

# Knowledge, Attitudes, and Practices Toward Drug-Induced Visual Impairment Due to Antitubercular Therapy Among Medical Officers of Primary Health Care Centers in Karnataka, South India

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**Purpose:** Ethambutol, a key first-line drug used in fixed-dose combinations for tuberculosis (TB) treatment, is associated with a well-known adverse effect, optic neuropathy, that can result in irreversible vision loss. Despite this risk, in high-burden countries such as India, the primary emphasis remains on disease elimination, often leading healthcare professionals to overlook the potential for serious vision-related side effects of ethambutol. This study sought to evaluate the knowledge, attitudes, and practices (KAPs) of medical officers at primary health centers (PHCs) in Karnataka regarding visual impairment caused by antitubercular therapy (ATT).

**Methods:** A questionnaire-based, prospective, observational, cross-sectional study was conducted. Participants were recruited via a convenience sampling approach from PHCs in Karnataka. The data were analysed via IBM SPSS version 27.

**Results:** Seventy-three medical officers responded to the questionnaire within the set period. Of these, 34.2% (25) were specialists, whereas 65.8% (48) were general practitioners. A majority (91.8%; 67) of the medical officers were actively involved in the diagnosis and treatment of TB patients, and 72.6% (53) of the medical officers claimed to have undergone a sensitisation program. A total of 75.3% (55) of the participants were aware of the visual complications of ATT. However, 69.9% (51) had never referred a patient with drug-induced visual impairment. A majority (95.9%) of the participants thought that there was a need for better awareness campaigns, and 91.8% of them felt that regular ophthalmic evaluations should be mandatory for patients on ATT. The mean KAP scores of specialists were significantly greater than those of general practitioners ( $p=0.002$  unpaired  $t$  test), indicating better knowledge and practices among them.

**Conclusion:** The medical officers of PHCs in Karnataka believe that grassroots-level training, increased awareness, mandatory visual screening of visual function by a physician or optometrist at every PHC, and prompt referrals to tertiary care centers can help address the challenges in identifying drug-induced visual impairment.

**Keywords:** tuberculosis, adverse drug reaction, ethambutol, drug toxicity, optic neuropathy

## Introduction

India bears the highest burden of tuberculosis (TB) globally, contributing to approximately 27% of the world's TB cases. In 2022, out of an estimated 10.6 million new TB cases worldwide, approximately 2.8 million were reported in India.<sup>1</sup> Ethambutol is a first-line drug used as part of a fixed-dose combination (FDC) to treat tuberculosis. Ethambutol-induced optic neuropathy (ON) leading to permanent vision loss is a well-established and documented adverse effect in the

medical literature. In countries such as India, which has a large TB burden, the focus has always been on eradicating the disease. Health care workers often ignore the sight-threatening adverse effects of ethambutol.<sup>2</sup>

Similar challenges have been reported in other high-TB-burden settings, such as Lahore, where misconceptions and stigmatising attitudes toward tuberculosis persist among healthcare workers. Akram et al, in their KAP study conducted at a teaching hospital in Lahore, highlighted the need for targeted educational initiatives to address these gaps.<sup>3</sup>

The clinical characteristics of ethambutol-induced optic neuropathy (EON) can range from loss of color vision to a gradually progressive, painless loss of central vision in both eyes.

Ethambutol was administered in the first two months of therapy in India under direct.

Observed Treatment Strategy (DOTS) protocol of the former Revised National Tuberculosis Control Program (RNTCP). The toxicity clinically becomes apparent usually between 3–5 months of drug intake. The incidence of ethambutol-induced optic neuropathy is approximately 1–2.5% at a daily dose of 15 mg/kg. This risk increases to 5–6% at a dose of 25 mg/kg.<sup>4,5</sup> The period of ethambutol intake has been extended from two months to six months, and the regimen of thrice weekly dosage has been replaced with a daily dosage according to the RNTCP 2016 guidelines.<sup>4,5</sup> This has raised concerns about the potential rise in ocular toxicity cases, which, if unchecked, might seriously impair patients' vision while they are receiving therapy.

Furthermore, if patients develop multidrug-resistant tuberculosis, they are prescribed second-line drugs. One such drug is linezolid. Linezolid is also known to cause dose-dependent toxic optic neuropathy.

