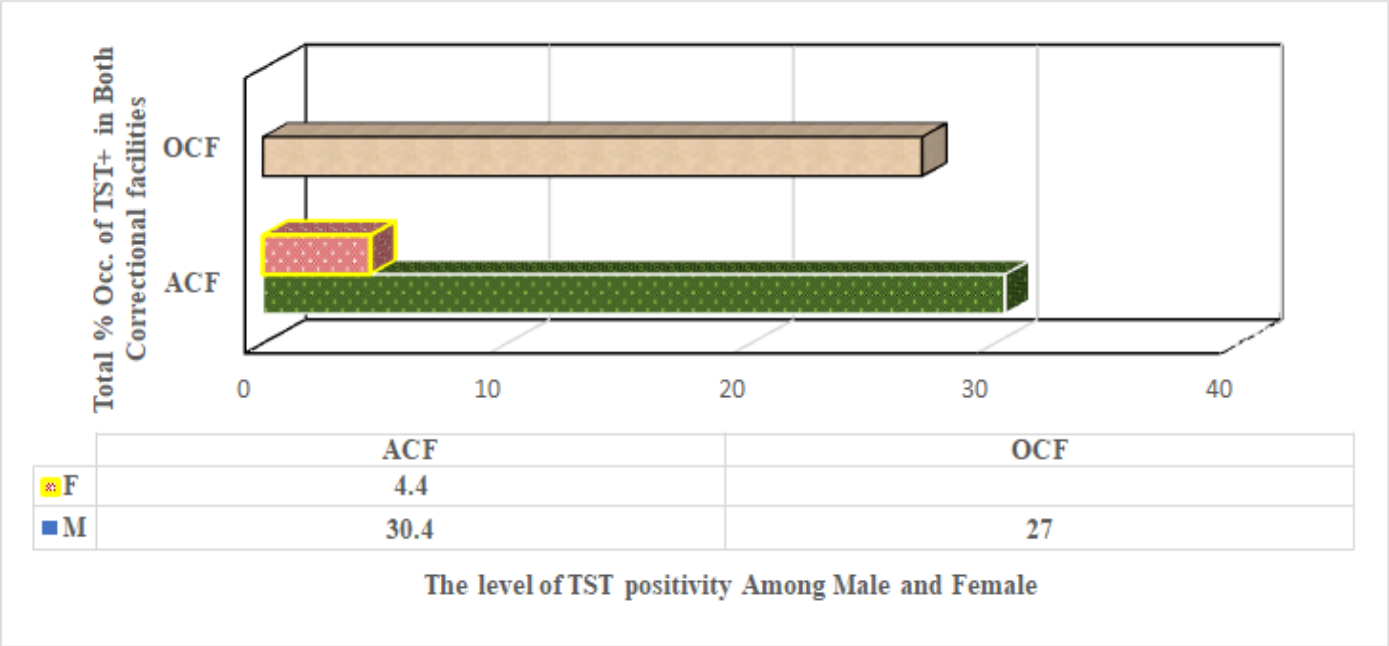

Fig 1 The rate of TST positivity Among Male and Female Inmates in ACF and OCF.

➢ *Induration Diameter and TST Positivity*

Table 1 is the distribution of TST⁺ individuals according to induration diameter in ACF and OCF. Altogether subjects in both facilities (14 in Afokang) and 8 in Ogoja had induration of 6.0 mm. 17 % developed induration of 7-12 mm while 10 % had indurations of ≥ 13 mm. The lowest induration diameter was 2 mm from OCF (Table 1)

Table 1 Distribution of Induration Diameter among Afokang and Ogoja Inmates (mm)

Induration (Range)	No. of TST ⁺ Afokang	No. of TST ⁺ Ogoja	Total
6.0	14 (43.8)	8 (47.0)	22 (44.9)
7-12	10 (31.2)	7 (41.2)	17 (34.7)
≥ 13 mm	8 (25.0)	2 (11.8)	10 (20.4)
Total	32	17	49

➢ *TST Result and AFB Outcome*

Among 14 TST⁺ individuals in ACF with induration diameter of 6.0, 5 (25 %) tested AFB ⁺ but none of the 8 TST ⁺ cases in Ogoja with 6.0 mm induration diameter were detected AFB⁺. Within the 7-9 mm induration diameter range in Afokang. 6 were TST⁺ among whom 4 (20 %) were AFB⁺, in the 10-12 range, there were 7 TST⁺ and all the 7 (35.0) were AFB⁺. There were 5 TST⁺ cases with induration diameter of 13-15 mm among whom 2 were AFB+ and there were 2 AFB+ individuals with induration ≥ 16 mm but who did not test TST⁺ (Table 2). Of all the 17 TST⁺ individuals encountered in OCF none was AFB⁺ (Table 3). Induration diameter of 10-12 produced the highest number of AFB⁺ cases of 7 (35 %). However, next to this number was 5 (25 %) with 6.0 induration diameter in ACF. Induration diameter had no statistical influence on the outcome of AFB result.

