**RESEARCH ARTICLE**                                             **OPEN ACCESS**

# Knowledge, Attitude and Practices Regarding Tuberculosis Infection Control Practices among Health Care Workers at Tertiary Care Centre, Rajnandgaon

Pawan Jethani[1] (ID), Surender Kaur[2]* (ID) and Prakash Khunte[3] (ID)

[1]Department of Respiratory Medicine, BRLSABVM Medical College Rajnandgaon, Chhattisgarh, India.
[2]Department of Microbiology, BRLSABVM Medical College Rajnandgaon, Chhattisgarh, India.
[3]Department of Medicine, BRLSABVM Medical College Rajnandgaon, Chhattisgarh, India.

## Abstract

Tuberculosis infectious disease owns highest burden of respiratory infection. India being the largest contributor to global Tuberculosis cases. Mycobacterium tuberculosis mode of transmission by respiratory route requires airborne precautions to be strictly followed in healthcare settings to minimize the transmission. Research was plan to assess fundamentals of Tuberculosis infection control among healthcare workers. Questionnaire based cross-sectional study which included sociodemographic characteristics, with twenty-five questions on knowledge of Tuberculosis, attitude and practices for Tuberculosis infection control was conducted in Bharat Ratna Late ShriAtal Bihari Vajpayee Memorial Medical College, Rajnandgaon Chhattisgarh from April 2023 to May 2023. 156 HCWs with mean age group 36 ± 9.7 (18-59) years participated in the study. Healthcare workers included were nurses (55.1%) and technicians (44.8%). Knowledge and attitude score observed in our study is 90.3% and 92.3% levelled as good to moderate but at the same time good to moderate practice observed is 59.6%. Certain deficiencies regarding some areas of preventive measures of tuberculosis was observed among participants which require improvement by conducting training sessions.

**Keywords:** Tuberculosis Infection Control, Questionnaire, Mycobacterium Tuberculosis

*Correspondence: kaursurender@gmail.com

## INTRODUCTION

Tuberculosis (TB) is caused by bacteria named Mycobacterium tuberculosis (MTB), which is accountable for approximately 1.5 million of death in 2020.[1] Around the globe in every second person get infected and in every 10 second a person dies due to TB.[2] It commonly affects lungs and also other parts of the body. Pulmonary tuberculosis patient can spread TB through coughing and spitting. Worldwide 10% of person can acquire TB in their life.[3]

It is crucial to implement tuberculosis infection control (TB IC) guidelines in hospitals to prevent nosocomial spread of TB, especially the emerging Multi drug resistant Tuberculosis (MDR-TB) spread to Health care workers (HCWs) and others.[4] Nosocomial transmission of tuberculosis is of significant concern in health care settings as health care workers have frequent exposure to infected patients.[5] Encouraging research and innovation in TB IC specific in resource poor settings to explore cost effective strategies to develop innovative solutions to overcome this challenge should be promoted.[6]

As HCWs being frontline workers are at higher risk of acquiring infection with MTB henceforth, they should be well acquainted with preventive measures. Any breach in TB IC practices may lead to spread of tuberculosis within health care facilities and community. Assessing knowledge, attitudes and practices of HCWs regarding TB IC provides valuable insight into their current understanding and implementation of TB IC measures, which would help to identify the gaps and area of improvement, enabling targeted interventions to enhance TB IC practices among HCWs.

### Aim

This study aims to gather data on the current state of TB IC knowledge, attitudes and practices in health care workers working in specific health care setting, Rajnandgaon.

## MATERIALS AND METHODS

### Study Setting

The study was conducted in Department of Respiratory Medicine, Bharat Ratna Late Shri Atal Bihari Vajpayee Memorial Medical College, Rajnandgaon Chhattisgarh, from April 2023 to May 2023.

### Study design

A Cross-sectional observational hospital based study.

### Study population

HCWs specially nurses and technicians (X-ray and Lab technicians) working in study area.

### Sample size

Total 156 HCWs were included, sampling was based on sample calculation formula n = (Z[2]a X P X (1-P))/d[2] where n = sample size; Z score (based on the confidence level); p = population proportion and d = margin of error. The confidence level was taken as 95% and the margin of error was 8%. Sample size was calculated based on the proportion of TB infection among HCWs, the prevalence was assumed to be 50%.[7]

### Inclusion criteria

All the HCWs who were willing to participate and gave their consent were included in the study.

### Exclusion criteria

HCWs not willing to participate were excluded from the study.

