



TUBERCULOSIS INFECTION CONTROL MANUAL

**National TB Programme
Department of Public Health
Ministry of Health and Sports
The Republic of the Union of Myanmar**

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FOREWORD

Tuberculosis (TB) is a major public health problem in Myanmar, and people with untreated infectious TB are the source of transmission. Unless TB is considered when individuals attend healthcare services, diagnosis will be delayed or missed altogether, and effective TB infection control (TB-IC) measures might not be in place.

The National Tuberculosis Programme (NTP) has expanded TB/HIV collaborative activities and Programmatic Management of Drug-resistant TB (PMDT) to all townships. There will be higher numbers of cross referrals between TB and HIV clinics to provide comprehensive care to people living with HIV (PLHIV). Similarly, there will be more patients with multi-drug resistant TB (MDR-TB) who will be admitted at public hospitals for the management of drug side effects in the course of their MDR-TB treatment. Therefore, good TB-IC practice has to be planned and implemented in general healthcare settings to minimise nosocomial infection of both sensitive and drug-resistant TB (DR-TB) and to protect health care workers (HCWs) from acquiring TB.

In 2014, the first edition of the Manual was developed by the NTP in collaboration with the World Health Organization (WHO). It has been crucial in establishing a programme for the implementation of control measures in healthcare facilities. This, the second edition of the Manual, provides updates based on new knowledge and lessons learnt during implementation of the first edition. The second edition was developed by the NTP in collaboration with the Challenge TB project. The draft of the second edition has been reviewed during a consultative expert meeting of relevant national and international partners working on tuberculosis prevention and care in the country.

This Manual is complementary to the overall infection prevention and control (IPC) policy of the Ministry of Health and Sports (MOHS) of Myanmar and is meant to assist in the establishment of a framework for TB-IC in healthcare facilities, as well as in those congregate and community settings where the potential for transmission of TB is likely to be high. The Manual provides both managerial and operational guidance.

While the Manual is based on internationally accepted TB-IC standards, the recommended control measures, work practices and procedure instructions (simple standard operating procedures) have to be tailored to different sites and settings across the country depending on the disease burden and availability of resources.

The Manual is intended to be used by:

- Basic health staff;
- Community volunteers;

- Health staff working in public and private hospitals and clinics, especially the members of IPC committees;
- Specialized health staff working in TB hospitals, TB-HIV and MDR-TB Partners' clinics;
- TB coordinators at the Regional/State, District and Township level;
- Private practitioners;
- Managers of private and state-owned business enterprises and companies responsible for the housing conditions and work environment of their workers.

Finally, NTP likes to express special thanks to , WHO, CDC, USAID, FHI360, PSI, MSF, KNCV, MAM, SCI, 3MDG and the MMA for the support they provided during the review of this second edition of the TB-IC Manual.

National Tuberculosis Programme

Department of Public Health

Ministry of Health and Sports

LIST OF ABBREVIATIONS

AC	Air Conditioning
ACH	Air Changes per Hour
AFB	Acid-fast bacilli
AIDS	Acquired immunodeficiency syndrome
AIIR	Airborne Infection Isolation Room
ART	Antiretroviral therapy
CDC	Centres for Disease Control and prevention
CXR	Chest X-ray
DM	Diabetes Mellitus
DOPH	Department of Public Health
DOTS	Directly Observed Treatment Short-Course
DR-TB	Drug-resistant tuberculosis
DST	Drug susceptibility testing
FHI 360	Family Health International
GUV	Germicidal UV
HC	Health centre
HCW	Health care worker
HEPA	High-Efficiency Particulate Air
HIV	Human immunodeficiency virus
IC	Infection Control
ILO	International Labour Organisation
INH	Isoniazid
IPC	Infection Prevention and Control
IPT	Isoniazid Preventive Therapy
KNCV	KNCV Tuberculosis Foundation
LPA	Line Probe Assay
LTBI	Latent Tuberculosis Infection
MDR-TB	Multidrug-resistant tuberculosis
M&E	Monitoring and Evaluation
MMA	Myanmar Medical Association
MOHS	Ministry of Health and Sports
MSF	Médecins sans Frontières
NGO	Nongovernmental organization
NTP	National Tuberculosis Programme

OPD	Out-patient department
PSI	Population Services International
PLHIV	People Living with HIV
PTB	Pulmonary tuberculosis
RR-TB	Rifampicin-resistant TB
R/S	Regional/State
R/S TBC	Regional/State Tuberculosis Centre
TB	Tuberculosis
USAID	United States Agency for International Development
UV	Ultraviolet
UVC	Ultraviolet-C
UVGI	Ultraviolet Germicidal Irradiation
WHO	World Health Organization
XDR-TB	Extensively drug-resistant tuberculosis

INTRODUCTION

The potential impact of TB transmission in healthcare and congregate settings on global TB morbidity and mortality has highlighted the urgent need to refocus attention on TB-IC. TB-IC prioritisation needs to be improved and changed urgently and drastically because of the threat posed by HIV infection and the emergence of MDR-TB and XDR-TB. PLHIV have a much higher risk of developing TB after being infected with Mycobacterium Tuberculosis and DR-TB is associated with very high mortality rates in PLHIV. Although all HIV infected patients with presumptive TB have to undergo Xpert testing according to national guidelines, they may not be able to produce sputum or test sputum-smear negative. Many of them have extra-pulmonary TB.

The association of TB and HIV/AIDS and the rather limited attention paid to TB transmission in healthcare, congregate and community settings have created a suitable environment for transmission of susceptible as well as drug-resistant forms of TB among patients, HCWs, other people living and working in congregate and community settings.

Weak health systems in general, and weak TB control programmes in particular, have caused MDR-TB to emerge in settings where directly observed TB treatment short-course (DOTS) was introduced in the absence of a strong public health programme. High lost-to-follow-up rates and poor clinical practice have resulted in increasing MDR-TB rates in new and previously treated patients. Ineffective treatment of these patients with second-line TB drugs has resulted in extensively drug-resistant tuberculosis (XDR-TB).

Emerging evidence suggests that in the absence of effective TB-IC, DR-TB will arise, leading to high morbidity and mortality among both patients and HCWs¹. The MOH is obligated to protect both HCWs and patients from acquiring TB infection both in the course of their professional practice and when seeking care in healthcare facilities, or living in congregate and high burden community settings. The implementation of TB-IC measures in healthcare facilities should therefore be a priority. Most of the TB-IC measures, work practices and procedure instructions, simple standard operating procedures (SOPs), outlined in this Manual also apply to airborne infection control in general.

TB-IC is a combination of measures aimed at minimising the risk of TB transmission. The foundation of such infection prevention and control is early and rapid diagnosis, prompt and effective treatment and proper management of TB patients. TB-IC requires and complements the implementation of core interventions in TB control, HIV control and strengthening of health systems. TB-IC should be part of general IPC policies, and should maximise synergies between

¹ Baussano I, Nunn P, Williams B, Pivetta E, Bugiani M, Scano F. (2011). Tuberculosis among health care workers. *Emerg. Infect. Dis.* 17(3):488-94

programmes that deal with infection prevention and control, and those focusing on TB and HIV control. TB-IC cuts across disciplines. The measures taken to reduce transmission strengthen the health services because, in their design and implementation, they draw from different areas of expertise, and they improve collaboration between disciplines. Once established, a sound IPC framework can provide a basis from which other programmes can benefit.

The specific TB-IC measures in this Manual are adapted from the WHO Policy on TB infection control in healthcare facilities, congregate settings and households² and include four major focus areas: (i) managerial activities at the national, sub-national and healthcare facility levels; (ii) administrative controls; (iii) environmental controls; and (iv) personal protective equipment (PPE).

The purpose of this Manual is to guide efforts aimed at reducing TB transmission in healthcare facilities, congregate settings such as crowded prisons, hostels, factories, as well as households of TB patients and the community at large, through the implementation of evidence-based, cost-effective and affordable TB-IC measures. The implementation shall be monitored closely to inform the NTP that TB-IC targets of the national strategic plan are met. To facilitate the implementation of TB-IC measures two companion documents have been developed: A Trainers' Manual and a Job Aids Package.

The process of producing the second edition of this TB-IC Manual started with a situational analysis in 2015, which included consultations with relevant stakeholders at all levels of the healthcare system, reviewing the first edition of the Manual which was developed in 2014. Input obtained from this process was consolidated to produce an updated draft Manual. After a consultative expert meeting, the second draft was produced. This draft was widely disseminated for additional input and then forwarded for review by the NTP. The final version was submitted to the MOHS for endorsement.

