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The Utility of C-reactive Protein Levels and Tb Lam Test as Diagnostic Tools for Tuberculosis among HIV Art Clients, attending Fort Portal Regional -Referral Hospital-Uganda

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ABSTRACT

Background: *Diagnosing tuberculosis (TB) in HIV-positive patients on Antiretroviral Therapy (ART) remains challenging, especially in resource-limited settings. C-reactive protein (CRP) levels and TB LAM tests have been suggested as potential diagnostic tools. This study aimed to assess the utility of CRP tests and TB LAM in diagnosing TB among HIV patients on ART at Fort Portal Regional Referral Hospital.*

Methods*: We conducted analytical cross-sectional study that, extracted quantitative data from HIV clients on ART at Fort Portal Regional Referral Hospital. This aimed to establish CRP levels and TB LAM test as diagnostic tools and the associated factors. Study respondents were purposively selected from ART clinic*

Results*: The study covered 401 participants with a median age 43.7 ± 12 years. Majority 60.1% were females and 40% males. The median (IQR) CRP levels were 5 (1.37-5) mg/L. This study revealed a CRP threshold of 0.325 mg/L with a moderate TB LAM sensitivity at 62.3% with low GENEXPERT sensitivity at 37.7%. However, the specificity for detecting TB for both TB LAM and Gene Expert was high at 96.4% and 94.6% for TB LAM and GENE EXPERT respectively. The positive predictive values were 71.7% and 100% for TBLAM and Gene Expert respectively, while Negative predictive value for TBLAM was 94.6% and for Gene expert 91.3%. This established that advanced HIV clinical stage (≥ stage 2, aOR: 15.77, p = 0.013), lower education levels (aOR: 0.21, p = 0.021), and shorter duration of HIV infection (aOR: 0.17, p = 0.028) were associated with TB LAM positivity.*

Conclusions: *Use of CRP in triaging and TB LAM tests as diagnostic tool for TB in HIV-positive patients on ART remain a good strategy in TB diagnosis. However, with TB LAM moderate sensitivity and high specificity may limit its use as a standalone diagnostic tool. Use of Gene Expert with high positive predictive performance improves the diagnostic outcome particularly in resource-limited settings like Fort Portal Regional Referral Hospital*

Keywords

Utility of C-Reactive Proteins, TB LAM tests, Tuberculosis, HIV.

Background

Tuberculosis (TB) remains a significant global health challenge, particularly among people living with HIV (PLHIV) [1]. The percentage of notified TB patients who had a documented HIV test result in 2023 was 80%, this was the same level as in 2022, but up from 76% in 2021[2]. PLWH are 15–21 times more likely to develop active TB and more likely to die from it when they do, compared with people without HIV [3]. Recent studies have implicated TB as the leading cause of morbidity and mortality among immunocompromised individuals and ranks as the second most fatal infectious disease after the COVID-19 pandemic [4]. Sub-Saharan Africa bears a disproportionately high burden, accounting for 75% of global HIV cases, with an estimated TB