Table 2 TST and AFB Positive Cases According to Induration Diameter (mm) Among Afokang Inmates

Induration (Range)	TST ⁺ No. (%)	AFB ⁺ No. (%)	HIV ⁺ No. (%)
6.0	14 (43.8)	5 (25.0)	3 (60.0)
7-9	6 (18.8)	4 (20.0)	1 (20.0)
10-12	7 (21.9)	7 (35.0)	1 (20.0)
13-15	5 (15.6)	2 (10.0)	0 (0.00)
	0 (0.00)	2 (10.0)	0 (0.00)
Total	32	20	5

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Table 3 TST and AFB Positive Cases According to Induration Diameter (mm) Among Ogoja Inmates

Induration (Range)	AFB $^{+}$	TST $^{+}$	HIV $^{+}$
6.0	0 (0.00)	8 (47.1)	0 (0.00)
7-9	0 (0.00)	7 (41.2)	0 (0.00)
10-12	0(0.00)	2 (11.8)	0 (0.00)
13-15	0(0.00)	0 (0.00)	0 (0.00)
≥ 16	0(0.00)	0(0.00)	0(0.00)
Total	0	17	0

➢ *Induration Diameter in TB HIV Co-Infection*

Among the 14 TST^{+} with 6 mm induration produced 5 (25 %) AFB^{+}, 3 (60 %) HIV+. The specific induration for the HIV+ cases were 3, 3 and 6 mm respectively. Other two HIV+ cases were with induration of 6 and 10 mm respectively. The HIV status of experimented subjects has no correlation with induration size.

The HIV status of the 32 TST^{+} were examined of which 4 % were $TST^{+}HIV^{+}$, 29 % were $TST^{+}HIV^{-}$, 1 % was $TST^{-}HIV^{+}$ while 65 % were $TST^{-}HIV^{+}$ in ACF (Figure 2).