### Study procedure

Study included self-structured questionnaire, which was validated by pilot study on twenty-five health care workers to evaluate its relevance before carrying out the study. Survey was incorporated with socio-demographic factors (age, gender, educational level, job category, duration of experience, TB IC training); knowledge of TB (causative agent, site, symptoms, transmission, risk factor, method of diagnosis); attitude towards TBIC (isolation of chronic cough patients, regular sputum testing, periodic health checkup of HCWs, regular training for health workers about latest updates on TB); TB IC practices(use of personal protective equipment, contact tracing, respiratory etiquette training to patients, ensuring complete treatment to patient). Six questions were asked in knowledge questions having four options with

one correct answer to be ticked where as attitude domain had nine questions with three responses agree, disagree and neutral whereas practice domain had ten questions, included always, sometimes and never. This scoring system allows quantification of HCWs knowledge, attitudes and practices regarding TB IC by assigning one point for correct response. The participants could potentially achieve maximum score of 6 for knowledge,9 for attitude and 10 for practice. Scores were classified into two categories: scores below 50% were considered as poor score and above 50% as good to moderate score.

**Statistical data-analysis**

Data was collected, entered and analysed in Microsoft Excel. Descriptive analysis was carried out by frequency and proportion used for Sociodemographic variables and mean and standard deviation for quantitative variables. Spearman's correlation coefficient was use to find out correlation between score obtained in different domains by participants. Bivariate Skewed analysis by one-way ANOVA was done for three and above socio demographic variables and for two socio demographic variable T test was done for analysing KAP scores of healthcare workers by using p-value <0.05 statistically significant. Association of confidence to handle TB Cases by Trained and Untrained health care workers with respect to different variables was analysed by frequency and percentage.

**RESULTS**

Pre-testing was done on twenty-five health care workers to evaluate its relevance before carrying out study. Data used in the validation phase were analyzed by Cronbach's alpha. Cronbach's alpha coefficients of knowledge, attitude, and practice were > 0.70, indicating that the questionnaire had good internal consistency (Table 1).

Sociodemographic profile of HCWs (n=156) who participated in the study, 97 (62.1%) were female and 59 (37.8%) were male. As per job category 86 (55.1%) of the HCWs were nurses, followed by 70 (44.8%) lab/X-ray/other technicians. Work duration of the HCWs varied from less than 1 year were 26 (16.6%), 1-5

years were 28 (17.9%), 6-10 years were 39 (25%) and more than 10 years were 63 (40.3%). More than half of the HCWs (96) in the study reported receiving some level of training or orientation on TB which could be helpful in combating tuberculosis. (Table 2).

Out of 156 participants, about 141 (90.3%) healthcare workers obtained good to moderate knowledge scores, 144 (92.3%) obtained good to moderate practice scores, and 93 (59.6%) had positive attitude scores regarding tuberculosis and its infection control practices (Table 3).

The results of Spearman's correlation coefficient showed a much weaker positive correlation between knowledge and practice scores (r= 0.143, p value- 0.998) as compared to knowledge and attitude scores (r=0.138, p value- 0.082) and a somewhat positive correlation between practice and attitude scores (r=0.155, p value 0.049) (Table 4).

The results of the bivariate analysis showed that higher mean knowledge scores were found in the male gender (4.32±0.75, p value - 0.538). On the basis of job description of

**Table 1.** Pre-testing by Cronbach's Alpha

| Domains | Cronbach's Alpha ($\alpha$) |
|---|---|
| Knowledge | 0.78 |
| Attitude | 0.91 |
| Practice | 0.94 |

**Table 2.** Sociodemographic profile of the healthcare workers

| Variables | Category | Frequency (%) |
|---|---|---|
| Age | 18-30 years | 136 (87.1) |
| | 31-40 years | 16 (10.2%) |
| | >41 years | 4 (2.5%) |
| Gender | Male | 59 (37.8%) |
| | Female | 97(62.1%) |
| Education level | Graduate | 113 (72.4%) |
| | Postgraduate | 43 (27.5%) |
| Job category | Nurses | 86 (55.1%) |
| | Technicians | 70 (44.8%) |
| Work duration | < 1 year | 26 (16.6%) |
| | 1-5 years | 28 (17.9%) |
| | 6-10 years | 39 (25%) |
| | >10 years | 63 (40.3%) |
| Orientation on Tb IC | Yes | 96 (61.5%) |
| | No | 60 (38.4%) |