incidence of 212 cases per 100,000 people, including 42 cases per 100,000 among PLHIV [5]. Uganda is among the 30 high-burden countries for TB and HIV-related illnesses [1] with 1.4 million people living with HIV and 29,000 TB cases reported in 2021, of which 6,200 resulted in TB-related deaths [6]. These statistics highlight the urgent need for improved TB screening and diagnostic strategies to enhance early detection and treatment. Despite advancements in TB diagnostics, timely and accurate detection remains a challenge, particularly in resource-limited settings. Molecular diagnostic tests such as GeneXpert MTB/RIF [7] and the TB lipoarabinomannan (TB LAM) lateral flow test [8] have improved TB detection, but their widespread use is hindered by high costs and infrastructure limitations [9]. Consequently, many facilities still rely on less sensitive tools like sputum smear microscopy and chest X-rays [10]. WHO recommends using TB LAM (lipoarabinomannan) testing to assist in the diagnosis of TB in HIV-positive patients who are severely immunocompromised or seriously ill, particularly as a point-of-care test [11], but its diagnostic accuracy varies across different settings. In previous systematic reviews, the sensitivity and specificity of TB -LAM in outpatients, irrespective of their TB symptoms, was 31% and 95%, respectively [12] and the just published WHO TB-LAM revised guidelines [11] recommend the use of LAM in HIV-positive patients with CD4 count less than 100 cells/μL, irrespective of signs and symptoms of TB. To enhance TB case detection, C-reactive protein (CRP) testing has emerged as a cost-effective point-of-care triage tool, as CRP is an acute-phase inflammatory marker that rises in response to infections, including TB [13,14]. Recognizing its potential, the WHO endorsed CRP testing as part of the systematic TB screening protocol for PLHIV in 2021 [11]. Studies have shown that, the effectiveness of CRP-based TB triaging depends on the threshold used. In healthy individuals, CRP levels are typically below 5 mg/L [15]. Studies suggest that lower CRP cut-off points, such as 8 mg/L, may improve TB case detection [16], while Uganda's Ministry of Health set the CRP threshold at 10 mg/L [17]. A study in Southern India recommended an 8.25 mg/L threshold for CRP-based TB screening [18]. At Fort Portal Regional Referral Hospital (FRRH), concerns were raised that the 10 mg/L threshold had resulted in missed TB cases, with some patients only diagnosed after TB LAM testing was initiated based on clinical judgment (Verbal communication, ART clinic in-charge, FRRH). This suggested that Uganda's CRP threshold might not have been optimal for TB screening in HIV patients, potentially leading to missed diagnoses and delayed treatment initiation. Similar concerns had emerged in lower healthcare facilities, where TB LAM positivity rates appeared disproportionately high compared to Gene-Xpert results (Verbal communication, district laboratory focal person). These inconsistencies necessitated a re-evaluation of TB LAM's diagnostic accuracy and its role in routine TB screening among HIV patients. Given these diagnostic gaps, this study aimed to evaluate the utility of CRP levels testing as triaging and TB LAM test as diagnostic tool for TB among HIV-positive individuals on ART at Fort portal regional referral hospital.

Materials and Methods

Aim of the study

The study aimed at determining the utility of CRP tests and TB LAM as a diagnostic tool for tuberculosis among HIV patients on ART at Fort Portal Regional Referral Hospital-Uganda. Specifically, this study was to: 1) Establish the threshold CRP cutoff point at which TB LAM becomes positive among HIV patients on ART with latent, sub clinical and active tuberculosis. 2) Establish factors associated with TB LAM positivity among HIV patients on ART and 3) establish the diagnostic accuracy of TB LAM test in the diagnosis of TB among HIV positive patients on ART.

Study Design and Setting

It was an analytical cross-sectional study that extracted quantitative data from ART clients about CRP levels and the TB LAM test as diagnostic tools for tuberculosis between July and Dec 2024. This followed Mbarara University REC approval.

Sampling

Sample size was determined by Yamane statistical formula. This was based on a precision of 5% and 95% confidence level to get 401 test participants on ART from a 7644 HIV positive patients purposively selected.

Sampling of Study Subjects and Lab Test Samples

HIV patients above 20 years on ART based on WHO criteria who consented in writing were considered in this study. Anticoagulated blood samples were collected and centrifuged to obtain plasma, for CRP test levels. Sputum was used for Gene-Xpert testing while mid-stream urine was used for TB LAM testing. Plasma CRP levels were quantitatively determined using Cobas C3111 within the clinical laboratory at the hospital. TB LAM test strips were used for TB LAM testing. Urine sample strip results were read up to 25 minutes [19]. A positive result was indicated by the presence of purple or grey bars at both the control and test areas. A negative result was indicated by a purple bar on the control area and none at the test window. The TB LAM test results were compared with Gene-Xpert test results. Gene-Xpert with its low limit of detection, demonstrated higher sensitivity and specificity for detecting Mycobacterium tuberculosis. This comparison was conducted to determine the diagnostic accuracy of the TB LAM test.