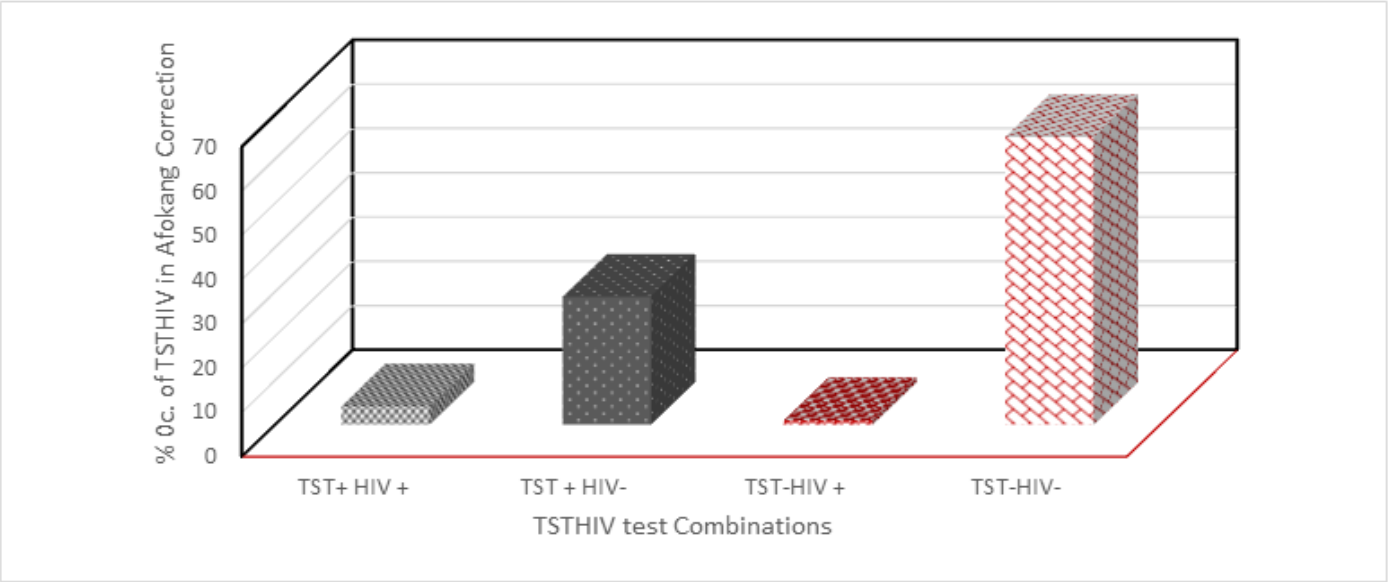

Fig 2 Occurrence of TSTHIV Co-Infection rate in Afokang Correctional facility

In Ogoja, 17 TST^{+} individuals had 27 % $TST^{+}HIV^{-}$, 73 % $TST^{-}HIV^{-}$. However, $TST^{+}HIV^{+}$ and $TST^{-}HIV^{+}$ tests combination was not detected (Figure 3).

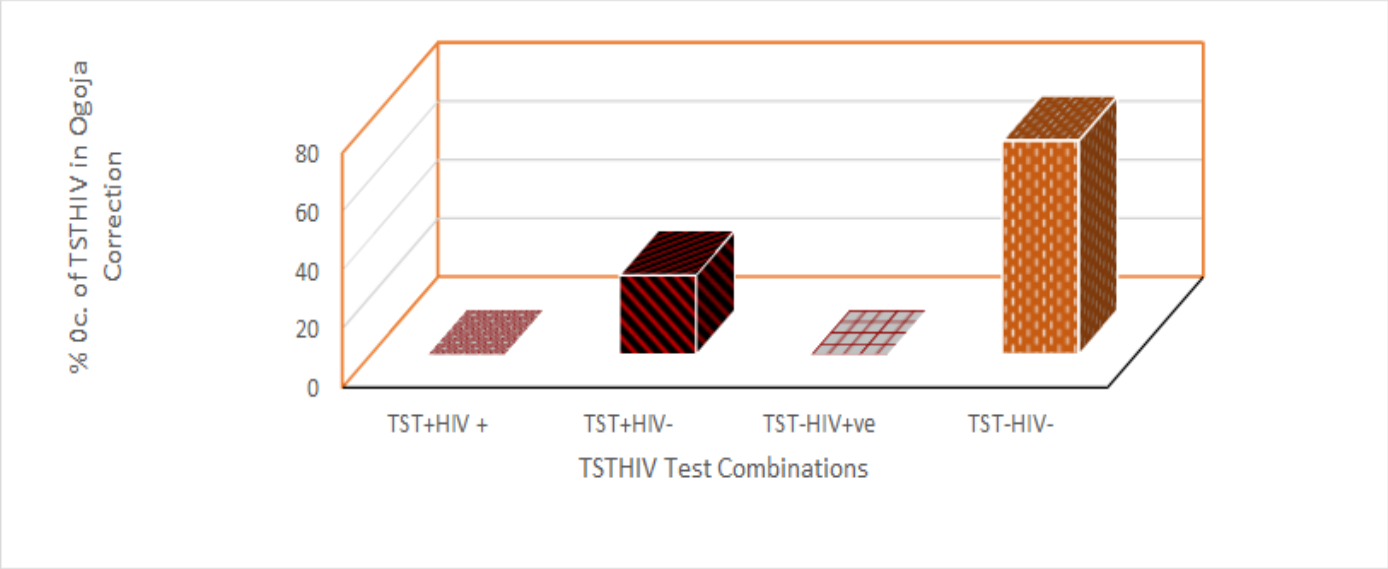

Fig 3 Occurrence of TSTHIV co-infection rate in Ogoja Correctional facility

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The percentage positivity of TST was 32 and that of GXPT was 22 making it a total of 54 %. The combination of $TST^{+}GXPT^{+}$ in Afokang revels that 22 % of 54 % individuals were $TST^{+}GXPT^{+}$, 10 % were $TST^{+}GXPT^{-}$, 3 % were $TST^{-}GXPT^{+}$ and the least was 2 % $TST^{-}GXPT^{-}$. The detection of 22 % $TST^{+}GXPT^{+}$ as well as 4 % $TST^{-}GXPT^{+}$ from asymptomatic TB individuals is a promising tracking or detection pattern for latent TB infection (Figure 4).

