Implementation fidelity of tuberculosis infection prevention and control practices in three hospitals with the highest notified tuberculosis cases in Bhutan: a mixed method study

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Background

The rise in multi-drug resistant tuberculosis (MDR-TB) cases indicates that it is being transmitted as a primary infection in the general population and has been linked to the health care environment. Studies in resource-limited countries have shown that even simple control measures to prevent TB (tuberculosis) infection appear to be inadequately implemented. This study aimed to assess implementation fidelity with a major focus on adherence, knowledge, and responsiveness to TB infection and prevention control (IPC) practices by exploring its barriers and enablers.

Methods

This research was an implementation research using a mixed-method explanatory sequential design. We conducted a descriptive cross-sectional study of health care workers (HCWs) working in TB and TB patients enrolled in the three hospitals with the highest notified TB cases in Bhutan from May to August 2019 to assess the implementation fidelity of TB IPC practices. Structured questionnaires and a non-participatory observation checklist were used to assess adherence, knowledge, and responsiveness of the participants. We carried out descriptive statistical analysis for quantitative data and thematic analysis for qualitative data.

Results

The overall adherence proportion of the participants was poor, with a poor adherence score of 82.6% by the healthcare workers and 93.1% by the patients. HCWs were judged to have overall good knowledge. Most patients strongly agree to the perceptions about TB transmissible through air and visitors wearing masks when they visit the facility; however, the overall response rate score was only 33%. Two overarching themes, "poor administrative policy" and "behavior and attitude" are identified as key barriers and enablers to the implementation of the TB IPC.

Conclusions

There was inadequate IPC practice among healthcare workers and patients. The overall good knowledge of the HCWs did not appear to have a positive influence on adherence. Hence, there is a need for continuous improvement and mandatory training, surveillance, awareness, and sensitization.

Tuberculosis (TB) control continues to be important, particularly due to increasing mortality and morbidity. The emergence of multi-drug resistant (MDR-TB) and extensive drug resistant (XDR-TB) has complicated TB prevention and treatment. In 2018, there were about half a million new cases of rifampicin-resistant TB (of which 78% had multidrug-resistant TB). Globally, 3.4% of new TB cases and 18% of previously treated cases had MDR-TB or rifampicin-resistant TB (MDR/RR-TB), with the highest proportions (>50% in previously treated cases). Most cases and deaths occurred in Asia. The emerging epidemic of MDR/XDR-TB further imperils health workers, patients, TB-HIV co-infected patients, and the community. This led to reappraisal of the importance of TB infection prevention and control (IPC). Health facilities with inadequate infection control are risky environments for TB transmission. TB remains a priority health problem in Bhutan. MDR-TB and HIV-TB co-infection cases have been increasing despite progress in the case detection rate and high treatment success rate of 95%. The latest estimated MDR-TB is 13% new cases and 33% previously treated cases. MDR-TB among new cases indicates that it is being transmitted as a primary infection in the general population and has been linked to the health care environment. Studies in resource-limited countries have shown that even simple control measures to prevent TB infection appear to be inadequately implemented. A large proportion of these transmissions are preventable through effective IPC measures. This study aimed to assess the implementation fidelity of TB-IPC practices among health workers and patients in three hospitals with the highest notified TB cases in Bhutan, and to explore perceived barriers and enablers responsible for TB-IPC imple-
mentation.

METHODS

The study adapted the fidelity framework of Carroll,9 the standards for reporting implementation studies (StARI)10 and reporting guidelines for implementation and operational research.11

STUDY DESIGN

This is an implementation study with mixed-method explanatory sequential design, which involved a quantitative cross-sectional study followed by qualitative interview and non-participatory observation. The quantitative study covered participant’s adherence, provider’s knowledge, and patient’s responsiveness. The qualitative included in-depth and key informant interviews using open-ended interview guides to explore perceived barriers and enablers to implementation fidelity of the TB IPC program. Qualitative narrative data were collected to gain insight into HCWs experiences and explore factors influencing effective implementation. Purposive sampling method was applied to select informants who possess rich knowledge, information and experienced on TB IPC until a data saturation point has reached. The data was then transcribed, analysed, coded and triangulated with the quantitative data findings.

STUDY SETTING

This study was carried out in three district hospitals in Bhutan, which has the highest number of TB cases notified (466) and accounts for more than 50% of TB cases reported.12 Jigme Dorji Wangchuck National Referral Hospital (JDWRNH), the Central Regional Referral Hospital (CRRH), and Punthsholing (P/LING) general hospital, are the sites included in this study.

