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Determinants of delayed pulmonary tuberculosis diagnosis in a rural district of Pakistan

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Abstract

Tuberculosis (TB) caused by acid-fast bacilli is one of the leading causes of morbidity and mortality in developing countries. Pakistan has the world's fifth-largest prevalence of TB, with 276/100,000 cases in prevalence and a mortality of 34/100,000. Delayed diagnosis, disruptions in treatment continuity and a lack of awareness are the key issues leading to multidrug-resistant TB. The current study aimed to find out the determinants of delayed pulmonary TB in a rural district of Khyber Pakhtunkhwa Province, Pakistan. The cross-sectional study was conducted in six TB control program centers designated by the National TB Control Program from March to December 2024. Data were collected from 250 eligible patients, and after removal of incomplete questionnaires, the data of 229 patients were analyzed. The study was approved by the district TB officer, and participants' consent was obtained before data collection. A delay of >21 days was considered the cutoff point for delayed TB diagnosis. Among 229 patients, 51.1% were male and 48.9% female participants, with a mean age of 33.31±21.32 years. The mean diagnostic delay was 23.66±14.94 days. Descriptive analysis of data showed 52% of delayed TB diagnosis cases; 92.2% of the studied patients were from rural areas, in which 80% of delayed TB diagnosis cases were reported. Male gender [odds ratio (OR)=2.31], getting treatment from public hospitals (OR=4.13), age group 31-45 years (OR=3.10), presence of acute extrapulmonary symptoms of cough, fever, and weight loss (OR=2.84), perception that the symptoms will be relieved by oneself (OR=9.99), economic constraints (OR=6.58), and perception of the poor quality of healthcare services at hospitals (OR=7.32) were found to be significant factors of delayed TB diagnosis. Primary school- (OR=0.20), college- or university-level education (OR=0.42) and high-income groups (OR=0.39) were significant protective factors against delayed TB diagnosis. Marital status, occupation, residence, comorbidities, distance from healthcare facility, previous exposure to TB patients, fever, weight loss, chronic cough, hemoptysis, fear of diagnosis, fear of social isolation, and bad experience of the healthcare staff behavior were found to be non-significant factors for delayed TB diagnosis. The study only focused on delayed diagnosis and did not report healthcare system-related or total delay in tuberculosis management. The study affirmed the significant impact of patient perceptions and socioeconomic status on delayed TB diagnosis.

Key words: pulmonary tuberculosis, TB diagnosis, TB diagnostic delay, tuberculosis sociodemographic factors, tuberculosis patient delay.

Introduction

Tuberculosis (TB) is caused by Mycobacterium, an acid-fast bacillus, which can lead to TB disease in people with a deficient immune system or comorbidities [1]. The TB infection most commonly occurs in the lungs but can affect any part of the body, including the brain, kidneys, and spine. TB is categorised by its form as active TB, or the Latent TB infection (LTBI), which does not present with symptoms, but has a positive TB test, and management is required only in high-risk patients, those with comorbidities and Immune suppression [2,3]. Thus, there is always the risk of TB disease development in people with LTBI [4]. Symptoms of Pulmonary TB include coughing for more than three weeks or the presence of blood in the sputum, and positive X-ray findings [5]. General body symptoms include fatigue, weight loss, loss of appetite, chills, fever and sweating at night [6]. TB is transmitted through inhalation of aerosol droplets (1-5 μm in diameter) from symptomatic patients to healthier humans in the surroundings [7].

According to the World Health Organisation (WHO)'s estimates in 2023, approximately 1.5 million people died from TB, including 161,000 positive cases of Human Immunodeficiency Virus (HIV), and 10.8 million annual incident TB cases within the same year [8]. Drug-resistant tuberculosis has been emerging as a critical public health issue, due to low detection rate, treatment failures and higher mortality [9]. According to World Bank statistics, the global incidence of TB has been reduced from 180/100,000 individuals since 2000 to 129/100,000 in 2020 [10]. In developed countries like the United Kingdom (UK) and the United States of America (USA), the TB incidence is lower. The Government of the UK reported 8.5/100,000 TB cases in 2023, still lower than the low incidence TB threshold of the WHO, with a standard of 10/100.000 cases [11]. The Centres for Disease Control and Prevention (CDC) in the USA reported 10,347 cases per year, with a 3/100,000 prevalence [12]. The World Bank data stated 275/100,000 cases of TB in Pakistan in the year 2000, without any significant decline up to 2022. The prevalence was reported as 259/100,000 during the COVID-19 pandemic, while recent estimates of 2023 reported the incidence as 277/100,000 population [13]. According to the National Institute of Health (NIH), Islamabad, Pakistan, the prevalence of TB in the country is 348/100,000, and 34/100,000 as the rate of mortality [14]. Furthermore, climate impacts have been reported to be associated with TB incidence as well; likewise, the Punjab and Sindh provinces of Pakistan, with comparatively higher temperatures reported higher prevalence [15].