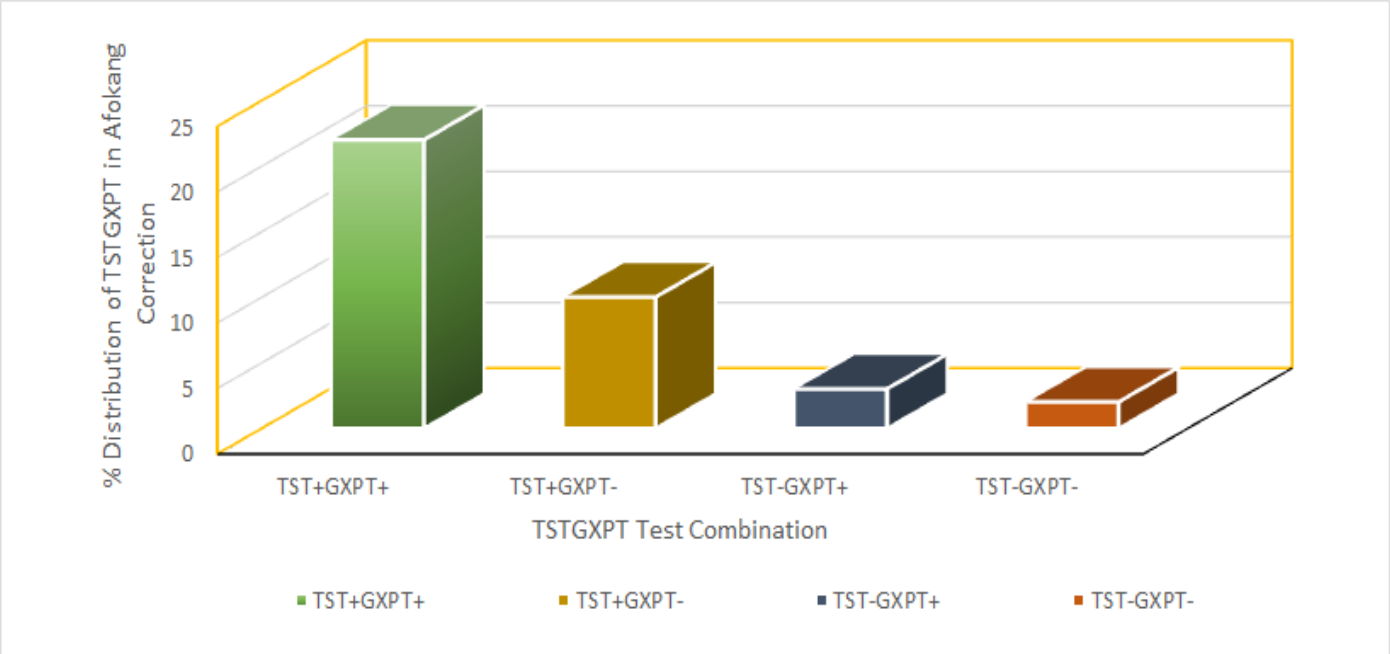

Fig 4 Levels of TSTGXPT Test Combination in Afokang Correctional facility

In Ogoja facility, 17 % of examined participants were $TST^{+}GXPT^{-}$, $TST^{-}GXPT^{-}$ were 46 % while $TST^{-}GXPT^{-}$ were not detected (Figure 5).