RESEARCH SUBJECTS

Nurses and laboratory staff working in TB and patients admitted in the TB and DR-TB wards from May to August 2019 in three hospitals were included in the study. Health workers providing IPC services at these facilities were interviewed.

DATA COLLECTION AND ANALYSIS

A pre-tested structured questionnaire was developed based on guidelines from the World Health organization (WHO)13,14 the Centre for Disease Control and Prevention (CDC),15 and from published articles13,16,17 to measure the participant’s adherence, HCWs knowledge, and patient’s responsiveness aspects on fidelity, with data on sociodemographic characteristics of the participants. A modified checklist drawn from the WHO15,14 and CDC15 was administered through non-participant observation to assess TB IPC measures in the facility. The data file was cleaned, double-checked, and entered into EpiData 3.1 software. Descriptive statistics were drawn using Stata 13 data analysis software. Participants’ level of adherence and responsive-ness was categorized as a scoring criterion on pre-determined levels based on Bloom’s cut-off point from KAP (knowledge, attitude, and practices) and on reference to a few published articles.18,19

SCORING SYSTEM

Each parameter in adherence was assigned zero points for "never", five points for "sometimes" and ten points for "always". Patients’ responsiveness was scored on a four-point Likert scale with a minimum score of one and a maximum of four. The scores of each parameter were added up to calculate the overall scores to identify the level that the participants had achieved. A score of 80 -100% was considered good, 60 – 79% as fair, and <59% as poor.

Qualitative data were collected using the in-depth interview (IDI) and key informant interview (KII) guide. A purposive sampling method was applied to identify and recruit informants with rich knowledge, information, and experience on TB IPC until the data saturation point. Interviews were conducted in English and then transcribed. The transcripts were read multiple times looking for repetitive patterns or consistency, grouping together based on similarity, difference, frequency, sequence, correspondence, and causation. Thematic analysis was drawn and categorized to link to the data.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval was obtained from the Medical and Health Research Ethics Committee of the Faculty of Medicine, Universitas Gadjah Mada, Indonesia, and from the Research Ethics Board of Health, Ministry of Health, Bhutan. Study permission was obtained from the facility prior to data collection. Written informed consent was obtained, illiterate participants were informed verbally, explained about the study to the participants, and confirmed consent was obtained using thumbprints. The participants were assured of confidentiality and anonymity in the data they provided.

RESULTS

SOCIODEMOGRAPHIC CHARACTERISTICS OF STUDY PARTICIPANTS

A total of 81 respondents were included in this study. The majority of TB cases admitted (44.8 %) were from JDWRNH and were new TB cases (84.5%). Most (>50%) of the study participants were males. The mean ± SD age of the HCWs was 30.1 ± 6.7 years and 34.8 ± 15.7 years for the patients. More than one-third (34.5%) of the patients included in the study had no formal education and 39.6% of them were unemployed at that time. More than one-third (43.1%) of TB patient’s respondents had attained high school. Among the HCWs profession, the majority were nurses (65.2%).

There was no statistically significant difference between age and gender among the HCW and patients’ respondents (P>0.05). However, there were statistically significant differences between education attainment and employment status among the HCW and patients (P<0.05) (Table 1).
## Table 1: Sociodemographic characteristics of the study participants (n=81)

