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High prevalence and risk factors of positive sputum smear in newly diagnosed pulmonary tuberculosis patients in Vietnam

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SUMMARY

Objectives: To assess the prevalence and identify risk factors associated with smear-positive tuberculosis (acid-fast bacilli [AFB]-positive) in newly diagnosed patients in Vietnam. *Methods*: A retrospective study was conducted on patients newly diagnosed with pulmonary tuberculosis (PTB) from August 2023 to August 2024. Patients were classified as smear-positive if at least one respiratory sample tested positive with AFB before starting anti-tuberculosis treatment. Smear-negative individuals had to submit a minimum of two sputum samples, all of which had to test negative before treatment initiation.
Results: 379 PTB patients were included with 48.3% being AFB-positive. The proportion of hemoptysis was significantly higher in AFB-positive than in AFB-negative patients (9.8% versus 4.1%, p=0.04). AFB-negative patients had a significantly higher rate of fatigue and crackles compared to AFB-positive patients with 85.7% versus 77.0%, p=0.03 and 36.2% versus 25.7%, p=0.03, respectively. Cavitary lung lesions were significantly more common in AFB-positive patients (48.6% versus 29.1%, p<0.0001). In multivariate analysis, patients with diabetes mellitus and those with long-term corticosteroid use were respectively three times and six times more likely to be AFB-positive (OR=2.71, p=0.002 and OR=6.15, p=0.009) more likely to. Cavitation in chest-x-ray was also associated with 2.5 times of risk for smear-positive (OR=2.53, p <0.0001). All of three HIV-coinfected patients were AFB-negative.
Conclusion: Our findings emphasize the importance of screening and early diagnosis of PTB in individuals with diabetes mellitus and in those on long-term corticosteroid therapy. Strengthening TB control efforts, particularly among high-risk populations, is crucial to reducing the burden of smear-positive TB and preventing further transmission.

Keywords: smear positive, tuberculosis, risk factors, Vietnam.

INTRODUCTION

Tuberculosis (TB) remains one of the most pressing global health challenges, particularly in low- and middle-income countries [1]. Despite significant advancements in diagnostic methods, treatment protocols, and public health initiatives, TB is still among the top 10 causes of death worldwide [1, 2]. According to the World Health Organization (WHO), approximately 10.6 million people developed TB in 2022, with 1.3 million succumbing to the disease [1]. This high burden is further compounded by undetected TB cases. In Vietnam, nearly 40% of TB cases in the community go undiagnosed or unreported, posing significant public

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health risks and impacting the TB control efforts in the country [3].

Among the various forms of TB, pulmonary tuberculosis (PTB) is the most common and poses the greatest threat to public health due to its airborne mode of transmission [4–6]. Smear-positive PTB, in particular, is of critical concern because it represents the most infectious stage of the disease [7–9]. Patients with smear-positive PTB can transmit *Mycobacterium tuberculosis* to others through coughing, sneezing, or even talking, making them key drivers in the spread of TB within communities [10–13]. Identifying and treating smear-positive cases is therefore essential in any effective TB control strategy.

Vietnam is among the 30 countries with the highest TB burden and is ranked 11th globally, facing approximately 172,000 new TB cases and 13,000 TB-related deaths annually [14]. Despite reductions in TB incidence and mortality over recent decades, significant challenges remain. The estimated TB incidence rate of 176 cases per 100,000 population and the high prevalence of undiagnosed cases underscore Vietnam's struggle to meet WHO's End TB targets by 2035 [14]. The prevalence of smear-positive PTB in Vietnam has shown a significant decline over the decade from 2007 to 2017. According to national TB prevalence surveys conducted in this period, the prevalence of smear-positive TB decreased by 53%, from 99 cases per 100,000 adults in 2007 to 46 cases per 100,000 adults in 2017. In contrast, the prevalence of smear-negative TB did not show a significant change during this period [15]. Contributing factors such as financial limitations, delayed or incomplete diagnoses, and the need for expanded case-finding initiatives create a complex landscape for TB control [16]. Additionally, the prevalence of socio-economic risk factors including poverty, overcrowded living conditions, malnutrition, and limited access to healthcare complicates TB elimination efforts [17, 18].

