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``Occupational Awareness and Preventive Practices on Pulmonary Tuberculosis Risk Factors among Dental Surgeons in Bangladesh``

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Abstract:
Background:
Tuberculosis remains a major public health challenge in developing countries, particularly in Bangladesh, where pulmonary tuberculosis continues to contribute significantly to the overall disease burden. Dental surgeons are at increased occupational risk because most dental procedures involve close contact with the patient's respiratory tract and the generation of aerosols. However, limited data are available regarding occupational awareness and preventive practices related to pulmonary tuberculosis among dental surgeons in Bangladesh.
Aim:
To assess occupational awareness and preventive practices regarding risk factors of pulmonary tuberculosis among practicing dental surgeons in Bangladesh.
Materials and Methods:
A descriptive cross-sectional study was conducted among practicing dental surgeons working in hospitals, dental clinics, and private chambers in Bangladesh. Data were collected using a structured, self-administered questionnaire. The questionnaire included socio-demographic characteristics, knowledge of pulmonary tuberculosis risk factors, awareness of occupational exposure in dental practice, and preventive measures followed during patient management. Participants were selected using a convenience sampling technique. Data were analyzed using appropriate statistical methods, and a p-value of less than 0.05 was considered statistically significant.
Results:
Most dental surgeons showed good knowledge and preventive practices regarding tuberculosis, although formal infection-control training was very limited. Just 10.51% of the 276 dental surgeons had formal TB infection-control training, although 74.28% had strong knowledge and 63.41% had good preventative behavior. The best indicator of good practice was good knowledge (AOR = 10.647; $p < 0.001$). Good knowledge was the strongest predictor of good preventive practice, along with training, longer clinical experience, and hospital-based work.
Conclusion:
The study highlights important gaps between knowledge and preventive practices among dental surgeons in Bangladesh. The findings emphasize the need for structured infection-control training programs to improve occupational safety and reduce the risk of tuberculosis transmission in dental settings.

Keywords: *Pulmonary tuberculosis; Occupational awareness; Preventive practices; Dental surgeons; Bangladesh.*

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I. Introduction:

Tuberculosis (TB) remains one of the oldest and most persistent infectious diseases affecting humans and continues to be a major global public-health concern. Despite the availability of effective anti-tubercular drugs for more than half a century, TB is still the leading cause of death from a single infectious agent worldwide. According to the World Health Organization (WHO) Global Tuberculosis Report 2025, an estimated 10.7 million people developed TB in 2024 and approximately 1.23 million deaths were attributed to the disease globally [1,2]. Although TB is both preventable and curable, delayed diagnosis, poor treatment adherence, drug resistance, and socioeconomic inequalities continue to sustain the global burden of the disease [2,3].

The burden of TB is disproportionately high in low- and middle-income countries, particularly in South-East Asia. Bangladesh remains one of the high-burden countries and continues to face significant challenges in TB control. According to WHO regional and country data, the South-East Asia region accounts for more than one-third of global TB cases, and Bangladesh is among the countries with a substantial incidence rate [1,4]. Factors such as poverty, malnutrition, overcrowded living conditions, poor ventilation, and low literacy levels contribute significantly to the persistence of TB in the country. In addition, a considerable number of cases remain undiagnosed or unreported, which increases the risk of community transmission [1,2].

Pulmonary tuberculosis is primarily transmitted through airborne droplet nuclei containing *Mycobacterium tuberculosis*. These infectious particles are released when an infected individual coughs, sneezes, speaks, or shouts and may remain suspended in the air for several hours, particularly in poorly ventilated environments [2,5]. The risk of transmission depends on several factors, including the concentration of infectious particles, duration of exposure, ventilation, and the immune status of the exposed individual. Following infection, individuals may either develop active TB disease or remain asymptomatic with latent tuberculosis infection (LTBI), which can later reactivate, especially in the presence of immunosuppression, malnutrition, or chronic disease [2,5].

Healthcare workers (HCWs) are at a higher occupational risk of TB compared with the general population, particularly in high-burden countries. This increased risk is mainly due to frequent exposure to undiagnosed or untreated TB patients and inadequate infection-control measures in healthcare settings [1,3]. Among healthcare professionals, dental surgeons may be particularly vulnerable because most dental procedures require close proximity to the patient's oral and respiratory tract and involve aerosol-generating instruments. Exposure to infectious aerosols during routine dental procedures may therefore increase the risk of occupational transmission if adequate preventive measures are not followed. [6,7].