The timely diagnosis and therapeutic interventions help reduce the complexity of the disease, improving prognosis, outcomes and Quality of life in TB patients [16,17]. The diagnostic test, the Mantoux skin test, was developed in 1909 and is still in use today with little modifications, while the Interferon-gamma release assay (IGRA) has been in use since 2014, providing another approach in TB diagnostics [18]. Despite the availability of diagnostic facilities in the country, delayed TB diagnosis leads to challenges in the management of the disease. Delayed TB diagnosis contributes to the severity of the patient's symptoms, risks for multidrug-resistant Tuberculosis (MDR-TB), poor prognosis and healthcare outcomes [19].

Delay in TB Diagnosis has been termed as the duration between the onset of symptoms and confirmation of diagnosis or initiation of the first treatment. Delay in TB diagnosis and treatment is common among developing countries as well as in some of the developed countries. More than 80% of cases were reported as delayed TB in Portugal, and 59% in China [20,21]. Thus, a study reported a mean delay of 56 days (8 weeks) in a cohort of 252 patients studied at a tertiary care hospital in Rawalpindi, Pakistan [22]. Significant factors of delayed TB diagnosis and seeking medical attention have been reported as alcohol abuse, lack of employment, and higher TB incidence in the community. Thus, healthcare delays have been common in female patients and patients with respiratory and oncological comorbidities [20]. TB diagnosis in Pakistan is delayed due to delayed medical care, use of self-medication and over-the-counter (OTC) drugs and dependence on the dispensaries and private clinics, where proper diagnostic approaches are not utilised. A study conducted in 516 TB patients in Karachi, Pakistan, reported that 54.1% of TB cases were first presented at private clinics after the onset of symptoms, thus concluding the lack of referral system and bypassing the National Tuberculosis program-designated centres.

The current study was conducted in District Buner, Khyber Pakhtunkhwa, Pakistan, with an area of 1865km^2, 1.016 million population and population density of 545 persons/km^2. The TB diagnosis and treatment facilities have been provided in one District Head Quarter (DHQ) hospital and seven peripheral centres in the villages and towns. The literacy level has been low in the area, reported to be 38.2% in males and 7.7% in females. The current study aimed to report the prevalence and evaluate the causes and determinants of delayed TB diagnosis in the rural area of a developing country, District Buner, Pakistan.

Methods

The cross-sectional study was approved by the District TB Control Office (DTO) Buner on 4th March 2024, through Letter No. 39/TBC/Daggar, District Buner, Pakistan. The study did not involve any intervention or experimentation; thus, the ethical standards for experimentation on human subjects were not applicable. For data collection from the study participants, the institutional approval from the TB district officer was sufficient. Data collection was carried out from March to December 2024. Records of 576 TB patients were checked retrospectively, registered in the district from one public sector tertiary care hospital, two private clinics, and three TB control centres. Based on the G-power analysis, Effect size 0.07, error probability 0.05, Power of 0.95 and number of predictors as 3, the calculated sample size was 250, which were randomly selected from the total registered patients through a random number generator. The number of participants was estimated to be 42 in each of the five data collection centres and 40 participants in the sixth data collection centre.

All the TB patients visiting the selected study settings and registered in the DTO office were eligible for participation. Participants visiting the centres for follow-up visits were included through voluntary involvement and consent, following the Declaration of Helsinki and World Medical Association guidelines. Participants were provided with the participation information sheet about the aim and purpose of the study, and details of the information and cooperation required from the participants. Incomplete records and incomplete questionnaires, patients with differential diagnoses or comorbidities suggestive of other pulmonary conditions were excluded.

Data were collected for sociodemographic characteristics of the participants, history of current illness, symptoms that forced the patient to seek medical attention, the type of consultation taken first by the patient, and measures taken by the visited healthcare professionals to confirm the TB diagnosis were recorded. For delayed diagnosis, data were collected for the time when first symptoms of the disease were known or experienced by the patient, the time when diagnosis was confirmed and the time when the first healthcare provider or the healthcare facility-initiated treatment. Diagnosis was termed as delayed if the gap between symptoms experienced and diagnosis of TB was >21 days, and not delayed if the gap was <21 days, based on an earlier publication of 2021 by Pan African Medical Journal [23]. Cough was categorised as an acute cough <3 Weeks and chronic cough >3 weeks according to (CDC) guidelines, while other publications have used the cutoff values of 2weeks to 8weeks in different respiratory conditions [24,25].

After removing the incomplete 21 questionnaires, the final statistical analysis was conducted with 229 responses. Univariate analysis, Multivariate analysis, multicollinearity analysis and AUC (Area under the Curve) were performed to find out the risk of delayed TB diagnosis related to sociodemographic and clinical characteristics of the patient. Odds ratios (OR) and Confidence intervals (CI 95%) for each variable have been reported in the results section. The level of significance was $P<0.05$. Detailed tables and figures in American Psychological Association (APA) format have been added and illustrated in the results section.

