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Identifying the gap in operational knowledge regarding the tuberculin skin test and interferon-γ release assay among interns and postgraduates of a medical college

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Abstract

Tuberculosis has remained an intractable challenge for mankind. The Cascade of Care approach is adopted, emphasizing early detection of latent tuberculosis infections through screening and primordial prevention of disease holistically. Currently available tests include the tuberculin skin test (TST) and interferon-γ release assays (IGRA). Our study aims at identifying the adequacy of prevailing operational knowledge about these tests amongst the interns and postgraduates who form the future medical fraternity. We conducted a prospective questionnaire-based study among interns and postgraduates. Further data compilation was done using Microsoft Excel. Comparison between groups was done using appropriate statistical tests. In our study conducted on 196 participants, we found that 53.41% of the total questions were answered rightly. The correct responses for the questions on TST were 65.29%, while for IGRA, they were 33.45%. Our study discloses the problem of a significant gap in operational knowledge about the screening tests, silently delaying the achievement of the vision, mission, and goals of the National Tuberculosis Elimination Program. India is both committed and concerned: as a solution, there is an urgent need to address this through continued medical education and periodic training workshops by utilizing the existing resources and allocations.

Key words: tuberculosis, IGRA, TST, screening, preventive therapy.

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Introduction

Worldwide an estimated 1 in 4 people demonstrates a positive immunological response to *Mycobacterium tuberculosis* (Mtb); in India it is 1 in 3, making a reservoir pool [1,2]. From this pool, 5-10% catch tuberculosis (TB) disease during their lifetime [3]. India is a high-burden country with about 35-40 crore Mtb infected in 2022 [2]. From this reservoir, an estimated 26 lakh developed TB disease annually [4]. Studies showed that 3/4 of the contacts with active TB cases developed TB within a year and up to 97% within 2 years, sustaining the current problem [5]. It is also learned that from every case of sputum-positive pulmonary TB (PTB), 15 more get infected in the community before the case becomes sputum-negative [6].

India is both committed and concerned, geared up the control program to the Elimination Programme (NTEP), advanced the goal by 5 years from Sustainable Development Goals 2030 to 2025, and lowered the impact indicators of incidence to 44 per lakh population, prevalence to 65 per lakh population, and mortality to 3 per lakh population from 195 per lakh population, 237 per lakh population, and 32 per lakh population, respectively, of 2015 and catastrophic cost to 0% [7]. The recent data from the 'India TB Report 2024' shows an incidence of 199 per lakh population and a mortality of 23 per lakh population, which gives a real-world picture of where we stand in the course to achieve these goals [2]. In compliance with the global Cascade of Care Approach, the Government of India, through the National Strategic Plan for "END TB", introduced the guidelines for the Programmatic Management of TB Preventive Treatment (PMTPT) since 2021 [7,8]. Patients with latent TB infections (LTBI) are provided TB preventive therapy (TPT) after ruling out TB disease [9]. A recent study in 2020, screening with screening tests, revealed an incidence of Mtb infection in about 71% of the household contacts of an index case of PTB [10]. TPT is estimated to lower the incidence by about 60% among the LTBIs and by 90% in those living with HIV [10,11].

Globally, the tuberculin skin test (TST) and interferon-γ release assay (IGRA) are the screening tests for detecting mycobacterial infections with or without TB disease. Screening

helps to initiate TPT according to PMTPT guidelines. Both TST and IGRA are indirect and non-confirmatory tests, measuring the delayed type of hypersensitivity reaction (DTH-type IV hypersensitivity) [12,13]. Both tests do not directly demonstrate the presence of mycobacteria. TST is an *in vivo* test that detects the reaction to the natural purified protein derivative of the mycobacterium; hence, it has a booster effect. IGRA is an *in vitro* test that measures the amount of interferon-γ (a chemical messenger—Ifnγ) released by the sensitized T-Lymphocytes (CD4) following stimulation by Quiagens—TB-specific synthetic peptides; either 3 peptides in QuantiFERON-TB Gold™ (QFT-GIT): in tube test or 2 peptides in T-SPOT®.TB™ test (T-Spot) spot test [14-16]. Hence, it has no booster effect. The result of the test highly depends on the quality of performance by the "testers" and the scientific interpretation of the test results by the clinicians [13]. Hence, for obtaining a reliable outcome for right decision-making, an acceptable level of operational knowledge focusing on both skill and practice is absolutely essential. The guidance document from the Government of India highlights this under the section of 'Implementation Considerations for Testing Services for TB Infection' [7]. However, TST and IGRA are not mutually exclusive, but they could be complementary. Hence, scientists all over the world are consistently looking for a better screening test. In this regard, the Cy-Tb™ skin test is a next-generation test that detects mycobacterial infections, which combines the accuracy of IGRA with the ease of TSTs, hence a candidate test [17].