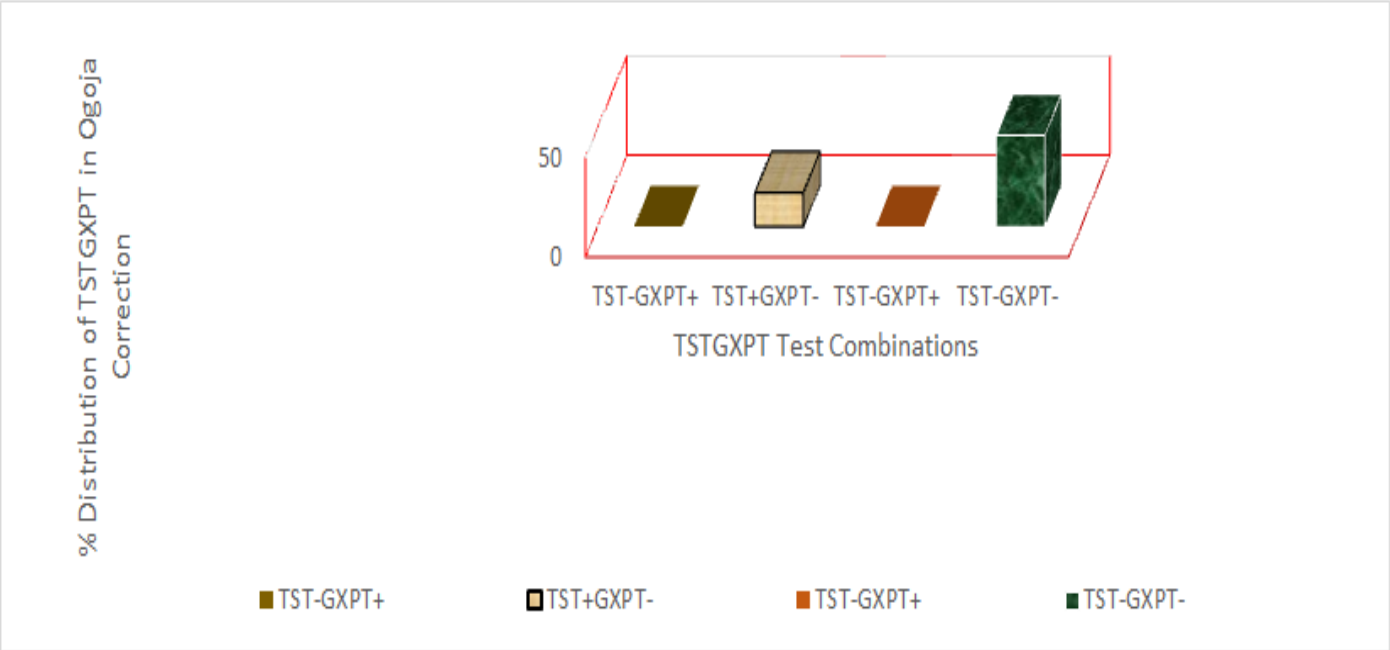

Fig 5 Levels of TSTGXPT Test Combination in Ogoja Correctional facility

Figure 6 displays the results of three (TST AFB GXPT) tests combinations carried out in AFC. 17 % subjects were $TST^{+}AFB^{-}GXPT^{+}$ while 1 % was categorize as $TST^{-}AFB^{-}GXPT^{-}$, but $TST^{+}AFB^{+}GXPT^{-}$ were not detected among all examined subjects.

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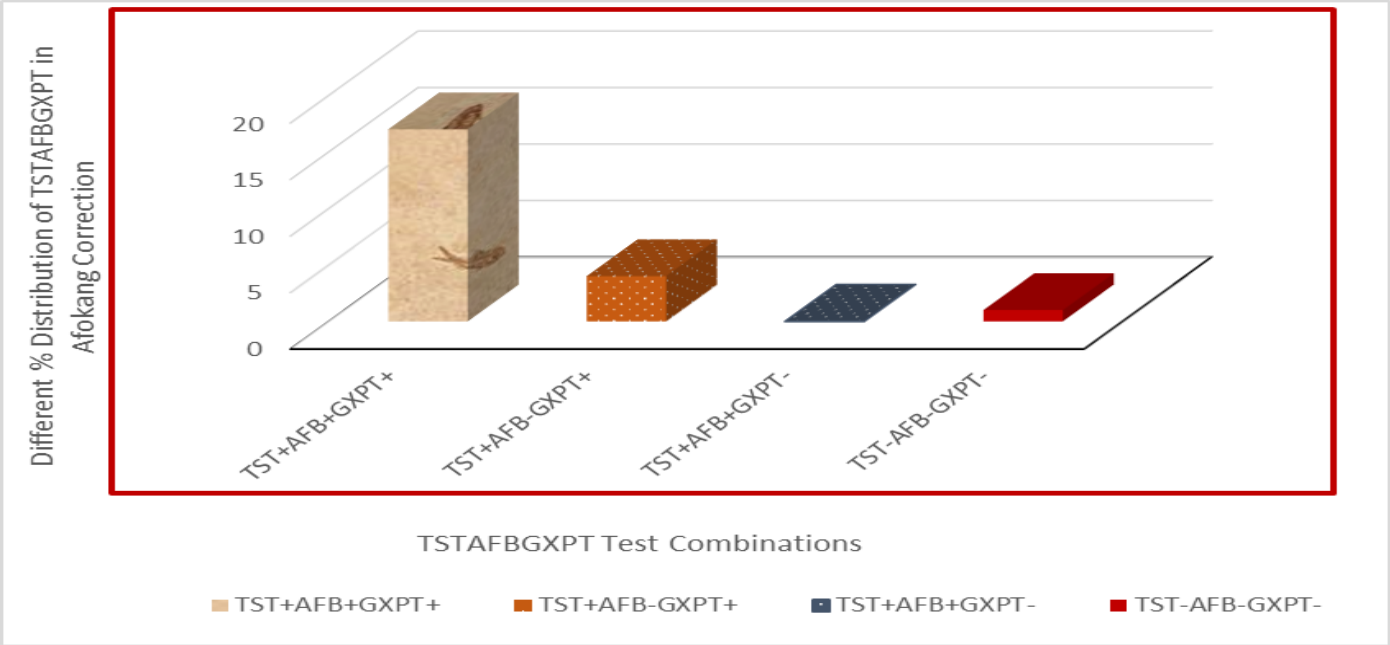