Results

Data were analysed for 229 participants, including 51.1% males and 48.9% female patients. The mean age was 33.31±21.32 years. Study participants included 152 from four public health facilities and 77 responses from two private clinics. Most of the initial diagnoses were made at public hospitals (50.7%), followed by private health facilities (33.6%), as reported in Table 1. Mean diagnostic delay was 23.66±14.94 days, ranging from 0 to 55 days. Only 4.4% of patients were diagnosed at the first visit, while 41% of patients had a gap of two weeks, 54.6% of patients had a gap of three weeks or more than a month before the diagnosis was made, as stated in Table 1. The presence of pulmonary symptoms successfully differentiated among the delayed and not delayed on AUC analysis with value of 0.810 (CI 0.754-0.866), $P<0.001$ as illustrated in Figure 1.

In the studied patients, 33% reported visiting the nearest Primary Healthcare Centre (PHC) hospital, 27% visited public hospitals, and 40% of patients reported visiting a private clinic or health facility. None of the participants visited a TB centre or Chest hospital for initial symptoms as given in Figure 2. Only 9.2% of the 65 patients visited were diagnosed at PHCs, 17.4% of the patients visited public health hospitals, and 7.52% of the patients who visited private hospitals or clinics for TB symptoms were diagnosed. While 56.3% patients affirmed that they have delayed their healthcare seeking for current symptoms, despite knowing that some major disease may be diagnosed. Delayed ranged from 5-53 days in the studied population as reported in Figure 3, while 52% (119/229) of patients were reported with delayed TB diagnosis, as illustrated in Figure 4.

The number of delays between the initiation of treatment and diagnosis was reported in only 28 (12.22%) and absent in 201 (87.77%) of participants. Thus, almost 87.8% of participants received treatment on the same day of confirmation of diagnosis, as reported in Table 1. Based on the cutoff point of 21 days, 48% of the study participants (110/229) were found not to be delayed, and 52% (119/229) were termed as late diagnosis, with a delay in diagnosis of more than 21 days.

Univariate analysis showed a significant gender difference (p value 0.002), between the public and private health facilities (p value <0.001), age group (p value 0.018), illiteracy (p value 0.005), higher education (p value 0.003), high income status (p value 0.007), and number of visits for diagnosis (p value <0.001). The non-significant factors were the type of healthcare facility of initial diagnosis, higher age group, marital status, occupation, residential area, comorbidities, gap between initial healthcare visit and initial diagnosis and residential distance from the healthcare facility.

Binary logistic regression was applied for the odds of delayed TB diagnosis in the sociodemographic characteristics of the participants. Male gender OR=2.31 (1.36-3.93); P<0.001, patients visiting the health facility OR=4.13 (2.26-7.56); P<0.001, patients in the age group 31-45 years, OR=3.10 (1.21-7.89); P=0.018, visiting 0-3t times before diagnosis OR=22 (CI 5.26-96.22); P<0.001 were found as significant and contributing factors of delayed TB diagnosis. The income level of the study participants reported OR=0.39 (CI 0.19-0.77); P=0.007, school level of education OR=0.20 (CI 0.07-0.61); P=0.005 and college or university level education OR=0.42 (CI 0.24-0.74); P=0.003 were found as protective factors against delayed TB diagnosis. While the age group of 45-60 years with OR=2.76 (CI 0.99-7.68), P=0.051 was found borderline significant. The healthcare facility, which confirmed the initial TB diagnosis (P=0.074), Marital status (P=0.104), Occupation (P=0.185), type of residence (P=0.436), gap between the initial visit and diagnosis (P=0.103), gap between the day of diagnosis and confirmation of initial diagnosis (P=0.071), and residential distance to healthcare facility (P=0.927) were found to be non-significant factors for delayed TB diagnosis.

Presence of Chronic cough OR=2.76; P=0.007 was significant for delayed TB diagnosis in univariate analysis, but was not significant in the multivariate model. Multivariate regression reported relieving the symptoms on their own with OR=4.17 (CI 1.91-9.11); P<0.001, and presence of economic constraints OR=2.44 (CI 1.07-5.53); P=0.032 as significant predictors of delayed TB diagnosis. The Multiple regression was analysed with Collinearity diagnostics, and the highest condition index was reported as 19.53 for the presence or absence of comorbidities, while the second highest index was 6.90 for the history of hemoptysis, thus far below the threshold of the multicollinearity index of 30, showing independence of the individual variables in the model. Previous exposure to TB patients with OR=1.23, P=0.456, presence of fever OR=1.08, P=0.922, weight loss OR=1.34, P=0.267 and Hemoptysis OR=1.49, P=0.370 and history of chronic cough OR=6.97, P=0.20 were reported as not significant for delayed diagnosis as reported in Table 2.