² World Health Organization (2009). WHO Policy on TB infection control in healthcare facilities, congregate settings and households, Geneva. WHO/HTM/TB/2009.419

CHAPTER 1

DETERMINANTS OF TRANSMISSION

TB is caused by *Mycobacterium tuberculosis* (*Mtb*). Droplets of 1 to 5µm (droplet nuclei³) invisible to the naked eye, containing *Mtb* are formed when a person with TB of the lung or larynx coughs, sneezes, laughs or speaks. Droplet formation can also occur in laboratories, autopsy rooms or during high-risk aerosol-producing procedures such as bronchoscopies and sputum induction. Droplet nuclei laden with bacilli remain suspended in air for long periods of time, while the bigger droplets fall to the floor quite quickly. Infection occurs when a susceptible person inhales one or more droplet nuclei containing *Mtb*, which then lodge in the alveoli of the lungs. Once in the lungs, the bacilli may then spread all over the body and TB disease may develop soon after infection. In most persons an immune response generated within two to ten weeks of infection, limits further multiplication and spread of the TB bacilli. More often, the bacilli remain dormant and viable, a condition called latent tuberculosis infection (LTBI). Persons with LTBI do not have the symptoms of active TB and are not infectious.

A person who has symptoms suggestive of TB, but in whom the diagnosis is yet to be made, should be considered infectious until diagnostic investigations are completed, while a person with TB of the lungs or larynx is considered infectious until the person has completed at least two weeks of anti TB treatment and whose symptoms have improved.

The probability of transmission of TB depends on the **infectiousness of the index patient**, the **environment**, **exposure** and the **susceptibility** of a contact.

³ In the case of droplet transmission patients with respiratory infections such as flu and SARS produce larger droplets. In the case of airborne transmission patients with pulmonary and laryngeal TB or measles produce smaller droplets, called droplet nuclei.

Table 1: Factors for Transmission of TB

Infectiousness	Environment	Exposure	Susceptibility
<ul style="list-style-type: none"> • TB disease of the lungs or larynx • Virulence • Lung cavities • Sputum smear positivity • Presence of cough • Undergoing cough-inducing or aerosol-generating procedures • Not on effective treatment 	<ul style="list-style-type: none"> • Small, enclosed spaces • Inadequate ventilation which results in the insufficient dilution or removal of airborne droplet nuclei • Inadequate direct sunlight • Recirculation of air, containing droplet nuclei • Inadequate cleaning and maintenance of equipment such as units for germicidal ultraviolet (GUV) and electrical fans 	<ul style="list-style-type: none"> • Proximity • Duration • Number of infected patients (overcrowding) • Number of airborne droplet nuclei in the room • Patients not covering mouth and nose while coughing • Improper laboratory procedures when handling samples 	<ul style="list-style-type: none"> • Weakened immune system <ul style="list-style-type: none"> ◦ HIV ◦ DM ◦ Age ◦ Drug dependency ◦ Alcohol dependency • Chronic disease • Smoking • On medication: anti-cancer immunosuppressive therapy, TNF-alpha blockers and long-term steroid therapy

Infectiousness

Sputum smear positivity:

The infectiousness of a patient is determined by the number of viable bacilli in the sputum. An infectious TB patient can infect 10-15 persons per year, in particular household and close contacts.

Exposure

Number of infected patients (overcrowding):

Large numbers of TB patients cared for in a healthcare facility or congregate setting, particularly those not yet diagnosed and not receiving treatment, are associated with an increased risk of (nosocomial) transmission. These numbers vary from facility to facility and setting to setting, and depend upon the prevalence of TB. In Myanmar, undiagnosed TB patients are likely to be present in outpatient departments (OPDs), HIV care clinics and prisons and they may also be found in other areas of the healthcare facility and other congregate settings.

Exposure

Duration of exposure:

The risk of transmission increases with close and prolonged⁴ contact with an infectious TB patient. Early intervention with appropriate chemotherapy reduces the time of infectiousness. Conversely, prolonged transmission occurs where TB goes unrecognised as well as when the chemotherapy is ineffective due to improper medicine combinations, poor adherence, lower dosages, malabsorption, medicine interactions or TB strains resistant to the prescribed medicines.

Susceptibility

Progression to disease following infection:

HIV infection is the highest risk factor for progression from LTBI to TB disease. PLHIV may become infected or re-infected with Mtb when they are exposed to someone with infectious TB. They can progress rapidly from infection to disease (over a period of weeks/months rather than years as is common with immunocompetent individuals). Also those with other medical conditions such as silicosis, diabetes mellitus, malignancies, chronic renal failure and other diseases which compromise the immune system have a higher risk of disease following infection.

⁴ The risk of developing disease after infection is much greater for infants and young children under 5 years of age. If disease does develop, it usually does so within 1 year of infection, but in infants the time-lag can be as short as a few weeks (Guidance for national tuberculosis programmes on the management of tuberculosis in children, 2nd ed. Geneva, World Health Organization, 2014).

Occupational risk for HCWs:

HCWs whose work entails regular, direct patient contact in healthcare settings where the risk of TB transmission is not assessed and effective TB-IC is not implemented and routinely adhered to have a three to five times higher risk of contracting TB than the general population. In particular, HCWs who undertake high-risk activities which include cough-inducing procedures (e.g. sputum induction, bronchoscopy and intubation), autopsy, morbid anatomy and pathology examination, and laboratory procedures such as the handling of cultures of Mtb have a higher risk of occupational TB. Medical and nursing students are often re-infected as suggested by tuberculin conversion studies. HCWs with duration of employment of more than ten years have a higher risk to be found with active TB disease. Laboratory and radiology staff is at the highest risk of contracting TB. The International Labour Organisation (ILO) has added TB to the occupational disease list in 2010⁵.

⁵ ILO List of Occupational Diseases (revised 2010)

CHAPTER 2

Managerial Activities

Managerial activities are policy and programme level activities which need to be in place to facilitate the implementation of effective TB-IC. The selection of the combination of control measures will be based on the situational analysis and TB-IC assessment of healthcare facilities, congregate and community settings. At facility level, the managerial activities ensure the smooth implementation of control measures at specific patient service areas: departments and rooms.

2.1 Managerial activities at national and sub-national level

- Establish coordinating bodies at all levels of the health system
- Assess the TB-IC
- Develop and revise national policy and guidelines
- Plan implementation and scale-up, ensuring the availability of the necessary resources, including commodities and human resource development
- Increase community awareness
- Enhance communication between disease programmes and with other relevant administrative government bodies
- Set up surveillance activities, including HCWs diagnosed with TB
- Monitor (frequent) and evaluate (periodic) implementation
- Conduct operational research

2.2 Managerial activities at healthcare facilities and congregate settings

- Assign a responsible committee/focal person
- Conduct a facility TB-IC assessment and re-assessments with technical support from region, state or district supervisors
- Plan TB-IC activities as integral part of the annual facility plan
- As part of the plan, rethink patient flow and the use of spaces, and consider renovations and installation of fans and GUV units
- Determine need for training & refresher training every 2 years
- Ensure visible TB-IC information, available in the local language for staff, patients and visitors

- Monitor occurrence of TB disease among staff and do TB screening, if the notification rate is 1% or more (approximately three times of the general population rate)
- Monitor the implementation of the plan (dashboard) and staff compliance with standards
- Participate in operational research to measure and improve the effectiveness of TB-IC

Training

TB-IC is only effective if each staff understands the importance of TB-IC work practices and their role and responsibility for implementing and following safe work practices and procedure instructions (simple SOPs). Each staff should receive instructions appropriate to their job category. All members of staff and volunteers, including those who do not directly provide TB care, such as administrators, cleaners, drivers, data clerks and security guards should undergo training and re-training every two years (formal/orientation/in-service) on the risks of TB transmission.

Training should include the following components:

- Basic concepts of TB transmission
- Epidemiology of TB and the risk factors for developing TB disease, including the occupational risk of TB disease among HCWs
- The facility's TB-IC planned activities, the prioritised combination of TB-IC measures, related work practices and procedure instructions (simple SOPs)
- The symptoms of TB to ensure staff and volunteers are screened and treated early

The facility TB-IC assessment

Assessing the facility for risk of TB transmission is a first step in developing TB-IC activities as part of an overall costed annual facility (IPC) plan. The risk will depend on the population served, climate, infrastructure, services provided, procedures performed, disease burden, behaviour of patients, knowledge of staff and compliance with safe work practices and standards.

The facility TB-IC plan

The facility TB-IC plan should specify the control measures and the name/designation of a responsible person, for each setting (room, space, department or service area) at the facility.

