Vuka! Let's unite towards a TB-free world!

9th SA TB Conference
8 - 11 June 2026

Comparison of BD MAX MDR-TB Assay with GeneXpert MTB/RIF Ultra assays and target sequencing for the detection of *Mycobacterium tuberculosis* complex and Rifampicin drug resistance in clinical specimens sent to a Tertiary laboratory in Pretoria.

Ms Orah Rikhotso
Sefako Makgatho Health Sciences University, TB Research Unit, Department of Microbiological Pathology
Supervisors: Dr NA Makhado, Dr E Mensah, Dr G Shikwambane-Ntlemo

Background

- Tuberculosis (TB) remains a major global public health challenge, with 10.8 million cases reported worldwide in 2023 (WHO, 2024).

- South Africa continues to experience a high burden of TB and drug-resistant TB (Shah *et al* ,2017) .

- Early detection of *Mycobacterium tuberculosis* complex (Mtbc) and rifampicin resistance is essential for timely treatment initiation and reducing transmission (Van Cutsem *et al* ,2016) .

- Rapid molecular assays such as GeneXpert MTB/RIF Ultra (Xpert Ultra) and BD MAX MDR-TB (BD MAX) are widely used for TB diagnosis (Mokaddas *et al*, 2019).

- However, studies have reported variable performance of BD MAX compared to Xpert Ultra, with limited data available from South Africa.

Problem Statement

- The BD MAX assay has raised concerns about its diagnostic accuracy, particularly in comparison to Xpert Ultra assay.

- Despite its potential, the BD MAX assay has been routinely observed to perform less superior and have less sensitivity compared to Xpert Ultra assay.

- There are no studies done to compare the BD MAX assay with Xpert Ultra/X/MDR-TB assays and target sequencing.

- Findings from this study will provide useful information to enable accurate detection of Mtbc and drug-resistant strains, which will further allow healthcare providers to initiate effective treatment promptly, improve patient treatment outcomes and reduce the spread of TB.

Objectives

- This study aimed to compare the BD MAX Assay with Xpert Ultra assays and target sequencing for the detection of *Mycobacterium tuberculosis* complex and rifampicin drug resistance in clinical specimens sent to a tertiary laboratory in Pretoria.

- To compare the diagnostic performance of BD MAX Assay with Xpert Ultra assays and target sequencing for the detection of *Mycobacterium tuberculosis* and rifampicin drug resistance.

- To determine and compare the sensitivity of BD MAX with Xpert Ultra assays and target sequencing for the detection of *Mycobacterium tuberculosis* and rifampicin drug resistance

Methods

STUDY DESIGN

Descriptive, observational study comparing BD MAX MDR-TB, Xpert MTB/RIF Ultra, and target sequencing for MTBC detection and rifampicin resistance identification in clinical specimens.

STUDY POPULATION

Patients' specimens with discordant results for GeneXpert RIF/Ultra and BD MAX MDR-TB assays.

INCLUDED

Specimens positive for MTBC with rifampicin discordant results between the two methods.

EXCLUDED

Specimens positive for MTBC without rifampicin discordant results, non-tuberculous mycobacteria and other bacteria.

LABORATORY TESTING

CLINICAL SPECIMENS (DISCORDANT)

MGIT culture tubes (n = 47 specimens)

MOLECULAR ASSAYS (REAL-TIME PCR)

BD MAX MDR-TB | **Xpert MTB/RIF Ultra**

Cartridge-based assays that detect MTBC, rifampicin and isoniazid. Results in ~3 hours.

Results for both assays will be retrieved from the NHLS Laboratory Information System (LIS).

DNA extraction

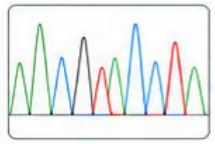
Zymo Quick-DNA™ Fungal/Bacterial Miniprep Kit

PCR amplification

- *rpoB* (nested PCR)
- *katG* (conventional PCR)
- *inhA* promoter region (conventional PCR)

Agarose gel electrophoresis

Amplicon size confirmed against DNA ladder



Sanger sequencing

Sequencing performed at Inqaba Biotechnical Industries

Bioinformatics analysis

ChromasPro 1.7.8, BioEdit, ClustalW, BLAST (PubMed/ GenBank)

Results

Table 1: Demographic distribution and clinical characteristics of study participants (n=47)

Characteristic		Frequency (n=47)	Percentage (%)
Gender			
	Male	31	66
	Female	16	34
Age (years)			
	0-14	2	4.3
	15-24	2	4.3
	25-44	28	59.5
	45-64	7	14.9
	>65	6	12.7
	Unknown	2	4.3
Province			
	Gauteng	45	95.7
	North West	2	4.3
Year of collection			
	2024	27	57.4
	2025	20	42.6
HIV status			
	Positive	7	14.9
	Unknown	40	85.1

Results cont..

Table 2: Comparison of BD MAX and Xpert Ultra

	Smear+ Culture+	Smear- Culture+	Smear+ Culture-	Smear- Culture-	Total
BD MAX Positive	24	0	0	0	24
BD MAX Negative	18	0	0	0	18
Xpert Ultra Positive	27	0	0	0	27
Xpert Ultra Negative	0	0	0	0	0

BD MAX tested on n=42 Xpert Ultra tested on n=27

Results cont..