Perceptions of participants towards delayed diagnosis and contributing factors have been reported in Table 3. Perceived barriers to TB delayed diagnosis were analysed and found "hoping the symptoms will fade over time OR=9.99 (CI 5.44-18.32); P<0.001, economic constraints OR=6.58 (CI 3.53-12.26); P<0.001 and poor quality of health services at hospitals OR=7.32 (CI 3.37-15.89); P<0.001 as significant predictors. Fear of diagnosis P=0.690, fear of social isolation P=0.605 and bad experience of healthcare staff behaviour P=0.075 were non-significant factors.

Discussion

Determinants and factors of delayed pulmonary TB diagnosis were evaluated in the current cross-sectional study carried out at six designated TB centres in District Buner, Pakistan. Median age of the study participants was 33.31±21.32 years, and the mean delay in TB diagnosis was 23.66±14.94 days in 52% of the study participants. Findings of the current study reported Male gender OR 2.31, P=0.002, using Public health facility for routine health examination OR: 4.13, P=<0.001, Age group 31-45 years OR=3.10, P=0.018, visiting the healthcare facility 0-3 times before TB diagnosis OR=22, P<0.001 as compared to 4-7 visits, P<0.007, Hoping the symptoms will go away without need of treatment OR=9.99, P<0.001, economic constraints: OR=6.58, P<0.001 and perception of poor quality of healthcare services: OR=7.32, P<0.001 were found the significant determinants of delayed TB diagnosis. Educational attainment of both the school level OR=0.20, P=0.005 and College or university level OR=0.42, P=0.003, compared to no education; thus, the high-income group OR=0.39, P=0.007, was reported to be a significant protective factor against delayed TB diagnosis. Thus, the study further reported perception of economic constraints OR=6.58, P<0.001 as a highly significant risk factor for delayed TB diagnosis. Among the non-significant factors were the Occupation, type of residence and distance from the healthcare facility, presence of comorbidities, number of days as the gap between initial visit and diagnosis, and initiation of treatment, exposure to TB patients, presence of fever, weight loss, hemoptysis, perceived fear of diagnosis, fear of social isolation and bad experience of healthcare staff behaviour were reported non-significant factors for delayed TB diagnosis.

Findings of the current study affirmed a mean delay of 23.55±14.94 days and a maximum delay of 55 days. Mean delay of 23 days is analogous to earlier findings of 21 days of delayed TB diagnosis of a study conducted in Kenya [23], and a relevant study from Pakistan reported diagnostic delay of more >30 days [26]; likewise, healthcare delay of treatment initiation of >30 days has been reported in the internally displaced population of Pakistan [27]. TB diagnostic delay, healthcare-associated and treatment initiation delays have been variably reported in the literature; for instance, patient delay was 23 days, and health system delay was 7 days [21]. Diagnostic delay has been reported at 35 days from Ethiopia, 60 days from Ireland, and up to 4 weeks in two different studies from Pakistan [22,27-29].

In the current study, 116 (50.7%), almost half of the study participants were using the public hospitals for treatment, and the study reported a significantly four times higher risk of delayed TB in such patients. Health systems associated with delayed TB diagnosis have been reported in 54.5% of patients by a study conducted in Southern Ethiopia, thus affirming our findings [30].

Furthermore, the study was conducted in rural settings, and 92.2% of the studied participants belonged to the rural areas, which can predispose them to delayed healthcare and affirms the inverse care law that health services are deficient in the areas where they are needed most [31].

Our findings affirmed several important factors responsible for delayed diagnosis common in rural settings, including the significance of literacy levels of school (P=0.005), college-level education (P=0.003) and income level (P=0.007). Thus, the same findings were reported from Ethiopia with university-level education OR=0.78 as a protective factor against delayed TB diagnosis [28,32].

Findings of the current study reported high-income group as a protective factor against delayed TB diagnosis; affirmed by a study from China, which reported OR=2.97, three times higher risk of delayed TB diagnosis in low-income groups [21]. Thus, a systematic review from Ethiopia, a mixed-method review from 19 countries, and a cross-sectional study from Pakistan affirmed a significant association of low income with delayed TB diagnosis [32-34].

Findings of the current study reported chronic cough OR=2.76, not significant for delayed TB diagnosis, in contrast to the evidence from China that affirmed three times OR=3.00 higher odds for delayed TB diagnosis in patients with chronic cough [21]. As the current study was retrospectively conducted in TB-diagnosed patients, recall bias may be a potential factor in relating cough history to delayed TB diagnosis. The current study reported the age group of 31-45 years OR=3.10 as a significant factor for delayed TB diagnosis, which matches with earlier findings from Ethiopia [28]. Simultaneously, evidence from Pakistan reported OR=3.37 as a significant risk for delayed TB diagnosis in the age group of 46-55 years of age [27].