A KAP study conducted among lay community treatment supporters in rural Eswatini, a developing country comparable to India, identified substantial gaps in the management of multidrug-resistant tuberculosis. Similar deficiencies may be observed among PHC doctors in India who receive comparable levels of training.<sup>6</sup> Notably, gaps across all three KAP domains have also been reported among healthcare workers in developed settings such as Canada, indicating that these challenges are not limited to resource-constrained contexts.<sup>7</sup>

Primary health care (PHC) doctors, who are also called medical officers, are the first source of health care for most of India's rural population. The ATT is administered and monitored by them; hence, adverse effects are also reported by these doctors. Inability to report potential cases of ON in time can cause permanent/irreversible visual impairment. This study aimed to assess knowledge, attitudes, and practices towards drug-induced visual impairment due to ATT among medical officers of PHCs in Karnataka, India.

## Materials and Methods

A questionnaire-based cross-sectional study was conducted among medical officers of primary health care centers in Karnataka, India. Medical officers (minimum-qualified MBBS) serving at PHCs in Karnataka were included in the study. The study was conducted between June and November 2024. The sample size was calculated via the formula  $n = \frac{DEFF * Np(1-p)}{[d^2/z(1-\alpha/2)^2 * (N-1) + p*(1-p)]}$

where  $N = 1000000$  (for the finite population correction factor).

$p = 15\% \pm 5$  (This was taken from a similar KAP study conducted in Jordan)<sup>8</sup>

$d = 5\%$

Design effect (for cluster surveys – DEFF) = 1

This gives a sample size of 196 with a 95% confidence level.

The study was carried out in accordance with the guidelines of the Declaration of Helsinki and subsequent revisions. The authorisation of the Institutional Ethics Committee of Kasturba Medical College, Mangalore, India (IEC KMC MLR 05/2024/276) was obtained. A self-structured, content-validated questionnaire was used to collect information from the study participants after informed consent was obtained ([Annexure 1](#)).

The questionnaire was developed on the basis of an expert review of the literature and relevant theoretical models related to drug-induced visual impairment due to ATT. Content validity was assessed by a panel of 5 experts (2 ophthalmologists, 2 public health specialists, and 1 specialist in pulmonary medicine). Each expert independently evaluated the relevance, clarity, and representativeness of each item. The content validity ratio (CVR) was calculated. Items with CVR values below the acceptable threshold were revised or eliminated.

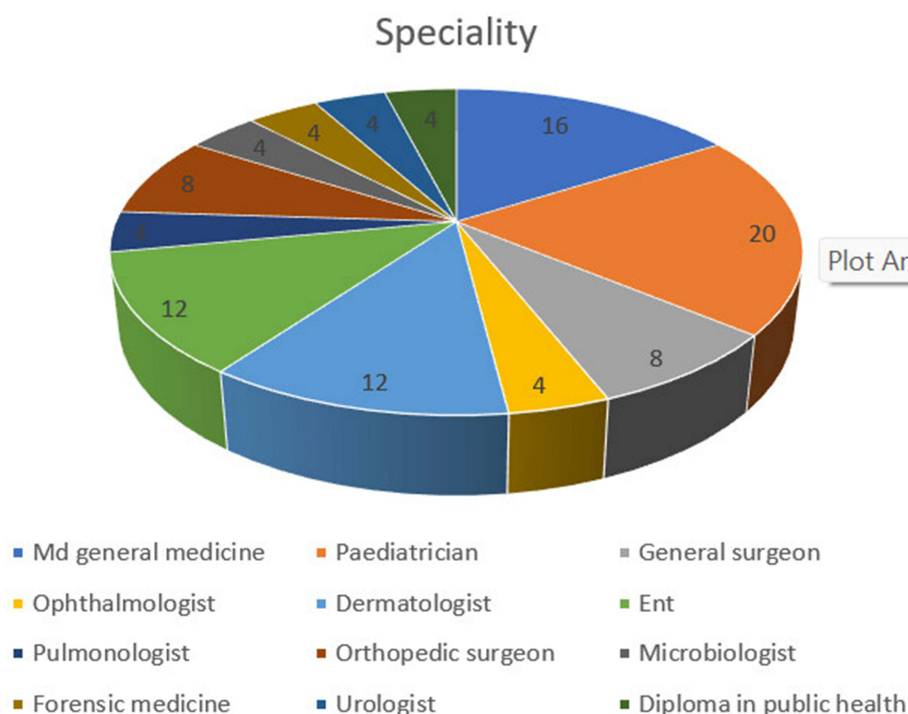
Participants were recruited via a convenience sampling approach from primary health centers (PHCs) in Karnataka. Eligible participants included medical officers currently working in PHCs who were willing to participate in the study. Permission to conduct the study was obtained from the relevant health authorities before recruitment. Potential participants were approached through official communication channels, including email/WhatsApp groups, and were invited to participate in the study. The purpose of the study, the voluntary nature of participation, and the confidentiality of the responses were clearly explained in the invitation message.