Although several studies have investigated TB risk among healthcare workers, relatively limited research has focused specifically on dental surgeons, particularly in developing countries such as Bangladesh. Furthermore, data regarding occupational awareness and preventive practices related to pulmonary tuberculosis among dental professionals remain scarce. Understanding the level of awareness and preventive practices among dental surgeons is essential for improving occupational safety and strengthening infection-control programs in dental practice. [8,9, 10, 11, 12, 13, 14].

Therefore, the present study aims to assess occupational awareness and preventive practices regarding risk factors of pulmonary tuberculosis among practicing Dental surgeons in Bangladesh.

II. Materials And Methods:

A clinic-based cross-sectional study was conducted among practicing dental surgeons in Bangladesh from 1 January 2025 to 31 December 2025. The study included dental surgeons working in both public and private clinics, hospital dental units, and chambers across different regions of the country.

The sample size was calculated using Epi Info version 3.5.1, assuming a 50% prevalence of tuberculosis infection-control (TBIC) practice, 95% confidence level, 80% power, and an odds ratio of 2. After adding a 10% non-response rate, a total of 276 participants were included. Participants were selected proportionately from different dental clinics, and individual participants were chosen using a simple random sampling technique (lottery method).

Data were collected using a pretested structured self-administered questionnaire consisting of socio-demographic variables, knowledge regarding pulmonary tuberculosis risk factors, awareness of occupational exposure in dental practice, and preventive practices related to tuberculosis infection-control. The questionnaire was pretested among dental surgeons from a private dental college in Dhaka who were not included in the final study. [15,16]

Data were entered and cleaned using Epi Info and analyzed using SPSS version 21. Descriptive statistics, chi-square test, and logistic regression analysis were used to assess the association between knowledge and preventive practices. A p-value of less than 0.05 was considered statistically significant. Ethical approval was obtained from the Institutional Ethical Review Committee of City Dental College and Hospital, Dhaka, Bangladesh, before the study.

III. Results:

A total of 313 practicing dental surgeons were approached for participation in the study. Among them, 276 completed the questionnaire, giving a response rate of 88%. The participants represented dental surgeons working in both public and private dental clinics, hospital-based dental units, and private chambers across different regions of Bangladesh.

Socio-demographic characteristics of the participants (n = 276). Most dental surgeons were young, with 42.03% aged ≤30 years and 33.70% aged 31–40 years. Male participants constituted 59.78% of the study population. The majority had less than 10 years of clinical experience and were mainly working in private dental clinics (56.16%). Only 10.51% of the participants had received formal training on tuberculosis infection-control, indicating a substantial gap in professional training among practicing dental surgeons.

The most dental surgeons demonstrated good knowledge regarding risk factors of pulmonary tuberculosis. The majority correctly identified airborne transmission (91.67%) and close contact with TB patients (94.20%) as major risk factors. However, comparatively lower awareness was observed regarding diabetes mellitus as a risk factor (73.91%). Overall, 74.28% of the participants had good knowledge, while 25.72% had poor knowledge.

Also, that most respondents reported routine use of masks during treatment (88.41%) and adequate clinic ventilation (60.51%). However, very low proportions reported screening patients for cough history (21.38%) and referring suspected TB patients (29.71%). Only 18.84% had received formal infection-control training. Overall, 63.41% of participants demonstrated good preventive practice, while 36.59% had poor practice.

The good knowledge was the strongest predictor of good preventive practice (AOR = 10.647; $p < 0.001$). Receiving TB infection-control training (AOR = 3.376; $p = 0.008$), having >10 years of clinical experience (AOR = 1.832; $p = 0.035$), and working in hospital-based settings (AOR = 2.115; $p = 0.019$) were also significantly associated with better preventive practices among dental surgeons.