**Table 3.** Score grading of the healthcare workers

| Variables | Maximum Score | Mean ±S.D. | Good to Moderate Score (>50%)n (%) | Poor Score < 50%n (%) |
|---|---|---|---|---|
| Knowledge score | 6 | 4.15 ±0.62 | 141 (90.3%) | 16 (10.25%) |
| Attitude score | 9 | 6.91 ±3.47 | 144 (92.3%) | 12 (7.69%) |
| Practice score | 10 | 5.73 ±2.69 | 93 (59.6%) | 63 (40.38%) |

**Table 4.** Analysis of KAP scores using Spearman's correlation coefficient

| Variables | Analysis | Attitude | Knowledge | Practice |
|---|---|---|---|---|
| Attitude | Correlation coefficient (r) | 1.000 | 0.138 | 0.155 |
| | P value | - | 0.082 | 0.049 |
| Knowledge | Correlation coefficient (r) | 0.138 | 1.000 | 0.143 |
| | P value | 0.082 | - | 0.998 |
| Practice | Correlation coefficient (r) | 0.155 | 0.143 | 1.000 |
| | P value | 0.049 | 0.072 | - |

health care workers nurses had higher knowledge score (4.25±0.74, p value-0.598) as compared technicians. Similarly, higher mean knowledge scores were also reported in the age group >41 years with experience of 1-5 years. (4.50±0.79, p value – 0.023) (Table 5).

Higher mean attitude scores were found in nurses (7.15±1.85, p value-0.966), the age group more than 41 years (5.50±1.87, p – 0.063) and in those with work experience of more than ten years (7.44±1.84, p value - 0.132), postgraduate by qualification (7.09±1.84, p value -0.966) who have undergone training (7.09±1.85, p value-0.946) (Table 5).

Bivariate analysis also showed that the higher mean practice scores were found among technicians (5.82±1.64, p value – 0.618) as compared to nurses, in the male gender (5.76±1.65, p value – 0.557), and in healthcare workers with work experience of less than one year (6.23±1.64, p value - 0.026), undergraduate (5.90±1.65,p value-0.759) but had received training in TB IC (5.82±1.63, p value- 0.918)(Table 5).

On analysing confidence level of healthcare workers to deal with the tuberculosis to some of the pertinent questions in the knowledge, attitude and practice sections with respect to TB IC training it is observed that out of 96 participants who have received TB IC training more than 20% strictly adapted standard precaution and contact tracing practices as compared to more than 13% not at all opted the same. Nearly half of them used N-95 mask while taking care of tuberculosis patients and felt responsibility of educating them respiratory etiquettes. Among 60 participants who didn't underwent training nearly 10% totally agreed to practice standard precaution and follow contact tracing, whereas less than 10% always used N-95 mask or educated patient cough etiquettes.(Table 6)

**DISCUSSION**

Knowledge empowers individuals to make informed decision and take proactive measures to protect themselves and others.[8] Therefore, in order to promote effective prevention practices, it is essential to prioritize knowledge dissemination and education ensuring individuals have access accurate information about disease and its prevention strategy this study was planned. Pre testing on twenty-five HCWs was done to know item clarity before carrying out the study. A reliability test was performed using Cronbach's alpha for knowing internal consistency of the questionnaire. A Cronbach's alpha coefficient in the range of 0.6–0.7 is considered acceptable, whereas a Cronbach's alpha coefficient of 0.8 indicates good reliability. We found that Cronbach's alpha coefficient was >0.70 for all parameters in the pretest of reliability, indicating that the