The questionnaire was administered via an online Google Form, and the survey link was shared with eligible participants. Informed consent was obtained electronically before the participants were able to access the questionnaire. Participation was voluntary, and no incentives were provided. Approximately 200 PHC doctors were contacted and requested to complete the survey. To improve response rates, periodic reminders were sent during the data collection period. Recruitment was continued until the end of the predefined study period. Records with less than 50% information were excluded. Multiple answers were allowed for only selected questions. Upon completion of the survey, the participants were provided with an information sheet outlining the recommended screening guidelines.

The data were analysed via IBM SPSS version 27. Continuous and categorical data are presented as the means  $\pm$  standard deviations and percentages, respectively. The normality of the data was checked via the Shapiro–Wilk test; hence, parametric tests were used, as the data were found to be normally distributed. The mean KAP scores were compared against dichotomous variables via an unpaired *t* test and against specialisation (with >2 categories) via ANOVA. A *p* value of  $\leq 0.05$  was considered significant for all analyses.

## Results

A total of 73 medical officers from PHCs all over Karnataka responded to the questionnaire within the set period. Of these, 34.2% (25) were specialists, whereas 65.8% (48) were general practitioners (Figure 1). A majority (91.8%; 67) of the medical officers were actively involved in the diagnosis and treatment of TB patients, and 72.6% (53) of the medical officers claimed to have undergone a sensitisation program/training under the RNTCP.



**Figure 1** Distribution of participants based on medical speciality.

A majority of medical officers, 86.3% (63), reported seeing between 0 and 5 patients on anti-tubercular therapy (ATT) each month. Additionally, 9.6% (7) of the patients were 6 to 10 patients, and 4.7% (3) were 11 to 20 patients a month. (Table 1)

A total of 75.3% (55) of medical officers were aware of visual complications of ATT, and 83.6% (61) asked about visual disturbances while a patient was receiving antitubercular therapy.

A total of 91.8% (67) of medical officers feel that it is important to test the visual acuity and colour vision of a patient on ATT. However, only 30.1% (22) of medical officers have referred patients with drug-induced visual impairment to specialists, whereas 69.9% (51) of them have never done so.

A total of 69.9% (51) of medical officers believe that ethambutol is the drug, 9.6% (7) of doctors believe that linezolid is the drug that causes vision-related problems, and only 5.5% (4) believe that both ethambutol and linezolid cause vision-related problems. A total of 94.5% (69) of medical officers believe that it is necessary to refer a patient complaining of a decrease in vision to a tertiary center, and 97.3% (71) believe that treating the adverse effects due to ATT is as important as treating the disease itself.

A scenario in which a patient on ATT presented with diminution of vision yielded various answers on the accurate course of action. A total of 50.7% (37) of medical officers felt that patients should continue ATT and be referred to a tertiary center. A total of 32.9% (24) of medical officers said that patients should stop ATT and then be referred to tertiary centers. Eight percent (11) of medical officers felt that the patient should stop the fixed drug combination of ATT immediately. A total of 2.7% (2) of medical officers stopped the fixed combination and prescribed “Linezolid”, whereas 2.7% (2) stopped the fixed drug combination and prescribed “Kanamycin”. Kanamycin and linezolid are second-line antitubercular drugs. (Table 2)

A question about the examination routinely performed for a patient on ATT during regular follow-up at their hospital revealed various answers from the PHC medical officers.