Table 1. Socio-demographic characteristics of the study participants (n = 276)

Variable	Frequency (n)	Percentage (%)
Age group (years)		
≤ 30 years	116	42.03
31–40 years	93	33.70
41–50 years	45	16.30
> 50 years	22	7.97
Gender		
Male	165	59.78
Female	111	40.22
Years of practice		
< 5 years	104	37.68
5–10 years	82	29.71
11–15 years	49	17.75
> 15 years	41	14.86
Type of workplace		
Private dental clinic	155	56.16
Both public and privet hospital-based dental unit	74	26.81
Both public and private and hospital practice	47	17.03
Received TB infection-control training		
Yes	29	10.51
No	247	89.49

The sociodemographic details of the research participants are shown in Table 1. The study comprised 276 dental surgeons who were currently in practice. 33.70% of participants were between the ages of 31 and 40, while 42.03% were under 30. Just 7.97% of participants were older than 50. This suggests that the majority of responders were in the early to middle phases of their careers.

Male dental surgeons made up 59.78% of the participants, while female dental surgeons made up 40.22%. This indicates that male practitioners were more likely to participate in the study.

In terms of work experience, 29.71% of participants had five to ten years of experience, while 37.68% had less than five years. Just 14.86% had worked in clinical practice for more than 15 years. This implies that early-career dental surgeons made up the majority of the study population.

Regarding the workplace, 26.81% of participants worked in both public and private hospital-based dental practices, however the majority of participants (56.16%) were employed in private dental clinics. Only 17.03% of respondents said they worked in both hospital and private clinics. This illustrates how dental surgeons in Bangladesh primarily practice in the private sector.

Remarkably, just 10.51% of participants said they had received official training in tuberculosis infection management, while 89.49% said they had not. This research reveals a substantial lack of formal infection-control training among dental surgeons in practice, which may have an impact on pulmonary tuberculosis knowledge and preventive measures.

Table 2. Knowledge regarding risk factors of pulmonary tuberculosis among dental surgeons (n = 276)

Knowledge variable	Correct response n (%)	Incorrect/Not sure n (%)
TB is transmitted through airborne droplets	253 (91.67)	23 (8.33)
Close contact with TB patient is a risk factor	260 (94.20)	16 (5.80)

Knowledge variable	Correct response n (%)	Incorrect/Not sure n (%)
Smoking increases risk of TB	226 (81.89)	50 (18.11)
Diabetes mellitus increases risk of TB	204 (73.91)	72 (26.09)
Malnutrition increases risk of TB	236 (85.51)	40 (14.49)
Immunocompromised patients have higher risk	246 (89.13)	30 (10.87)
Dental surgeons are at occupational risk	235 (85.14)	41 (14.86)

Overall knowledge level

Category	Frequency (n)	Percentage (%)
Good knowledge	205	74.28
Poor knowledge	71	25.72

The participating dental surgeons' level of awareness of pulmonary tuberculosis risk factors is displayed in Table 2. The main risk factors for pulmonary tuberculosis were accurately identified by a significant percentage of participants. The majority of respondents knew that close contact with a TB patient is a substantial risk factor (94.20%) and that the disease is spread by airborne droplets (91.67%). There was also a comparatively high level of knowledge of other significant risk factors, including smoking (81.89%), malnutrition (85.51%), and immunocompromised conditions (89.13%).

However, only 73.91% of participants correctly identified diabetes mellitus as a risk factor, indicating a rather low level of awareness. Furthermore, 85.14% of respondents acknowledged that dental surgeons are susceptible to contracting tuberculosis during work.

Overall, 25.72% of the participants had low knowledge, compared to 74.28% who were classified as having high knowledge. These results imply that while dental surgeons have a decent general understanding of pulmonary tuberculosis risk factors, there are still significant gaps in several areas, especially when it comes to systemic risk factors like diabetes mellitus.

Table 3. Preventive practices related to pulmonary tuberculosis in dental practice (n = 276)

Preventive practice	Yes n (%)	No n (%)
Routine use of mask during treatment	244 (88.41)	32 (11.59)
Screening patients for cough history	59 (21.38)	217 (78.62)
Use of protective measures for suspected TB patients	156 (56.52)	120 (43.48)
Referral of suspected TB patients	82 (29.71)	194 (70.29)
Adequate ventilation in clinic	167 (60.51)	109 (39.49)
Received infection-control training	52 (18.84)	224 (81.16)

Overall preventive practice level

Category	Frequency (n)	Percentage (%)
Good practice	175	63.41
Poor practice	101	36.59

Table 3 presents the preventive practices related to pulmonary tuberculosis among the participating dental surgeons. The majority of participants reported routine use of masks during dental treatment (88.41%), indicating good compliance with basic protective measures. More than half of the participants (56.52%) reported using additional protective measures when treating suspected TB patients, and 60.51% stated that their clinics had adequate ventilation.