Although various studies have assessed TB risk factors, there is a scarcity of data focused on smear-positive PTB in Vietnam, where resource limitations and demographic factors may affect transmission dynamics [18–21]. Most available studies in the country do not distinguish between smear-positive and smear-negative cases, or they focus on aggregated TB outcomes without stratifying by diagnostic category. Moreover, regional data from Northern provinces, including Thai Binh, are particularly limited. Given the high burden of TB and the reliance on smear microscopy in routine practice, identifying factors associated with smear positivity is essential for optimizing diagnostic strategies and targeting high-risk populations. Factors such as co-infections with HIV, smoking, alcohol abuse, and chronic diseases like diabetes mellitus further exacerbate the risk of active TB in such settings [18, 20–24]. Understanding the specific risk factors for smear positive PTB in this context is crucial for the implementation of tailored interventions.

This study aims to investigate the prevalence and identify the associated risk factors of smear-positive PTB among newly diagnosed patients in Vietnam. We also described socio-demographic characteristics, underlying chronic medical conditions and addictions, clinical and laboratory findings, and chest X-ray results of AFB-positive compared to AFB-negative patients. The findings are expected to support public health policies and inform TB control strategies tailored to the region's unique socio-economic and healthcare landscape, contributing to the country's efforts to reduce TB transmission and ultimately achieve the goals of the National TB Program.

MATERIALS AND METHODS

Study design and location

This was a retrospective study, conducted among patients with newly diagnosed PTB hospitalized at Thai Binh Lung Hospital, Vietnam, between August 2023 and August 2024.

Sample size and population

This was a convenient sampling method with all patients with newly diagnosed PTB hospitalized during the period time of study being included. A newly registered episode of TB in a patient who has never been treated for TB or who has taken anti-TB medicines for less than 1 month also qualified for inclusion [25].

Diagnosis of pulmonary tuberculosis

Possible diagnosis of PTB followed the established tuberculosis prevention and control guidelines in Vietnam, which rely on clinical symptoms, sputum smear microscopy, and chest X-rays as core diagnostic tools [26]. Suspected PTB cases under-

went sputum smear testing. Respiratory sputum samples were first screened using auramine-rhodamine stains. Patients were classified as smear-positive if at least one respiratory sample tested positive before starting anti-tuberculosis treatment. Smear-negative individuals had to submit a minimum of two sputum samples, all of which had to test negative before treatment initiation [26].

In addition, the Xpert MTB/RIF (Cepheid, Sunnyvale, CA, USA) was performed to detect *M. tuberculosis* and rifampin resistance simultaneously within 2 hours using RT-PCR for the TB-specific rpoB gene. The Xpert assay was performed according to the manufacturer's instructions. Due to lack of facilities and laboratory equipment, sputum culture was rarely done.

Patients who were negative for any bacteriological or PCR tests were diagnosed with active TB by clinician based on X-ray abnormalities TB (Supplementary Table 1) [25].

Data collection

Sociodemographic characteristics included age, gender, and occupation. Clinical symptoms, laboratory findings and chest x-ray results were also included in the questionnaire. Potential risk factors for TB such as history of contact with patients with TB, comorbidities (diabetes mellitus, peptic ulcer, chronic respiratory diseases, chronic kidney diseases, HIV or long-term corticotherapy), and lifestyle including smoking and alcohol abuse were collected. Long-term corticosteroid use was defined as the systemic administration of corticosteroids for more than four consecutive weeks at a dose equivalent to ≥10 mg of prednisolone per day, prescribed for chronic conditions such as autoimmune diseases or other inflammatory disorders.

Statistical analysis

Stata 17.0 software was used for statistical analysis. To compare proportions of clinical features, laboratory findings and chest x-ray between AFB-positive and AFB-negative groups, we used either Pearson's chi-square test or Fisher's exact test, depending on the distribution of the data. Pearson's chi-square test was applied when all expected cell frequencies were ≥5. In cases where one or more expected frequencies were <5, Fisher's exact test was used to ensure the validity of the statistical inference. Our main outcome was the presence of smear-positive PTB among newly diagnosed patients. Unadjusted associations between multiple independent factors and the presence of smear-positive pulmonary TB were established. The results are presented by odds ratios (ORs) with 95% Cis. P <0.05 was statistically significant. Logistic regression was used to estimate a factor's adjusted OR of the outcome. Variables with a p-value <0.20 in univariate analysis were included in the multivariate logistic regression model. This threshold was chosen to ensure that potentially important variables, especially those with known biological plausibility, were not prematurely excluded due to sample size or statistical fluctuations. In addition, the use of a p-value threshold of <0.20 for variable inclusion in multivariate logistic regression is a widely accepted practice in epidemiology and biostatistics. It is commonly used to ensure that potentially important predictors are not excluded prematurely, especially in observational studies [27].