A total of 53.4% (39) of the medical officers checked their visual acuity, 28.8% (21) performed a colour vision evaluation, 23.3% (17) tested their visual field via a confrontation test, and 4.1% (3) performed Amsler’s grid test. A total of 31.5% (23) of the participants checked all these parameters, and 17.8% (13) did not check any of these parameters as part of regular follow-up for patients on ATT.

**Table 1** Number of TB Patients Seen Monthly by PHC Doctors

Number of TB Patients Seen Per Month	N (Number of Doctors)	%
0 to 5	63	86.3
6 to 10	7	9.6
11 to 20	2	2.7
>30	1	1.4

**Table 2** Distribution of Participants Based on Responses to the Following Question: If a Patient on ATT Presents with Diminished Vision, What Is the Course of Action?

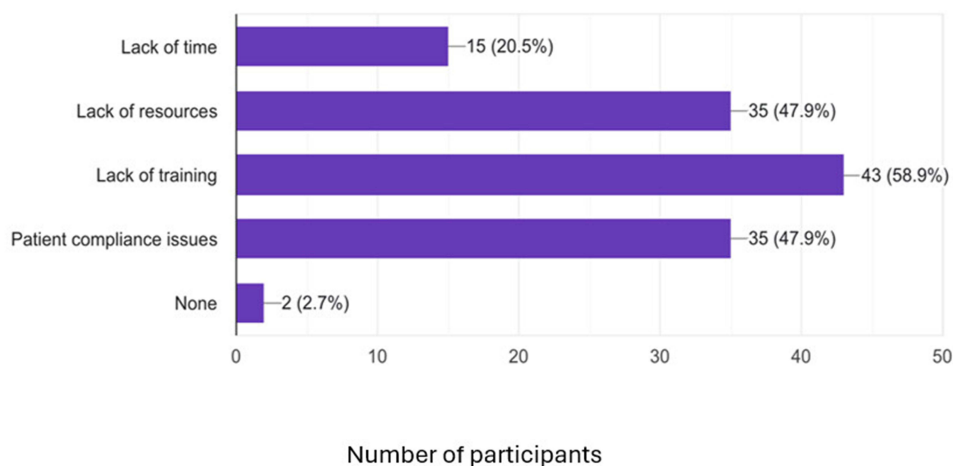
Response	N	%
Ask the patient to continue ATT and refer to tertiary care	37	50.7
Stop FDC of ATT immediately	8	11.0
Stop ATT and refer to tertiary centre	24	32.9
Stop FDC and prescribe Kanamycin	2	2.7
Stop FDC and prescribe Linezolid	2	2.7

A total of 72.6% (53) of medical officers agreed that ocular complaints are common among patients on ATT. A total of 71.2% (52) believe that these side effects are reversible for up to 2 months of starting therapy, 17.8% (13) believe that they are reversible for up to 8 months of starting therapy, and 5.5% (4) believe that they are reversible for up to 2 years of starting therapy. In comparison, 5.5% (4) believe that they are irreversible.

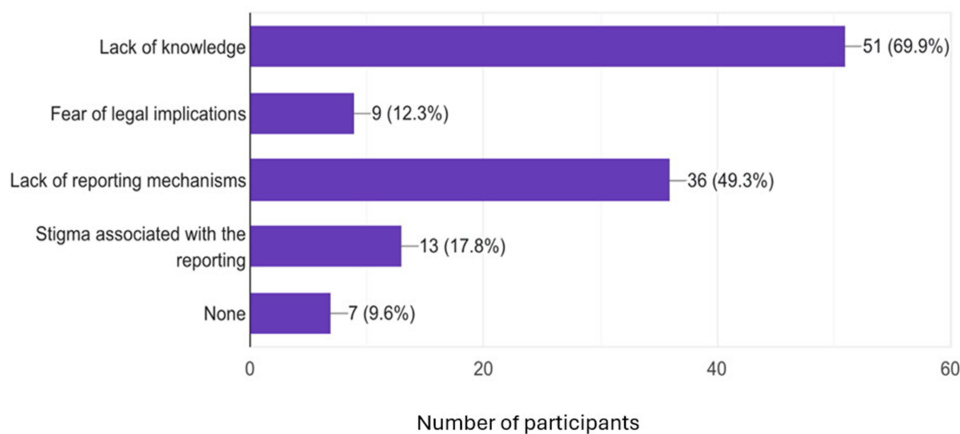
In terms of 2nd-line antitubercular drugs, 38.4% (28) of medical officers were aware of linezolid-related optic neuropathy.