Nonetheless, significant deficiencies were noted in a number of crucial preventive measures. Just 29.71% of participants reported recommending suspected TB patients for medical examination, and only 21.38% reported screening patients for cough history prior to treatment. Furthermore, just 18.84% of the participants had formal training in infection control.

Overall, 63.41% of the participants were categorized as having good preventive practices, while 36.59% had poor preventive practices. These findings indicate that although basic protective practices such as mask use are commonly followed, several essential preventive measures related to tuberculosis infection-control are still inadequately practiced among dental surgeons.

Table 4. Factors associated with good preventive practice among dental surgeons (Binary logistic regression)

Variable	Good practice n (%)	Poor practice n (%)	AOR	95% CI	p-value
Good knowledge	153 (74.64)	52 (25.36)	10.647	5.768 – 18.330	<0.001
Received TB training	22 (75.86)	07 (24.14)	3.376	1.377 – 8.330	0.008
> 10 years of experience	77 (68.75)	35 (31.25)	1.832	1.041 – 3.259	0.035
Hospital-based practice	55 (74.33)	19 (25.76)	2.115	1.128 – 3.961	0.019

Table 4 shows the factors associated with good preventive practice related to pulmonary tuberculosis among dental surgeons. Participants with good knowledge were significantly more likely to demonstrate good preventive practice compared with those with poor knowledge (AOR = 10.647; 95% CI: 5.768–18.330; $p < 0.001$). This indicates that knowledge was a strong predictor of preventive practice.

Dental surgeons who had received formal tuberculosis infection-control training were also more likely to have good preventive practice (AOR = 3.376; 95% CI: 1.377–8.330; $p = 0.008$). In addition, participants with more than 10 years of clinical experience showed significantly better preventive practice compared with those with less experience (AOR = 1.832; 95% CI: 1.041–3.259; $p = 0.035$).

Another important feature linked to good preventive practice was working in hospital-based dental settings (AOR = 2.115; 95% CI: 1.128–3.961; $p = 0.019$). Overall, the results show that among dental surgeons, preventive practice was significantly predicted by knowledge, professional training, clinical experience, and workplace environment.

IV. Discussion:

This study examined Bangladeshi dental surgeons' occupational awareness of pulmonary tuberculosis (TB) and their preventive measures. There are still large gaps in essential occupational behaviors, especially in patient screening and referral of suspected cases, even though the majority showed high awareness (74.28%) and a reasonable level of preventative actions (63.41%). These results must be weighed against regional data on dental professionals and healthcare workers (HCWs) as well as global TB control measures.

Consistent with international literature, healthcare workers face a disproportionate occupational risk of tuberculosis due to routine exposure to undiagnosed cases and aerosol-generating procedures. A systematic review reported that HCWs have a significantly higher prevalence of latent TB infection than the general population, with prolonged healthcare employment and inadequate infection control measures as key risk factors[17]. Similarly, a meta-analysis in India found that TB prevalence among HCWs remains high, highlighting the occupational hazard in high-burden settings [18]. Although the direct prevalence of TB among dental surgeons was not measured in this study, the observed gaps in preventive behavior suggest continued susceptibility in this group.

The finding that most dental surgeons correctly identified airborne transmission and close contact with TB patients as major risk factors aligns with studies exploring knowledge among HCWs in South Asia. For example, HCWs in India demonstrated high levels of TB knowledge and preventive practices compared to patients, though gaps existed particularly in translation of knowledge into practice [19]. In contrast, a study in Nepal revealed that nearly half of HCWs had poor knowledge of TB infection–control measures, and use of respirators or patient triage was notably limited [20]. These regional studies reinforce the notion that awareness alone may not predict the full adoption of preventive behaviors, particularly without formal training or institutional support.

Crucially, although being strongly linked to improved preventative actions, formal infection control training was uncommon (10.51%) in the current study. This is similar to findings from Bangladesh, where many health facilities had poor implementation of TB infection-control recommendations, frequently as a result of a lack of organized plans or committees and a lack of knowledge of national protocols [21]. Even among professionals who are aware of basic risk factors, these systemic inadequacies probably lead to inadequate preventive activity.