HCW surveillance and screening for TB

The following should be done for all HCW and volunteers in regular contact with TB patients:

- A baseline clinical examination and chest X-ray (CXR) should be done at the time of recruitment **using a screening checklist**
- A clinical examination should be performed once per year (using the screening checklist in Annex B)
- An annual CXR should also be taken when the HCW is working in a high-risk environment (e.g. laboratory, radiography and MDR-TB clinic staff) as per facility TB-IC assessment, or when TB is clinically suspected and when TB among HCWs occurs at a rate of 1% or more
- Free screening and investigations for TB and HIV should be available in case of symptoms compatible with TB or HIV
- All HCWs with presumptive TB should have priority access to diagnosis as per international guidelines⁶
- A patient who belongs to a risk group i.e. HCW should be stated in the Remarks column of the Township TB Register

Monitoring and Evaluation (M&E)

There should be continuous collection and periodic analysis of data to identify strengths and weaknesses in implementation of TB-IC and any (un-)desirable trends. The following are objectives of monitoring and evaluating of TB-IC measures:

- To facilitate the most effective and efficient use of human and financial resources to achieve maximum health benefit for the population served
- To provide information to inform and improve programme management. In this regard M&E of TB-IC can help to:
 - Measure programme performance in TB-IC
 - Ensure quality and effectiveness in service provision
 - Measure progress towards the achievement of specific objectives
- To help promote service quality improvement
- To define roles and responsibilities of staff, and to improve accountability
- To attract resources for TB-IC

⁶ World Health Organisation (2010). Joint WHO-ILO-UNAIDS policy guidelines for improving health worker access to HIV and TB prevention, treatment, care and support

The National Expert DR-TB Committee is responsible for guiding the Region/State Committee for MDR-TB Management that directly monitors, evaluates and makes recommendations on the overall proper implementation of the TB-IC measures, work practices and procedures, as well as activities at all levels of the healthcare system: hospitals, Region/State TB Centres (TBCs) and Township Health Centres (HCs). Additionally, the National Expert DR-TB Committee and the Region/State Committee for MDR-TB Management are responsible for conducting periodic supervision of TB-IC at hospitals, Region/State TBCs, Township HCs, and MDR-TB patients' homes. Focal points are assigned at each level to conduct supervision. At NTP level one of the assistant directors is acting as a focal person for country TB-IC.

Annually, the following five WHO standards⁷ will be monitored by the assigned focal point persons:

- There is a written facility IPC plan (that includes TB-IC)
- There is a designated person (and committee in larger facilities) responsible for implementing TB-IC practices in the facility
- TB symptoms occurring among staff are immediately screened, and, if TB is diagnosed, treated, registered and reported to NTP.
- Patients with a cough are identified on arrival at the facility, given guidance on cough etiquette and fast-tracked through all waiting areas, including consultation, investigations and drug collection
- Waiting areas are well ventilated (i.e. windows and doors open when feasible) and there is clear display of messages on cough hygiene in all areas frequented by patients

Minimum TB-IC monitoring checklist will be monitored by the healthcare facilities on a quarterly basis as integral part of IPC quality monitoring and improvement. To meet the requirements eight of the ten standards must be met. Minimum TB-IC monitoring checklist will be monitored at national, regional and state levels. See Annex B for the tool of Minimum TB-IC monitoring checklist with TB-IC standards.

⁷ World Health Organization (2015) Checklist for Periodic Evaluation of TB Infection Control in Health-Care Facilities

CHAPTER 3

TB Infection Control Measures

Airborne infection control including TB-IC measures, complement the standard precautions and other transmission-based precautions.

Standard precautions include the following:

- Hand Hygiene
- Personal Protective Equipment (PPE)
- Safe Injection Practices
- Needle prick injury and Sharps Injury Prevention
- Cleaning and Disinfection
- Waste Disposal

Transmission-based precautions include the following:

- Contact precautions
- Droplet Precautions
- Airborne Precautions

TB-IC is based on a hierarchy of controls, namely administrative and environmental controls, and PPE.

Each control operates at a different level in the TB transmission process:

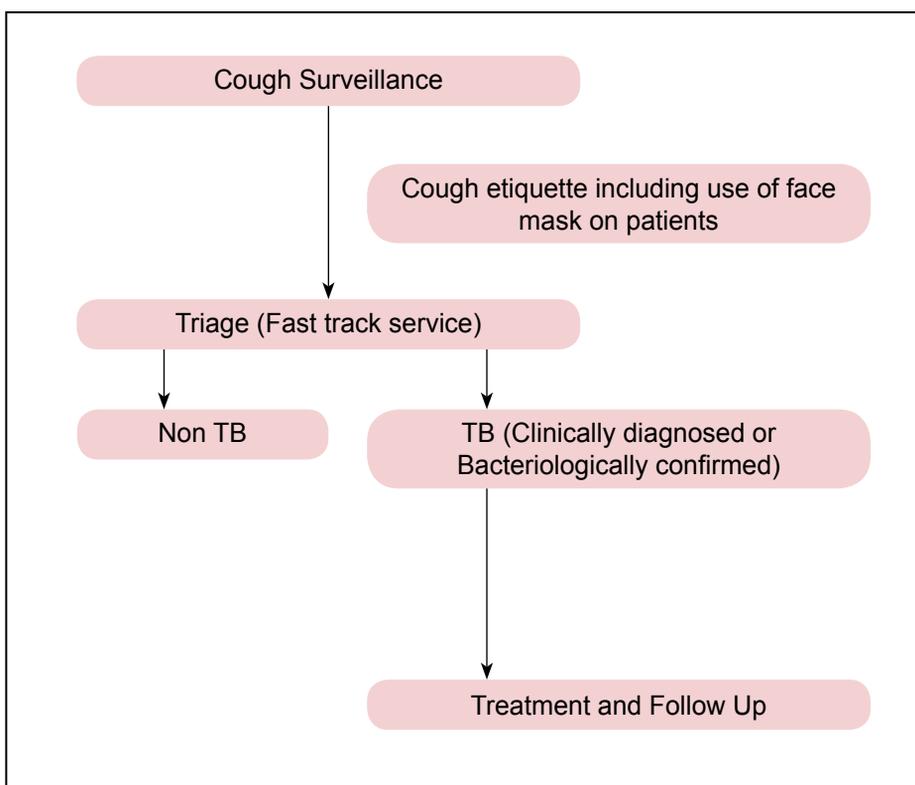
- Administrative control measures reduce the chances of exposure to airborne droplet nuclei
- Environmental control measures reduce the concentration of airborne droplet nuclei
- Personal protective equipment protects HCWs from inhaling infectious droplet nuclei

3.1 Administrative controls

- Promptly identify persons with symptoms suggestive of TB (triage)
- Separate or isolate potentially infectious patients
- Control the spread of pathogens (cough etiquette)
- Minimise time spent in healthcare facilities by persons with symptoms suggestive of TB
- Provide a package of HIV and TB care and prevention, that may include TB screening for staff.

Administrative control measures serve as the first line of defence against the spread of TB. They have the potential to have the greatest impact on preventing the transmission of TB and should be prioritised in all healthcare facilities and congregate settings. These control measures, respective work practices and procedures prevent droplet nuclei containing Mtb from being spread in the facility, hence reducing the risk of exposure to TB for both HCWs and patients.

Administrative controls consist of a combination of appropriate and applicable measures to implement cough surveillance, educate them on cough etiquette, separate the presumptive TB cases from other patients and placed in well ventilated waiting area, assist them with priority to reduce their exposure time to others and diagnose/treat them with minimal delay. Confirmed or clinically diagnosed TB patients should be followed up or given consultation in a separate area.



Hospitalisation should be reduced or avoided to the greatest extent possible. Hospitalised patients should be separated (cohorted) according to their bacteriological status, drug-resistance profile and HIV status. See Annex A for work practices and procedure instructions (simple SOPs) to implement the administrative controls.

The FAST strategy⁸ is a refocused approach to stopping TB spread in healthcare facilities. FAST stands for: Finding cases Actively, Separation and Treatment. FAST focuses HCWs on the most important administrative TB transmission control intervention: effective (when appropriate: DST-based) treatment⁹. The strategy is built on a renewed appreciation of evidence showing that effective TB treatment reduces TB spread rapidly, even before sputum smear and culture turn negative. The FAST strategy can be used to reduce susceptible TB or DR-TB transmission at out- and inpatient healthcare settings. See Annex A for the work practices and procedure instructions to implement the FAST strategy.

3.2 Environmental controls

- Ensure sufficient air exchange and control airflow direction by using natural and mechanical ventilation systems
- Allow direct sunlight to enter patient care settings and other service areas
- Inactivate TB bacilli in suspended droplet nuclei by using upper-room UV, in combination with slow-moving ceiling fans.