**Table 5.** Bivariate analysis of different variables with KAP scores of healthcare workers

| Variable | | Knowledge (Mean±SD) | Attitude (Mean±SD) | Practice (Mean±SD) |
|---|---|---|---|---|
| Gender | Male | 4.32±0.75 | 6.42±1.85 | 5.76±1.65 |
| | Female | 4.25±0.76 | 7.20±1.84 | 5.71±1.62 |
| | p-value | 0.538 | 0.929 | 0.557 |
| Age | 18-30years | 4.28±0.76 | 6.95±1.86 | 5.84±1.64 |
| | 31-40 years | 4.18±0.75 | 6.87±1.73 | 4.81±1.90 |
| | >41 years | 4.50±0.79 | 5.50±1.87 | 5.50±1.64 |
| | p-value | 0.023 | 0.063 | 0.165 |
| Job description | Nurse | 4.25±0.74 | 7.15±1.85 | 5.65±1.63 |
| | Technician | 4.31±0.75 | 6.61±1.84 | 5.82±1.64 |
| | p-value | 0.598 | 0.966 | 0.618 |
| Work duration | <1 yr (26) | 4.38±0.76 | 6.88±1.84 | 6.23±1.64 |
| | 1-5 yrs (28) | 4.46±0.75 | 6.64±1.85 | 5.92±1.63 |
| | 6-10 Yrs (39) | 4.15±0.70 | 6.25±1.90 | 4.64±1.58 |
| | >10 yrs (63) | 4.23±0.72 | 7.44±1.84 | 6.11±1.13 |
| | p-value | 0.100 | 0.132 | 0.026 |
| Education | Graduate (113) | 4.30±0.73 | 6.84±1.85 | 5.90±1.65 |
| | Postgraduate (43) | 4.23±0.76 | 7.09±1.84 | 5.27±1.84 |
| | p-value | 0.963 | 0.966 | 0.759 |
| Training/ Orientation | Yes (96) | 4.34±0.75 | 7.09±1.85 | 5.82±1.63 |
| | No (60) | 4.18±0.76 | 6.61±1.84 | 5.58±1.64 |
| | p-value | 0.968 | 0.946 | 0.918 |

**Table 6.** Association of confidence to handle TB Cases by Trained and Untrained health care workers with respect to different variables

| Responses | Participant TB IC training status | Practices standard precaution % (n) | Follow Institutional contact tracing policy | Use of N-95 Mask while patient care | Educate respiratory etiquette |
|---|---|---|---|---|---|
| Not at all | Yes | 16.6% (16) | 13.5% (13) | 00% (00) | 5.25% (05) |
| | No | 46.6% (28) | 41.6% (25) | 35% (21) | 46.6% (28) |
| To some extent | Yes | 31.2% (30) | 28.1% (27) | 17.7% (17) | 19.7% (19) |
| | No | 33.3% (20) | 28.3% (17) | 41.6% (25) | 31.6% (19) |
| To considerable extent | Yes | 28.1% (27) | 37.5% (36) | 36.4% (35) | 36.4% (35) |
| | No | 5% (03) | 11.6% (07) | 11.6% (07) | 16.6% (10) |
| To great extent | Yes | 23.9% (23) | 20.8% (20) | 45.8% (44) | 38.5% (37) |
| | No | 15% (09) | 18.3% (11) | 11.6% (07) | 5% (03) |

questionnaire had good internal consistency.[9] HCWs very well knew the cause, its transmission, and signs symptoms of TB. However, infection control practices against tuberculosis were poor in spite of good level of understanding regarding TB. The HCWs with "good to moderate" knowledge score was 90.3% which is relatively more than reported 74% in Ethiopia[10] and only 10.25 % showed poor score which is still less than what observed by Lebena *et al.* (13.6%).[11] Since nurses and Lab technicians two cadres have been included in our study as their close proximity to patients put them at higher risk of contracting disease. Hence, we can say our study was female predominant which is consistent with Wang *et al.*[12] HCWs have higher baseline knowledge due to education and training they receive during their curriculum. HCWs attributed to poor knowledge level due to lack of training and orientation on TB IC. Knowledge alone is not sufficient to ensure proper implementation of infection control practices.[13] Knowledge provides foundation but attitude

and motivation drive the actual behaviour and adherence to infection control practice. Despite of positive attitude towards TB IC, 93.8% HCWs' agreed and 86.92% were phobic of contracting TB which is much more than the Neha Agrawal *et al.* study, where 40% of participants reported fear of getting infection.[14] The cause of fear could be not only getting themselves TB but also their family members.[15] This is in consistency with the finding of a study by Menzies *et al.*[16] 74.61% HCWs realized the need of regular screening and use of respirator while taking care of MDR patients. This finding supports appropriate attitude and understanding of infection control measures towards tuberculosis.[17]

Significant (68.46%) number of HCWs agreed with screening of patient with chronic cough for TB which indicates they are well aware of symptoms of TB and the importance of early detection and treatment. 62.3% of the HCWs agreed isolation of TB patient is crucial to minimize the risk of transmission to HCWs and others which is higher than Omole *et al.* survey where 49.2% health care workers agreed isolation of TB patients.[18] Marme *et al.* in their study carried out in thirteen facilities in Papua observed 90% facilities indicated systematic screening for coughing patients.[19]