| Characteristics                      | Facility Name | Facility Name | Facility Name |
|--------------------------------------|---------------|---------------|---------------|
|                                      | All n (%)     | JDW/NRH       | CRRH          | P/ling        |
|                                      | All n (%)     | JDW/NRH       | CRRH          | P/ling        |
|                                      | X² value      | P value       |               |               |
| Total TB cases admitted              |               |               |               |               |
| Patient Status (n=58)                |               |               |               |               |
| New case                             | 58 (100.0)    | 26 (44.8)     | 19 (32.8)     | 13 (22.4)     |
| Re-treatment case                    |               |               |               |               |
| Gender                               |               |               |               |               |
| Male                                 | 30 (51.7)     | 12 (20.7)     | 11 (19.0)     | 7 (12.1)      |
| Female                               | 28 (48.3)     | 14 (24.1)     | 8 (13.8)      | 6 (10.3)      |
| Age (years)                          |               |               |               |               |
| 18 - 24                              | 16 (27.6)     | 8 (14.1)      | 6 (10.3)      | 2 (3.4)       |
| 25 - 34                              | 21 (36.3)     | 9 (15.5)      | 7 (12.1)      | 5 (8.6)       |
| 35 - 44                              | 10 (17.2)     | 5 (8.6)       | 3 (5.2)       | 2 (3.4)       |
| 45 - 54                              | 5 (8.6)       | 1 (1.7)       | 2 (3.4)       | 2 (3.4)       |
| 55 and above                         | 6 (10.3)      | 3 (5.2)       | 1 (1.7)       | 2 (3.4)       |
| Mean ± SD age                        | 34.8 ± 15.7   |               |               |               |
| Educational attainment               |               |               |               |               |
| NFE                                  | 20 (34.5)     | 8 (13.8)      | 8 (13.8)      | 4 (6.9)       |
| Primary                              | 4 (6.9)       | 2 (3.4)       | 1 (1.7)       | 1 (1.7)       |
| High                                 | 25 (43.1)     | 12 (20.7)     | 6 (10.3)      | 7 (12.1)      |
| Certificate*                         | 0 (0.0)       | 0 (0.0)       | 0 (0.0)       | 0 (0.0)       |
| Diploma                              | 1 (1.7)       | 0 (0.0)       | 1 (1.7)       | 0 (0.0)       |
| Graduate                             | 8 (13.8)      | 4 (6.9)       | 3 (5.2)       | 1 (1.7)       |
| Employment status                    |               |               |               |               |
| Civil servant                        | 7 (12.1)      | 3 (5.2)       | 2 (3.4)       | 2 (3.4)       |
| Contract                             | 0 (0.0)       | 0 (0.0)       | 0 (0.0)       | 0 (0.0)       |
| Unemployed                           | 23 (39.6)     | 13 (22.4)     | 7 (12.1)      | 3 (5.2)       |
| Private                              | 15 (25.9)     | 7 (12.1)      | 4 (6.9)       | 4 (6.9)       |
| Others                               | 13 (22.4)     | 3 (5.2)       | 6 (10.3)      | 4 (6.9)       |
| HCWs Profession (n=23)               |               |               |               |               |
| Nurse                                | 15 (65.2)     | 6 (26.1)      | 5 (21.8)      | 4 (17.3)      |
| Lab officer/technician               | 8 (34.8)      | 4 (17.4)      | 2 (8.7)       | 2 (8.7)       |

NA: Not applicable;
* Two years course on relevant medical fields offered by the Royal Government of Bhutan;
JDWNRH: Jigme Dorji Wangchuck National Referral Hospital; CRRH: Central Regional Referral Hospital; P/LING: Phuntsholing General Hospital; HCWs: Healthcare Workers; TB: tuberculosis; NFE: No formal education
## Table 2: Participant’s adherence to TB-IPC practices (n= 81)

