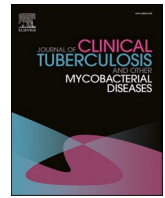


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## Pulmonary tuberculosis at Patan Hospital, Nepal: One year audit

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### ABSTRACT

**Background:** Globally, Tuberculosis (TB) is one of the top 10 causes of death. In Nepal, poverty and malnutrition aggravate the burden of TB. To identify *Mycobacterium tuberculosis* sputum is the best sample to identify the bacterium which is helpful for diagnosis. The aim of this study is to identify the situation, burden and challenges of pulmonary tuberculosis in low-middle income country like Nepal.

**Method:** A retrospective-audit with reliable-secondary-data of one year was collected (n = 4131). Descriptive-analysis was performed using frequency, percentage and analytical using chi-square-test. Level of significance was set at  $p < 0.05$ . Ethical Approval was obtained from IRC-PAHS.

**Result:** The prevalence of notified/suspected cases was highest among the patients having >60 years of age 1344 (32.54%) and least among the patients with  $\leq 15$  years of age 239(5.79%). The male had 1.67 times more smear-positive pulmonary TB cases. Among the AFB-positive cases, smear 3+ was seen in most of the cases 69(38.54%) followed by smear 1+ and smear 2+ in 56(31.28%) and 54(30.16%) respectively.

**Conclusion:** The prevalence of smear-positive pulmonary TB case is higher in male. Smear 3+ is seen in most of the followed by smear 1+ and smear 2+. The Burden of Pulmonary TB is more among adult and old-age-people and its control is a challenge for developing and low-middle income countries like Nepal.

### 1. Background

Worldwide, Tuberculosis (TB) is one of the top 10 causes of death and the leading cause of a single infectious agent (above HIV/AIDS) [1]. It still constitutes a major global health problem and it is estimated that almost one-third of the population is infected worldwide [2,3]. It is a chronic, granulomatous, air-born bacterial infectious disease that can involve lung and other organ systems. Poverty and malnutrition aggravates the burden of TB. The main microbiological agent is *Mycobacterium tuberculosis* in the vast majority of cases. The disease may transform into the active phase in 10% of cases and lungs are the most common site of involvement [3]. Since viable bacilli continue to be expelled for up to two months, infection control measures should be maintained for such a time. Thus up to two months of active infection sputum is positive for mycobacterium (Acid Fast Bacilli- AFB) [4].

Nepal is a landlocked country between India and China with 31% of the total population of 26 million under the poverty line and with 86% living in the rural area [4]. In Southeast Asia, in 2017, 4.4 million people fell ill with TB and an estimated 0.638 million died because of the

disease which is more than half of global TB deaths and associated with poverty in the developing countries. In Nepal, 31% of the total population of 26 million are under the poverty line and with 86% are living in the rural area [4]. Nepal being landlocked with two high TB burden countries i.e. India and China has added further difficulties to National Tuberculosis program [5].

In Nepal, 9 out of 10 newly registered (new and relapse) TB patients are successfully treated. TB cases are decreasing but the TB mortality rate is consistently at around 3% which is unacceptably high (Male > Female) given that TB deaths are prevented if it is diagnosed on time, treated with a prescribed regimen till the end of treatment duration [5]. *Mycobacterium tuberculosis* is mostly transmitted by droplet nuclei produced during coughing, speech, singing or sneezing. Thus sputum is the best sample to identify the bacterium which is helpful for diagnosis. A widely applied diagnostic tool for tuberculosis (TB) is Ziehl-Neelsen/fluorescent sputum staining, together referred to as acid-fast-bacilli (AFB) staining.

AFB smear grading are Negative, Scanty and 1+ to 3+. According to National Guideline of Tuberculosis of Nepal, based on WHO

**Abbreviations:** AFB, Acid Fast Bacilli; AIDS, Acquired Immune Deficiency Syndrome; HIV, Human Immunodeficiency Virus; IRC, Institutional Review Committee; Lab., Laboratory; PAHS, Patan Academy of Health Sciences; TB, Tuberculosis; WHO, World Health Organization.