Finally, 53.4% of PHC medical officers in Karnataka feel that enough emphasis is not given to visual impairment monitoring in patients on ATT. A total of 58.9% of these medical officers believe that their “lack of training” is a challenge faced while monitoring visual impairment. 47.9% (35) believe it is the ‘lack of resources that is the challenge. A total of 47.9% (35) attributed this to patient compliance, whereas 20.5% (15) thought that this was due to a lack of time. (Figure 2)

The underreporting of drug-induced visual impairment cases is due primarily to a lack of knowledge among medical officers, as reported by 69.9% (51) of medical officers. (Figure 3) A total of 49.3% (36) of medical officers thought this was due to a lack of reporting mechanisms, whereas 17.8% (13) linked it to the stigma associated with reporting. A total of 12.3% (9) of the doctors reported being afraid of legal implications. A total of 87.7% (64) of PHC doctors thought that drug-induced visual impairment affects patient compliance with ATT.



**Figure 2** Distribution of participants based on their response to the question—challenges faced in monitoring patients on ATT.



**Figure 3** Distribution of participants based on the response to the question on factors that lead to underreporting of the cases of ATT-induced visual impairment.

**Table 3** Descriptive Statistics for Continuous Scores (KAPs) Used in the Study

Variable	Minimum	Maximum	Mean	Standard Deviation
Knowledge score	0.0	9.0	5.38	1.58
Aptitude score	2	9	7.85	1.48
Practice score	0.25	3.00	2.04	0.660
Total KAP score	6.25	19.50	15.29	2.75

**Table 4** KAP Scores Compared with Educational Qualifications

Qualification	Mean (KAP)	Standard Deviation	Mean Difference (95% Confidence Intervals)	P value
General practitioner	14.57	2.96	2.09 (-3.36 and -0.82)	0.002
Specialist	16.67	1.58		

A majority of 95.9% (70) of medical officers thought there was a need for better awareness campaigns on drug-induced visual impairment, and 91.8% (67) of medical officers felt that regular ophthalmic evaluations should be mandatory for patients on ATT.

However, 38.4% (28) of medical officers are “not entirely confident” in detecting early signs of drug-induced visual impairment, 17.8% (13) are “not at all confident” and 43.8% (32) are confident in detecting these signs.

A total of 95.9% (70) of medical officers also strongly believe that there is a need for better collaboration between ophthalmologists and primary health care providers in managing drug-induced visual impairment.

The distribution of KAP scores among the study participants is given in Table 3. The mean KAP scores of specialists were significantly greater than those of general practitioners ( $p = 0.002$  unpaired  $t$  test), indicating better knowledge and practices among them. (Table 4)

## Discussion

Ethambutol-induced optic neuropathy (EON) poses a risk of potentially irreversible vision loss. This requires urgent attention, especially considering the extended use of the drug under India’s revised tuberculosis treatment guidelines. Although the harmful effects of ethambutol on the optic nerve and retina have been recognised for some time, no definitive treatment exists. Despite discontinuation of ethambutol, most patients achieve only partial visual recovery, with rare instances progressing to complete blindness.<sup>9,10</sup> Therefore, preventing ocular toxicity and promptly stopping the drug at the first sign of symptoms remain the most effective strategies.<sup>11</sup> Increased awareness among healthcare professionals, physicians, especially medical officers in PHC, is crucial to reduce sight-threatening complications due to antitubercular therapy.

Nearly 69.9% of medical officers have never referred patients with visual impairment caused by anti-tubercular therapy (ATT) to a tertiary care center. This is a concerning finding, as it may have led to delayed detection and referral. Notably, only 5.5% of medical officers in Karnataka are aware that linezolid, in addition to ethambutol, can cause optic neuropathy, revealing a significant knowledge gap among frontline healthcare providers.