The National Medical Council aims to roll out confident and competent Indian medical graduates/postgraduates (PGs) who are the future game changers in the program implementation. However, inquisitively, through well-designed studies, significant gaps in the operational knowledge of screening tests were discovered among the health care service providers rolled out through regular curriculum. This can adversely affect the rapid progress of this flagship program of the country. The present study is also for providing consistent evidence to reiterate the persistent need for continued medical education (CMEWs)/training workshops for reorientation to close the prevailing knowledge gap.

Materials and Methods

The Institutional Ethical Committee for research approved the study with Approval No. KVGMCIEC202401 dated 01.01.2024. Inquisitively, in addition to regular academic activity, a pre-survey of all the interns and postgraduates (universe) of the Institute was done. Data was collected through a pre-structured questionnaire whose content validity was ensured and internal consistency reliability was acceptable as per Cronbach's α on pilot data. The 25-point questionnaire (*Supplementary Material 1*) consisted of 14 questions on TST and 11 on IGRA, testing the cognitive domain of the subjects. It comprehensively assessed the knowledge, comprehension, and application in TST and IGRA testing, covering the theoretical concepts, technical execution, biosafety, and interpretative accuracy. With equal weightage for all questions, the correctly answered questions were given 1 point, and the total was computed out of 25; further, the scores were entered into Microsoft Excel (Microsoft, Redmond, WA, USA) for further analysis. The analysis was done through SPSS version 30.0 (IBM, Armonk, NY, USA) to compute the measures of central tendency and measures of dispersion. The data was presented in the form of charts and tables. Further comparison between the groups was done using unpaired *t*-tests and paired *t*-tests.

Results

Our study included a total of 196 participants (universe), of whom 97 were interns and 99 were postgraduates from different departments. The mean total score was 12.82±4.22 points for the total of 196 participants. The mean score for TST was 9.14±2.84; for IGRA, the mean score was 3.68±2.05. It is also noteworthy that the maximum obtained total score was 22, while the least was 3; the mode was 12—obtained by 23 participants. In terms of percentages, overall, 53.41% of questions were answered correctly. 65.29% of responses for TST questions were correct; for IGRA it was 33.45%. Figure 1 is the scatter graph showing the scores

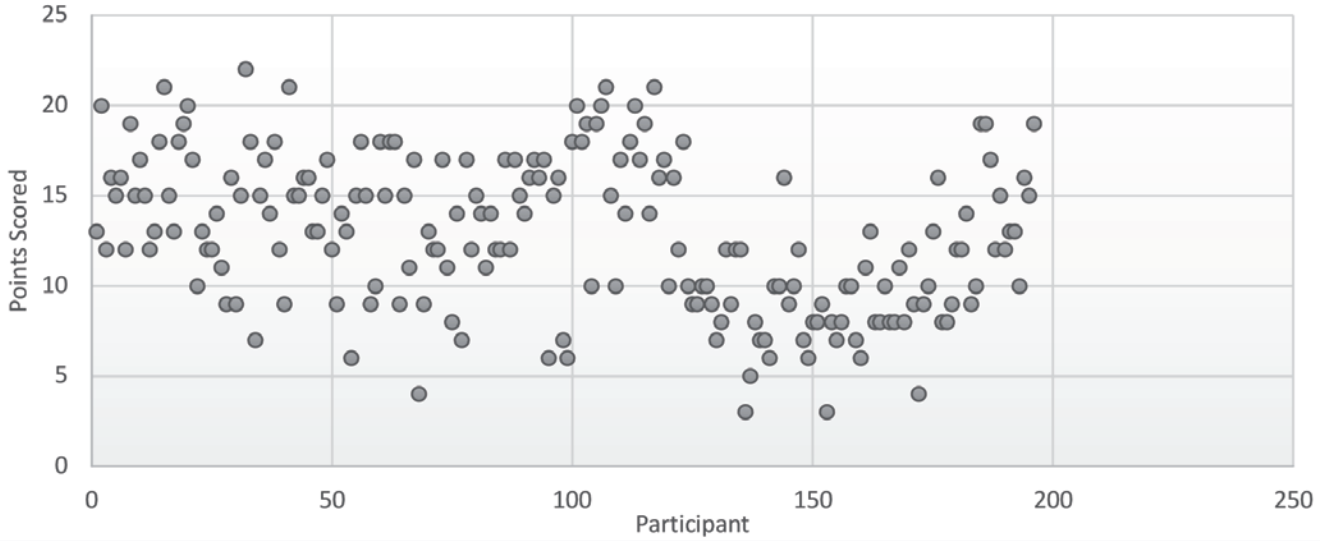


Figure 1. Scatter graph showing the distribution of scores by the participants).