Fig 6 Different Levels of TSTAFBGXPT $^{+}$ Percentage Occurrence in Afokang Correctional facility

➢ *Synergism of TST AFB and GXPT in Latent and Overt TB Diagnosis*

Of the 32 TST^{+} inmates in AFC, 22 tested $GXPT^{+}$ while 20 were AFB^{+} which means that GXPT TB detection technique detected 68.8 % TST^{+} but only 20 (62.5 %) prove overt TB using microscopy. Among the 17 TST^{+} inmates in Ogoja facilities, none were screened $GXPT^{+}$ during the research period. This result implies that the relationship of TST, AFB and GXPT in TB diagnosis have 30 % sensitivity in detecting asymptomatic (Latent) TB in high-risk population as justify in their ability to screen 22 % $GXPT^{+}$, 20 % AFB^{+} from 32 TST^{+} inmates. The combinational diagnostic technique also detected 17 % TST^{+} AFB^{-} $GXPT^{+}$ and 4 % TST^{-} AFB^{-} $GXPT^{+}$ which is classified as latent TB in this research.

During the course of this research, it was found that eleven (11) inmates were previously diagnosed TB^{+} and were undergoing TB routine medication known as direct observe treatment (DOT), manage at different durations. They were re-examined using AFB and GXPT TB diagnostic techniques. Of the 11 AFB^{+} subjects, 2 were placed on 2 months DOT, of which both were re-detected TB^{+} by both AFB and GXPT screening methods. 7 individuals among the 11 were placed on 5 months DOT, 1 was re-diagnosed as TB^{+} by AFB screening method while 7 were re-detected TB^{+} by GXPT technique. 2 placed on 6 months DOT were all screened negative by AFB and GXPT techniques respectively. AFB rescreened 3% TB^{+} out of 11 individuals on DOT treatment while GXPT detected 9 % of the total (11) examined (table 4)

Table 4 Re-Diagnosis of TB Inmates on DOT Treatment

Drug Duration (Months)	No. Examined	AFB $^{+}$	GXPT $^{+}$
2	2	2	2
5	7	1	7
6	2	0	0
Total	11	3	9

IV. DISCUSSION

It was observed that the European center for disease prevention and control (ECDC) in conjunction with European monitoring center for Drugs and Drug addiction (EMCDDA) guidelines of examining inmates at arrival before admitting them into any cell was neglected except only on pathological expression. The disadvantage of this pattern of admitting inmates without proper medical screening is the underlying reason for unknown spread of infectious diseases that can endanger other prison mates.

The research choose prison to investigate communicable diseases that strive better in overcrowding situation notably *Mycobacterium tuberculosis*, and seek to used combinational diagnostic techniques to screen overt and latent TB infection in a mixed population like prison. There was a significant difference at (P= 0.05) in the occurrence of TST in Afokang to Ogoja Correctional facility.

Of the 34.8 % TST^{+} inmates at Afokang, some may have current *M. tuberculosis* infection, some may be merely exposed to *M. tuberculosis*, *M. bovis* or other Mycobacteria or have received BCG vaccination. These alternative interpretation of the TST result explain the low specificity of the screening method. Its advantage lies on the simplicity of test procedure, the low cost and ease of covering a larger population in screening test. Since it has a high sensitivity, and low specificity large number of false positive would be

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encountered and so, it is why it is termed, a screening test that need confirmation with acid fast microscopy, culture and/or GeneXpert. Only 27% of the Ogoja inmates tested were TST^+ compared with the 34.8 % in Afokang (Calabar). It is not known whether the disparity came from the small number of prisons incarcerated in Ogoja (280) compared with 870 in Afokang. Neither of these proportions may represent the situation in the population outside correctional facilities. However, it would be interesting to undertake the survey in the large Ogoja population, given that no overt TB was included in the 27 % TST^+ individuals and neither a single AFB^+ nor $GXPT^+$ case was among them.