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classification, the grades are interpreted as Negative. = (0 AFB/100 Field), Scanty = (1–9 AFB/100 Field) 1+ = (10–99 AFB/100 field), 2+ = (1–10 AFB/field), 3+ = (>10 AFB/Field) [1,6]. However, data quantifying the effect of sputum smear grade on the risk of transmission are lacking [7]. AFB is a widely used diagnostic-tool for Pulmonary-TB. Thus grading also signifies the load of the bacteria and possibilities of transmission. Thus we can identify the grade grades of Pulmonary TB patients visiting Patan Hospital and thus we can plan for prevention of tuberculosis at Patan Hospital.

The aim of the study was to identify the situation, burden and challenges of pulmonary tuberculosis in low-middle income country like Nepal. Other specific objectives are to identify the age at which pulmonary tuberculosis is common, to find out the distribution among different sexes and to find out the burden of AFB grading of sputum in pulmonary tuberculosis.

## 2. Methods

### 2.1. Study design, study population, sample size

A retrospective quantitative audit was used to analyse one-year data present at TB laboratory of Patan Hospital, a central level hospital having TB laboratory where sputum is collected from notified/suspected TB patient for AFB evaluation. The secondary data of all patients registered with sputum for AFB evaluation in June 16, 2017 to June 15, 2018 was traced from the register books of TB laboratory. The registered patients having no record on AFB were excluded. A record of 4131 patients was taken for this study.

### 2.2. Ethical approval and data collection procedures

Ethical Approval was taken from Institutional Review Committee, Patan Academy of Health Sciences "IRC-PAHS" (reference Number: std2007301403). Valid and reliable data were collected from the patient record book (register, a hard copy) of TB laboratory of Patan Hospital from June 16, 2017 to June 15, 2018. Confidentiality of the patient information was assured by maintaining the privacy and not recording the personal information from the record book.

### 2.3. Study variables

Study variables

#### 2.3.1. Socio-demographic variables

The socio-demographic variables included: Age of the patients which was categorized as <5 or <5 years, 6–15 years, 16–30 years, 31–45 years, 45–60 years, and > 60 years. The gender of the participants was categorized as male and female.

#### 2.3.2. Result AFB test of sputum

The result of the AFB test of Sputum was categorized as either positive or negative. Positive result was further divided into smear scanty, 1+, 2+, and 3+. To apply the test, scanty group is included in negative group. The analysis is done to find out the burden of specific grade type of TB in Patan Hospital.

### 2.4. Statistical analysis

The valid and reliable data from the record book of TB Laboratory, Patan Hospital, which was a secondary source. Data was entered in Ms-Excel 2010 and analysis was done using SPSS software, version 23. Descriptive analysis was performed using frequency and percentage. For the analytical part, chi-square test was used to analyse the categorical data. P-value <0.05 is considered statistically significant.

## 3. Results

This was a retrospective one year audit conducted to identify the situation and burden of pulmonary tuberculosis at Patan Hospital, Nepal.

The result of this audit showed the burden of pulmonary tuberculosis according to AFB grading of sputum. About 4131 records were obtained from the patients who visited Patan Hospital in different departments and were suspected for pulmonary TB. Most of the sputum sample was collected from the patient having >60 years of age 1344 (32.54%) and least for a patient with ≤15 years of age 239 (5.79%). Table 1 shows, for the number of cases according to age distribution. No significant association between age group and sputum sample collection was seen (p = 0.79). Sputum sample of the suspected male was significantly (p = 0.036) more [2269 (54.93%)] than suspected female [1862 (45.07%)]. Among the total samples collected only 179 (4.33%) cases were positive and sputum AFB reports of 3952 (95.67%) cases were negative. Among the positive cases, male were 1.6 times more. Out of 179 cases, 62.57% cases were male and 37.43% were female (Table 1). Table 1 also shows children less than or equal to 15 years had fewer prevalences of AFB (sputum) positive Pulmonary TB cases 7 (2.92%) compared to other age groups 48 (4.66%), 36 (5.06%), 44 (5.44%) and 44 (3.27%) with respect to sample collection as well as among the positive cases. Similarly, female had fewer prevalences of AFB (sputum) positive pulmonary TB cases 67 (3.59%) compared to male 112 (4.94%). In all age groups, male were more than female came for evaluation of sputum. AFB positive is more among the males of age group above 30 years. In the age group ≤15 years female 4 (2.22%) was more than male 3 (1.67%) and in the age group 16–30 years both male and female were equal to 24 (13.4%) (Tables 2 and 3).