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obtained by each participant. The distribution of scores is shown in Figure 2.

The scores obtained by the interns and postgraduates are given in Table 1. The mean total score amongst the interns was 14.06±3.57, while it was 11.61±4.46 among postgraduates. A statistically significant difference ($p<0.001$) was observed between two groups regarding both the screening tests—for TST: 10.18 ± 2.49 by interns and 8.13 8.13±2.80 by postgraduates; for IGRA: 3.89±1.82 by interns and 3.47±2.24 by postgraduates.

In terms of %, correct responses for IGRA were 35.33% and 31.59% by the interns and postgraduates, respectively. Three participants scored 0 out of 11 scores for IGRA.

Discussion

For eliminating TB by 2025, it is wise to arrest the progression of LTBI to active TB cases through TPT as per PMTPT guidelines [18]. This needs early detection of LTBIs through screening tests, TST and IGRA [3,7]. For properly conducting and interpreting these tests, healthcare service providers should have adequate operational knowledge [19,20].

The overall correct response rate of 53.41% suggests that the foundational knowledge base among the participants, though adequate for over half the questionnaire, has considerable room for improvement, especially given their professional stage. The wide range of scores (from a minimum of 3 to a maximum of 22) and a mode score of 12 indicate a heterogenous distribution of knowledge, with a significant cluster performing just below the overall mean.

Also, participants demonstrated a significant disparity in knowledge on TST and IGRA (65.29% correct responses *vs.* 33.45% correct responses). This is an expected yet noteworthy difference, as TST has been the standard screening test for decades and is likely emphasized more consistently in undergraduate curriculum and routine clinical practice. In contrast, IGRA is a newer, more technically advanced, and potentially more complex test, which may not yet be as fully integrated or emphasized in training programs.

Our results indicate a statistically significant difference in knowledge amongst the interns and postgraduates, with interns outperforming postgraduates in the mean total score (14.06±3.57 *vs.* 11.61±4.46). This is a surprising observation, as greater clinical experience is generally expected to correlate with higher knowledge scores. This trend therefore warrants further investigation in future studies. Possible explanations for this counterintuitive finding may be that the interns, having recently completed their undergraduate curricula, have more information fresh in their memory. Also, the postgraduates, who were from across all broad specialities, might have a perceived reduced need for in-depth knowledge of TB screening compared to those in internal medicine or respiratory medicine, leading to a decline in knowledge over time. The data thus may expose a potential gap in postgraduate medical education, suggesting that as trainees progress into their specialization, the general principles of TB screening are not consistently reinforced or updated, particularly for newer technologies like IGRA.

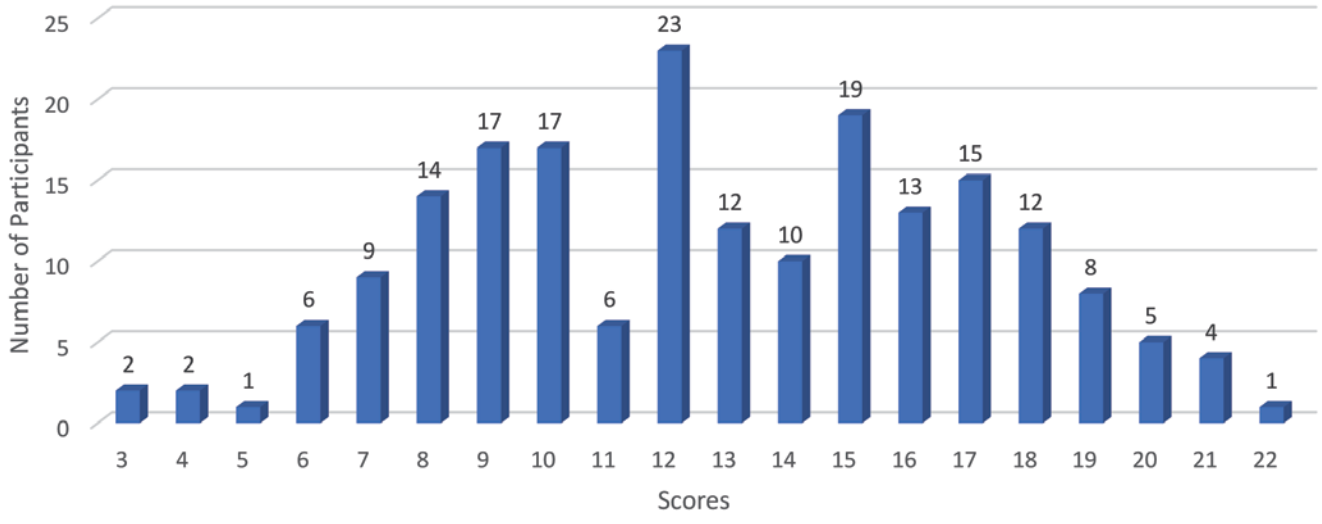


Figure 2. Distribution of total scores obtained by the participants.