RESULTS

Characteristic of population

A total of 379 patients diagnosed of new PTB were included in this study, with a mean age of 57.0 ± 16.3 years (minimum=18 and maximum=94 years). 152 participants were aged ≥65 years, accounting for 40.1% of participants. A total of 291 (76.8%) patients were male, and the sex ratio male/female was 3.3. A history of contact with tuberculosis patients was reported by 8.4% of participants. Diabetes mellitus was the most common comorbidity, present in 14.5% of cases, followed by peptic ulcer disease (9.0%), long-term corticosteroid use (3.7%), and chronic respiratory diseases (2.6%). Three patients (0.8%) were co-infected with HIV. None of the patients had chronic kidney disease. Fifty-nine patients (15.6%) were smokers, and 25 patients (6.6%) had a history of alcohol abuse (Table 1).

Overall, 343 (90.5%) patients were positive for TB by microbiological or PCR findings and 36 (9.5%) patients were diagnosed TB based on clinical criteria only. The proportion of AFB-positive newly diagnosed PTB was 48.3% (183/379). The GeneXpert testing showed that 38/379 (10.0%) of patients were negative, 336/379 (88.7%) of patients were positive with non-resistant *M. tuberculosis*

Table 1 - Characteristics of included patients.

Characteristics	*AFB negative N=196*		*AFB positive N=183*		*p-value*
	n	%	*n*	%	
Age ≥65 years	75	38.3	77	42.1	0.45
Male gender	144	73.5	147	80.3	0.12
Occupation					
Farmer	116	59.2	101	55.2	0.11
Worker	30	15.3	39	21.3	
Official staff	10	5.1	15	8.2	
Retiree	29	14.8	25	13.7	
Others	11	5.6	3	1.6	
Having contact with TB patients	13	6.6	19	10.4	0.19
Comorbidities					
Diabetes mellitus	17	8.7	38	20.8	0.001
Peptic ulcer	20	10.2	14	7.6	0.39
HIV	3	1.5	0	0	0.25
Long-term corticosteroid use	3	1.5	11	6.0	0.03
Lifestyle					
Smoker	29	14.8	30	16.4	0.67
Alcohol abuse	14	7.1	11	6.0	0.66

Table 2 - Differences in clinical findings between AFB positive and AFB negative pulmonary TB patients.

Clinical findings	*AFB negative N=196*		*AFB positive N=183*		*p-value*
	n	%	*n*	%	
Fever	114	58.2	93	50.8	0.15
Fatigue	168	85.7	141	77.0	0.03
Loss of weight	114	58.2	115	62.8	0.35
Anorexia	139	70.9	113	61.8	0.06
Night sweats	64	32.6	53	29.0	0.44
Muscle and joint pain	16	8.2	25	13.7	0.08
Chronic cough	186	94.9	176	96.2	0.55
Hemoptysis	8	4.1	18	9.8	0.04
Chest pain	56	28.6	41	22.4	0.17
Dyspnea	61	31.1	46	25.1	0.20
Pulmonary auscultation					
No crackles	118	60.2	132	72.1	0.01
Crackles	71	36.2	47	25.7	0.03
Sibilant rales	7	3.6	4	2.2	0.55

and 5/379 (1.3%) of patients had rifampicin resistant *M. tuberculosis*. Only three patients received *M. tuberculosis* culture, but the results were negative.

Clinical and laboratory findings and chest x-ray results of AFB-positive versus AFB-negative patients

Table 2 showed no differences in almost all clinical findings between AFB-positive and AFB-negative PTB patients. The proportion of hemoptysis, however, was significantly higher in AFB-positive than in AFB-negative (9.8% versus 4.1%, p=0.04). AFB-negative patients had a statistically significantly higher rate of fatigue and crackles compared to AFB-positive patients with 85.7% versus 77.0% and 36.2% versus 25.7%, respectively (Table 2).

No significant differences in laboratory findings and chest x-ray results between two groups of patients was reported, except for cavitary lung lesions which were more common in AFB-positive patients (48.6% versus 29.1%) (Table 3).