Environmental controls are of secondary importance after administrative controls in the prevention of TB transmission. In healthcare facilities and congregate settings with inadequate administrative controls, environmental control measures alone will not eliminate the risk of TB transmission. For environmental controls to be implemented, managerial activities and administrative controls should also be in place to ensure availability of resources, the proper use and maintenance of equipment, the training of staff, etc. The choice of environmental control measures is largely determined by local factors and resources.

Environmental control measures include methods to reduce the concentration of airborne droplet nuclei, and methods to control the direction of movement of contaminated air. A variety of simple to complex environmental controls can be used to reduce the number of airborne droplet nuclei in the work environment. The simplest and least expensive technique is to remove and dilute the air from TB patient care areas away from patients without TB by maximising natural ventilation through open windows and doors. More complex and costly methods involve the use of mechanical ventilation (e.g. simple window fans to complex supply-exhaust ventilation systems) in Airborne Infections Isolation Rooms (AIIRs) or wards to evacuate contaminated room air and produce negative pressure preventing the contaminated room air from escaping into hallways and other surrounding patient care or staff areas.

⁸ Barrera E, Livchits V, Nardell EA. (2015). F-A-S-T: a refocused, intensified, administrative tuberculosis transmission control strategy. *INT J TUBERC LUNG DIS* 19(4):381–384

⁹ Farmer P, Raviglione M. (2014). Rapid impact of effective chemotherapy on transmission of drug-resistant tuberculosis: pity the guinea pig. *INT J TUBERC LUNG DIS* 18(9):1009

Directional air flow should be maintained from a “clean” area, across the HCW, across the patient, and to the outside. The area where air is entering should be located away from the exhaust area to avoid re-entry of contaminated air. See Annex A for preventive maintenance of ventilation systems.

Ventilation systems can be natural or mechanical:

- Natural ventilation relies on open doors and windows, and permanent openings to bring in air from the outside. When fresh air enters a room it dilutes the concentration of air particles inside the room, such as droplet nuclei containing Mtb. Designing rooms with adequate windows to maximise natural ventilation, can help reduce the spread of TB. A rule of thumb is openable window area of 20%, preferably at opposite walls.
- Mechanical ventilation should be considered in those healthcare facility and congregate settings where inadequate natural ventilation cannot be improved, because openable windows are far too small, or the climate does not allow having the windows open at all times, for example because it is too cold, or too dusty. Mechanical ventilation measures include electrical and wind-driven fans which may assist to (i) distribute the air (thus allowing better dilution of air), (ii) evacuate the air (fans pulling air out of a room) and (iii) maintain negative pressure ventilation systems (to ensure that air is pulled from adjacent rooms into the negative pressure patient room). Ceiling fans are primarily used for comfort, not for airborne infection control. They do not control the air flow direction. In TB-IC they are beneficial in large spaces where the natural ventilation expressed in air changes per hour (ACH) is adequate. When mechanical ventilation systems are used, management must ensure that the system is regularly maintained.

The threshold for ventilation requirements may vary according to the type of ventilation (e.g. recirculated air versus fresh air). There are two ways to measure ventilation rate: one uses the volume of the room i.e. ACH while the other takes into account the number of people occupying a room (i.e. litres/second/person). Occupancy-based measurement of ventilation rates takes into account the fact that each person should have a certain supply of fresh air. Evidence shows that for non-isolation rooms, ventilation rates lower than 2 ACH are associated with higher tuberculin conversion rates among staff. A higher ventilation rate is able to provide a higher dilution of airborne pathogens and consequently reduces the risk of airborne infections. The current WHO recommendation for an AIIR is at least 12 ACH. See Annex A for ACH measurement and calculation.

Additional methods include High-Efficiency Particulate Air (HEPA) filtration to remove infectious particles and GUV light to kill Mtb organisms. In high-risk settings where optimal ventilation cannot be achieved through natural or mechanically-aided means, properly designed, placed and maintained shielded or louvered GUV units should be considered as an effective control measure.

Ultraviolet-C (UVC) inactivates Mtb organisms when adequately exposed to the light (long enough and close enough). Effective use of GUV systems ensures that TB bacilli contained in airborne droplet nuclei are exposed to a sufficient dose of UVC at 253.7 nm to result in inactivation. At least 2.7 m ceiling height is required to be able to place fixtures with the bottom 2.3 m from the ground. If a GUV system is used, responsibility should be assigned to ensure the lamps are cleaned, maintained (replaced) and monitored (measure UV intensity), and adverse exposure is avoided. The best solution is to contract an engineering company specialized in design, installation and maintenance of medical equipment including GUV systems. The main hazard of GUV light is inadvertent keratitis and dermatitis of room occupants (patients and staff), if not designed or installed properly. See Annex A for preventive maintenance of GUV systems.

Conventional dosing guidelines for the number of GUV units per room have commonly been based on nominal electrical or UV power, not total UV unit-output, resulting in radically different numbers of unit recommendations based on different dosing formulas. There are two relatively simple dosing guidelines¹⁰, but both depend on knowledge of total GUV unit-output, and one guideline requires full gonioradiometry of units. So far, few commercially available units have been tested either for total UV output or by full gonioradiometry, and that is a major barrier. The new dosing guidelines will be either a total GUV unit-output (rather than electrical or UV lamp wattage) of 15-20 mW/m³ total room volume, or an average whole room UV fluence rate of 5-7 μ W/cm², calculated by a lighting computer assisted design programme modified for ultraviolet use.

3.3 Personal protective equipment

- Reduce the inhalation of infectious particles, by breathing air which has been effectively filtered to 0.3 microns with a particulate respirator.

Respirators are the last line of defence against TB transmission. Unfortunately, even the combination with administrative and environmental controls can never provide 100% safety. Respirators are recommended for HCWs when caring for patients with presumptive or confirmed infectious TB. In particular, respiratory protection is needed during the performance of specific aerosol-generating procedures, to supply the desired level of safety. The main limitation of respirators is that they may not be practical to wear at all times, and they are often not used when unsuspected (untreated) TB patients are being seen.

¹⁰ Mphaphlele M, Dharmadhikari AS, Jensen PA, Rudnick SN, van Reenen TH, Pagano MA, Leuschner W, Sears TA, Milonova SP, van der Walt M, Stoltz AC, Weyer K, Nardell EA. (2015). Institutional tuberculosis transmission. Controlled trial of Upper Room Ultraviolet Air Disinfection: A basis for new dosing guidelines. *Am J Respir Crit Care Med* Aug;192(4):477-84

Respirators are available in different makes, models and sizes, because of variation in the size and shape of people's faces (not 'one-size-fits-all'). Foldable respirators are preferred above cup-shaped respirators. It is recommended that HCWs be "fit tested" to ensure selection of the appropriate respirator. Qualitative fit testing of respirators should be performed to ensure that the appropriate respirator (model, type, size and shape) for each HCW is used. Fit testing should be repeated once a year and at any time when a different model or type of respirator is procured and distributed. Qualitative fit testing involves the use of an aerosol which may be "tasted". If the HCW "tastes" the aerosol (usually saccharin or a bitter-tasting material such as Bitrex) the respirator must be adjusted (i.e. the nose clip) and retested. If the HCW fails the test a second time, a different size or type of respirator should be tested. Beard and facial hair do not allow for the proper sealing of respirators to the face and therefore staff with facial hair should shave. Any leak between the face and the mask is a potential entry point for airborne droplet nuclei. See Annex A for qualitative respirator fit testing and respirator application.

Respirators are made of a material which filters out very small particles in the air (including the infectious particles in aerosols). Respirators are closely fitted to the face to prevent leakage around the edges. If the respirator is not fitted correctly, airborne droplet nuclei can easily enter a person's airway, potentially resulting in infection. Respirators manufactured with at least 95% filter efficiency for particles of 0.3 microns in diameter are usually recommended to prevent inhalation of droplet nuclei containing TB bacilli. They are disposable but can be re-used repeatedly if they are taken care of properly. The general rule is to use them for a maximum of one week if used frequently, and two weeks if not used daily.

The main factors responsible for the deterioration of respirators are humidity, dirt and crushing and relaxing of the elastic bands. They should be stored in a clean dry location. One method is to fold a light paper towel around the respirator (being careful not to crush it). Another practical method is to hang the respirators on a hook or nail in the staff room. Plastic bags should never be used since they retain humidity. Respirators can be disposed of in normal garbage and do not need to be disinfected.

CHAPTER 4

TB Infection Control Measures at Specific Healthcare Settings

Airborne infection precautions will vary from one setting to another depending on the risk of transmission in that facility. Some areas of the facility could be considered high risk relative to others. Each of the high-risk areas should have an independent risk assessment and should have detailed written TB-IC activities and key control measures. See Annex B for examples of recommended setting-specific control measures.