Among the AFB positive cases, smear 3+ was seen in most of the case 69 (38.54%) flowed by smear 1+ and smear 2+ in 56 (31.28%) and 54 (30.16%) respectively (Table 3). In Table 4, age group ≤15 and 16–30 years was merged in a single category ≤30 years to calculate chi-square value and to analyze statistically. AFB positive with smear 1+ and smear 2+ was mostly seen in the age group ≤30 years whereas smear 3+ was mostly common in the age group 46–60 years and 1+ was least in age group 46–60, 2+ was least in the age group 31–45 and 3+ was least in the age group 31–45 which were not statistically significant (p = 0.82) (Table 4).

## 4. Discussion

Tuberculosis (TB) is a communicable disease and caused by the bacillus *Mycobacterium tuberculosis*. It typically affects the lungs (pulmonary TB) but can also affect other sites (extrapulmonary TB) [8]. The global burden of tuberculosis remains enormous, mainly because of poor control in southeast Asia, sub-Saharan Africa, and eastern Europe and because of the high rate of *M. tuberculosis* and HIV co-infection in some

**Table 1**  
Demographic pattern of burden of Pulmonary TB.

Characteristics	AFB Positive (Row %)	AFB Negative (Row %)	Row Total (Column %)	P value
<b>Age (in years)</b>				<b>0.079*</b>
≤15	7 (2.92)	232 (97.07)	239 (5.79)	
16–30	48 (4.66)	981 (95.34)	1029 (24.90)	
31–45	36 (5.06)	675 (94.94)	711 (17.21)	
46–60	44 (5.44)	764 (94.56)	808 (19.56)	
>60	44 (3.27)	1300 (96.73)	1344 (32.54)	
Column Total	179 (4.33)	3952 (95.67)	4131	
<b>Sex</b>				<b>0.036*</b>
Male	112 (4.94)	2157 (95.06)	2269 (54.93)	
Female	67 (3.59)	1795 (96.41)	1862 (45.07)	
Column Total	179 (4.33)	3952 (95.67)	4131	

Bold indicates statistically significant

\* Chi-Square test

**Table 2**

Distribution of sputum sample collected according to their gender and age group and their AFB report.

Age (Yrs)	≤15		16–30		31–45		46–60		>60		Total
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	
<b>Smear Negative*</b>	123	109	545	436	374	301	450	314	665	635	<b>3952</b>
<b>Smear Positive</b>	3	4	24	24	23	13	32	12	30	14	<b>179</b>
<b>Total</b>	126	113	569	460	397	314	482	326	695	649	<b>4131</b>

\* All cases with 0–9 AFB/100 filed of a smear are considered as negative.

**Table 3**

AFB grading of sputum positive cases according to their gender and age group.

Age (Yrs)	≤15		16–30		31–45		46–60		>60		Total Positive Cases (Column %)
	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)	
<b>Smear Positive for AFB</b>											
<b>Smear 1+</b>	3 (1.68)	1 (0.58)	8 (4.47)	7 (3.91)	7 (3.91)	6 (3.35)	9 (5.02)	1 (0.58)	9 (5.02)	5 (2.79)	56 (31.28)
<b>Smear 2+</b>	0 (0.00)	3 (1.67)	5 (2.79)	9 (5.03)	7 (3.91)	3 (1.68)	8 (4.46)	5 (2.79)	9 (5.02)	5 (2.79)	54 (30.16)
<b>Smear 3+</b>	0 (0.00)	0 (0.00)	11 (6.14)	8 (4.46)	9 (5.02)	4 (2.24)	15 (8.38)	6 (3.35)	12 (6.70)	4 (2.24)	69 (38.54)
<b>Total</b>	3 (1.68)	4 (2.24)	24 (13.40)	24 (13.40)	23 (12.84)	13 (7.28)	32 (17.88)	12 (6.72)	30 (16.74)	14 (7.82)	179

**Table 4**

AFB grading of sputum positive cases according to their age group.