In the studied participants, TB treatment was initiated for 87.8% of patients on the day of diagnosis, which is 66% of treatment initiation in a previous study from Pakistan [35]. Thus, unawareness of TB-designated centres and free treatment services has been reported to be a significant risk factor in Pakistan by earlier studies [34], while findings of the current study reported that not a single patient visited a chest hospital or TB centre before initial diagnosis was made, which shows a lack of awareness in the communities about available TB diagnostic and treatment facilities.

Our findings reported delayed TB diagnosis in male patients, OR=2.31, while most of the earlier evidence reports contradictory evidence and has reported higher odds of delayed TB in female patients. For instance, a study from Ethiopia reported odds of delayed TB diagnosis OR=1.46 times higher in female patients; thus, a systematic review from multiple countries affirmed the female gender as a significant factor for delayed diagnosis. Furthermore, a study from Pakistan also reported OR=2.42 times higher for female patients [27,28,33]. Likewise, unexpected results were found for fever: P=0.922, weight loss: P=0.267, and hemoptysis: P=0.370 as non-significant factors for delayed TB diagnosis, although, contradictorily, earlier evidence has affirmed the weight loss OR=15.59, OTC drugs OR=2.73 as risk factors and fever OR=0.13, and hemoptysis OR=0.06 as protective factors against delayed TB diagnosis [21]. Thus, weight loss P=0.267 an important predictor and clinical sign of TB diagnosis was not found significant.

The current study reported the use of public health hospitals OR=4.13 as a significant factor for delayed TB diagnosis, which manifests as an important finding, and can be a cause of an overburdened healthcare system. Another important finding, which has not been reported in earlier relevant studies, is the number of healthcare visits, which reported OR=22, P=<0.001, a significant risk factor for delayed TB diagnosis when compared with patients with more frequent 4-7 visits. These findings can be found synchronous with a study from Nepal reporting (AOR: 5.62; 95% CI: 2.26-13.96), with delayed TB diagnosis in patients visiting the healthcare facilities >3 times [36]. Thus, perceptions of patients towards the healthcare system, including quality of the healthcare system, OR=7.32, P<0.001, and hoping that symptoms will relieve over time, OR=9.99, were reported to be highly significant P<0.001 risk factors for delayed diagnosis.

Due to a lack of a Health management information system, data about initial symptoms, initial visit to the hospital, and date of diagnosis were provided by patients in an estimated number of weeks in the questionnaire. Such information can include recall bias, and the estimated mean and number of days in delay of TB diagnosis cannot be precise. The study did not report any use of OTC drugs, self-medication or use of traditional medicines and knowledge about TB that has been reported as a significant factor of delayed diagnosis in earlier evidence [21,27,28,32]. The study reported only the diagnosis delay, not focusing on the health systems delay or total delay, which can give deep insights into the implications of delayed TB diagnosis. Furthermore, the study found a four times higher risk of delayed diagnosis in public hospitals but did not report any details about referral history, accessibility or factors of delayed diagnosis.

Findings of the current study emphasise that education of the communities, TB awareness and knowledge, frequent and timely visits to the hospital upon experiencing symptoms, education and training of the healthcare professionals for TB screening and improving the referral system can collectively improve patient prognosis and will help in lowering the mean delay in diagnosis and initiation of TB treatment.

Future research studies should focus on longitudinal research designs to eliminate the risk of information and recall bias and have access to precise data about dates of patient diagnosis and treatment initiation. Empirical evidence from Pakistan has affirmed poor prognosis and disruptions in continuity of treatment as well, which should be explored with thorough research studies, specifically in the rural and remote areas with economic constraints and poor healthcare accessibility.

Conclusions

The cross-sectional study reported factors and determinants of delayed pulmonary TB diagnosis in a rural district of a TB high-incidence country, Pakistan. Findings of the study affirmed a high incidence of delayed TB diagnosis in public health hospitals, age-specific delayed diagnosis, significant impact of education and income level and frequency of hospital visits on delayed diagnosis. Patients' perceptions, including Perceptions of the symptoms will heal themselves, economic constraints and poor quality of health services, were reported as significant risk factors for delayed TB diagnosis.

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Table 1. Sociodemographic characteristics of the study participants and odds of delayed Tuberculosis diagnosis