Different TST^+ individuals produced different induration diameters, AFB positivity and or GXPT positivity correlation between induration diameter and detection of AFB in sputum would mean that size of induration could be used to predict current infection. Induration diameter ranging from 6-18 mm was taken to be positive TST result. The association in induration diameter with detection of AFB in sputum varied greatly. Although not all TST^+ individuals were AFB^+, it was striking that AFB was detected even in person with indurations as low as 6 mm, hence the said mm was accepted in this work to be TST

High TST report has been documented by the research of Lou *et a*l., 2015 [4] who state that TST^+ occurrence rate was 53.0 % among clinical medical students compare to 39.9 % found among preclinical students in Makerere Medical college Kampala in Uganda. Reasons for elevated level of TST induration among the populace is not scientifically provable. This is because previous vaccination to BCG, socio-economic class, exposure to other non-tuberculosis mycobacterium, underlying infection like HIV that affect the immune etc. are some factors that may influence induration diameter by activating and stimulating the delayed type hypersensitivity response mediated by T lymphocytes resulting in elevated induration and false positive TST results

Auld *et al*., 2013 [5] report on the association between tuberculin skin test result and clinical presentation of tuberculosis disease among US versus foreign group of people. They realize that, individuals with TST ≥ 15 mm were more likely to have cavitary pulmonary than non-cavitary pulmonary disease among the foreign group of participants. Statistically, it doesn't seem to be correlation between induration diameter and the presence of MTB bacterium. This is true because 2 inmates who had no induration after the administration of TST eventually had MTB bacilli in acid fast stain of their sputum.

So-ngem *et al*., (2022) [6] uses 20 mm TST induration diameter to screen thick skin systemic sclerosis patients, and established that induration ≥ 15 mm produced high specificity for tuberculosis infection.

Again, Nkuninungi *et al.,* (2012) [7] in their work of determining Mycobacterium tuberculosis infection among BCG-immunized Ugandan children by T-SPOT, TB and Tuberculin Skin Test, uses induration diameter ≥ 10 mm in combination with other diagnostic methods like T-SPOT. They established that T-SPOT TB positives are unstable and that TST compares poorly with T-SPOT TB making it difficult to categorized children as TB-infected or TB-uninfected.

Murthy *et al.,* (2013) [8] reported high TST^+ cases of 49.8 % (n= 1257) among South India with induration diameter of 0-4mm.

Elevated induration diameter among the populace is not surprising because induration is not dependent on the bacterium but immunological status of an individual. This means that, there should be a confirmatory assessment of asymptomatic case with AFB screening.

Among the 34.8 % TST^+ individuals emerge 20 % AFB^+ and 22 % $GXPT^+$ in Afokang facility. The 20 % AFB+ individuals included 11 % previously identified overt that were manifesting the characteristic TB symptoms including coughing, night sweat, weight loss etc. and were placed on different stages of treatment. Some had been treated for 2 months, some for five months and some for six month and above, hence symptoms were suppressed in these individuals. 8 % were those who were not expressing any TB symptoms who in this work were regarded as asymptomatic. The observation of AFB bacilli in expectorated mucus of those on treatment for 2 months or 5 months only showed that although the treatment was on, the organisms is not sufficiently cleared from the respiratory tract. At six months treatment, no bacilli were apparent in the sputum indicating the drug administered was effecting cure. Those on treatment were not coughing intensely showing conditions similar to asymptomatic cases. This means that GXPT has a better TB screening capacity compare to AFB. Again, complete eradication of Mycobacterium bacilli is better achieved during the 6 months DOT treatment phase as all 2 on this category were re-diagnosed negative by AFB and GXPT techniques respectively

Microscopy is one of the most efficient tools for diagnosis of TB in sputum of an infected persons. Smear-positive patients is ten times more likely to be infectious than a smear-negative patients. However, the sensitivity of this method in diagnosis of pulmonary tuberculosis ranges from 34% to 80%. Acid fast staining microscopy, however, does not have one hundred percent specificity because of other organisms apart from M. tuberculosis which could give acid fast staining and so tend to confused the interpretation of acid-fast microscopy. For example, *Norcadia* Spp, an *Actinomycete* could cause a TB-like pulmonary symptoms and invariably give acid fast sputum microscopy. Careful examination of Norcadia slide would show a mycelial-type branching of the acid-fast cells which does not occur with *M, tuberculosis*.

