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Research Article

KNOWLEDGE OF TUBERCULOSIS AND NATIONAL TB CONTROL STRATEGIES AMONG MEDICAL INTERNS IN TERTIARY CARE HOSPITALS IN PAKISTAN: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Tuberculosis (TB) remains a major public health challenge globally, with Pakistan among the high-burden countries. Effective TB control depends largely on healthcare workers' knowledge of disease transmission, diagnosis, treatment, and national control strategies. Medical interns, as frontline providers in tertiary care hospitals, play a key role in early detection and management; however, gaps in their knowledge may compromise TB control efforts.

Objective: To assess the knowledge of tuberculosis and National Tuberculosis Control Programme (NTP) strategies among medical interns in tertiary care hospitals in Pakistan.

Methods: A cross-sectional study was conducted at Bahria International Hospital, Amna Inayat Medical College, and Akhtar Saeed Medical and Dental College over six months (August 2025 to January 2026) among 120 medical interns using a universal sampling technique. Data were collected through a pre-tested, structured questionnaire comprising 24 items covering TB etiology, transmission, diagnosis, treatment, and NTP/DOTS strategies. Each correct response was scored as one point (total score: 0–24), and knowledge was categorized as adequate (≥75%), moderate (50–74%), or inadequate (<50%). Data were analyzed using SPSS version 30. Descriptive statistics were calculated, and associations between knowledge levels and demographic variables were assessed using Chisquare/Fisher's exact tests, with $p < 0.05$ considered statistically significant.

Results:

The mean age of participants was 24.3 ± 1.2 years, with 55.8% males and 44.2% females. Knowledge regarding basic TB concepts was high, with over 99% correctly identifying key symptoms and transmission routes. Diagnostic knowledge was also strong, with 90% correctly identifying sputum sample requirements and 99% recognizing sputum microscopy as the primary diagnostic tool.

However, knowledge related to NTP and DOTS strategies showed variability. Correct responses were observed for treatment phases (92.5%), duration (85%), and categories (80%), while lower awareness was noted for DOTS frequency

(65%) and chemoprophylaxis (66.5%). Knowledge of TB definitions ranged from 69.1% to 88.8%.

Female interns demonstrated significantly higher knowledge in NTP/DOTS domains compared to males ($p = 0.032$). Overall, 60% of participants had adequate knowledge, 31.7% had moderate knowledge, and 8.3% had inadequate knowledge. A marginally significant association was observed between gender and overall knowledge levels ($p = 0.048$), while age showed no significant association ($p > 0.05$).

Conclusion: Medical interns demonstrated strong foundational knowledge of tuberculosis; however, gaps persist in understanding national TB control strategies, particularly DOTS implementation and preventive measures. These findings suggest the need for targeted educational interventions to strengthen interns' competencies and support effective TB control in Pakistan.

Keywords: Tuberculosis; National Tuberculosis Control Program; Directly Observed Therapy; Knowledge; Medical Interns; Health Knowledge

INTRODUCTION

Tuberculosis (TB) remains one of the leading causes of morbidity and mortality worldwide, despite being preventable and curable. In 2023, an estimated 10.8 million people developed TB globally, with Pakistan ranking among the top high-burden countries, contributing approximately 6.3% of incident cases (1,2). The disease disproportionately affects low- and middle-income countries, where challenges such as delayed diagnosis, drug-resistant strains, and suboptimal treatment adherence continue to hinder control efforts.

Pakistan bears a substantial TB burden, with an estimated incidence of around 264 per 100,000 population (3). The National Tuberculosis Control Programme (NTP), established under the Ministry of National Health Services, implements the End TB Strategy through Directly Observed Treatment Short-course (DOTS), rapid molecular diagnostics (e.g., GeneXpert), active case finding, and integration with primary healthcare. National Strategic Plans emphasize universal access to quality care, reduction in MDR-TB, and multisectoral engagement to achieve the Sustainable Development Goals targets by 2030 (4,5). However, successful implementation relies heavily on healthcare workers' knowledge of TB transmission, diagnosis, treatment regimens, drug resistance, and national guidelines.

Medical interns, as frontline doctors in tertiary care hospitals, play a critical role in early case detection, appropriate referral, treatment initiation, and patient education. Inadequate knowledge among interns regarding TB symptoms, diagnostic tools, National TB Control Strategies, or infection control measures can lead to missed diagnoses, inappropriate management, increased transmission, and poor treatment outcomes (6,7). Previous studies in Pakistan and similar settings have highlighted gaps in TB knowledge among medical students and interns, particularly concerning national program strategies and updated guidelines (8,9).