Variables	Frequency	Percentage	OR (CI)	Level of significance
Gender				
Male	117	51.1	2.31 (1.36-3.93)	0.002*
Female	112	48.9		
Data collection centre:				
Public Health facility	152	66.4	4.13 (2.26-7.56)	<0.001*
Private health facility	77	33.6		
Initial diagnosis confirmed at:				
Public health facility	116	50.7		
Private health facility	77	33.6		0.074
Primary Healthcare Centre	22	9.6		
Chest Hospital	8	3.5		
TB Center	6	2.6		
Patients' Age groups:				
1-15 years	52	22.7		
16-30 years	75	32.8		
31-45 years	42	18.3		0.018*
46-60 years	31	13.5		0.051
61-75 years	23	10.0	3.10 (1.21-7.89)	
76-90 years	5	2.2	2.76 (0.99-7.68)	
90 years & above	1	0.4		
Marital Status:				
Single	135	59.0		
Married	87	38.0		0.104
Divorced	1	0.4		
Widowed	6	2.6		
Academic Qualification of patients:				
Not conventional schooling	122	53.3		0.005*
Attended School level	88	38.4	0.20 (0.07-0.61)	0.003*
College or University level	19	8.3	0.42 (0.24-0.74)	
Occupation				
Unemployed or Housewives	106	46.3		
Students	73	31.9		0.185
Clerical or office work	39	17.0		
Technical professions	11	4.8		
Household income				
Lower Income	69	30.1		0.007*
Middle Income	89	38.9		
High Income	71	31.0	0.39 (0.19-0.77)	
Residence of patients:				
Urban	6	2.6		
Sub-Urban	24	10.5		0.897
Rural	187	81.7		
Homeless or displaced	12	5.2		
Comorbidities				
No	181	79.0		
Diabetes	20	8.7		0.436
COPD	19	8.3		
other	9	3.9		

Variables	Freq	%	OR (CI)	Level of Significance
Gaps between the initial Visit and Diagnosis				0.103
Did not visited	10	4.4		
One week	60	26.2		
Two weeks	34	14.8		
Three weeks	31	13.5		
Four weeks	43	18.8		
One Month or beyond	51	22.3		
Number of healthcare visits before the initial Diagnosis				<0.001
0-3 visits	192	83.8	22 (5.26-96.22)	
4-7 visits	37	16.1		
Gaps between the day of diagnosis confirmation and initiation of treatment				0.071
The same day	201	87.8		
Second day	20	8.7		
Third day	3	1.3		
Fourth day	3	1.3		
Fifth day	1	0.4		
Sixth day	1	0.4		
Distance from the Healthcare facility				0.927
Less than 1 Kilometre (KM)	1	0.4		
1-15 KMs	136	59.4		
16-30 KMs	61	26.6		
31-45 KMs	30	13.1		
45 KMs or above	1	0.4		

Table 2. Patients' clinical signs and symptoms as predictors of delayed TB diagnosis.

Variables	**Frequency and (%)**				**OR (CI)**	**Level of Significance**
	Yes		**No**			
	Freq	**%**	**Freq**	**%**		
Exposure to TB patients	89	38.8	140	61.1	1.23 (0.71-2.08)	0.456
Cough	167	72.9	62	27.1	2.76 (1.32-5.77)	0.007*
Fever	223	97.3	6	2.6	1.08 (0.21-5.48)	0.922
Weight loss	117	51.0	112	48.9	1.34 (0.79-2.25)	0.267
Extra-pulmonary symptoms	60	26.2	169	73.8	2.84 (1.37-5.89)	0.005*
Hemoptysis	23	10	206	90.0	1.49 (0.62-3.62)	0.370

Table 3. Perceptions as causes of delayed TB diagnosis reported by Patients

Variables	Frequency and (%)				OR (CI)	Level of Significance
	Yes		No			
	Freq	%	Freq	%		
Fear of diagnosis	14	6.1	215	93.9	1.24 (0.41-3.72)	0.690
Hope the symptoms relieve themselves	118	51.5	111	48.5	9.99 (5.44-18.32)	<0.001*
Fear of social isolation	10	4.4	219	95.6	1.40 (0.38-5.12)	0.605
Economic Constraints	85	37.1	144	62.9	6.58 (3.53-12.26)	<0.001*
Bad experience of healthcare staff behavior	8	3.5	221	96.5	6.81 (0.82-56.29)	0.075
Poor quality of healthcare services at hospitals	56	24.5	173	75.5	7.32 (3.37-15.89)	<0.001*

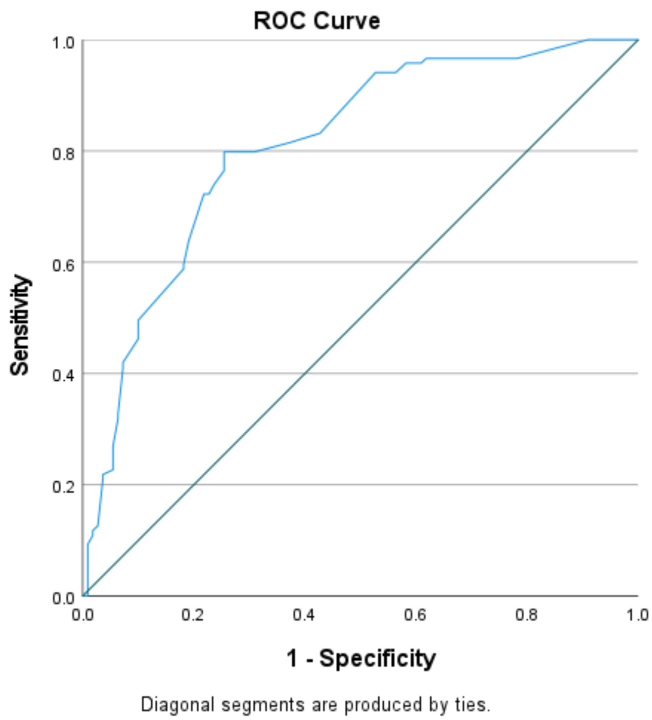

Figure 1. Area under the curve (AUC) graph for differentiation of delayed versus non-delayed TB cases.