Risk factors for smear-positive pulmonary tuberculosis among newly diagnosed patients

Univariate and multivariate analysis showed that age, gender, occupation, having contact with TB patients and lifestyle such as smoking, and alcohol abuse were not significantly associated with smear-positive PTB among newly diagnosed patients (Supplementary Table 2 and Table 4).

Diabetes mellitus was associated with a three time-increased risk for AFB-positivity with adjusted OR=2.71, p=0.002. Long-term corticosteroid use was associated with a six time-increased risk for AFB-positivity with adjusted OR=6.15, p=0.009. Cavitation in chest-xray was also associated with 2.5 times of risk for smear-positivity (OR=2.53, p <0.0001). In addition, fatigue and pulmonary auscultation with crackles were associated with lower risk for smear-positivity TB with OR=0.47, p=0.009 and OR=0.57, p=0.02, respectively (Table 4). Of note, HIV co-infection was not associated with

Table 3 - Differences in laboratory findings and chest x-ray between AFB positive and AFB negative pulmonary TB patients.

Laboratory findings and chest x-ray	*AFB negative N=196*		*AFB positive N=183*		*p-value*
	n	*%*	*n*	*%*	
Laboratory findings					
Leukocytosis (>10G/L)	37	18.9	35	19.1	0.95
Hypo-hemoglobin (<120 mg/dL)	40	20.4	44	24.0	0.39
Hyperglycemia (>6.4 mmol/L)	33	16.8	44	24.0	0.08
Elevated blood urea (>7.5 mmol/L)	10	5.1	6	3.3	0.45
Elevated blood creatinine (>120 µmol/L)	6	3.1	6	1.6	0.50
Elevated alanine aminotransferase (>40 IU/L)	34	17.4	30	16.4	0.80
Elevated aspartate aminotransferase (>37 IU/L)	37	18.9	35	19.1	0.95
Chest x-ray					
Affected lung					
Unilateral	68	34.7	63	34.4	0.96
Bilateral	128	65.3	120	65.6	
Cavitation	57	29.1	89	48.6	<0.0001
Fibrothorax	72	36.7	66	36.1	0.89
Consolidation	114	58.2	98	53.6	0.37
Nodular or reticulonodular lesions	120	61.2	126	68.8	0.12
Pleural effusion	6	3.1	5	2.7	0.85
Pleural lesion	9	4.6	5	2.7	0.42
Pneumothorax	1	0.5	0	0	1.0

Table 4 - Association factors with smear-positive pulmonary tuberculosis among newly diagnosed patients (multivariate analysis).

Association factors	*OR [95%CI]*	*p-value*
Diabetes mellitus		
No	1	0.002
Yes	2.71 [1.42 – 5.15]	
Long-term corticosteroid use		
No	1	0.009
Yes	6.15 [1.58 – 23.90]	
Fatigue		
No	1	0.009
Yes	0.47 [0.27 – 0.83]	
Pulmonary auscultation with crackles		
No	1	0.02
Yes	0.57 [0.36 – 0.92]	
Cavitation in chest x-ray		
No	1	<0.0001
Yes	2.53 [1.61 – 3.96]	

smear-positive pulmonary tuberculosis and all HIV-coinfected patients were AFB-negative.

DISCUSSION

Our study showed that a high proportion of newly diagnosed PTB patients were smear-positive, which is consistent with findings from previous studies. A large study conducted in Canada among 1176 cases reported a similar prevalence of 52.1% smear-positive TB [28]. Another study conducted in Ethiopia showed a proportion of 36% of participants were AFB-positive TB [29]. In a systematic review and meta-analysis including 20 studies with 162,574 adults from 14 countries, the pooled estimate for the percentage of TB cases with smear positivity was 52.0% [30]. Given that smear-positive patients are the most infectious and play a central role in community transmission, targeted interventions are essential. These include prioritizing rapid case detection through active screening of high-risk groups.

In terms of demographic characteristics, the predominance of males and older adults in our study aligns with the global pattern of TB, where men and older individuals have been found to be more susceptible to the disease [31,32]. This could be related to lifestyle factors such as smoking and alcohol abuse, which are more prevalent among men and are known to increase TB risk. Indeed, all participants who smoked or abused alcohol in our study were male. However, our multivariate analysis did not show a significant association between smoking or alcohol abuse and smear-positive PTB, suggesting that other factors may play a more prominent role in determining smear positivity.