| TB IPC components                                                                 | Always n (%) | Sometimes n (%) | Never n (%) |
|----------------------------------------------------------------------------------|--------------|-----------------|-------------|
| **Staff nurse adherence to TB IPC practices (n=15)**                              |              |                 |             |
| Frequency of wearing N95 mask when around TB patients and inside the ward?        | 11 (73.3)    | 4 (26.7)        | 0 (0.0)     |
| Perform fit test/check your N95 is airtight and does not allow any air to pass/leak | 10 (66.7)    | 4 (26.7)        | 1 (6.6)     |
| Frequency of cough hygiene education for patients                                 | 7 (46.7)     | 8 (53.3)        | 0 (0.0)     |
| Frequency of offering surgical masks to visitors at the ward?                    | 12 (80.0)    | 3 (20.0)        | 0 (0.0)     |
| Frequency of visitors using surgical masks when you offer them?                   | 10 (66.7)    | 5 (33.3)        | 0 (0.0)     |
| Frequency of using gloves when giving TB care                                     | 7 (46.7)     | 8 (53.3)        | 0 (0.0)     |
| Frequency of hand hygiene practices with:                                         |              |                 |             |
| Soap and water                                                                    | 15 (100.0)   | 0 (0.0)         | 0 (0.0)     |
| Alcohol-based rub                                                                 | 10 (66.7)    | 5 (33.3)        | 0 (0.0)     |
| **Lab staff adherence to TB IPC practices (n=8)**                                  |              |                 |             |
| Frequency of wearing an N95 mask while working with TB samples in the lab?         | 8 (100.0)    | 0 (0.0)         | 0 (0.0)     |
| Use of biological safety cabinets during sample processing                         | 8 (100.0)    | 0 (0.0)         | 0 (0.0)     |
| Protective laboratory clothing worn always while working in the lab?              | 8 (100.0)    | 0 (0.0)         | 0 (0.0)     |
| Lab footwear worn inside the laboratory                                            | 0 (0.0)      | 1 (12.5)        | 7 (87.5)    |
| Sputum sample collected in the sample collection room                              | 4 (50.0)     | 1 (12.5)        | 3 (37.5)    |
| Frequency of rejecting leaked sputum samples                                       | 2 (25.0)     | 6 (75.0)        | 0 (0.0)     |
| Frequency of hand hygiene practices with:                                         |              |                 |             |
| Soap and water                                                                    | 5 (62.5)     | 3 (37.5)        | 0 (0.0)     |
| Alcohol-based rub                                                                 | 7 (87.5)     | 1 (12.5)        | 0 (0.0)     |
| **TB patient’s adherence to TB IPC practices (n=58)**                              |              |                 |             |
| How frequently do you use a surgical mask?                                        | 40 (69.0)    | 16 (27.6)       | 2 (3.4)     |
| How often you wash your hands after coughing/ sneezing/ blowing your nose.        | 22 (38.0)    | 34 (58.6)       | 2 (3.4)     |
| You use the designated sputum collection area for the sputum collection process   | 28 (48.3)    | 14 (24.1)       | 16 (27.6)   |
| Your sputum waste is discarded in a proper designated waste bin                    | 40 (69.0)    | 16 (27.6)       | 2 (3.4)     |
| Cover the nose/mouth when coughing or sneezing or cough into a disposable tissue and discard the tissue immediately into a designated bin. | 40 (69.0)    | 18 (31.0)       | 0 (0.0)     |
| Turn away/move from other people when coughing/ sneezing.                          | 43 (74.2)    | 14 (24.1)       | 1 (1.7)     |
| Frequency of hand hygiene practices with:                                         |              |                 |             |
| Soap and water                                                                    | 37 (63.8)    | 21 (36.2)       | 0 (0.0)     |
| Alcohol-based rub                                                                 | 11 (19.0)    | 13 (22.4)       | 34 (58.6)   |

TB: tuberculosis; TB IPC: tuberculosis infection prevention and control
Table 3: Overall adherence score of participants

| Level of adherence | HCWs (n=23) | TB patient (n=58) |
|--------------------|-------------|------------------|
|                    | Frequency | % | Frequency | % |
| Good (> 80%)       | 0         | 0.0 | 0         | 0.0 |
| Fair (60 – 79%)    | 4         | 17.4 | 4         | 7.0 |
| Poor (< 59%)       | 19        | 82.6 | 54        | 93.0 |

HCWs: Healthcare workers; TB: tuberculosis

ADHERENCE TO TB-IPC PRACTICES

Both health workers (100%) reported full implementation of practices on hand hygiene with soap and water, wearing a N95 mask, using a biological safety cabinet, and wearing a PPE (Table 2). Where practices regarding the frequency of cough hygiene education and using gloves while giving TB care is partially adhered (53.3%) and 87.5% laboratory staff reported not wearing lab footwear inside the laboratory. Among patients, 74.2% reported to turn/move away from other people when coughing while practices like wearing a mask, proper sputum disposal, and covering the mouth with disposable tissues while coughing is only 69.0%. More than half (58.6%) reported never used alcohol hand rub as a means of hand hygiene practices.

The overall adherence proportion of participants was poor, with a poor adherence score of 82.6% by health care workers and 93.0% by patients (Table 3).

NON-PARTICIPANT OBSERVATION FOR TB-IPC IMPLEMENTATION

All health facilities have an IPC committee or a designated focal person, a tracking system for all TB suspects, referrals and sputum smear results in place. The facility is located away from other facilities, TB cases hospitalized are grouped according to sensitivity, and basic PPE measures are available. Other components like signage to keep doors and windows open when feasible, evaluation of TB-IPC practices, soap, water, and sink in patient care areas, alcohol-based hand rubs, TB admission facilities, and environmental controls were found unavailable in one or two wards (n=3). None of the facilities had a written TB-IPC plan, no autoclave or chemical disinfectant facility in the ward, no designated sputum collection and disposal area, and none of the lab staff wearing lab footwear inside the lab.

HEALTH CARE WORKER’S KNOWLEDGE

Knowledge assessment showed that health professionals have good knowledge of TB IPC. All nurses depicted good knowledge of the mode of transmission, environmental controls, cough hygiene, and administrative controls. Almost a third (26.7%) of nurses had poor knowledge regarding respirator use and screening of HCWs as infection control measures. More than one-third (37.5%) of lab respondents reported "No" for ventilated workstations as an optional solution for aerosol containment. Further details are presented in Tables 4 and 5.