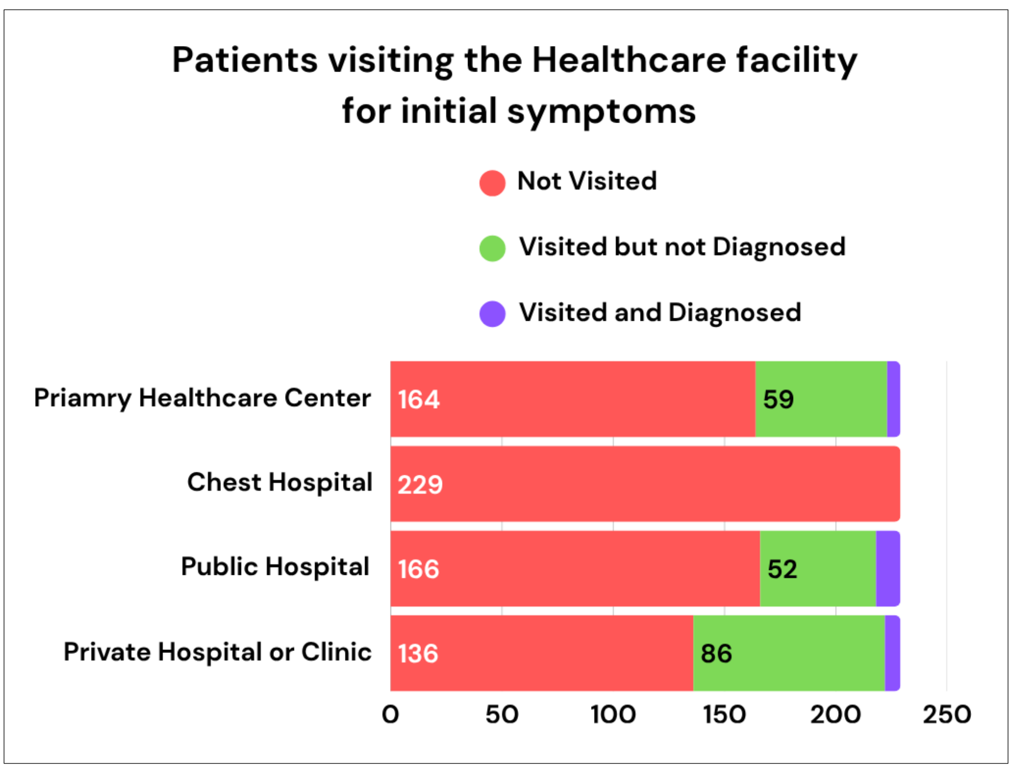

Figure 2. Illustration of the healthcare facilities visited by patients for initial symptoms of tuberculosis.