The report of this study shows that the level of sensitivity of GXPT was higher compared to that of microscopy in TB diagnosis. This was seen first, in the overall percentage of TB detection of 22 % detected by

GXPT to 20 % detected by microscopy. Second, GXPT diagnostic ability in subjects that were placed on different stages of TB drug is notable. The combinational diagnostic technique also detected 17 % TST^+ AFB^- $GXPT^+$ and 4 % TST^- AFB^- $GXPT^+$ which is classified as latent TB in this research. GeneXpert has a pooled sensitivity of 69.4- 84.7% and a pooled specificity of 98.8% in smear-negative sputum samples. The principle and the performance of the assay is based on automated and integrated sample purification, nucleic acid amplification, and detection of the target sequence (IS6110) using real- time reverse transcriptase PCR (RT-PCR) and real-time PCR assays. As a molecular TB test, it uses sputum to detect DNA in TB bacteria involving genetic mutations associated with resistance to the drug Rifampicin and give result in less than 2 hours. This genomic insertion element (IS6110) contains 1361bp found exclusively within the members of the Mycobacterium tuberculosis complex (MTBC), and because of this exclusivity, it is an important diagnostic tool in the identification of MTBC species.

The result report that 3 (60 %) individuals that were HIV^+ had an induration diameter of 6.0 mm, while other 2 HIV^+ subjects who were also positive for microscopy, each 1 (20 %) had induration diameter of 7-9 and 10-12 mm respectively. Induration diameter was statistically significant at ($P = .05$) among individuals that had positive combination of TST AFB and HIV co infection. The conclusion was drawn as the mean value of this group of inmates were ≤ 0.05.

Though some scholars report low induration diameter in HIV^+ individuals. Sawhney and Sharma (2006) [9] in their work on significance of Tuberculin testing in HIV infection: Indian Perspective shows that 45 % TST HIV positive with early acquired HIV with unimpaired immune system had induration diameter of ≥ 10 mm. Others 45 % with 0-4 mm had a lower CD4+ count of 200/cmm and others with HIV^+, with no TST induration cannot be consider as independent marker for suspecting tuberculosis in such groups and concluded that cases with TST of = or >10mm and cases with no induration with CD4+ count of <200/cmm should be considered as high-risk for developing tuberculosis.

Cobelens *et al.,* (2006) [10] report that 5mm induration was observed among non-anergic HIV-infected individuals and 10 mm from uninfected/infected unimpaired HIV subjects.

It is a long-established fact that the CD4 cell count measurement aid in understanding the progression of the human immunodeficiency virus (HIV) disease. This infection is a fatal one, characterized by targeting and destroying of CD4 T lymphocytes in the peripheral blood. CD4 T lymphocytes are a part of the human T-lymphocyte cells that are produced in the bone marrow and mature in the thymus. CD4 circulate the body to fight against bacteria, viruses, and other microorganisms. Untreated HIV enters the cell and replicates and causes massive death of CD4 cells. The remaining infected cells release virions, and infect other cells resulting in progression of the disease. The loss of CD4 T lymphocytes also results in impaired and or improper immune responses resulting in low TST induration.

V. CONCLUSION

The present study showed risk of not screening inmates before admitting them into prison cells, potential health risk of mixed population of unidentified (asymptomatic) infection as an endangering tool for rapid transmission and high chances of infection outbreak within the prison environment. Our report shows the working synergy of different (TST, AFB and GXPT) TB diagnosing techniques in identification and diagnosis of both overt and latent TB in mixed population.

We call on health agencies as a matter of importance to set up surveillance team in each Correctional facility for screening of incoming inmates as well as regular and or periodic screening of inmates for early detection of infection, commencement of treatment to avoid intra or inter cell transmission of infection that may lead to outbreak.

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The research is a self-sponsored study

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➢ *Ethical Approval*

Approval was sought and obtained from Cross River State Ministry of Health, Calabar (Health Research Ethics Committee) with Ref No: CRSMOH/RP/REC/2017/541 Prior to samples collection, participants informed consent were duly obtained, and participation was purely voluntary. Information revealing the true identity of the inmates were avoided and demographics data of the participants were kept confidential. Results of positive cases were reported to the medical unit of the correctional center for action. All inmates, symptomatic and asymptomatic including warders were included in the exercise.

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