TB PATIENT’S RESPONSIVENESS TO TB-IPC PRACTICES

Most respondents agreed to the perceptions about TB transmissible through air and visitors wearing masks when they visit the facility, while an average of 5.2% respondents reported disagreement responses to the majority of TB IPC practice statements. The overall response rate scored was only 33% (Table 6).
| Question                                                                 | Yes | No  | Don’t Know |
|-------------------------------------------------------------------------|-----|-----|------------|
| **Mode of transmission**                                                 |     |     |            |
| Patients with active TB disease can infect people by talking             | 11(73.3) | 4 (26.7) | 0 (0.0) |
| TB is often spread from person to person through the air                 | 15 (100.0) | 0 (0.0) | 0 (0.0) |
| Patients with active TB disease can infect people by coughing            | 15 (100.0) | 0 (0.0) | 0 (0.0) |
| HIV-positive patients are more vulnerable to catching TB than HIV-negative patient | 15 (100.0) | 0 (0.0) | 0 (0.0) |
| TB is often spread from person to person by sexual contact               | 4 (26.7) | 11 (73.3) | 0 (0.0) |
| **PPE**                                                                 |     |     |            |
| A wet or dirty N95 can still be used                                    | 1 (6.7) | 12 (80.0) | 2 (13.3) |
| Surgical masks can protect HCWs and visitors from contracting TB particles from being breathed in | 8 (53.3) | 6 (40.0) | 1 (6.7) |
| Respirators can protect the HCWs from contracting tuberculosis           | 8 (53.3) | 3 (20.0) | 4 (26.7) |
| Surgical masks keep TB patients from coughing TB particles into the air  | 13 (86.7) | 2 (13.3) | 0 (0.0) |
| **Hand hygiene**                                                         |     |     |            |
| Handwashing is the most preventative method to prevent the spread of infection. | 14 (93.3) | 1 (6.7) | 0 (0.0) |
| Wearing gloves eliminates the need to wash hands.                       | 3 (20.0) | 11 (73.3) | 1 (6.7) |
| **Environmental controls**                                               |     |     |            |
| Keeping doors and windows of the ward open helps to reduce the spread of TB | 12 (80.0) | 2 (13.3) | 1 (6.7) |
| Most DR-TB transmission occurs inside the hospital/facility/ward         | 8 (53.3) | 6 (40.0) | 1 (6.7) |
| Patients suspected or confirmed to have DR-TB should be kept separately from the rest of the TB patients | 15 (100.0) | 0 (0.0) | 0 (0.0) |
| Fans (Ventilators) can be used in TB wards to reduce the transmission of TB | 13 (86.6) | 1 (6.7) | 1 (6.7) |
| **Cough hygiene**                                                       |     |     |            |
| TB patients must be educated to cover their mouth with a handkerchief or scarf while coughing | 15 (100.0) | 0 (0.0) | 0 (0.0) |
| **Administrative control**                                               |     |     |            |
| Regular screening of the HCWs for presence of TB is one of the TB infection control measures | 12 (80.0) | 0 (0.0) | 3 (20.0) |
| Implementation of effective TB infection control measures can prevent transmission of TB in hospitals | 14 (93.3) | 0 (0.0) | 1 (6.7) |

HCWs: Healthcare workers; TB: tuberculosis; DR-TB: drug resistant tuberculosis; HIV: Human Immuno-deficiency virus
Table 5: Knowledge assessment of TB-IPC among lab staff (n = 8)