Statistical Analysis

Data initially from Microsoft Excel was exported to STATA V.17 for analysis. CRP levels were summarized using median (IQR). Categorical variables were summarized using frequencies and percentages. The threshold CRP cutoff point at which TB LAM becomes positive was analyzed using receiver operating curve analysis and the optimal cut point obtained using Jouden index J method. Statistical significance at bivariate analysis and multivariate was considered at a p-value ≤ 0.05. Sensitivity, specificity, positive predictive value, and negative predictive value of the indicator test (TB-LAM) was done using Gen expert as the gold standard.

Results

From August 2024 to Dec 2024, a total of 401 mid-stream urine samples, 401 sputum samples and 401 anticoagulated blood samples were collected, and all included in the final analysis.

Characteristics of the Study Participants

A total number of 401 study participants were recruited in this study with a mean age of 43.68 ± 12.5years old and ranged from 20 to 72. Majority of the study participants 241 (60.1%) were females, slightly more than a half 213 (53.1%) were married, about 218 (54.4%) had primary level of education while 70 (17%) were illiterate. Most respondents 312 (77.8%) were employed as indicated in Table 1. The median CRP levels were 5 (1.37-5) mg/L. majority of the study participants were on DTG-based ART regimens; 397 (99.0%), had HIV infection for a duration of greater than five years; 376 (93.8%), were in stage 1 of the disease; 300 (74.8%), and had non-detectable viral load; 369 (92.0%). Adherence to ART was at 384 (95.8%) Table 1 displays other clinical characteristics of the study participants.

Table 1: Characteristics of the study participants.

Variable	Total N=401
Age in years; mean (SD)	43.68 (12.47)
Age categories	
20years	17 (4.2%)
≥20years	384 (95.8%)
Sex	
Male	160 (39.9%)
Female	241 (60.1%)
Marital status	
Single	138 (34.4%)
Married/cohabiting	213 (53.1%)
Separated/Divorced	50 (12.5%)
Education level	
No education	70 (17.5%)
Primary	218 (54.4%)
Secondary and above	113 (28.2%)
Employment status	
Unemployed	89 (22.2%)
Employed	312 (77.8%)
CRP levels (mg/L); Median (IQR)	5 (1.37-5)
ART regimen type	
DTG-based ART regimen	397 (99.0%)
Non DTG-based ART regimen	4 (1.0%)
ART treatment line	
First line	395 (98.5%)
Second line	6 (1.5%)
Regimen duration	
≤5years	20 (5.0%)
>5years	381 (95.0%)
DSDM model	
FBIM	58 (14.5%)
FBG	93 (23.2%)
FTDR	250 (62.3%)
TPT initiation	
Yes	399 (99.5%)
No	2 (0.5%)
Adherence	
95% (Good)	384 (95.8%)
85-94% (Fair)	17 (4.2%)
Duration of HIV infection	
<5years	25 (6.2%)
≥5years	376 (93.8%)
Course of Regimen taken	
One course	48 (12.0%)
Two course	350 (87.3%)
Three course	3 (0.7%)
Duration on HAART	
6-12months	4 (1.0%)
12-24months	13 (3.2%)
>24months	384 (95.8%)
Comorbidities	
Absent	363 (90.5%)
Present	38 (9.5%)
Most recent CD4 count	
<200cells/µL	6 (1.5%)
≥200cells/µL	395 (98.5%)
Most recent viral load	
Low viremia	23 (5.7%)
High viremia	9 (2.2%)
Target not detected	369 (92.0%)
Clinical stage	
Asymptomatic	92 (22.9%)
Stage 1	300 (74.8%)
Stage 2 and above	9 (2.2%)

Threshold CRP cutoff point at which TB LAM becomes positive among HIV patients on ART with latent, sub clinical and active tuberculosis. The quantity variable CRP: [AUC: 0.524 (95%CI: 0.491 -0.557)] was able to identify participants with and without TB LAM positive results at an optimal cut-off point of 5mg/L at a sensitivity of 94% and specificity of 11% as indicated in Figure 1.