A patient presenting with diminution of vision on ATT should ideally be advised to stop the FDC and be referred to a tertiary centre.<sup>12</sup> However, 50.7% of medical officers felt otherwise. While they agreed that referral is needed, they would not advise stopping the drug. This finding indicates that the toxic effects of ethambutol may continue to affect patients until they find the means and the will to reach a tertiary center.

During their routine clinical practice, many medical officers do not check a single parameter that tests the visual function of a patient on antitubercular therapy. Although most doctors believe that testing visual acuity and color vision in patients on ATT is important, this awareness is not reflected in actual practice, with many fundamental eye assessments routinely overlooked. A similar study by Shambhu et al analysed 5 years of data from patients who were diagnosed with drug-sensitive TB on ATT and admitted to a tertiary care center in Karnataka. The results revealed that only 32% of patients were screened for ocular manifestations and referred to an ophthalmologist. The authors noted suboptimal referrals of patients to an ophthalmologist by primary care physicians. The authors concluded that ophthalmic examination should be mandatory in patients on ATT to screen for adverse effects of the treatment regimen.<sup>13</sup>

The steady rise in drug-resistant tuberculosis in India has led to the widespread use of second-line antitubercular drugs. Linezolid is one such second-line ATT drug that causes optic neuropathy. Multiple studies have reported adverse effects of linezolid since it was first introduced as ATT.<sup>14</sup> Notably, the majority of the doctors in our study were unaware of this. Linezolid is also known to cause toxic optic neuropathy. Hence, starting a patient who is already complaining of a decrease in vision on another drug that causes the same effect can be quite dangerous. As a country that is dealing with drug resistance, this situation adds to many problems.

A similar study conducted in Lahore highlighted that health care workers who serve not only as frontline caregivers but also as important personnel in public health and disease control, such as those in the health care setting in India, present notable misconceptions and inconsistencies, reinforcing our study findings.<sup>3</sup>

Furthermore, in southern Africa, community treatment supporters (CTSs), which can be comparable to ASHA (Accredited Social Health Activist) workers, who work directly under medical officers and are guided and oriented by them, present major gaps in MDR-TB management skills. Furthermore, 14.6% of those with CTS had not attended a training workshop but were involved in the management of patients, whereas in our study, 72.6% claimed to have undergone a sensitisation programme. This is a preferable percentage for our country in comparison. Additionally, 59.8% of the CTS respondents felt that there was social stigma about TB in their country, which only 17.8% of our medical officers attributed this to underreporting of the adverse effects of ATT.<sup>6</sup>

In Canada, however, the study participants demonstrated moderately high knowledge and positive attitudes towards TB and strong practices in TB care, while there were gaps in pretreatment initiation and few inconsistent practices. Our study identified gaps in the understanding of the adverse effects of mid-term treatment and did not dwell much into the pretreatment stage.<sup>7</sup>

Now that a general lack of awareness is apparent, we dive into the reasons why. Medical officers themselves feel that their lack of training and time play a role in their inability to screen for ophthalmic problems. Approximately 40% of medical officers are not entirely sure about early signs of drug-induced visual impairment, so how can they be expected to formulate a treatment plan to prevent this? Furthermore, the majority feel that enough emphasis is not given to visual impairment monitoring; hence, visual impairment monitoring is simply not performed at the PHCs. When 87.7% of medical officers feel that patient compliance is affected by a drug's adverse effects, it is even more important for a country and its medical professionals to stop the adverse effects while still possible.

The article by Sabhapandit et al systematically reviewed the incidence of optic neuropathy associated with the extended use of ethambutol in tuberculosis treatment. These findings indicate that prolonged ethambutol therapy, particularly beyond two months, significantly increases the risk of optic nerve toxicity, leading to various visual impairments. This review highlights the need for awareness and monitoring in patients undergoing such treatment.<sup>2</sup>

A study conducted by Bhargava et al investigated the increasing prevalence of ethambutol-induced optic neuropathy (EON) in India following the introduction of weight-based fixed-dose combinations in tuberculosis treatment. This study, which was conducted at a tertiary eye care center, analysed 156 patients who were diagnosed with ethambutol-induced optic neuropathy and revealed a concerning increase in cases. The increase in the number of cases of toxic optic neuropathy due to ATT correlates with prolonged ethambutol use in tuberculosis treatment, emphasising the need for careful monitoring and dosage adjustments. Early diagnosis and cessation of ethambutol are crucial for improving visual outcomes, as other studies have shown better recovery with timely intervention.<sup>5,10</sup>