| Question                                                                 | Yes  | No   | Don’t know |
|--------------------------------------------------------------------------|------|------|------------|
| **Measures**                                                             |      |      |            |
| Which of the following are set of essential biosafety measures required  |      |      |            |
| to minimize risks?                                                       |      |      |            |
| Codes of practice                                                        | 8 (100.0) | 0 (0.0) | 0 (0.0)   |
| Bio safety equipment                                                     | 8 (100.0) | 0 (0.0) | 0 (0.0)   |
| Laboratory designs and facilities                                        | 8 (100.0) | 0 (0.0) | 0 (0.0)   |
| Training                                                                 | 8 (100.0) | 0 (0.0) | 0 (0.0)   |
| Waste handling                                                           | 8 (100.0) | 0 (0.0) | 0 (0.0)   |
| **Risk**                                                                 |      |      |            |
| Factors that increase the risk of infection in the lab:                  |      |      |            |
| Bench spaces may be used improperly                                      | 7 (87.5) | 1 (12.5) | 0 (0.0)    |
| Specimen containers may leak                                             | 7 (87.5) | 1 (12.5) | 0 (0.0)    |
| Specimens manipulated carelessly may lead to subsequent aerosolization  | 7 (87.5) | 1 (12.5) | 0 (0.0)    |
| Specimens may be shaken vigorously                                       | 7 (87.5) | 1 (12.5) | 0 (0.0)    |
| Ventilation or illumination may be poor                                  | 8 (100.0) | 0 (0.0) | 0 (0.0)    |
| **PPE**                                                                  |      |      |            |
| Protective laboratory coats are always not necessarily to be worn in the  | 0 (0.0) | 8 (100.0) | 0 (0.0)    |
| TB laboratory                                                            |      |      |            |
| A wet or dirty N95 or surgical mask can still be used                    | 0 (0.0) | 8 (100.0) | 0 (0.0)    |
| **Hand hygiene**                                                         |      |      |            |
| Handwashing is the most preventative method to prevent the spread of     | 8 (100.0) | 0 (0.0) | 0 (0.0)    |
| infection.                                                               |      |      |            |
| Wearing gloves eliminates the need to wash hands.                        | 1 (12.5) | 7 (87.5) | 0 (0.0)    |
| **Administrative controls**                                              |      |      |            |
| Bench space used to process sputum specimens should be separate from     | 8 (100.0) | 0 (0.0) | 0 (0.0)    |
| areas used to receive specimens and from administrative areas used for   |      |      |            |
| paperwork and telephones.                                                |      |      |            |
| Ventilated workstations are an optional solution for aerosol              | 5 (62.5) | 3 (37.5) | 0 (0.0)    |
| containment                                                              |      |      |            |

PPE: Personal Protective Equipment; TB: Tuberculosis

BARRIERS FOR TB-IPC IMPLEMENTATION

Two overarching themes were identified as barrier and enabler to implementation of TB IPC: “poor administrative policy” and “behavior and attitude”. Five sub-themes were identified as barriers and three sub-themes as enablers that impede the implementation and practice gap.

POOR INFRASTRUCTURE

The main challenge for effective implementation in health facilities is the lack of proper infrastructure in the lab or in the ward. Many reported difficulties in implementing when the infrastructure is small and congested.

"... When they initially designed, I think they did not take it for consideration. So, the rooms are congested, and ventilation is not that good ...." - Male, laboratory in-charge.

In one facility, HCWs complained that there was no TB ward. They used a small vacant space with no proper ventilation and toilets.

"... At present, we do not have a ventilated room for the TB ward and exhaust fans are also not available. There is no attached toilet for the patients, which makes the patients use other common toilets posing high risk to the other users ...." - Female, TB focal.

INADEQUATE RESOURCES

A consistent comment across participants was about limit-
Table 6: TB patient responsiveness to TB-IPC practices (n = 58)

| Statement                                                                 | Strongly disagree | disagree | Agree | Strongly agree |
|---------------------------------------------------------------------------|-------------------|----------|-------|---------------|
| TB is transmissible through air.                                           | 2 (3.4)           | 3 (5.2)  | 24 (41.4) | 29 (50.0)     |
| Keeping windows open whenever possible will increase natural ventilation  | 3 (5.2)           | 2 (3.4)  | 36 (62.1) | 17 (29.3)     |
| and reduce circulation of TB aerosols.                                    |                   |          |        |               |
| Covering mouth while coughing/sneezing will help reduce the spread of    | 3 (5.2)           | 2 (3.4)  | 26 (44.8) | 27 (46.6)     |
| bacteria in the air.                                                      |                   |          |        |               |
| Wearing mask will help stop the spread the TB to others.                  | 3 (5.2)           | 7 (12.1) | 22 (37.9) | 26 (44.8)     |
| You should collect your sputum only in the designated area.               | 2 (3.4)           | 6 (10.3) | 26 (44.8) | 24 (41.4)     |
| Washing hands with soap and water prevents the spread of infection.      | 3 (5.2)           | 1 (1.7)  | 32 (55.1) | 22 (37.9)     |
| The mask should be changed whenever it is wet, soiled and dirty.         | 3 (5.2)           | 0 (0.0)  | 29 (50.0) | 26 (44.8)     |
| Your sputum waste and other waste should be discarded in a proper        | 2 (3.4)           | 1 (1.7)  | 28 (48.3) | 27 (46.6)     |
| designated waste bin.                                                     |                   |          |        |               |
| Your visitor should wear mask when they visit you at the facility.        | 3 (5.2)           | 0 (0.0)  | 14 (24.1) | 41 (70.7)     |

TB: Tuberculosis

ed logistics and other resources that are important for implementation. The main logistical barrier was believed to be the shortage of N95 masks.