The following healthcare settings are included:

- Waiting area
- Consultation room
- X-ray room
- Emergency room
- General ward
- TB ward
- MDR ward / AIIR
- TB microscopy lab
- TB culture lab
- TB containment lab
- Sputum collection area
- High-risk procedure rooms

To determine the proper combination of key TB-IC measures for a specific setting/area, conduct the following:

- List the different specific patient care and other service areas/settings at the facility
- Conduct a risk assessment using the facility TB-IC assessment and planning checklist to evaluate the strengths and weaknesses related to work practices and infrastructure features at the different specific settings
- Prioritise the control measures for each setting/area depending on assessed transmission risk, feasibility and availability of resources

CHAPTER 5

Measures at Congregate and Community Settings

Congregate Settings

Congregate settings include a heterogeneous mix of facilities that range from prisons, detention centres (police cells, jails), refugee camps or camps for internally displaced persons, dormitories, homeless centres, orphanages, hostels and nursing homes. Congregate settings differ in risk of TB transmission related to the resident population and the duration of stay of residents; the longer the duration of stay the higher the risk of contracting TB. Because of the diversity in facilities, recommendations for congregate settings are less specific than those for healthcare facilities. However, any healthcare facility (medical or infirmary) within a congregate setting should be considered as a healthcare setting, in which airborne precautions should be implemented as in any other healthcare facility. The prevalence of TB disease particularly among inmates of correctional facilities exceeds the prevalence among the general population. Prisons are prioritized to develop and implement a prison TB-IC plan.

The approach should be to include congregate settings in TB-IC facility risk assessments. The facility TB-IC assessment & planning checklist in Annex B may be adapted for use. The TB-IC assessment carried out by trained and experienced HCWs will be useful in determining the level of risk of that facility and the relevant control measures that should be addressed in the TB-IC programme.

Recommended control measures for congregate settings are the following:

- Triage - TB screening of new detainees and active case finding
- Separation – in the case of presumptive TB in a separate area of the sick bay
- Cough etiquette – face masks for coughing persons
- Voluntary screening of staff for TB
- Natural ventilation – esp. in case of planned construction and renovation

In designated prisons for MDR-TB management the use of GUV systems and of respirators for respiratory protection of staff should be considered in addition to the recommended control measures above. For these jails and prisons special arrangements must be made for expert advice.

Community settings

The most important community settings to consider are the households of MDR-TB and XDR-TB patients. Their household members are at high risk of becoming infected and consequently developing the disease. Whether the patient subsequently remains at home or moves to a healthcare facility appears to be of little importance, provided the patient is treated effectively. Early case detection and treatment of the index patient and infected family members and other close contacts remain the most important interventions for reducing the risk of TB transmission in households.

Contact investigation of household members and close contacts of diagnosed TB patients, including provider initiated testing and counselling for HIV, is paramount for case finding among households. At least one home visit should be conducted as soon as possible for assessment and planning of interventions based on the assessment. Family members of infectious TB patients, close contacts and care providers should be educated on how to minimize exposure.

Measures for reducing transmission include the following:

1. Anyone who coughs should be educated on cough etiquette
2. Infectious TB patients should spend as little time as possible in crowded public places and public transportation
3. Houses should be well-ventilated, particularly rooms where infectious TB patients spend much time
4. If possible, infectious TB patients should sleep in a separate room
5. Sodium hypochlorite (1%) solution can be used to sterilize sputum receptacles

Today, community-based care provided by trained community health workers and volunteers can achieve comparable results and consequently may decrease nosocomial infection. Additional infection control measures should be implemented for the management of MDR-TB patients at home as per national MDR-TB guidelines.

The following guidance should be observed for households with smear-positive MDR patients in addition to the measures given above:

6. Smear-positive MDR-TB patients should always practice cough etiquette when in contact with people. They should wear face mask during these time until they become non-infectious (culture converted).
7. Ideally, HIV-positive family members should not provide care for MDR-TB patients until they have converted for culture. HIV-positive family members should wear respirators.
8. Children below 5 years of age should spend as little time as possible in the same living spaces as infectious MDR-TB patients. Children should be periodically screened for TB

and, if positive, drug susceptibility testing (DST) should be performed.

9. Consider possibilities of renovating the patient's home or improving ventilation (for example extension with a veranda or a separate bedroom; installation of a window, a fan).
10. Respirators for HCWs and community volunteers while visiting smear positive MDR-TB patients and while caring for bed-ridden patients. Consultation with DR-TB patients should not be done in enclosed areas.

There are other community settings such as pagodas, meditation centres including lead monasteries, poor urban and rural settlements, public transport and business enterprises such as garment factories where key populations may be exposed when they congregate, crowd or work for long hours.

Key recommended control measures for community settings for the community at large and for key populations are the following:

1. Triage – targeted active case finding strategies (peer-to-peer and door-to-door) through campaigns among key populations in close collaboration with community based organisations
2. Cough etiquette – health education campaigns and IEC materials
3. Natural ventilation – this should be addressed in campaigns and IEC materials in collaboration with the local municipal authorities, and housing companies and business enterprises

Community DOT points should be considered as healthcare settings.

CHAPTER 6

Annex A: Work Practices and Procedure Instructions

6.1 Triage (cough surveillance)

Work practices:

- Place large eye-level notices (translated into local languages) at entryways, stating that the patients with current cough lasting for 2 weeks or more must inform immediately to staff, or if they suspect that they might have TB
- Display signs and posters at the exterior entrances explaining that this healthcare facility prioritises persons with current cough which has lasted for two or more weeks, over others in the queue and makes use of designated separate waiting areas
- Screen patients for cough at the first point of contact or when they have joined the queue or have a seat/bed
- Explain persons with presumptive TB why they are being selected for special attention
- Explain other patients in the waiting area why persons with symptoms suggestive of TB are prioritised
- Provide fast track service for sputum examination

Procedure instructions:

1. It is the responsibility of an assigned HCW according to a roster to conduct daily cough surveillance at the OPD and general wards
2. Ask all patients at first point of contact the following screening questions:
 - a. Are you coughing?
 - b. If answer is yes: For how long?
3. A clinician or nurse will then ask those with a current cough that lasts two weeks or more, additional questions:
 - a. Have you lost weight?
 - b. Do you have fever?
 - c. Do you sweat at night?
 - d. Are you being investigated or treated for TB? Were you treated for TB in the past?
 - e. Have you been in close contact with someone who has a prolonged cough or is a known TB patient?
 - f. Do you have any other infectious disease?

4. Record names and contact details in the OPD Register
5. Document (daily) and evaluate (monthly)
 - a. The total number of outpatients
 - b. The number of persons with presumptive TB
 - c. The number of notified TB patients
 - d. The number of bacteriologically confirmed TB patients

6.2 Cough Etiquette

Work practices:

- Place signs and posters on cough etiquette at the exterior entrances and other settings in the healthcare facility, e.g. waiting areas, corridors, patient rooms/wards and communal areas. They should be where patients cannot miss them, directly in front of them and at eye-level and not on back walls
- Provide (daily) health education on cough etiquette
- Remind non-adhering persons to comply with the respiratory hygiene policy of the healthcare facility.
- Use your own attitude and behaviour to set an example to others. Part of every health worker's responsibility is to model and educate others on the best healthcare practices
- Provide tissues or disposable face masks to all persons with presumptive TB and bacteriologically confirmed TB patients, especially MDR-TB and XDR-TB patients

Procedure instructions:

1. It is the responsibility of HCWs to provide daily health education talks on cough etiquette
2. Explain patients with current cough to cover mouth and nose with tissues (or) with upper sleeve when coughing or sneezing
3. Tell them to turn head away from others
4. Tell them not to spit on the floor, but in a plastic bag or sputum mug with a cover
5. Explain them to avoid using hands or lifting the shirt's neckline to cover mouth and nose on coughing or sneezing
6. Tell them to discard used tissues or disposable face masks in the nearest waste bin
7. Tell them to wash hands frequently

6.3 Separation

Caveat:

Separation and isolation are particularly sensitive TB-IC measures. It involves multiple facets which can vary facility by facility even in a single community. Things to consider will include culture & ethnicity, religion, social norms, human rights, stigma, structure of the facility and health education. Strict enforcement of this measure for presumptive TB patients (majority of whom will not be TB eventually) will have a negative impact on the healthcare facility and in particular on TB case finding. Thus it will need to accommodate public acceptable variations facility by facility.