25.6% of the HCWs claim to always counsel patient correct cough etiquette which indicate they realize the importance of educating patients on how to prevent spread of infection through proper coughing practices. Comparing our finding with Shrestha *et al.* in Nepal which reported only 38.3% of the HCWs always educate patients on cough etiquette.[20] In our study, 16.6% trained and 46.6% untrained HCWs did not availed standard precautions in spite of hospital policy, whereas Biswas *et al.* reported 85% deficiency in core components of standard precaution which could be a possible reason of nosocomial transmission of tuberculosis.[21] Apriani et al. carried out study in 21 Peripheral health center found only 11.7% staff undergone TB IC training.[22] Overall, in our study, we observed poor adherence to infection control practice (40.38%) which is almost half than Gyem *et al.* study.[23,24] It is concluded that training plays vital role in improving attitude and practice which can be observed in our study and similar finding was observed by Wondimu *et al.*[25] Thus, by integrating TB IC measures into the day-to-day working environment and ensure these practices become routine and contribute in curbing spread of TB.[26]

**Strength and limitations**

Limitation of our study was Pre and post-test could better assess TB infection control practices as many HCWs had not undergone orientation or training of TB IC. Hence, regular trainings should be given to HCWs to improve their knowledge and health care centres should prepare TB IC plan and orient HCWs.

**CONCLUSION**

Study reveals more than 90% participants knowledge and attitude regarding tuberculosis is good to moderate, but 40.38% lack in adequate practice. Comparing trained and untrained staff in TB IC practice nearly 85% trained staff were more confident in handing TB patients. hence addressing the gaps in preventive practices towards TB infection control requires comprehensive approach that includes updating knowledge, conducting regular workshop and implementing monitoring system. Health care professionals should time to time assess effectiveness of current strategies by identifying gaps and area of improvement. By doing so, health care facilities can work ensuring safety of both health care workers and patients in context of tuberculosis prevention and control.

**CONFLICT OF INTEREST**

The authors declare that there is no conflict of interest.

**AUTHORS' CONTRIBUTION**

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

## DATA AVAILABILITY

All datasets generated or analyzed during this study are included in the manuscript.

## ETHICS STATEMENT

This study was approved by the Institutional Ethics Committee, BRLSABVM Medical College, Rajnandgaon, Chhattisgarh, India, with reference number 66/IEC/BRLSABVMMCRJN/2023.

## INFORMED CONSENT

Written informed consent was obtained from the participants before enrolling in the study.