".... Sometimes, we do not have an adequate N95 mask, whereby staff during that period they have to use a simple surgical mask ...." - Male, infection control focal.

STAFFING

Another perceived consequence of staff shortage was that those people responsible for the implementation of IPC were also under pressure with multisasking responsibilities. This was perceived to have negative consequences on the ability to deliver effective and optimal practices, as explained by:

".... The lack of human resources makes them too busy to adhere properly ...." - Male, infection control focal.

BEHAVIOR AND ATTITUDE

Behaviour and attitude are noted as the main barriers to facilitating the good implementation by the participants. Staff negligence, forgetfulness, and lack of interest leaves staff feeling demoralized and unable to accept additional challenges required by implementing the intervention. To encourage uptake, the behavior and perceptions of service providers and recipients need to change:

".... I feel it is individual concept, behaviour, and culture. This is a very serious issue. The concept and perception are hard to change in individual ...." - Male, infection control focal.

INADEQUATE DISSEMINATION OF GUIDELINES

Many respondents expressed TB IPC components lacking details in the guidelines. They decried it as a negligence of the program. TB transmission can be preventable; however, most guidelines currently only address a single type of program or a component. Hence, proper dissemination is critical to adopting supported interventions to expand practices.

".... In general sense, this program is not given much attention. .... Just giving out the new protocol will not work ...." - Male, infection control focal.

".... We do have general IPC guidelines, but not laboratory practices to be clear. It is for the overall IPC practices ...." - Male, laboratory in-charge.

ENABLERS FOR TB-IPC PRACTICE IMPLEMENTATION

SENSITIZATION AND TRAINING

Health professionals reported that their knowledge comes from sensitization and training. Many of them highlighted that lack of provider knowledge or awareness of guidelines, attitudinal barriers including disagreement with guidelines, lack of self-efficacy, lack of outcome expectancy, and incompetence with the practices would be overcome if there is regular sensitization:

".... To achieve this, there should be a sensitization program and later a cascade training for the other staff to share their knowledge and skills ...." - Male, laboratory in-charge.

SUPERVISION AND MONITORING

Supervision and monitoring are one of the most enabling factors as expressed by all respondents. Having a regular and dedicated team to supervise and monitor and come up with recommendations on TB-IPC practices will enhance
the uptake and facilitate and promote joint problem-solving approaches.

   ".... Doing supervision and monitoring on a regular basis and asking questions on the practices will make implementation easy ...."- Male, infection control focal.
   ".... Monitoring and evaluation require monitoring on site and then coming up with feedback to improve the practices ...."- Male, laboratory in-charge.

COLLABORATION AND COORDINATION

Collaborations and co-ordination among departments and organizations emerged as key enablers facilitating successful implementation of practices. Participants commented that information sharing and involving relevant people were particularly important in terms of facilitating greater engagement and ensuring wide dissemination of information and knowledge sharing.

   ".... I always suggest my management that IPC and waste management cannot be dealt by a single person. It should be a collaborative and coordination among the staff and beyond the organization ...."- Male, infection control focal.

DISCUSSION

This study assessed health workers and TB patient’s adherence to TB infection prevention and control practices. Additionally, we also assessed enablers and barriers to implementation. Our study’s main findings were poor rate of adherence and responsiveness with overall good knowledge among health workers.

ADHERENCE TO TB-IPC PRACTICES

Our findings revealed that both HCWs and patients had poor level of adherence, in line with other studies that found even lower reported levels of compliance.\(^{20,21}\) However, our findings differ from studies that reported directly observed healthcare worker’s IPC practices or self-reported compliance exceeding 90% compliance with IPC, and over 62% of HCWs deemed to have good overall practice scores, with only 1% receiving a poor score.\(^{22,23}\) The lower level of adherence scores may be attributable to HCWs and patient’s behaviour and attitudes towards practices. These were mostly related to overburden work responsibilities and insufficient staff, willingness to work in the TB ward and ignorance from the patients despite repeated advice. The lack of proper facilities and inadequate resources contributed, in accordance with previous reports.\(^{23,24}\) The majority of lab staff reported that lab footwear was not used inside the laboratory. There was confusion regarding whether lab footwear should be worn inside the laboratory or not. Whilst, WHO\(^{25}\) mandated the use of laboratory foot wears while working inside the laboratory, some staff believed that wearing laboratory foot wear is not necessary. Clear and consistent guidelines need to be in place across hospitals for better adherence.\(^{26}\) Non-participatory observations of health facilities found that none had written SOP on TB-IPC. Precaution signage and promotional materials are not in place encouraging low adherence, in contrast with findings from a previous study.\(^ {26}\)