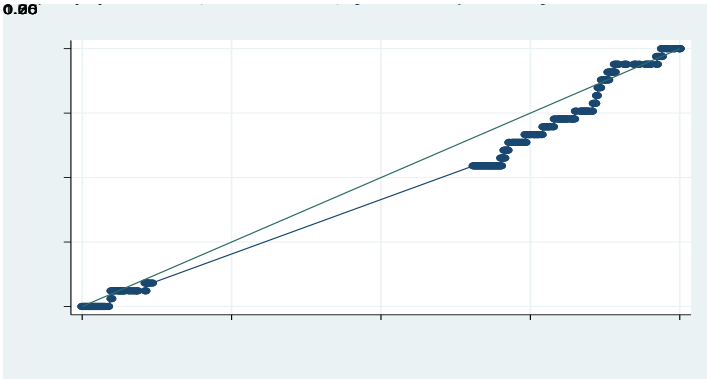

Figure 1: A ROC curve showing predictive performance of CRP for TBLAM positivity at optimal cut-off point.

At bivariate analysis, participants with secondary level of education and above; cOR: 0.25 (95% CI: 0.07 0.84, p-value 0.025), and those having HIV infection duration of ≥5 years; cOR: 0.32 (95%CI: 0.11 0.92, p-value 0.035) was observed to have significantly lower odds of TB-LAM positive results. However,

Table 2: Factors associated with TB LAM Test positivity at bivariate analysis.

Variable	Total 401	TB-LAM RESULTS		p-value	cOR:(95%CI)	P-value
		Negative N=368	Positive N=33			
Age categories				0.59		
<20years	17 (4.2%)	15 (88.2%)	2 (11.8%)		1.00	
≥20years	384 (95.8%)	353 (91.9%)	31 (8.1%)		0.66(0.14 3.01)	0.590
Sex				0.66		
Male	160 (39.9%)	148 (92.5%)	12 (7.5%)		1.00	
Female	241 (60.1%)	220 (91.3%)	21 (8.7%)		1.18(0.56 2.47)	0.665
Marital status				0.28		
Single	138 (34.4%)	128 (92.8%)	10 (7.2%)		1.00	
Married/cohabiting	213 (53.1%)	197 (92.5%)	16 (7.5%)		1.04(0.46 2.36)	0.926
Separated/Divorced	50 (12.5%)	43 (86.0%)	7 (14.0%)		2.08(0.75 5.81)	0.161
Education level				0.053		
No education	70 (17.5%)	61 (87.1%)	9 (12.9%)		1.00	
Primary	218 (54.4%)	198 (90.8%)	20 (9.2%)		0.68(0.30 1.58)	0.375
Secondary and above	113 (28.2%)	109 (96.5%)	4 (3.5%)		**0.25(0.07 0.84)**	**0.025**
Employment status				0.89		
Unemployed	89 (22.2%)	82 (92.1%)	7 (7.9%)		1.00	
Employed	312 (77.8%)	286 (91.7%)	26 (8.3%)		1.06(0.45 2.54)	0.887
CRP levels mg/L	5 (1.37-5)	5 (1.465-5)	5 (76-5)	0.24	0.92(0.81 1.05)	0.215
ART regimen type				0.29		
DTG-based ART regimen	397 (99.0%)	365 (91.9%)	32 (8.1%)		1.00	
Non DTG-based ART regimen	4 (1.0%)	3 (75.0%)	1 (25.0%)		3.80(0.38 37.61)	0.253
ART treatment line				0.080		
First line	395 (98.5%)	364 (92.2%)	31 (7.8%)		1.00	
Second line	6 (1.5%)	4 (66.7%)	2 (33.3%)		**5.87(1.03 33.33)**	**0.046**
Regimen duration				0.26		
≤5years	20 (5.0%)	17 (85.0%)	3 (15.0%)		1.00	
>5years	381 (95.0%)	351 (92.1%)	30 (7.9%)		0.48(0.13 1.755)	0.268
DSDM model				0.78		
FBIM	58 (14.5%)	52 (89.7%)	6 (10.3%)		1.00	
FBG	93 (23.2%)	85 (91.4%)	8 (8.6%)		0.82(0.27 2.48)	0.720
FTDR	250 (62.3%)	231 (92.4%)	19 (7.6%)		0.71(0.27 1.87)	0.492
TPT initiation				0.031		
Yes	399 (99.5%)	367 (92.0%)	32 (8.0%)		1.00	
No	2 (0.5%)	1 (50.0%)	1 (50.0%)		11.47(0.70 187.71)	0.087
Adherence				0.72		
95%(Good)	384 (95.8%)	352 (91.7%)	32 (8.3%)		1.00	
85-94%(Fair)	17 (4.2%)	16 (94.1%)	1 (5.9%)		0.69(0.09 5.35)	0.720
Duration of HIV infection				**0.044**		
<5years	25 (6.2%)	20 (80.0%)	5 (20.0%)		1.00	
≥5years	376 (93.8%)	348 (92.6%)	28 (7.4%)		**0.32(0.11 0.92)**	**0.035**
Course of Regimen taken				0.26		
One course	48 (12.0%)	45 (93.8%)	3 (6.3%)		1.00	
Two course	350 (87.3%)	321 (91.7%)	29 (8.3%)		1.36(0.40 4.63)	0.68
Three course	3 (0.7%)	2 (66.7%)	1 (33.3%)		7.50(0.52 108.28)	0.139
Duration on HAART				0.35		
6-12months	4 (1.0%)	3 (75.0%)	1 (25.0%)		1.00	
12-24months	13 (3.2%)	12 (92.3%)	1 (7.7%)		0.25(0.01 5.26)	0.26
>24months	384 (95.8%)	353 (91.9%)	31 (8.1%)		0.26(0.03 2.61)	0.254
Comorbidities				1.00		
Absent	363 (90.5%)	333 (91.7%)	30 (8.3%)		1.00	
Present	38 (9.5%)	35 (92.1%)	3 (7.9%)		0.95(0.28 3.28)	0.937
Most recent CD4 count				1.00		
<200cells/µL	6 (1.5%)	6 (100.0%)	0 0.0%)			
≥200cells/ µL	395 (98.5%)	362 (91.6%)	33 (8.4%)			
Most recent viral load				0.74		
Low viremia	23 (5.7%)	21 (91.3%)	2 (8.7%)		1.08(0.24 4.81)	0.923
High viremia	9 (2.2%)	8 (88.9%)	1 (11.1%)		1.41(0.17 11.68)	0.79
Target not detected	369 (92.0%)	339 (91.9%)	30 (8.1%)		1.00	
Clinical stage				0.009		
Asymptomatic	92 (22.9%)	89 (96.7%)	3 (3.3%)		1.00	
Stage 1	300 (74.8%)	273 (91.0%)	27 (9.0%)		2.93(0.87 9.90)	0.083
Stage 2 and above	9 (2.2%)	6 (66.7%)	3 (33.3%)		**14.83(2.45 89.85)**	**0.003**