Age (Yrs)	Smear Grading				
	Smear 1+ (10–99 AFB/100 Field)	Smear 2+ (1–10 AFB/Field)	Smear 3+ (>10 AFB/field)	Row Total	P value
≤30	19	17	19	55	0.82*
31–45	13	10	13	36	
46–60	10	13	21	44	
>60	14	14	16	44	
Column Total	56	54	69	179	

Bold indicates statistically significant.

\* Chi-Square test.

African countries. In the South Asia region alone, it accounts for 39% of the total global burden of TB. In Nepal one-fourth of the total population of 26.6 million live under the poverty line and 83% live in the rural areas [9]. TB is one of the major public health challenges in Nepal. Early detection of tuberculosis is essential to prevent transmission and to build an effective approach to tuberculosis control policy [6].

Sputum microscopy is one of the cost-effective and easy way to diagnose the case of tuberculosis among the suspected cases whose sputum sample is collected. It is very simple, convenient, and requires less effort and can be performed in any hospital setting where only fundamental resources are available. AFB smear grading was done National Guideline of Tuberculosis of Nepal which is based on WHO classification where Negative=(0 AFB/100 Field), Scanty=(1–9 AFB/100 Field) 1+=(10–99 AFB/100 field), 2+ = (1–10 AFB/field), 3+=(>10 AFB/Field) [1,10]. For the analytical purpose in this study AFB smear grading of scanty is also included in the negative.

Study sample was collected at TB laboratory from notified/suspected case of different departments of Patan Hospital. This study tried to identify the age at which pulmonary tuberculosis was common among Nepali people visiting Patan Hospital. This audit was also useful to find out the distribution of pulmonary tuberculosis among different sexes. Out of 4131 records of the patient who visited Patan Hospital in the different departments and are notified/suspected for pulmonary TB, most of the sputum sample was collected from the patient having >60 years of age 1344 (32.54%) and least for patients with ≤15 years of age 239 (5.79%). For the age group 16–30, 31–45, 46–60 years of age

prevalence were 1029 (24.90%), 711 (17.21%) and 808 (19.56%) respectively. A similar result of less prevalence of suspicion among children (2.1% notified/suspected cases among the patient age ≤15 years) has shown in a study done in western region of Nepal in 2017 by Dhakal A. et al. [6]. But the data of this study shows no statistically significant association between age group and the sputum sample (p = 0.79). This study also shows sputum sample of notified/suspected male was collected comparatively more 2269 (54.93%) than notified/suspected female 1862 (45.07%) which is statistically significant (p = 0.036) and this result is similar to the study done by Dhakal et. al. where notified/suspected male case cases is more than notified/suspected female cases with a result of 58.2% and 41.8% respectively [6].