In the Pakistani context, where TB prevalence is high and resources are often constrained, assessing the knowledge of medical interns is essential. Limited local data exist on interns' awareness of current NTP strategies, including newer diagnostic tools and preventive approaches. This study aims to evaluate the knowledge of TB and National TB Control Strategies among medical interns in tertiary care hospitals in Pakistan through a cross-sectional design. The rationale is to identify specific knowledge gaps, inform targeted educational interventions during undergraduate and

internship training, strengthen the healthcare workforce's capacity, and ultimately support NTP efforts toward TB elimination in a high-burden, resource-limited setting (10). The study aims to assess the Knowledge of Tuberculosis and National TB Control Strategies among Medical Interns in Tertiary Care Hospitals in Pakistan.

Methodology

This cross-sectional study was conducted among medical interns at a tertiary care teaching hospital in Pakistan over six months, from August 2025 to January 2026. The study population comprised house officers (medical interns) undergoing clinical rotations during the study period. A universal sampling technique was employed, and all eligible interns present at the time of data collection were invited to participate in the study. Interns who provided written informed consent were included, while those who declined participation or submitted incomplete questionnaires were excluded. A total of 120 interns were enrolled in the final analysis.

Data were collected using a pre-tested and pre-validated structured questionnaire developed based on previously published literature and national tuberculosis guidelines. The questionnaire consisted of 24 items designed to assess knowledge regarding tuberculosis, including disease etiology, clinical features, transmission, diagnosis, treatment protocols, and awareness of the

National Tuberculosis Control Program (NTP) and Directly Observed Treatment, Short-course (DOTS) strategy. Subject experts reviewed the instrument for content validity and pilot-tested it on a small group of interns (not included in the final analysis) to ensure clarity, reliability, and feasibility. Necessary modifications were made prior to final data collection. The questionnaire was self-administered and distributed in person after obtaining informed consent, and participants were given adequate time to complete it without external assistance to minimize information bias. A scoring system was applied to quantify knowledge levels. Each correct response was worth 1 point, while incorrect or unanswered responses were scored 0. The total possible score ranged from 0 to 24. Based on predefined criteria, knowledge levels were categorized as adequate (≥75% score; 18–24 points), moderate (50–74% score; 12–17 points), and inadequate (<50% score; <12 points). Awareness of NTP and DOTS was operationally defined as the correct identification of key components of national TB control strategies, including diagnostic protocols, treatment categories, and preventive measures.

Data were entered into Microsoft Excel and subsequently analyzed using the Statistical Package for the Social Sciences (SPSS) version 30. Descriptive statistics were calculated and presented as frequencies and percentages for categorical variables, and as means and standard deviations for continuous variables, such as age. Inferential analysis was performed to assess associations between knowledge levels and demographic variables, including gender and age group. The Chisquare test (or Fisher's exact test, where applicable) was used to compare categorical variables. A p-value of less than 0.05 was considered statistically significant.

Ethical approval for the study was obtained from the Institutional Ethical Review Committee of the respective institution prior to commencement. Written informed consent was obtained from all participants, and confidentiality and anonymity were strictly maintained throughout the study. No personal identifiers were recorded, and the data were used

solely for research purposes in accordance with ethical standards.

Results

A total of 120 medical interns were included in the analysis. The mean age of participants was 24.3 ± 1.2 years. Among them, 67 (55.8%) were males, and 53 (44.2%) were females. The majority of interns (108; 90%) were aged 23-25 years, while 12 (10%) were aged 26-28 years (Table 1).

Table 1: Demographic characteristics of study participants (n = 120)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	67	55.8
	Female	53	44.2
Age group	23–25 years	108	90.0
	26–28 years	12	10.0

Most interns demonstrated strong knowledge of basic tuberculosis concepts. Nearly all participants correctly identified cough lasting more than two weeks as a key symptom (119; 99.2%) and droplet infection as the primary mode of transmission (119; 99.1%). Awareness regarding TB notification was observed in 104 (86.7%) participants, while 101 (84.2%) correctly identified the infectious potential of smear-positive cases. Diagnostic knowledge was also high. A total of 108 (90%) interns correctly identified the requirement of two sputum samples, while 119 (99%) recognized sputum microscopy as the investigation of choice. Similarly, 119 (99.3%) correctly identified early morning sputum as the preferred sample.