Significant gaps were observed in specific preventive practices. For example, only 21.38% screened patients for cough history and less than one-third referred suspected TB cases. Poor adoption of patient triage and early identification approaches has also been documented in South Asia, where lack of training and resources hinder implementation of basic infection-control measures [22]. In dental settings, the risk of aerosol-mediated transmission remains a practical concern, although a meta-narrative review emphasizes that strict application of basic infection-control guidelines (masks, ventilation, and standard precautions) can effectively mitigate TB transmission risk [23]. This underlines the need for adherence to standards rather than mere awareness.

The strong association between good knowledge and good preventive practice (AOR = 10.647; $p < 0.001$) in this study echoes evidence from broader HCW research, where training and knowledge have

consistently been linked to improved practices. A mixed-method study in India found that HCWs with better knowledge and positive attitudes towards TB prevention were more likely to demonstrate good preventive behavior compared with patients and the general population [24]. This reinforces the crucial role of formal education and continuing professional development in translating awareness into consistent practice.

Preventive practices in this study were also influenced by clinical experience and the work environment. Good practices were more prevalent among dental surgeons with over ten years of clinical experience and those employed in hospital settings. This pattern is in line with regional data showing that healthcare workers in organized institutional settings benefit from established infection control systems and supervision, while those in private or non-hospital settings encounter more difficulties because of a lack of oversight [25]. Similar discrepancies in the use of infection control have been reported in Pakistani hospital settings handling drug-resistant tuberculosis, where inadequate ventilation infrastructure, training, and personal protective equipment hindered efficient management [26].

From a public-health perspective, the observed gap between knowledge and practice highlights the need for comprehensive policy and institutional interventions. Structured training programs tailored to dental settings should be integrated into both public and private dental curricula and continuing professional education. Periodic refresher courses and mandatory certification in infection prevention and control (IPC) could help strengthen consistent practice. Routine screening protocols for TB symptoms, clinic-level triage systems, and improved ventilation should be standard operating procedures in dental practices, especially in countries with high TB incidence.

This study contributes to an increasing amount of regional research demonstrating that solid infection control procedures are not guaranteed by static information alone. It supports extensive data on the knowledge and behaviors of HCWs from primary healthcare studies in Bangladesh that shows a lack of proficiency in important preventive areas outside of respiratory hygiene [27]. Combining data from Nepal, Pakistan, and India reveals a recurring pattern in which knowledge is essential but insufficient to guarantee practice.

Several limitations should be acknowledged. The cross-sectional design restricts causal interpretation between knowledge and practice. Self-administered questionnaires may be subject to social desirability bias. The focus on dental surgeons' limits generalizability to other healthcare professionals. Future research could include longitudinal designs and objective measurement of IPC behaviors (e.g., direct observation, clinical audits). Studies comparing dental surgeons with other high-risk HCWs could further contextualize occupational risk profiles and IPC effectiveness.

In conclusion, dental surgeons in Bangladesh are reasonably well-informed about the risk factors for pulmonary tuberculosis, but they lack formal IPC training and comprehensive prevention procedures. To increase workplace safety and lower the risk of TB transmission in dental settings both locally and regionally, it is crucial to improve institutional training, standardize screening and triage procedures, and incorporate TB infection control principles into regular dental practice.

Limitations of the study:

There is imitated reference material available to compare our study with other studies done in similar settings.
Causal relationships between knowledge and preventive practice cannot be definitively established.

Reliance on self-administered questionnaires may introduce reporting and social desirability bias, potentially overestimating adherence to preventive practices. Observing practices may produce more accurate results than asking about practices in a questionnaire, but this study did not include observation as a data collection method.

V. Conclusions:

This study shows that although dental surgeons in Bangladesh are typically well-informed about the risk factors for pulmonary tuberculosis, there are still significant gaps in formal infection-control training and preventive measures. Important procedures like patient screening, triage, and referral of probable TB patients were noticeably lacking, even though the majority of participants regularly wore masks and maintained proper ventilation. Proper preventative behavior was significantly predicted by formal training, longer clinical experience, hospital-based practice, and good knowledge, underscoring the impact of both education and the workplace. To protect dental professionals and lower occupational TB transmission in high-burden settings, it is essential to strengthen structured infection-control training, implement standardized TB preventive guidelines in dental clinics, and ensure compliance with patient screening and referral protocols.
It is advised to conduct more research to determine why training is not linked to improved practice.

Conflicts of interest:

There are no conflicts of interest

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