In terms of clinical presentation, hemoptysis was significantly more common in smear-positive patients, while fatigue and crackles were more prevalent among smear-negative patients. These findings are consistent with a previous study showing that smear-positive TB tends to present with more severe respiratory symptoms, such as hemoptysis, likely due to the higher bacterial burden causing greater lung tissue damage [33, 34]. On the other hand, smear-negative TB may present with more nonspecific symptoms, such as fatigue, reflecting the subclinical nature of the disease in these patients. Radiologically, cavitary lung lesions were significantly more common in smear-positive patients compared to smear-negative patients, which aligns with the well-documented association between cavitation and high bacterial loads in pulmonary TB [33, 35].

Interestingly, our study identified diabetes mellitus and long-term use of corticosteroids as significant risk factors for smear-positive PTB.

The association between diabetes mellitus and TB is well-documented, with diabetes mellitus known to impair immune function, thereby increasing susceptibility to TB and the likelihood of severe manifestations, including smear-positive disease [36, 37]. For instance, in India, over 13,800 patients with diabetes mellitus were screened for TB, identifying 254 TB cases, 46% of whom were smear-positive. The estimated TB incidence among clinic attendees ranged from 642 to 956 per 100,000, varying by region [36]. Similarly, long-term corticosteroid use has been associated with immunosuppression, which may promote the progression of latent TB to active disease and increase bacterial burden, contributing to smear positivity [37].

These findings are particularly relevant to Vietnam, where the prevalence of diabetes mellitus has increased markedly in recent years, driven by rapid economic development and associated lifestyle changes [38, 39]. This growing diabetes mel-

litus burden poses a significant challenge to TB control, as individuals with diabetes mellitus are not only more prone to developing TB but also tend to present with higher bacterial loads. Our study found that patients with diabetes mellitus had over three times the odds of being smear-positive, highlighting the need for targeted screening and early diagnosis in this at-risk group.

Moreover, TB can complicate diabetes mellitus management. Active TB induces systemic inflammation and stress-related hyperglycemia, which may impair glycemic control and worsen outcomes for individuals with pre-existing diabetes mellitus [40]. This bidirectional relationship underscores the need for integrated management approaches, particularly in high-burden settings like Vietnam where both diseases co-exist at significant levels.

It is notable that all three TB-HIV co-infected patients were smear-negative TB in our study. This finding corroborates previous studies and could be explained because patients living with HIV are less likely to have cavitary lesions due to the impairment of granuloma formation [41-44]. Another possible explanation is that HIV-positive individuals are monitored more closely in clinical settings, allowing for earlier detection of tuberculosis before cavitary lesions have had time to develop [45]. This early diagnosis may contribute to the lower rates of smear positivity observed among co-infected HIV patients. However, the association between TB and HIV in our study needs to be considered carefully because of the relatively low prevalence of HIV cases.

Our study has some limitations. First, despite a large number of included patients, this was a monocentric retrospective, and the results might not be representative for the general population in Vietnam. Second, the use of convenience sampling is indeed a limitation. This method might introduce selection bias, as it does not ensure a representative sample of the target population. Therefore, caution is needed when generalizing the results to the entire country. Mycobacterial culture is widely regarded as the gold standard for confirming active tuberculosis infection, particularly in cases with low bacillary loads or when evaluating the potential for transmission, as it can detect viable *M. tuberculosis* organisms. However, due to resource constraints and the practical limitations of our study setting, culture-based confirmation was not feasible. To mitigate diagnostic bias due to lack of culture confirmation, we used Xpert MTB/RIF, an advanced molecular diagnostic tool with high sensitivity as a core part of our diagnostic algorithm, alongside sputum smear microscopy and clinical-radiological assessments. This reflects common diagnostic practice in Vietnam and many other resource-limited settings [25]. On the other hand, we were not able to follow patients longitudinally and evaluate their treatment effectiveness. Given the small number of HIV-coinfected patients in our study (n=3), we are unable to draw definitive conclusions regarding the impact of HIV co-infection on smear positivity. Finally, nutrition is closely associated with pulmonary tuberculosis with underweight was risk factor for TB and smear positive TB [46]. But due to lack of body mass index information among most patients, this factor was not investigated.