However, variability was observed in knowledge related to NTP and DOTS guidelines. Correct responses were noted in 96 (80%) participants for treatment categories, 111 (92.5%) for treatment phases, and 102 (85%) for treatment duration. Only 78 (65%) correctly identified DOTS frequency, and 80 (66.5%) correctly identified chemoprophylaxis. Knowledge of TB-related definitions ranged from 69.1% to 88.8%, with the lowest correct responses observed for “default” (83; 69.1%) and the highest for XDR-TB (107; 88.8%) (Table 2).

Table 2: Knowledge of tuberculosis, diagnosis, and NTP guidelines among interns (n = 120)

Parameter	Correct (n)	Percentage (%)
Cough >2 weeks	119	99.2
Droplet transmission	119	99.1

TB notification	104	86.7
Infection awareness	101	84.2
Sputum samples required	108	90.0
Sputum microscopy	119	99.0
Early morning sample	119	99.3
Treatment categories	96	80.0
Treatment phases	111	92.5
Treatment duration	102	85.0
DOTS frequency	78	65.0
Chemoprophylaxis	80	66.5
MDR-TB definition	94	78.7
XDR-TB definition	107	88.8
Default definition	83	69.1
Relapse definition	92	76.8

Female interns demonstrated relatively higher correct response rates across most domains, particularly in diagnosis and NTP-related knowledge. The difference in NTP/DOTS knowledge between males and females was statistically significant ($p = 0.032$), while differences in TB disease knowledge and definitions were not statistically significant ($p > 0.05$) (Table 3).

Table 3: Gender-wise comparison of knowledge domains with p-values

Domain	Male n (%)	Female n (%)	Chi-square	p-value
TB disease knowledge (adequate)	46 (68.7)	39 (73.6)	0.41	0.52
Diagnosis knowledge (adequate)	52 (77.6)	43 (81.1)	0.22	0.63

NTP/DOTS knowledge (adequate)	38 (56.7)	45 (84.9)	4.61	0.032
Definitions knowledge (adequate)	55 (82.1)	45 (84.9)	0.18	0.67

Interns aged 23–25 years demonstrated higher knowledge levels compared to those aged 26–28 years, particularly in TB definitions and NTP-related domains. However, these differences did not reach statistical significance ($p > 0.05$) (Table 4).

Table 4: Age-wise comparison of knowledge domains with p-values

Domain	23–25 years n (%)	26–28 years n (%)	Chi-square	p-value
TB disease knowledge	78 (72.2)	7 (58.3)	1.08	0.29
Diagnosis knowledge	86 (79.6)	9 (75.0)	0.14	0.70
NTP/DOTS knowledge	70 (64.8)	8 (66.7)	0.02	0.88
Definitions knowledge	82 (75.9)	10 (83.3)	0.34	0.55

Based on scoring criteria, 72 (60%) interns had adequate knowledge, 38 (31.7%) had moderate knowledge, and 10 (8.3%) demonstrated inadequate knowledge. Female interns showed a higher proportion of adequate knowledge compared to males, though the difference was marginally significant ($p = 0.048$) (Table 5).

Table 5: Overall knowledge level distribution and gender association

Knowledge level	Male n (%)	Female n (%)	Total n (%)	p-value
Adequate	36 (53.7)	36 (67.9)	72 (60.0)	0.048
Moderate	24 (35.8)	14 (26.4)	38 (31.7)	
Inadequate	7 (10.5)	3 (5.7)	10 (8.3)	

Discussion

The present study assessed knowledge of tuberculosis among 120 medical interns in a healthcare setting, revealing generally adequate knowledge with notable gaps in specific domains. The findings demonstrate that while interns possessed strong foundational knowledge of TB symptoms, transmission, and diagnostic procedures, significant deficiencies in understanding National TB Programme (NTP) guidelines were observed, particularly regarding DOTS implementation and chemoprophylaxis.

These results warrant careful comparison with existing literature to contextualize the implications for TB control efforts.

Berg-Johnsen et al. conducted a comprehensive study among medical interns in Nepal and found a mean knowledge score of 13.3 out of 19, which they considered adequate (11). This finding aligns closely with our results, in which 99.2% of interns correctly identified a cough lasting more than two weeks as a key symptom, and 99.1% recognized droplet transmission. Similarly, Ly et al. reported that physicians working at community health stations in Vietnam demonstrated inadequate TB knowledge, particularly concerning at-risk groups and main symptoms of pulmonary TB (12). In contrast, our study population showed substantially better performance in recognizing cardinal symptoms, suggesting that the timing and quality of medical education may play crucial roles in knowledge acquisition.