## REFERENCES

1. Global Tuberculosis Reports. Available online at: https://www.who.int/teams/ global-tuberculosis-programme/tb-reports. (accessed April 9, 2022).
2. Lonnroth K, Raviglione M. Global epidemiology of tuberculosis: prospects for contro. *Semin Respir Crit Care Med.* 2008;29(5):481-491. doi: 10.1055/s-0028-1085700
3. World Health Organization. WHO Global Tuberculosis Report 2016. Geneva, Switzerland: World Health Organization, WHO Press. 2016.
4. World Health Organization. Guidelines for the programmatic management of drug-resistant tuberculosis emergency update 2008. Geneva: World Health Organization; 2008.
5. World Health Organization. WHO policy on TB infection control in healthcare facilities, congregate settings and households. Geneva: WHO 2009.
6. Gill CM, Dolan L, Laura M. Piggott, Anne Marie McLaughlin. New developments in tuberculosis diagnosis and treatment. *Breathe.* 2022;18(1):210149. doi: 10.1183/20734735.0149-2021
7. Joshi R, Reingold AL, Menzies D, Pai M. Tuberculosis among health-care workers in lowand middle-income countries: A systematic review. *PLoS Med.* 2006;3(12):e494. doi: 10.1371/journal.pmed.0030494
8. Launiala A, Honkasalo ML. Ethnographic study of factors infuencing compliance to intermittent preventive treatment of malaria during pregnancy among Yao women in rural Malawi. *Trans R Soc Trop Med Hyg.* 2007;101(10):980-989. doi: 10.1016/j.trstmh.2007.04.005
9. Douglas G, Wright TA, Bonett TAW. Cronbach's alpha reliability: Interval estimation, hypothesis testing, and sample size planning. *J Organ Behav.* 2014;36(1):3-15. doi: 10.1002/job.1960
10. Temesgen C, Demissie M. Knowledge and practice of tuberculosis infection control among health professionals in Northwest Ethiopia; 2011. *BMC Health Serv Res.* 2014;14(1):593. doi: 10.1186/s12913-014-0593-2
11. Labena F, Kassa Y, Gambura E. Tuberculosis and Public Health Care Workers: Infection Prevention and Control Practices and Associated Factors Among Governmental Health Centers and Hospitals in Wolaita Zone, Southern Ethiopia. *J Multidiscip Healthc.* 2021;14:2111-2122. doi: 10.2147/JMDH.S321592
12. Wang XN, He TL, Geng MJ, et al. Prevalence of and risk factors for tuberculosis among healthcare workers in Chinese tuberculosis facilities. *Infect Dis Poverty.* 2018;7(1):26. doi: 10.1186/s40249-018-0407-6
13. Demissie GG, Aderaw AZ, Kibret KT. Assessment of knowledge and practice of health workers towards tuberculosis infection control and associated factors in public health facilities of Addis Ababa, Ethiopia: a cross-sectional study. *Arch Public Health.* 2015;73(1):15. doi: 10.1186/s13690-015-0062-3
14. Agrawal N, Kumar A, Ali N, Uppadhaya SK, Singh HK. Knowledge, Attitude and Practices Regarding Tuberculosis among Outpatients of a Rural Field Practice Area: A Cross-sectional Study in Uttar Pradesh, India. *J Clin Diagn Res.* 2022;16(8):LC06-LC11. doi: 10.7860/JCDR/2022/57590.16691
15. van der Westhuizen H-M, Dorward J, Roberts N, et al. Health worker experiences of implementing TB infection prevention and control: A qualitative evidence synthesis to inform implementation recommendations. *PLOS Glob Public Health.* 2022;2(7):e0000292. doi: 10.1371/journal.pgph.0000292
16. Menzies D, Joshi R, Pai M. Risk of tuberculosis infection and disease associated with work in health care settings. *Int J Tuberc Lung Dis.* 2007;11(6):593-605.
17. Johnston BL, Toju O, Defalco K, Savard N, Stephanie W. Smith Chapter 14: Prevention and control of tuberculosis transmission in healthcare settings. *Canadian Journal of Respiratory, Critical Care, and Sleep Medicine.* 2022;6(Supl 1):205-228. doi: 10.1080/24745332.2022.2043677
18. Omole OR, Okeh DU, Abali IO, et al. Assessment of the awareness and knowledge on standard precaution of Tuberculosis among primary healthcare workers in Edo state Nigeria. *Asian Journal of Research in Nursing and Health.* 2023; 6 (1):160-172.
19. Marme G, Kuzma J, Zimmerman PA, Harris N, Rutherford S. Tuberculosis infection prevention and control in rural Papua New Guinea: an evaluation using the infection prevention and control assessment framework. *Antimicrob Resist Infect Control.* 2023; 12,31. doi: 10.1186/s13756-023-01237-9
20. Shrestha A, Bhattarai D, Thapa B, Basel P, Wagle RR. Health care workers knowledge, attitudes and practices on tuberculosis infection control, Nepal. *BMC Infect Dis.* 2017;17(1):72. doi: 10.1186/s12879-017-2828-4
21. Gyem K, Ahmad RA, Mahendradhata Y. Implementation fidelity of tuberculosis infection prevention and control practices in three hospitals with the highest notified tuberculosis cases in Bhutan: a mixed method study. *Journal of Global Health Reports.* 2020;4:e2020070. doi: 10.29392/001c.14140
22. Apriani L, McAllister S, Sharples K, et al. Tuberculosis infection control measures and knowledge in primary health centres in Bandung, Indonesia. *J Infect Prev.* 2022;23(2):49-58.doi: 10.1177/17571774211046880
23. Biswas MAAJ, Hassan MZ, Monjur MR, et al.

Assessment of standard precaution related to infection prevention readiness of healthcare facilities in Bangladesh: Findings from a national cross-sectional survey. *Antimicrob Steward Healthc Epidemiol.* 2021;1(1):E52. doi: 10.1017/ash.2021.226

24. Tan C, Kallon II, Colvin CJ, Grant AD. Barriers and facilitators of tuberculosis infection prevention and control in low- and middle-income countries from the perspective of healthcare workers: A systematic review. *PLoS ONE.* 2020;15(10):e0241039. doi: 10.1371/journal.pone.0241039

25. Wondimu W, Yosef T, Gebremedhin T, Muze M. Service years of health professionals are associated with tuberculosis infection control practice in Ethiopian Teaching Hospital. *Pan Afr Med J.* 2021;38:253. doi: 10.11604/pamj.2021.38.253.23044

26. Kielmann K, Karat AS, Zwama G, et al. Tuberculosis infection prevention and control: why we need a whole systems approach. *Infect Dis Poverty.* 2020;9(1):56. doi: 10.1186/s40249-020-00667-6