Table 3: Detection of *Mtb* by both Xpert Ultra and BD MAX Assay on the same samples (n=22)

Sample type	Sputum	Tracheal Aspirate	Tissue	Total
Xpert Ultra positive	21	1	0	22
BD MAX positive	9	0	0	9
BD MAX negative	12	0	1	13

Results cont..

Table 4 :Comparative sensitivity of Xpert Ultra and BD MAX assays using target sequencing as reference

Sample type	Sputum (43)	Tracheal aspirate (3)	Tissue (1)	Total (47)
Target sequencing positive	44	3	1	47
BD MAX positive	22	2	0	24
BD MAX negative	17	1	0	18
Xpert Ultra positive	25	1	1	27
Xpert Ultra negative	0	0	0	0
BD MAX Sensitivity (%)	56.4	NA	NA	57.1
Xpert Ultra Sensitivity (%)	100	NA	NA	100

NA not applicable BD MAX tested on n=42 Xpert Ultra tested on n=27

Discussion

- Rapid molecular diagnostics are vital for detecting M*tb* and rifampicin resistance, offering faster results than microscopy and culture (Dheda et al., 2017) .
- Xpert Ultra showed higher MTB detection sensitivity than BD MAX. At least two previous studies showed similar results (Opota et al.,2019) but only when considering smear-positive specimens (Hodille et al.,2019) .
- BD MAX missed several confirmed Mtbc-positive specimens.
- Target sequencing identified rifampicin-resistance mutations missed by both assays.
- These findings support the use of sequencing to strengthen TB detection and surveillance in high-burden settings.
- Therefore, sequencing proved essential for identifying resistance mutations that fall beyond the coverage of routine molecular assays (Makhado *et al.*,2018) .

Conclusion

- Overall, this study argues that while BD MAX offers workflow automated advantages, its low sensitivity in comparison to Xpert Ultra is a limitation for its diagnostic value.

- Target sequencing detected mutations missed by both assays, emphasizing the importance of introducing sequencing to routine TB diagnostics.

Reference list

- Dheda, K., Gumbo, T., Maartens, G., Dooley, K.E., McNerney, R., Murray, M., Furin, J., Nardell, E.A., London, L., Lessem, E. and Theron, G., 2017. The epidemiology, pathogenesis, transmission, diagnosis, and management of multidrug-resistant, extensively drug-resistant, and incurable tuberculosis. *The lancet Respiratory medicine*, *5*(4), pp.291-360.
- Hodille, E., Maisson, A., Charlet, L., Bauduin, C., Genestet, C., Fredenucci, I., Rasigade, J.P., Lina, G. and Dumitrescu, O., 2019. Evaluation of Xpert MTB/RIF Ultra performance for pulmonary tuberculosis diagnosis on smear-negative respiratory samples in a French centre. *European Journal of Clinical Microbiology & Infectious Diseases*, *38*(3), pp.601-605.
- Opota, O., Mazza-Stalder, J., Greub, G. and Jaton, K., 2019. The rapid molecular test Xpert MTB/RIF ultra: towards improved tuberculosis diagnosis and rifampicin resistance detection. *Clinical microbiology and Infection*, *25*(11), pp.1370-1376.
- Makhado, N.A., Matabane, E., Faccin, M., Pinçon, C., Jouet, A., Boutachkourt, F., Goeminne, L., Gaudin, C., Maphalala, G., Beckert, P. and Niemann, S., 2018. Outbreak of multidrug-resistant tuberculosis in South Africa undetected by WHO-endorsed commercial tests: an observational study. *The Lancet Infectious Diseases*, *18*(12), pp.1350-1359.
- Mokaddas, E.M., Ahmad, S. and Eldeen, H.S., 2019. GeneXpert MTB/RIF is superior to BBD Max MDR-TB for diagnosis of tuberculosis (TB) in a country with low incidence of multidrug-resistant TB (MDR-TB). *Journal of Clinical Microbiology*, *57*(6), pp.10-1128.
- Shah, N.S., Auld, S.C., Brust, J.C., Mathema, B., Ismail, N., Moodley, P., Mlisana, K., Allana, S., Campbell, A., Mthiyane, T. and Morris, N., 2017. Transmission of extensively drug-resistant tuberculosis in South Africa. *New England Journal of Medicine*, *376*(3), pp.243-253.
- Van Cutsem, G., Isaakidis, P., Farley, J., Nardell, E., Volchenkov, G. and Cox, H., 2016. Infection control for drug-resistant tuberculosis: early diagnosis and treatment is the key. *Clinical Infectious Diseases*, *62*(suppl_3), pp.S238-S243.
- World Health Organization. Global tuberculosis report 2024. Geneva: World Health Organization; 2024. Licence: CC BY-NC-SA 3.0 IGO.

Acknowledgements

NATIONAL HEALTH LABORATORY SERVICE

AHRI AFRICA HEALTH RESEARCH INSTITUTE

SEFAKO MAKGATHO HEALTH SCIENCES UNIVERSITY

NIH National Institutes of Health