Table 1. Scores obtained by interns and postgraduates.

	TST score		IGRA score		Total score	
	Score ± SD	In %	Score ± SD	In %	Score ± SD	In %
Interns	10.18±2.49	72.68	3.89±1.82	35.33	14.06±3.57	56.25
Postgraduates	8.13±2.80	58.08	3.47±2.24	31.59	11.61±4.46	46.42
Total	9.14±2.84	65.28	3.68±2.05	33.45	12.82±4.22	53.41

TST, tuberculin skin test; IGRA, interferon-γ release assay; SD, standard deviation.

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A thorough literature search revealed a limited availability of studies that assessed the operational knowledge about TST and IGRA. A prospective questionnaire-based study done in South India in 2023, involving the healthcare workers, found that the baseline level of knowledge before a training workshop was 51.9% and 53.6% among the postgraduates and interns, respectively. This study also found a significant improvement in the level of knowledge following a training workshop, improving to 89.4% and 89.5% among postgraduates and interns, respectively, highlighting the need for such interventions [21]. Another study from Karnataka in India found that the level of knowledge was 42.11% among the interns regarding both TST and IGRA. The level of knowledge about IGRA alone stood at a mere 17.85%. We too found a significantly low level of knowledge on IGRA, *viz-a-viz*, with only 35.33% and 31.59% among interns and postgraduates, respectively [22]. Our study also discovered a myth, 27.83% in interns and 54.54% in PGs, that IGRA is a confirmatory test for TB being a blood test, but in reality, both TST and IGRA are indirect non-confirmatory tests that detect DTH to mycobacterial infection. Regarding TST, in another study in 2018 from South India, in the pre-test, nurses, interns, and postgraduates scored 4.89%, 48.46%, and 54.09%; after the training workshop, they scored 89.13%, 92.36%, and 96.82%, respectively. They also noted a significant improvement in the level of overall knowledge, including all thematic areas, among nurses, interns, and postgraduates from 38.02%, 29.48%, and 34.01% to 78.01%, 87.76%, and 94.30%, respectively, following a training workshop [23].

A study amongst the nurses in the state of Haryana in India evaluated the knowledge about TB and found that only 22.8% of the nurses had a 'good' awareness, defined within their study as >75% of correct responses [24]. These studies, along with our current study, highlight the significant information void that exists in the current arena of our fight against TB.

A study by Berg-Johnsen *et al.* surveyed 185 medical interns from 3 medical colleges in Nepal in 2018 and found that the mean knowledge score on TB was 13.3±2.12 out of a total score of 19 and had found some 'unacceptable knowledge gaps' regarding symptoms of TB and identifying at-risk populations for TB. They found a positive association between the knowledge of TST and having done the test themselves in the 5 years [25]. This emphasizes the importance of developing the skills as a part of operational knowledge. The various studies have shown a noticeable outcome in terms of knowledge acquisition subsequent to a formal training or sensitization program on the topic [26-28].

It is noteworthy that all these studies have had their own limitations and were all small-scale studies mostly from a single center. Our study is also limited to interns and postgraduates covering only one thematic area, *i.e.*, screening tests, while other thematic areas like diagnostic tests/criteria, treatment modalities, adverse drug reactions, epidemiology, medico-social impact, *etc.*, also need to be studied. Also, subspecialty-wise analysis in future studies shall help in differentiating knowledge levels across different specialities, and such an assessment could possibly aid in a more targeted approach for the policy makers in structuring the future policies. A gap in knowledge and skill delays the elimination of TB, which is very costly and inhuman. We discovered only the tip of an iceberg. We recommend a multicentric study done at regular intervals involving all the categories of healthcare service providers will help the TB eliminators immensely to fight TB.

Conclusions

All the studies including the present study are providing substantial evidences for an urgent intervention in the form of CMEWs and Training Workshops to close the gap in operational knowledge as boosters beyond the routine curriculum for improving the knowledge, skills and practice for timely achievement of the Vision, Mission, Goals and objectives of NTEP.

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Online supplementary material:
Supplementary Material 1. Questionnaire.

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Informed consent: written informed consent was obtained from all study participants.

Patient consent for publication: not applicable.

Availability of data and materials: the datasets used and/or analysed during the study are collected through the process described in methodology and is available from the corresponding author upon request.

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