CONCLUSIONS

In conclusion, our study identified diabetes mellitus, long-term corticosteroid use and cavitation on chest-x-ray as significant risk factors for smear-positive PTB among newly diagnosed patients. These findings underscore the importance of screening and early diagnosis of TB in individuals with diabetes mellitus, long-term corticosteroid therapy and those presenting with cavitary lesions. In the context of low- and middle-income countries like Vietnam, applicable strategies include routine symptom-based screening during regular healthcare visits, annual chest radiography for high-risk individuals, and prompt microbiological testing, such as sputum smear microscopy and Xpert MTB/RIF assays, for those with symptoms or abnormal radiographic findings. Furthermore, the lack of association between HIV co-infection and smear positivity suggests the need for tailored diagnostic strategies for HIV-positive TB patients. A larger sample would be required to better understand the impact of HIV co-infection on smear positivity. Strengthening TB control efforts, particularly among high-risk populations, is crucial to reducing the burden of smear-positive TB and preventing further transmission.

Conflict of interest

The authors declare that they have no conflict of interest.

Authors' contribution
Xuan Thuy Tran and Khanh Linh Duong contributed equally as co-first authors.

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Supplementary Table 1 - Diagnosis of pulmonary tuberculosis.

Diagnosis	*Criteria*
Pulmonary tuberculosis	Any bacteriologically confirmed or clinically diagnosed case of TB involving the lung parenchyma or the tracheobronchial tree
New case	A newly registered episode of TB in a patient who has never been treated for TB or who has taken anti-TB medicines for less than 1 month
Bacteriologically confirmed TB	Case is one from whom a biological specimen is positive by smear microscopy, culture or a WHO-recommended rapid diagnostic (such as Xpert MTB/RIF). All such cases should be notified, regardless of whether TB treatment has started
Clinically diagnosed TB	Case is a person who does not fulfil the criteria for bacteriological confirmation but has been diagnosed with active TB by a clinician or other medical practitioner who has decided to give the patient a full course of TB treatment. This definition includes cases diagnosed on the basis of X-ray abnormalities without laboratory confirmation

Notes: Definitions. WHO consolidated guidelines on tuberculosis: Module 4: Treatment - Drug-susceptible tuberculosis treatment [Internet], World Health Organization; 2022. Available at: https://www.ncbi.nlm.nih.gov/books/NBK581326/

Supplementary Table 2 - Association factors with smear-positive pulmonary tuberculosis among newly diagnosed patients (univariate analysis).