cOR: *Crude Odds Ratio* ***CI****: Confidence Interval level, Tested α of significance **p value <0.05*

second line ART treatment; cOR: 5.87 (95%CI: 1.03 33.33, p-value 0.046), and clinical stage of ≥stage 2; cOR: 14.83 (95% CI: 2.45 89.85, p-value 0.003) were significantly associated with higher odds of TB-LAM positive results as indicated in Table 2 above.

Table 3: Factors associated with TB LAM Test positivity at multivariate analysis.

Variables	aOR: (95%CI)	P-value
Age categories		
<20years	1.00	
≥20years	1.02 (0.15 7.15)	0.984
Sex		
Male	1.00	
Female	0.95 (0.42 2.16)	0.911
Education level		
No education	1.00	
Primary	0.66 (0.27 1.61)	0.362
Secondary and above	**0.21 (0.05 0.80)**	****0.021**
CRP levels mg/L	0.92 (0.80 1.05)	0.221
ART regimen type		
DTG-based ART regimen	1.00	
Non DTG-based ART regimen	1.02 (0.03 30.17)	0.989
ART treatment line		
First line	1.00	
Second line	2.65 (0.17 42.00)	0.489
TPT initiation		
Yes	1.00	
No	11.43 (0.31 420.04)	0.185
Duration of HIV infection		
<5years	1.00	
≥5years	**0.17 (0.04 0.83)**	****0.028**
Duration on HAART		
6-12months	1.00	
12-24months	0.11 (0.02 2.03)	0.276
>24months	1.61 (0.08 32.42)	0.757
Comorbidities		
Absent	1.00	
Present	0.78 (0.19 3.19)	0.730
Most recent viral load		
Low viremia	0.98 (0.20 4.97)	0.985
High viremia	0.66 (0.06 7.50)	0.737
Target not detected	1.00	
Clinical stage		
Asymptomatic	1.00	
Stage 1	3.01 (0.82 11.03)	0.097
Stage 2 and above	**15.77 (1.78 140.05)**	****0.013**