This study showed, among the total sample collected from notified/suspected cases, only 179 (4.33%) cases were positive and sputum AFB report of 3952 cases (95.67%) was negative. This is markedly reducing trend in comparison to the report of the study done by Adhikari N. et al. According to Adhikari et al. cases notification had contributed 20% (6677 out of 34,112 notified TB cases) of total TB cases notification in 2015 and has been decreasing thereafter (17%; 5850 out of 32,056 notified TB cases in 2016, 15%; 5216 out of 31,764 notified TB cases) in 2017) [5]. Among the positive cases, 112 (62.57%) cases were male and 67 (37.43%) were female indicating male–female ratio among smear-positive pulmonary TB cases is (1.67: 1) which is almost maintained for all age groups except for age groups ≤15 (0.75:1) and 16–30 (1:1). The result of our study is similar to the report of year 2017/18 which is mentioned in the national tuberculosis management guideline 2019 of Nepal and study conducted. However, according to study conducted by Dhakal et al., males were only 1.3 times more in comparison to female smear-positive cases smear-positive cases were more in male [1,6]. This study also shows children of age ≤15 years had fewer prevalences of AFB (sputum smear) positive Pulmonary TB cases 7 (2.92%) compared to other age groups 48 (4.66%), 36 (5.06%), 44 (5.44%) and 44 (3.27%) with respect to sample collected as well as among the positive cases. In the study done by Dhakal et. al. No smear-positive cases were detected among the notified cases of age group ≤15 years [6]. However, in a study conducted by Agrawal A. et. al. in 2014 in India there is less prevalence of pulmonary TB with sputum smear-positive cases in age group < 20 years which is similar to the result of our study but in contrary to our study the result of the study of Agrawal et. al is similar to that of our study for adults [11].

In this study, among the AFB positive cases, smear 3+ was seen in

most of the case 69 (38.54%) followed by smear 1+ and smear 2+ in 56 (31.28%) and 54 (30.16%) respectively which is supported by similar finding in the study done by Agrawal et. al. [11]. Our study also showed that there is no significant statistical association between age different age groups and smear grading of AFB positive cases.

#### 4.1. Strength and limitation

Though retrospective audit is done, the strength of the study is that a large number of the sample (4131 notified cases) is considered for this study. All cases of one year were taken for study purposes. 179 AFB smear-positive cases were analyzed. The limitations of the study are:

1. This study is audit of one year only.
2. The scanty AFB is considered as negative AFB for analysis purpose in this study.
3. Since the secondary data was used, the analysis was limited to very few variables such as age, sex, AFB status, smear grading.

The generalizability of the study findings from this study should be interpreted with caution. The outcome is useful in the country and area with similar GDP and healthcare setup.

#### 5. Conclusion

Though the situation of pulmonary tuberculosis is getting better which is suggested by decrease number of AFB positive cases 179 (4.33%) among the suspected cases but its burden is still present in Nepal. The prevalence of notified/suspected cases is highest among the patients having >60 years of age and least among the patients with ≤15 years of age. Sputum sample of notified/suspected males were collected comparatively more than the female. The male has 1.67 times more smear-positive pulmonary TB cases in comparison to the female which is almost maintained for all age groups. Children of age ≤15 years had fewer prevalences of AFB (sputum smear) positive Pulmonary TB cases compared to other age groups. Among the AFB positive cases smear 3+ is seen in most of the followed by smear 1+ and smear 2+. The Burden of TB is more among adult and old age people in Patan Hospital and so as in Nepal and its control is still a challenge for developing and low-middle income country like Nepal.

##### Declaration

##### Ethical approval

Ethical approval was obtained from Institute Review Committee of Patan Academy of Health Sciences, Lalitpur, Bagmati Province, Nepal (Committee's Ref. No: std2007301403).

##### Consent for publication

Consent was taken for a scientific publication.

##### Availability of data and materials

The data supporting the findings of this article is available in PAHS, TB laboratory, and tally sheet with authors.

##### Funding

None

##### Contributions

Sah MK and Shrestha SR conceived, conceptualized and designed the study. Maharjan K and Aryal P tallied the data. Sah MK, Jha AK, and Jha G, analyzed the data. All authors drafted the manuscript with assigned

different sections, critically read the manuscript, and agreed to its submission and publication.

##### Ethical Consideration

Ethical Approval was taken from Institutional Review Committee, Patan Academy of Health Sciences "IRC-PAHS" (reference Number: std2007301403). Valid and reliable data were collected from the patient record book of TB laboratory of Patan Hospital from June 16, 2017 to June 15, 2018. Confidentiality of the patient information was assured by maintaining the privacy and not recording the personal information from the record book.

##### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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