Work practices, if appropriate:

- Separate persons with presumptive TB, clinically diagnosed TB and bacteriologically confirmed TB from other patients, in particular paediatric, HIV-positive and other immunodeficient patients
- Where designated separate waiting areas, clinics, isolation rooms and wards are not available, divide big areas into smaller ones
- Create multiple isolation rooms or small wards
- Combine any separation and isolation measures with the highest quality of care. Ensure that any curtailing of individual freedom happens as a last resort and make great efforts to explain the process and the reasoning for such action
- Limit patient movement both within and outside the healthcare facility until a diagnosed pulmonary TB patient has been treated with a standardised regimen for at least two weeks
- Provide a surgical mask if an infectious patient or person with symptoms suggestive of TB has to undergo essential investigations elsewhere in the health facility or meets other patients, visitors and staff
- Inform patients, staff and visitors by placing visible signage on doorways to restricted areas (“You are entering a restricted area”)
- Ensure that patients, staff and visitors follow the information and signage as to where and when they can visit isolated patients and how to protect themselves
- Limit the number of visitors and visiting hours
- Do not allow children to visit patients in isolation; place visible signage on doorways (“This area is prohibited for children”)
- If possible, create a designated roofed area outside, where TB patients can receive visitors and socialise with other TB patients

Procedure instructions:

1. At the OPD, it is the responsibility of an assigned HCW to request patients with presumptive TB to go to a nearby designated well-ventilated waiting area away from other patients, where they can wait until they can be seen
2. In the wards, separate different cohorts: persons with clinically diagnosed TB patients, bacteriologically confirmed TB patients; and HIV-infected TB patients
3. In the wards, separate persons with presumptive or confirmed MDR-TB from other patients in designated MDR-TB waiting areas, clinics, single-patient rooms, small wards away from paediatric, HIV care and oncology departments
4. In the ward, separate persons with presumptive MDR-TB; smear positive MDR-TB patients; smear negative RR-TB or culture positive MDR-TB patients and HIV positive MDR-TB patients according to drug resistance profile
5. Isolate persons with presumptive and confirmed XDR-TB in AIIRs

6.4 Safe Sputum Collection and Transport

Work practices:

1. The basic packaging system for local surface transport of all specimens consists of three layers:
 - a. Primary receptacle—the specimen container packaged with enough absorbent material to absorb all fluid in case of breakage
 - b. Secondary packaging—a second durable, watertight, leak-proof packaging to enclose and protect the primary receptacle(s). Several cushioned primary receptacles may be placed in one secondary packaging, but sufficient additional absorbent material must be used to absorb all fluid in case of breakage

For cold transportation conditions, ice or dry ice shall be placed outside the secondary receptacle. Wet ice shall be placed in a leak-proof container;

- c. Outer packaging—secondary packaging is placed in shipping packaging with suitable cushioning material. Outer packaging protects the contents from external influences, such as physical damage, during transit

For surface transport there is no maximum quantity per package. For air transport, no primary receptacle shall exceed 1 l for liquids or the outer packaging mass limit for solids. The volume shipped per package shall not exceed 4 l or 4 kg

Procedure instructions:

1. It is the responsibility of HCWs and community volunteers to collect sputum specimens from patients with (presumptive) TB
2. At healthcare facilities and community settings, HCWs and community volunteers should follow-up persons with presumptive TB to ensure samples are collected
3. For in-patients, the ward nurse should check with the patient and/or guardian each morning to encourage sputum production and to collect samples for submission to the laboratory
4. Sputum collection should be done in the open air (or ventilated room) away from other people to avoid infecting them
5. Sputum sample should be collected in a wide-mouthed, unbreakable, leak-proof container
6. Explain the patient to ensure that no one is standing in front of a patient producing sputum
7. Tell the patient to avoid contaminating the walls of the sputum collection area or outside of the container with sputum

8. If the outside is contaminated, discard the container and repeat the collection with a fresh container
9. Tell the patient to wash hands with soap and clean water, after collection
10. Record the patient 's details in the OPD and Lab register

6.5 FAST strategy

Work practices:

- **Finding cases in general medical settings:**

The most infectious TB patients are the ones who are not diagnosed and treated. Undiagnosed TB patients can be in clinics, waiting areas, emergency departments, surgical and medical wards. Asking patients about TB symptoms, such as cough, fever, night sweat and weight loss can lead to identification of TB cases. In addition, observing patients for cough in waiting rooms, registration areas, and wards can also lead to identification of TB

- **Actively:**

TB is usually diagnosed passively, such that it occurs when patients' symptoms lead them to seek help. The FAST strategy incorporates daily assigned nursing and auxiliary staff whose responsibility is to identify patients with current cough that lasts two weeks or more (of any duration for PLHIV), fast-track them to be screened for other symptoms suggestive of TB, promptly collect sputum of those with presumptive TB for lab investigations, including rapid molecular testing, as per national guidelines

- **Separating safely:**

While waiting in queue, patients identified through cough surveillance should be educated on cough etiquette and moved to a designated, well-ventilated waiting area away from other patients to prevent further spread of TB

- **Effective treatment:**

Effective treatment is the most important step in preventing TB spread to others. Patients become non-infectious soon after starting effective TB treatment. Patients with undiagnosed DR-TB, may not be on DST-based treatment that is effective and may still spread the disease, which creates even greater risks for other patients and HCWs

- **Finding cases in TB settings:**

Undiagnosed and inadequately treated DR-TB patients can infect or re-infect other patients or HCWs. Such patients remain infectious. The purpose of detecting DR-TB is to treat it effectively and thereby stop transmission

- **Actively:**

It is essential that TB patients are tested for DR-TB if they belong to a risk group according to the national DR-TB guidelines. The fastest way to diagnose a MDR-TB patient from a patient with drug-susceptible TB is Xpert MTB/RIF®. Xpert can identify RR-TB patients in two hours. The fastest way to diagnose genetic mutations in MDR-TB strains, making

them resistant to fluoroquinolones and injectable second-line TB drugs is MTBDRsl, the WHO-recommended DNA-based rapid test that also identifies XDR-TB patients

- **Separating safely:**

After diagnosis, for the short time that it takes for effective treatment to begin and take effect, DR-TB patients should be educated on cough etiquette and if hospitalised, the patient must be moved to a well-ventilated MDR-TB ward to prevent transmission to HCWs, other patients and care takers

- **Effective treatment**

DR-TB patients should be started immediately on second-line TB drugs according to the national DR-TB guidelines. Also, DR-TB patients rapidly become non-infectious after being started on effective treatment. The effect of effective treatment on transmission occurs much faster than the conversion of sputum smear or culture to negative

Procedure instructions:

1. It is the responsibility of assigned HCWs to daily conduct cough surveillance at selected entrance and service areas of the health facility
2. Fast-track the patient identified with current cough that lasts two weeks or more to be seen by the clinician or nurse, or refer the patient to the DOTS clinic TB as per the national guidelines
3. If TB is presumed,
 - a. Educate the patient to submit sputum as per the national guidelines
 - b. Educate the patient on cough etiquette, let him/her wear a face mask
4. Test the sputum for TB:
 - a. Sputum AFB microscopy for presumptive TB according to the national TB guideline
 - b. Xpert MTB/RIF® for presumptive DRTB, PLHIV
5. As soon as possible after receiving results, start any patient that has a sputum positive result on effective TB treatment:
 - a. If Xpert MTB/RIF® is MTB positive/RIF resistance negative, standard treatment for drug-susceptible TB is likely to be effective
 - b. If Xpert MTB/RIF® is MTB positive/RIF resistance positive, the patient should be enrolled in MDR-TB programme
6. Collect from all (presumptive) TB patients the following time intervals for monitoring effective FAST implementation monthly:
 - a. Time to Diagnosis: Number of days (same, next, 3-5, >5) from the date of patient

presentation on which sputum was collected to the date the lab result was received as recorded in the OPD register

- b. Time to Treatment: Number of days (same, next, 3-5, 5-14, >14) from the date on which the lab result was received to the date treatment was initiated as recorded in the OPD register, or were referred elsewhere for treatment

6.6 Preventive Maintenance of Ventilation System

Procedure instructions:

1. It is the responsibility of the nurse in-charge to daily check if windows and doors are in a proper position in all areas/settings and if they are easy to open/close and to keep open/closed
2. Daily, check extractor fans by holding a tissue or a piece of paper against the grille. If the fan is working, the tissue or paper should be pulled against the grille
3. Monthly, check if all windows and doors are in good condition
4. Keep a log with the date and the action: checking / maintenance / repair
5. Monthly, check if fans are clean
6. Keep a log with the date and what was done: checking / cleaning / maintenance / repair

6.7 Preventive Maintenance of UVGI/GUV¹¹ systems

Procedure instructions:

1. It is the responsibility of a trained person to maintain the GUV system according to an agreed schedule
2. Turn off the upper-room GUV system and let the lamps/units cool
3. Open the units in accordance with the manufacturer's directions
4. Remove the lamps from the unit for cleaning. Handle the lamps only while wearing clean gloves to prevent oil deposits from accumulating on the lamps and decreasing their emission efficiency
5. Use a cloth dampened with alcohol to clean the lamps and reflectors; do not use water
6. Dry the lamps and reflectors with a soft cotton cloth to remove any residue while continuing to wear gloves
7. Lamps should be changed according to a fixed schedule based on the lamp manufacturers' recommendation. If feasible, group re-lamping should be done on a yearly basis. The lamp or ballast should also be replaced if the lamp stops glowing or flickers
8. Close the unit
9. When all appropriate lamps have been replaced in the upper-room GUV system, turn on (re-energise) the system and verify (e.g. visually) lamp operation and that (if present) all louvers are in the correct position. If necessary, UV-protective eyewear should be used when verifying the lamps are re-energised
10. Document cleaning, and lamp replacement in a preventive maintenance logbook

¹¹ Ultraviolet Germicidal Irradiation(UVGI) systems can be used interchangeably with Germicidal Ultraviolet (GUV) systems

6.8 ACH Measurement and Calculation

Work practices:

- To measure ACH, a vaneometer or rotating anemometer is used to measure the wind speed
- To visualize air flow direction, ventilation smoke tubes or incense sticks are used
- When a vaneometer or anemometer is not in hand, wind speed can be roughly estimated:
 - Feeling a draft on the skin equals at least 0.3 m/s
 - Moving leaves of a tree equals at least 0.5 m/s
 - Average wind speed values can also be obtained from local weather stations

Procedure instructions:

1. Area of window opening = width x height:
= 0.5 m wide x 0.5 m high = 0.25 m²
2. Air velocity through window measured by vaneometer:
= 1 m/s
3. Air Flow Rate = Area of window opening x air velocity x seconds per hour:
= 0.25 m² x 1 m/s x 3600 seconds per hour = 900 m³/hour
4. Room volume = width x depth x height:
= 3 m wide x 5 m deep x 3 m high = 45m³
5. ACH = Air flow rate divided by room volume:
= 900 m³/hour divided by 45 m³ = 20 ACH

$$\text{ACH} = \text{Air Flow Rate} / \text{Room Volume}$$

6.9 Respirator Application

Procedure instructions¹²:

1. Find centre of nose piece and squeeze
2. Open respirator in a hand, looking into the inside
3. Place straps on back of hand
4. Place respirator on nose and mouth
5. Pull top elastic band over head
6. Place top elastic band on crown of head
7. Pull lower elastic band over head
8. Pull respirator over chin
9. Pinch metal clip or foam cuff around nose – use both hands
10. Check for major leaks

¹² Instruction video: <https://www.youtube.com/watch?v=Tzpz5fko-fg>

¹³ Instruction video: <https://www.youtube.com/watch?v=7IAsoU6h-8g>

6.10 Qualitative Respirator Fit Test

Procedure instructions¹³:

1. Use sensitivity solution to establish if the HCW tastes the test agent (Saccharine or Bitrex)
2. Cover head of the HCW with hood with opening in front
3. Squeeze to spray the fit test sensitivity solution 5-10 times
4. Replace sensitivity solution with fit test solution (higher concentration)
5. Observe if the HCW applies the respirator in a correct manner
6. Cover head of the HCW with hood with opening in front
7. Squeeze to spray the fit test solution 5-10 times and repeat between next steps
 - a. Normal breathing 1 minute
 - b. Deep breathing 1 minute
 - c. Move head side-to-side 1 minute
 - d. Move head up-and-down 1 minute
 - e. Talk non-stop 1 minute
 - f. Jog or walk in place 1 minute
 - g. Normal breathing 1 minute
8. Remove hood
9. Remove elastic bands one by one from behind over the head

¹³ Instruction video: <https://www.youtube.com/watch?v=7IAsoU6h-8g>

7.2HCW Screening checklist (to be used at least once a year)

Identification

1. Health facility:
2. Date:
3. Screened by (name and designation):
4. Employee (name and number):
5. Written informed consent:
 - Yes _____(Signature)
 - No (if no then defer screening)
6. Date of birth:
7. Gender:
 - Male
 - Female

Exposure history in job

8. Job title:
9. Current department/duty station:
10. Years of employment

TB Contact

1. Did you have direct contact with TB patients in the last year? (More than 1 answer possible)
 - Yes, in own household
 - Yes, outside household
 - Yes, in healthcare facility
 - No
 - Don't know

TB History

1) Did you ever use medication to prevent you from developing TB, such as IPT:

- Yes
- No
- Unknown

If yes

- a. In which year did you take IPT:
- b. Duration of treatment: ____weeks/____months

2) Are you currently on TB treatment?

- Yes
- No

3) Did you ever have TB disease: Yes No Unknown If no, skip to No: (4). If yes can you tell about latest or current episode:

- a. Date of diagnosis: __/__/____ (if unknown tick here:)
- b. Where was your TB diagnosed?
 - Government facility
 - Private facility
 - Elsewhere, specify:

c. How was the TB confirmed?

c - 1 Smear

- Yes
- No
- Unknown

c - 2 Xpert

- Yes
- No
- Unknown

c - 3 Chest x-ray

- Yes
- No
- Unknown

c - 4 Culture

- Yes
- No
- Unknown

d. Where did you receive treatment for your TB?

- Government facility
- Private facility
- Elsewhere, specify:

e. Was your TB cured?

- Yes
- No
- Unknown

f. Have you had TB more than once?

- Yes
- No
- Unknown

4) Do you have any symptoms suspected for active TB disease?

- Cough > 2 weeks Yes No
- Fever Yes No
- Weight loss Yes No
- Night Sweats Yes No
- Haemoptysis Yes No
- Chest pain Yes No
- Breathlessness Yes No
- Fatigue Yes No

Comorbidity (HIV and DM)

1) HIV

- a) Have you ever been tested for HIV? I
 - Yes
 - No
- b) Date of latest HIV test: __/__/20__
- c) Is this less than 1 year ago?
 - Yes
 - No
- d) Latest HIV test result: If HIV test is positive, go to No: (e).
 - Positive
 - Negative
 - Unknown
 - Not willing to disclose
- e) Are you on ART? If Yes, go to No: (f).
 - Yes
 - No
- f) How long have you been taking ART?
.....

2) DM

- a) Do you have DM? If Yes, go to No: (b).
 - Yes
 - No
 - Unknown
- b) How long have you been on hypoglycaemic drugs?
.....

7.3 Facility TB-IC Assessment & Planning checklist

Name of the Facility	
Address	
Telephone Number	
Date Assessment Completed	
Name and Position of Person(s) Completing Assessment	
Level of Facility	Regional, State, District, Township level Hospital, Health Centre, Dispensary
Type of Facility	Public, Private, Other
Services Provided	OPD, In-patients, HIV testing, ART TB Microscopy, Xpert, Culture/DST

Managerial

		Yes	No	Other	Comments
1.	The National Infection Control Manual is available on-site.				
2.	An infection control focal person has been assigned to carry out infection control in the facility				
3.	An Infection Control Committee/Team has been designated at this site				
4.	A site-specific TB-IC plan has been written and is available to staff				
5.	The TB-IC plan contains a statement of endorsement by the facility manager				
6.	A TB-IC assessment is completed at least annually				
7.	Facility design and patient flow has been assessed for the best use of space and ventilation				
8.	All patients with TB disease are managed on DOTS per the national guidelines				
9.	TB-IC practices are monitored daily				
10.	There is a Presumptive TB and TB register for all patients on-site				
11.	TB-IC training for all staff has been done and documented at least annually				
12.	Information on TB-IC is available for all patients and visitors and is offered by staff				
13.	Operational research to improve TB-IC measures is conducted at this site				

Administrative

		Yes	No	Other	Comments
1.	Patients are routinely asked about cough when entering the facility.				
2.	Patients who are coughing are separated from others and "fast tracked" to a clinician.				
3.	A "Cough Monitor" or other designated person gives cough etiquette guidance and assists with separation and triage.				
4.	Signage for cough etiquette is present in the clinic.				
5.	Supplies are available to cough patients. (tissues, cloths, masks, trash bins, etc.)				
6.	Sputum samples are collected in a designated area and away from others.				
7.	There is a tracking mechanism to monitor turn-around time of lab results.				
8.	Time to treatment of patients is documented and evaluated for number of days.				
9.	TB disease among HCW is recorded, monitored and reported. If 1% or above, staff receive an evaluation for TB at least annually.				
10.	A confidential log is kept of all staff that are diagnosed with TB disease.				
11.	HIV-infected staff are reassigned if they request.				
12.	INH preventive treatment is offered to HIV-infected staff.				