*cOR: Crude Odds Ratio CI: Confidence Interval, statistical significance at α = **p value <0.05*

After adjustment for confounding effects at multivariate analysis, participants with secondary level of education and above; aOR: 0.21 (95%CI: 0.05 0.80, p-value 0.021), and those having HIV infection duration of ≥5 years; aOR: 0.17 (95%CI: (0.04 0.83, p-value 0.028) were observed to have significantly lower odds of TB-LAM positive results. However, clinical stage of ≥stage 2; aOR: 15.77 (95%CI: 1.78 140.05), p-value 0.013) were significantly associated with higher odds of TB-LAM positive results as indicated in Table 3 above.

Table 4: Diagnostic accuracy of TB-LAM Test in the diagnosis of TB.

RESULTS	TB LAM	GENEXPERT
Negative	348	368
Positive	33	20
Total Tests	401	401
Sensitivity	63.3%	37.7%
Specificity	96.4%	94.6%
Positive predictive value	71.7%	100%
Negative predictive value	94.6%	91.3%

From Table 4 above TB-LAM sensitivity was at 63.3% and specificity at 96.4%, while Gene Expert sensitivity was 37.7% and specificity at 94.4%. The positive predictive values were 71.7% and 100% for TBLAM and Gene Expert respectively.

Discussion

Tuberculosis (TB) remains a critical health challenge among people living with HIV (PLHIV), particularly in sub-Saharan Africa. While TB is a preventable and curable disease, co-infection with HIV significantly complicates its management, particularly in resource-limited settings [20]. The emergence of diagnostic tools like C-reactive protein (CRP) levels and TB Lipoarabinomannan (LAM) tests has provided new opportunities for early TB detection, especially in HIV-positive individuals on antiretroviral therapy (ART). C-reactive protein (CRP) is a non-specific inflammatory marker that has been found to be elevated in both HIV-infected and uninfected people with pyogenic infections including active tuberculosis [21]. In this study, we explore the CRP threshold at which TB LAM tests become positive, factors associated with TB LAM positivity, and the diagnostic accuracy of TB LAM in detecting TB in HIV-positive patients.

The CRP threshold at which the TB LAM test becomes positive is a key consideration for improving TB case detection among HIV-positive individuals. In our study, a CRP cut-off of 0.325 mg/L was found to have high sensitivity (94%) but very low specificity (11%), indicating that CRP alone may not be sufficiently relied on to accurately triage patients for TB testing. This aligns with other research suggesting that while CRP levels rise in response to TB-related inflammation, they lack the specificity needed to differentiate TB from other infections [22,23]. The low specificity observed in this study supports these conclusions, as it may lead to the potential risk of over-screening and false-positive TB triaging. Other studies have identified higher CRP cut-offs for TB diagnosis in HIV-positive patients, such as 8.25 mg/L in Southern India, where sensitivity and specificity were more balanced at 70.13% and 69.86%, respectively [24]. In Uganda, the Ministry of Health (MOH) currently recommends a CRP threshold of 10 mg/L for TB LAM testing, a much higher value that risks missing recommending patients for TB testing with lower CRP levels. This may result into missing many TB case diagnoses. The discrepancies in CRP cut-off values across studies highlight the need for context-specific guidelines based on local epidemiology and resource availability. Notably, a recent study suggested that lowering the CRP threshold to 8 mg/L could enhance TB screening sensitivity while maintaining reasonable specificity

[25]. Given that, CRP is primarily used as a triage tool, adjusting the threshold appropriately could enhance early case detection, ensuring that more patients undergo confirmatory testing. This may be particularly important in regions with high TB prevalence, such as the Tooro region, where the current CRP threshold may contribute to missed diagnoses. Improving TB screening strategies is essential, as delayed case detection can lead to worse health outcomes, including increased mortality among HIV-positive patients [26].