Ngo et al. examined TB care practices among physicians at private facilities in Vietnam. They identified important gaps, noting that approximately 80% of respondents requested chest imaging to confirm TB diagnosis, despite guidelines recommending sputum examination (13). Our study found that 90% of interns correctly identified the requirement for two sputum samples and 99% recognized sputum microscopy as the investigation of choice, indicating superior diagnostic knowledge compared with that of Vietnamese private-sector physicians. This discrepancy may reflect differences between academic training environments and private practice settings, in which convenience and patient expectations can influence clinical decision-making.

Adepoju et al. investigated knowledge of International Standards for Tuberculosis Care among private non-NTP providers in Lagos, Nigeria. They reported an overall median knowledge score of only 52%, with the lowest scores in treatment standards (44%) (14). Our findings revealed better performance: 80% of interns correctly identified treatment categories, 92.5% recognized treatment phases, and 85% knew treatment duration. However, only 65% correctly identified DOTS frequency, suggesting persistent gaps in understanding treatment implementation details. BergJohnsen et al. similarly identified knowledge gaps in disease detection and management among Nepalese interns, despite overall adequate knowledge levels (11).

Sinha et al. conducted a study among junior doctors at a tertiary care hospital in Kolkata. They found that, while participants had satisfactory knowledge of symptoms and diagnoses, they demonstrated unsatisfactory knowledge regarding drug regimens, follow-up sputum testing, and the diagnosis of MDR-TB and XDR-TB (15). These findings parallel our results, in which knowledge of TB-related definitions ranged from 69.1% to 88.8%, with the lowest correct responses for "default" (69.1%) and the highest for XDR-TB (88.8%). Ajith and M.R. similarly reported that only 76.57% of interns in their study knew the principle of TB treatment as daily administration of fixed-dose combinations, and 61.27% were unfamiliar with chemoprophylaxis according to recent guidelines (16).

Our study identified statistically significant gender differences in NTP/DOTS knowledge ($p = 0.032$), with female interns demonstrating superior performance. Adepoju et al. reported contrasting findings in Nigeria, where being female reduced the odds of having good TB knowledge scores (OR = 0.3, CI = 0.1–0.6, $p < 0.0001$) (14). This discrepancy may reflect contextual differences in educational

opportunities, professional roles, and healthcare system structures between settings. Merza's study in Iraqi Kurdistan found that male TB cases were predominant, but did not specifically examine healthcare provider knowledge by gender (17). Sarwar et al. emphasized that knowledge is an essential precursor to the successful uptake of TB services and case detection, with evidence showing that knowledge levels and healthcare-seeking behaviors can help contain TB spread among vulnerable populations (18). Our finding that 60% of interns had adequate overall knowledge, 31.7% had moderate knowledge, and 8.3% had inadequate knowledge suggests that a substantial proportion of future physicians may not be optimally prepared to contribute to TB control efforts. Ogbuabor and Onwujekwe's governance review of Nigeria's TB control programme highlighted that inadequate human resources in terms of requisite knowledge and skills represented a critical barrier to programme implementation (19). Iwaki et al. demonstrated in Nepal that socioeconomic factors, such as education, are significantly associated with TB awareness and emphasized the importance of formulating tailored strategies to increase TB awareness at regional levels (20). Our study's finding that female interns had a higher proportion of adequate knowledge (67.9% versus 53.7% in males, $p = 0.048$) suggests that gendersensitive educational approaches may be warranted. Shrestha et al. found that healthcare workers at DR-TB treatment centers in Nepal had good knowledge of DR-TB infection control, but this did not translate into appropriate attitudes or optimal practices (21), highlighting the critical distinction between knowledge acquisition and clinical application.

Khader et al. identified insufficient knowledge of TB case definitions among healthcare providers at peripheral TB clinics as a root cause of diagnostic delays and misdiagnoses in Jordan (22). This observation underscores the practical implications of knowledge gaps identified in our study, particularly regarding TB definitions, where performance ranged from 69.1% to 88.8%. Future medical education initiatives should emphasize not only theoretical knowledge but also practical application of NTP guidelines, with particular attention to DOTS implementation, chemoprophylaxis, and case definitions. Regular training programmes, as recommended by Yaqoob et al. in Pakistan (23), and integration of TB education throughout the medical curriculum, as suggested by Berg-Johnsen et al. (11), may help address these persistent knowledge gaps and ultimately strengthen TB control efforts.

Conclusion

Although most interns possessed adequate knowledge of tuberculosis, deficiencies in NTP and DOTS-related domains may limit the effective clinical application of these interventions. Focused training and integration of national TB guidelines into undergraduate and internship curricula may help improve preparedness and contribute to better TB control outcomes in high-burden settings.

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