Association factors	*AFB negative N=196*		*AFB positive N=183*		*OR [95%CI]*	*p-value*
	n	*%*	*n*	*%*		
Socio-demographic characteristics						
Age						
<65 years	121	61.7	106	57.9	1.17 [0.78 – 1.77]	0.45
≥65 years	75	38.3	77	42.1		
Gender						
Female	52	26.5	36	19.7	1.47 [0.91 – 2.39]	0.12
Male	144	73.5	147	80.3		
Occupations						
Farmer	116	59.2	101	55.2	reference	reference
Worker	30	15.3	39	21.3	1.49 [0.86 – 2.58]	0.15
Official staff	10	5.1	15	8.2	1.72 [0.74 – 4.00]	0.21
Retiree	29	14.8	25	13.7	0.99 [0.54 – 1.80]	0.97
Others	11	5.6	3	1.6	0.31 [0.08 – 1.15]	0.08
Having contact with TB patients						
No	183	93.4	164	89.6	1.63 [0.78 – 3.40]	0.19
Yes	13	6.6	19	10.4		
Comorbidities						
Diabetes						
No	179	91.3	145	79.2	2.76 [1.50 – 5.09]	0.001
Yes	17	8.7	38	20.8		
Peptic ulcer						
No	176	89.8	169	92.4	0.73 [0.36 – 1.49]	0.39
Yes	20	10.2	14	7.6		
HIV						
No	193	98.5	183	100	Not applicable	Not applicable
Yes	3	1.5	0	0		
Long-term corticosteroid use						
No	193	98.5	172	94.0	4.11 [1.13 – 15.00]	0.03
Yes	3	1.5	11	6.0		
Lifestyle						
Smoker						
No	167	85.2	153	83.6	1.13 [0.65 – 2.97]	0.67
Yes	29	14.8	30	16.4		
Alcohol abuse						
No	182	92.9	172	94.0	0.83 [0.37 – 1.88]	0.66
Yes	14	7.1	11	6.0		
Clinical presentations						
Fever						
No	82	41.8	90	48.2	0.74 [0.50 – 1.12]	0.15
Yes	114	58.2	93	50.8		
Fatigue						
No	28	14.3	42	23.0	0.56 [0.33 – 0.95]	0.03
Yes	168	85.7	141	77.0		
Loss of weight						
No	82	41.8	68	37.2	1.22 [0.80 – 1.84]	0.35
Yes	114	58.2	115	62.8		
Anorexia						
No	57	29.1	70	38.2	0.66 [0.43 – 1.01]	0.06
Yes	139	70.9	113	61.8		
Night sweats						
No	132	67.4	130	71.0	0.84 [0.54 – 1.30]	0.44
Yes	64	32.6	53	29.0		
Muscle and joint pain						
No	180	91.8	158	86.3	1.78 [0.92 – 3.45]	0.09
Yes	16	8.2	25	13.7		
Chronic cough						
No	10	5.1	7	3.8	1.35 [0.50 – 3.62]	0.55
Yes	186	94.9	176	96.2		
Hemoptysis						
No	188	95.9	165	90.2	2.56 [1.09 – 6.05]	0.03
Yes	8	4.1	18	9.8		
Chest pain						
No	140	71.4	142	77.6	0.72 [0.45 – 1.15]	0.17
Yes	56	28.6	41	22.4		
Dyspnea						
No	135	68.9	137	74.9	0.74 [0.47 – 1.17]	0.20
Yes	61	31.1	46	25.1		
Pulmonary auscultation						
Crackles						
No	125	63.8	136	74.3	0.61 [0.39 – 0.95]	0.03
Yes	71	36.2	47	25.7		
Sibilant rales						
No	189	96.4	179	97.8	0.60 [0.17 – 2.10]	0.43
Yes	7	3.6	4	2.2		
Laboratory findings						
Leukocytosis (>10G/L)						
No	159	81.1	148	80.9	1.02 [0.61 – 1.70]	0.95
Yes	37	18.9	35	19.1		
Hypo-hemoglobin (<120 mg/dL)						
No	156	79.6	139	76.0	1.23 [0.76 – 2.00]	0.40
Yes	40	20.4	44	24.0		
Hyperglycemia (>6.4 mmol/L)						
No	163	83.2	139	76.0	1.56 [0.94 – 2.59]	0.08
Yes	33	16.8	44	24.0		
Elevated blood urea (>7.5 mmol/L)						
No	186	94.9	177	96.7	0.63 [0.22 – 1.77]	0.38
Yes	10	5.1	6	3.3		
Elevated blood creatinine (>120 µmol/L)						
No	190	96.9	180	98.4	0.53 [0.13 – 2.14]	0.37
Yes	6	3.1	6	1.6		
Elevated alanine aminotransferase (>40 IU/L)						
No	162	82.6	153	83.6	0.93 [0.54 – 1.60]	0.80
Yes	34	17.4	30	16.4		
Elevated aspartate aminotransferase (>37 IU/L)						
No	159	81.1	148	80.9	1.02 [0.61 – 1.70]	0.95
Yes	37	18.9	35	19.1		
Chest x-ray						
Affected lung						
Unilateral	68	34.7	63	34.4	1.01 [0.66 – 1.54]	0.96
Bilateral	128	65.3	120	65.6		
Cavitation						
No	139	70.9	94	51.4	2.31 [1.51 – 3.52]	<0.0001
Yes	57	29.1	89	48.6		
Fibrothorax						
No	124	63.3	117	63.9	0.97 [0.64 – 1.48]	0.49
Yes	72	36.7	66	36.1		
Consolidation						
No	82	41.8	85	46.4	0.83 [0.55 – 1.24]	0.37
Yes	114	58.2	98	53.6		
Nodular or reticulonodular lesions						
No	76	38.8	57	31.2	1.40 [0.92 – 2.14]	0.12
Yes	120	61.2	126	68.8		
Pleural effusion						
No	190	96.9	178	97.3	0.89 [0.27 – 2.97]	0.85
Yes	6	3.1	5	2.7		
Pleural lesion						
No	187	95.4	178	97.3	0.58 [0.19 – 1.78]	0.34
Yes	9	4.6	5	2.7		
Pneumothorax						
No	195	99.5	183	100	Not applicable	Not applicable
Yes	1	0.5	0	0		