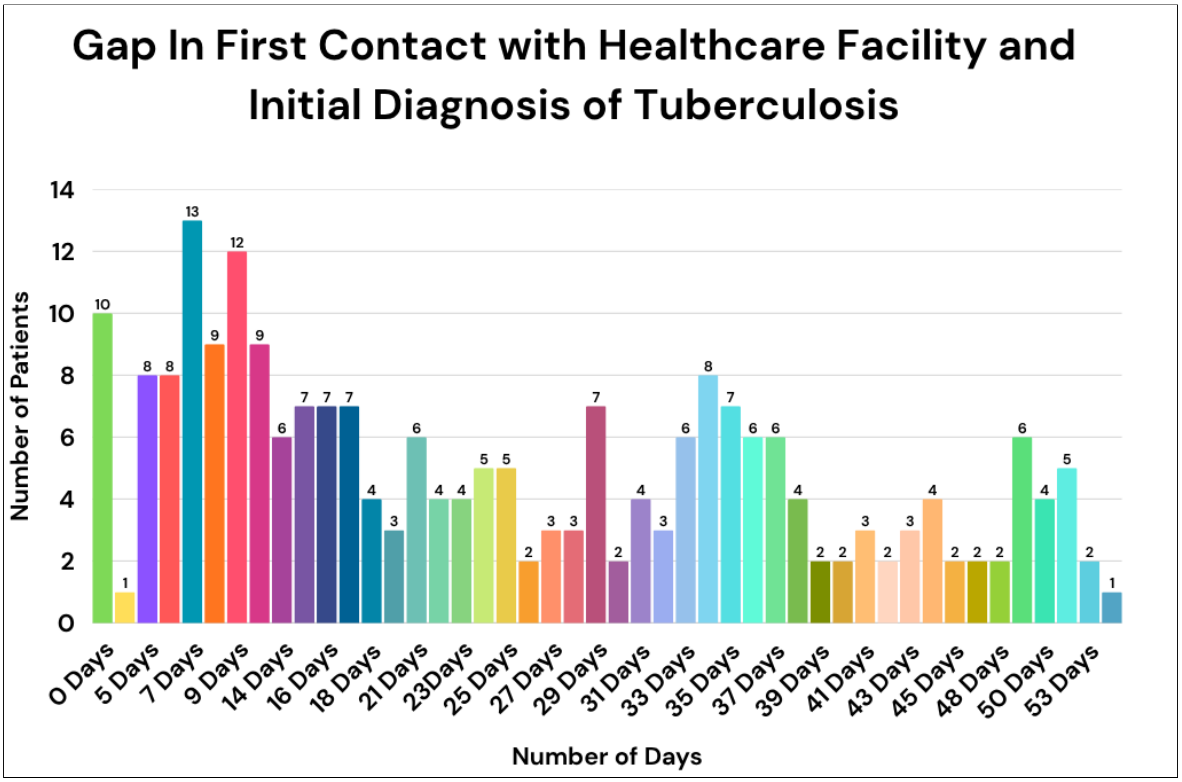

Figure 3. Number of days between the experience of initial symptoms by patients and when the diagnosis was confirmed

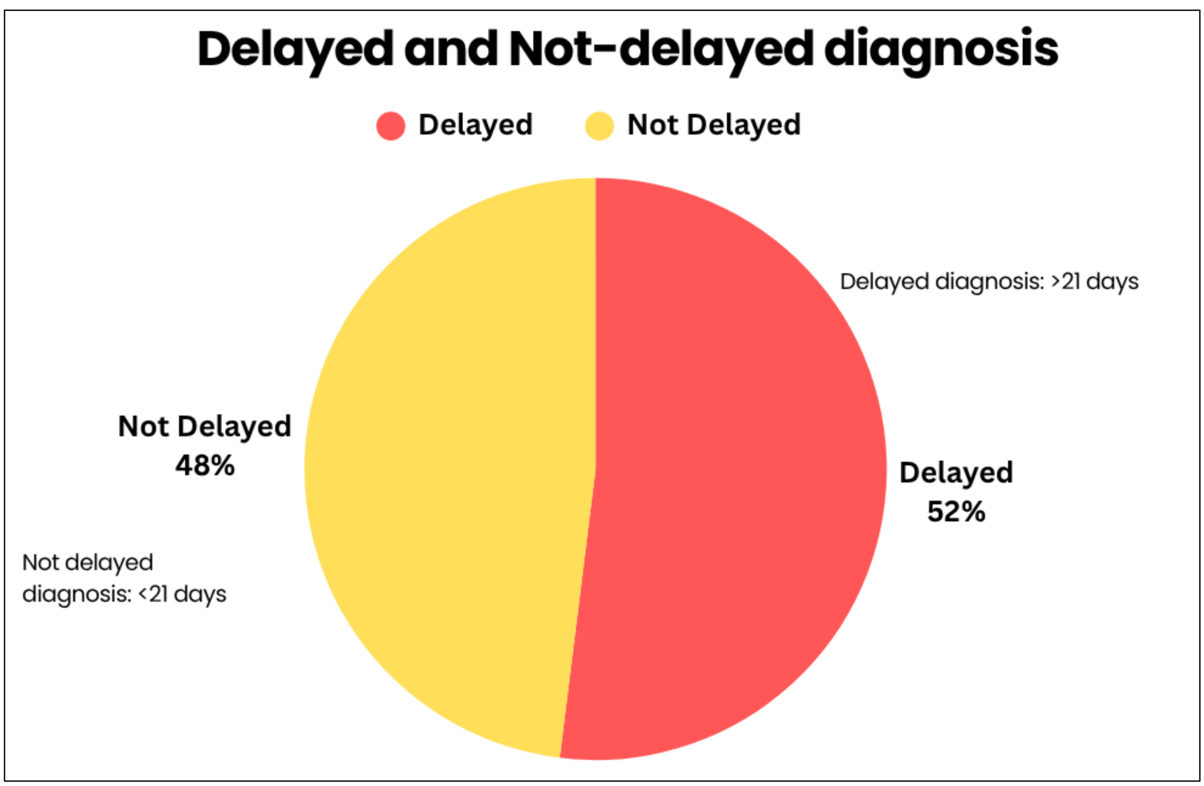

Figure 4. Description of delayed and Not-delayed Tuberculosis diagnosis cases (cutoff value for delay is >21 days).