A consensus document by Saxena et al, developed under the aegis of the Indian Neuro-Ophthalmology Society (INOS) by a multidisciplinary group of neuro-ophthalmologists, infectious disease experts, and scientists, outlines

practical strategies to reduce the risk of vision-threatening complications associated with anti-tubercular therapy (ATT).<sup>4</sup> The panel emphasized the importance of improving awareness among primary care physicians and community health workers about the potential ocular toxicity of ATT. They advised that patients should be counselled about possible visual adverse effects at the time of prescribing these medications and encouraged to promptly seek medical attention if they experience visual blurring. Ideally, clinics should be equipped with basic tools such as visual acuity or color vision charts to allow rapid screening. The experts further highlighted that any visual complaints in patients receiving ATT warrant a high degree of clinical suspicion, with immediate discontinuation of ethambutol or linezolid, followed by referral to a higher center for diagnostic confirmation and further management.<sup>4,13,15</sup>

This study has several limitations that should be considered when interpreting the findings. First, the data were collected through self-reported responses, including self-reported practices rather than directly observed clinical behavior, which may be subject to recall bias and social desirability bias. Consequently, reported practices may not accurately reflect actual clinical performance. Second, the sample size was limited, and the intended sample size could not be fully achieved. One possible reason for this was the comprehensive nature of the questionnaire, which was necessary to adequately assess all three domains of knowledge, attitudes, and practices. Although efforts were made to reduce the length of the questionnaire to improve response rates, further reduction risked compromising the depth and quality of assessment across these domains.

Third, the study findings are region specific, as the data were collected exclusively from primary health centers (PHCs) in Karnataka. Therefore, the results may not be generalizable to medical officers working in other regions or healthcare settings. Additionally, participant responses were assessed solely on the basis of the information provided in the Google Form, with no mechanism to independently verify or corroborate the responses. As a result, actual practices may differ from those reported. Finally, owing to the cross-sectional design of the study, causal relationships between knowledge, attitudes, and practices cannot be inferred, and the findings represent associations at a single point in time.

Despite these limitations, the study provides valuable insights into the knowledge, attitudes, and practices of medical officers in PHCs within the study region and highlights key areas for future research using larger, more diverse samples and mixed-method approaches. Future studies incorporating objective measures, observational assessments, and larger multicentric samples may help overcome these limitations and increase the generalizability of the findings.

## Conclusion

This study highlights the perceptions of medical officers regarding the challenges in diagnosing drug-induced visual impairment. The findings suggest that medical officers perceive training, increased awareness, and timely referral to tertiary care centres as potentially helpful strategies in addressing these challenges. Additionally, respondents indicated that capacity building at the grassroots level, routine visual acuity screening at PHCs, and greater involvement of ophthalmologists in tuberculosis treatment programs may contribute to the early identification and prevention of sight-threatening adverse effects associated with antitubercular therapy.

These findings underscore the need for further research, including interventional and observational studies, to evaluate the effectiveness of these suggested strategies in improving clinical outcomes.

## Data Sharing Statement

The datasets generated and/or analysed during the current study are available in the following repository.

Mendonca, T. (2025, November 1). Knowledge, attitude, and practice towards drug-induced visual impairment due to Anti-Tubercular therapy among medical officers of primary health care centers in Karnataka, South India. Retrieved from [OSF Overview](#).

## Consent to Participate

(According to ICMJE Recommendations for protection of research participants): Obtained from participants.

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The authorisation of the Institutional Ethics Committee of Kasturba Medical College, Mangalore, India (IEC KMC MLR 05/2024/276) was obtained.

## Disclosure

The authors report no conflicts of interest in this work.