From our study findings factors influencing TB LAM positivity included education level, HIV infection duration, and clinical stage (Table 3). A higher level of education was significantly associated with a lower likelihood of testing positive for TB LAM, with participants possessing secondary education or higher having reduced odds of TB LAM positivity (aOR: 0.21). This may be linked to increased health literacy among more educated individuals, enabling them to engage in better HIV management and reduce the risk of TB co-infection. The results of this study concur with other studies [27,28], which also established that, more educated individuals have better health seeking behavior than the less educated. Additionally, individuals who had been living with HIV for five years or more had lower odds of TB LAM positivity (aOR: 0.17). Previous studies with a similar finding [29] implicate the long-term benefits from ART, which strengthens the immune system and decreases the likelihood of TB infection. Conversely, patients in advanced clinical stages of HIV (≥ stage 2) had higher odds of TB LAM positivity (aOR: 15.77). Recent studies, have established that, such a finding consistent with the increased vulnerability to opportunistic infections such as TB as HIV progresses (Obeagu and Onuoha, 2023) [30].

The diagnostic accuracy of TB LAM among HIV positive patients on ART positively impacts on treatment outcomes. In our study TB LAM showed a moderate sensitivity of 62.3% in detecting TB among HIV posive clients, but had high specificity at 96.4% compared to Gene expert. Gene expert on the other hand demonstrated higher specificity at 94.6% with a low sensitivity of 37.7%. This implied that Gene expert had missed some TB cases, that TB LAM was able to capture. It is therefore, more feasible to use both tests to maximise the benefit of diagnostic accuracy.

Our study findings on TB LAM tests are not different from a study by Kiyingi et al., that also demonstrated moderate diagnostic accuracy for tuberculosis (TB) in HIV-positive patients, with sensitivities ranging from 40% to 75% and specificities around 90%. Important to note is that, this is particularly useful for diagnosing TB in severely immunocompromised individuals with advanced HIV disease. Over all, our results align with previous research highlighting the challenges of using TB LAM in less immunocompromised populations. While TB LAM may have higher sensitivity in severely immunosuppressed patients, such as those hospitalized with advanced HIV, its performance diminishes in more stable HIV-positive patients on ART [32]. In resource-limited settings where GeneXpert may not always be available, TB LAM's high specificity could still be useful when used in combination with other diagnostic tools, such as CRP or Gene-Xpert, to improve overall diagnostic accuracy [33].

Recent studies suggest that a combined approach to TB diagnosis, incorporating both TB LAM and Gene-Xpert, may enhance diagnostic sensitivity, particularly in high-burden settings [34]. However, in settings like Fort Portal Regional Referral Hospital, our study indicates that TB LAM alone may not be sufficient for accurate TB detection, reinforcing the need for comprehensive diagnostic algorithms that integrate multiple testing methods.

Conclusion

Use of CRP in triaging and TB LAM tests as diagnostic tool for TB in HIV-positive patients on ART remain a good strategy in TB diagnosis. However, with TBLAM moderate sensitivity and high specificity may limits its use as a standalone diagnostic tool. Use of Gene Expert with high positive predictive performance improves the diagnostic outcome particularly in resource-limited settings like Fort Portal Regional Referral Hospital further research is needed to refine CRP thresholds and optimize diagnostic strategies to improve TB detection rates, reduce false positives, and ensure timely treatment initiation for PLHIV. Efforts should also focus on expanding access to rapid and accurate diagnostic tools like Gene -Xpert, especially in regions with high HIV and TB co-infection rates.

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Institutional Review Board Statement

The study was approved by the Institutional Ethics Committee. Mbarara University of Science and Technology; Ref IRB NO: MUST-2024-1597.

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