HEALTH CARE WORKER’S KNOWLEDGE

Many HCWs have good overall knowledge of TB-IPC practices. Almost half of the respondents were highly educated, which explains the high rate of good knowledge. In addition to good overall knowledge, they reported good knowledge of hand hygiene, PPE, safety measures, and mode of transmission. While this finding contrasts with some studies,\(^ {19,22,28}\) it is congruent with other studies.\(^ {17,24}\) HCWs emphasised the need to attend sensitization training and supervision programs. Sensitization and continuous re-training appear to be strong determinants of knowledge of TB-IPC, while knowledge of TB-IPC is a strong predictor of good practices.\(^ {24}\) The relatively low level of knowledge regarding respirator use and fans/ventilators is probably due to the unavailability of these supplies; hence, the availability of these supplies can improve their utilization and enhance their knowledge.

PATIENT’S RESPONSIVENESS

The patient’s responsiveness shows disagreement with most of the TB-IPC practices. This finding raises the possibility that patients are either not knowledgeable, not aware of the practices, or not engaged in the interventions. This could be due to a lack of environment and administrative controls, social, and cultural influences that might have contributed to patient experiences.\(^ {25}\) Maldistribution in health facilities for TB admission and human resources might partially explain the poor experience of patients.\(^ {30}\)

BARRIERS AND ENABLERS FOR TB IPC IMPLEMENTATION

Perceived barriers to the implementation of TB-IPC in this study included poor administrative policies, limited human resources, inadequate infrastructure, and limited logistics. These findings are similar to those of previous studies.\(^ {1,31}\) Additionally, enhanced infrastructure is needed to improve TB IPC practices. Deficiencies were due to lack of supervision and monitoring, weak managerial and administrative support, poor funding, or over dependence on donor funds. Other researchers have also cited similar reasons for poor environmental control measures.\(^ {31}\)

Another barrier to adherence is IPC protocols, which were neglected by program implementers. The TB-IPC program should be given due importance and implemented fully. The practice of hand hygiene was particularly good for all respondents, but there appeared to be misconceptions among few health care workers that glove use eliminates the need to wash hands. Hand antisepsis using alcohol was almost never practiced by the majority of patients owing to the unavailability of alcohol-based solutions inside the ward. This finding is consistent with existing evidence that the use of gloves represents a major barrier to compliance to hand antisepsis.\(^ {26}\) The availability of hand hygiene resources is indispensable for healthcare workers and patient’s adherence.\(^ {23,52}\)

Physical infrastructure to admit patients and inadequate spaces in the laboratory poses a challenge. Strict adherence to contact precautions is crucial to avoid nosocomial transmission and prevent the development of DR-TB. Thus, adequate physical infrastructure and guidelines are essential.\(^ {32}\) Improved communication, coordination and collaboration, sensitization and re-training can enhance adherence and improve implementation. However, behavioural and attitudinal changes remain challenging.

STRENGTHS AND LIMITATIONS

Fidelity assessment is not routinely done thus can serve as a
baseline for future study. The identified barriers could serve as a baseline to designing interventions. No observations were conducted to observe the practices, but a non-participatory observational checklist was maintained for a better understanding of the data collected. Adherence to practices might have been over/underestimated since respondents can be influenced by potential recall or reporting bias. The data collected may not be exhaustive; however, they offer enough insights into IPC practices that may encourage other hospitals to review practices and guidelines.

CONCLUSIONS

There was poor adherence and response level regarding TB-IPC among the study participants. Overall, good knowledge did not have a positive influence on adherence. Even though IPC is implemented in healthcare settings, it has not received enough attention. There is an (unsupported) impression that IPC practice implementation is good and further improvements are not necessary. Notwithstanding, continuous improvement through in-service educational programs, sensitization, and training on a regular basis are needed and require urgent attention. Replication of similar studies in other health facilities is recommended and should be designed for more applicability to other contexts.

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