## References

1. Available from: <https://dghs.mohfw.gov.in/national-tuberculosis-elimination-programme.php>. Accessed March 18, 2026.
2. Sabhapandit S, Gella V, Shireesha A, et al. Ethambutol optic neuropathy in the extended anti-tubercular therapy regime: a systematic review. *Ind J Ophthalmol*. 2023;71:729–735. doi:10.4103/ijo.IJO\_1920\_22
3. Akram I, Arif M, Nadeem F, Nisa WT, Knowledge ZJ. Attitudes, and practices of healthcare workers toward tuberculosis at arif memorial teaching hospital, Lahore. *J Health Wellness Commun Res*. 2025;e83. doi:10.61919/fxkvcy23
4. Saxena R, Singh D, Phuljhele S, et al. Ethambutol toxicity: expert panel consensus for the primary prevention, diagnosis and management of ethambutol-induced optic neuropathy. *Ind J Ophthalmol*. 2021;69:3734–3739. doi:10.4103/ijo.IJO\_3746\_20
5. Bhargava A, Sahoo NK, Das AV, et al. From Scylla to Charybdis: fixed drug combinations for tuberculosis and increased ethambutol-induced optic neuropathy in India. *Ind J Ophthalmol*. 2022;70(8):3073–3076. doi:10.4103/ijo.IJO\_3082\_21
6. Peresu E, Heunis JC, Kigozi NG, De Graeve D. Knowledge, attitudes and practices of community treatment supporters administering multidrug-resistant tuberculosis injections: a cross-sectional study in rural Eswatini. *PLoS One*. 2022;17(7):e0271362. doi:10.1371/journal.pone.0271362
7. Oh HJ, Law MA, Knowledge SICT-R. Attitudes, and practices among healthcare workers in atlantic canada: a descriptive study. *Trop Med Infect Dis*. 2025;10(8):214. (). doi:10.3390/tropicalmed10080214
8. Abu-Humaidan AHA, Tarazi A, Hamadneh Y, et al. Knowledge, attitudes, and practices toward tuberculosis among Jordanian university students. *Front Public Health*. 2022;10:1055037. doi:10.3389/fpubh.2022.1055037
9. Shanmugam MK, Sajja S, Kowsalya A, Balakrishnan HK, Jayasri KN. Ethambutol induced toxic optic neuropathy - A retrospective study in a tertiary eye care centre in Southern India. *Nepal J Ophthalmol*. 2022;14(28):108–115. doi:10.3126/nepjoph.v14i2.42780
10. Chaitanuwong P, Srithawatpong S, Ruamviboonsuk P, Apinyawasisuk S, Watcharapanjamart A, Moss HE. Incidence, risk factors and ophthalmic clinical characteristics of ethambutol-induced optic neuropathy: 7-year experience. *Front Ophthalmol*. 2023;3:1152215. doi:10.3389/fopht.2023.1152215
11. Sadun AA, Wang MY. Ethambutol optic neuropathy: how we can prevent 100,000 new cases of blindness each year. *J Neuroophthalmol*. 2008;28(4):265–268. doi:10.1097/WNO.0b013e31818f138f
12. Ambika S, Lakshmi KP, Gopal M, Noronha OV. Visual outcomes of toxic optic neuropathy secondary to ethambutol: a retrospective observational study from India, an endemic country. *Ind J Ophthalmol*. 2022;70(9):3388–3392. doi:10.4103/ijo.IJO\_2996\_21
13. Shambhu R, Tank, Parvez, Hegde V, Madhukeshwar AK, Tank PAM. Are patients with drug-sensitive tuberculosis screened for ocular manifestations? A five-year analysis from a medical college hospital of Karnataka, India. *Ind J Tuberc*. 2021;68(4):497–501. doi:10.1016/j.ijtb.2021.03.006
14. Vallabhaneni S, Mendonca TM, Nayak RR, Kamath G, Kamath A. Linezolid-induced toxic optic neuropathy in drug-resistant tuberculosis case series. *Ind J Tuberc*. 2024;71(suppl 1):S5–S9. doi:10.1016/j.ijtb.2023.06.016
15. Dudani AI, Dudani AA, Dudani K, Dudani AA. Hobson's choice—fixed drug combinations for tuberculosis and epidemic of ethambutol-induced optic neuropathy in India. *Ind J Ophthalmol*. 2024;72(1):139. doi:10.4103/IJO.IJO\_1135\_23

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