Environmental

		Yes	No	Other	Comments
1.	Staff monitors natural and/or mechanical airflow daily in high risk areas identified in the plan				
2.	HCWs that assist during sputum collection take precautions				
3.	Regular cleaning and maintenance of directional and extractor fans is conducted				
4.	Servicing documentation is maintained and is available for review				
5.	Signage is in place to keep doors and windows open when feasible				
6.	If germicidal UV lighting is used, routine cleaning and maintenance is conducted and documentation logs kept				
7.	Patient waiting areas have good cross-ventilation				

Personal Protective Equipment (PPE)

		Yes	No	Other	Comments
1.	Surgical masks are available and worn by cough patients				
2.	N-95 or FFP2 respirators are readily available and used by staff				
3.	Staff has been trained and tested on proper fit of respirators and test results are documented				

Agreed Issues and Priority Activities

Main Issues	Priority activities

Planning

Managerial	Who responsible	Start	End	Ongoing

<Name area>				

<Name area>				

<Name area>				

<Name area>				

<Name area>				

<Name area>				

<Name area>				

7.4 Minimum TB-IC Monitoring checklist

The health facility review collects information on the minimum that sites are doing, but also serve to show facilities what they need to be doing with the information to make better decisions and provide better care.

Instructions:

The monitoring checklist should be used as an integral part of the IPC checklist or supervision checklist

At least one of the given Means of verification/Benchmarks should be present for a YES per standard

“Observed” means the practice was seen occurring during the site visit

The total score is expressed as a percentage: 8 means 80% compliance which is considered as meeting requirements

Date of site visit:		Facility:	
Assessor		Contact person (Name/Phone/Email):	
Control Measures		Yes	No
IPC plan that includes airborne transmission precautions			1. Up-to-date plan 2. Responsible focal person
Cough surveillance at OPD *			1. Practice observed 2. SOP on triage implemented 3. Triage registers
Outside or well ventilated waiting areas			1. Practice observed 2. SOP on separation implemented
Masks on Patients identified with a cough			1. Practice observed 2. SOP on cough etiquette implemented 3. Face masks readily available
Sputum sample collection outside			1. Practice observed 2. SOP on safe sputum collection implemented
Xpert MTB/RIF based treatment for at least all Presumptive DRTB patients and PLHIV *			1. MTB/RIF results documented in OPD and TB registers and evaluated periodically
Time to Diagnosis and Time to Treatment documented and evaluated *			1. Dates documented in OPD, Lab and TB registers and evaluated for same day/next day/3-5 days/5-14 days/>14 days
Adequate natural ventilation			1. Practice observed 2. Up-to-date open window log books
Respirators on Staff based on risk assessment			1. Practice observed 2. SOP on respirator application implemented 3. Respirators readily available
TB infection or TB disease among staff is documented and evaluated			1. 'HCW' recorded on Township TB register 2. Occupational Health register
Total scores and %			

* FAST strategy standards

7.5 Setting-Specific Control Measures Planning checklist

Setting	Key control measures	Proposed control measures to be filled during assessment
Waiting Area	<ul style="list-style-type: none"> ● Triage – soon after patients have entered the healthcare facility ● Separation – in separate area or partition of large waiting area ● Cough etiquette – face mask for coughing persons ● Minimising waiting time – Fast-tracking to the front of the queue ● Natural ventilation – outdoor or well ventilated waiting areas strongly recommended ● Mechanical ventilation – ceiling fans in large well-ventilated indoor waiting areas 	
Consultation room	<ul style="list-style-type: none"> ● Cough etiquette – face masks for coughing persons ● Natural (cross) ventilation – airflow direction from HCW to patient ● Mechanical ventilation – extractor fans (requires expert advice) ● GUV – if ventilation cannot be improved (requires expert advice) ● Respirator – depending on burden and resources 	
X-ray room	<ul style="list-style-type: none"> ● Separation – scheduling patients with presumptive or confirmed PTB during a specific time slot and identifying a specific X-ray room in the case of multiple rooms for performing CXRs. ● Cough etiquette – face masks for coughing persons ● Minimising waiting time – in special time slots ● Mechanical ventilation – extractor fans (requires expert advice) ● GUV – if ventilation cannot be improved (requires expert advice) ● Respirator 	
Emergency room	<ul style="list-style-type: none"> ● TB-IC measures in emergency room should follow as in other general waiting area because patients who come to emergency room might have active TB disease. However, it should have exception for some critically ill patients. ● HCW should wear respirator whenever he/she give intensive care to the patient and do the procedures such as tracheostomy to the patient. ● As so many patients can come to emergency room simultaneously, GUV system should be installed in the room if good ventilation could not get. 	

	<ul style="list-style-type: none"> ● Respirators – especially when performing cough-inducing procedures on patients presenting with respiratory symptoms 	
General ward	<ul style="list-style-type: none"> ● Triage – screen for TB symptoms as a routine work practice for all new admissions ● Separation – of patients with symptoms suggestive of pulmonary TB in a well-ventilated part of the ward; away from immune-compromised patients (e.g. diabetes, malignancies, HIV infection) ● Cough etiquette – face masks for coughing patients ● Minimising admission time in the general ward ● Natural ventilation – strongly recommended ● Respirators – when attending patients with presumptive TB 	
MDR-TB ward / AIIR	<ul style="list-style-type: none"> ● Separation and isolation – preferably in designated treatment sites with a separate entrance, in single-patient rooms or otherwise cohorted according to infectiousness and (if known) drug resistance profiles; restriction of patient movement; visiting hours and designated outdoor areas to meet with visitors ● Cough etiquette – face masks on patients when not in room ● Minimising waiting time (when visiting other departments such as the X-ray department) and admission time ● Natural (cross) ventilation – to the maximum ● Mechanical ventilation – extractor fans (requires expert advice) ● Mechanical ventilation – of AIIRs for XDR-TB patients ● GUV - in combination with slow-moving ceiling fans if adequate ventilation rates cannot be realised (requires expert advice) ● Respirators on staff and visitors – in areas where the signage on entry doors indicates that respirators must be used 	
Sputum collection area	<ul style="list-style-type: none"> ● Natural ventilation – sputum collection must be ideally collected in a designated outdoor area. Also, bed ridden patients suspected of having pulmonary TB should be assisted to collect sputum in a well-ventilated area, preferably outside or on a balcony 	
High-risk procedure room	<ul style="list-style-type: none"> ● Mechanical ventilation – adequate time should be allowed between patients for disinfection of air (required expert advice) ● GUV – if adequate ventilation rates with mechanical ventilation cannot be realised (required expert advice) ● Respirators 	

TB microscopy lab	<ul style="list-style-type: none"> ● Natural ventilation – the direction of airflow through the laboratory should be from functionally clean areas to dirty areas ● Use of open bench – separation of dirty and clean areas 	
TB culture lab	<ul style="list-style-type: none"> ● Access control – laboratories are restricted areas except for authorised staff only; patients are only allowed to enter well-ventilated rooms for blood sample collection ● Code of Practice – specialised laboratory equipment should always be accompanied by, but can never replace, appropriate procedures and good microbiological technique ● Mechanical ventilation – extractor fans for maintaining unidirectional airflow and ventilated class II bio-safety cabinets protecting worker, environment and specimen in laboratories with a high workload (requires expert advice) ● PPE: Protective laboratory clothing must be worn at all times while staff is working in the laboratory. <p>The use of respirators may be considered if the risk of accidental spillage increases in cases of unusual workload, understaffing, or to meet specific requirements related to the medical status of laboratory staff</p>	
TB containment lab	<ul style="list-style-type: none"> ● Access control – laboratories are restricted areas for authorised staff only; patients are only allowed to enter designated well-ventilated rooms for blood sample collection ● Samples are provided via a double-door pass-through, staff enters the lab via a locked double-door anteroom, all waste is autoclaved before it leaves the containment facility. Specialized equipment (pipettes, centrifuges) is used to avoid generation of aerosols. ● Code of Practice – specialised laboratory equipment should always be accompanied by, but can never replace, appropriate procedures and good microbiological technique ● Mechanical ventilation – negative pressure systems in anterooms and DST areas; and ventilated class II bio-safety cabinets protecting worker, environment and specimen in laboratories with a high workload (requires expert advice) ● PPE – Protective laboratory clothing must be worn at all times while staff is working in the laboratory. <p>Respirators should be used when performing culture concentration technique, DST, LPA (extraction of DNA), MGIT (centrifugation)</p>	