REPUBLIC OF KENYA

MINISTRY OF HEALTH

Guidelines for TB Infection Prevention and Control for Health Care workers in Kenya

2021

NATIONAL TUBERCULOSIS, LEPROSY AND LUNG DISEASE PROGRAM

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National Tuberculosis, Leprosy and Lung Disease Program,

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FOREWORD

Tuberculosis (TB) and the emergence both multi-drug-resistant tuberculosis (MDR-TB), extensively drug-resistant tuberculosis (XDR-TB), as well as the novel respiratory diseases such as Coronavirus (COVID-19), severe acute respiratory syndrome (SARS), novel influenza viruses such as H1N1, all highlight the need to establish effective respiratory infection prevention and control (RIPC) measures in healthcare facilities. Infectious respiratory diseases (IRDs) cause an increase in morbidity and mortality from infectious disease in the world. Almost four million people die from IRDs each year, with 98% of these deaths due to lower respiratory tract infections. The recent Coronavirus pandemic has demonstrated the importance of effective infection-control measures in health care settings. The spread of the virus causing COVID-19 was amplified in health care settings, where 55–72% of probable cases occurred, and health care workers (HCW) were severely affected in 2020. Of the lessons learnt from the COVID-19 pandemic, there is an indication of the need for healthcare facilities to be prepared and to consider a normalcy of safe practices to prevent and control the spread of infections associated with health care.

Health care workers are at increased risk of TB infection and disease as well as other infectious respiratory diseases compared to the general population. Patients and non-medical staff in health care settings are also at risk. Health care settings especially present risk of these transmissions from those who are undiagnosed and are in close contact with patients and health care workers. Overcrowding and poorly ventilated environments increase this risk. Waiting rooms or corridors where patients wait to receive medical care, including medical wards where undiagnosed patients admitted, are often areas of particular risk.

The primary audiences for this document are the health care providers in health care facilities and isolation facilities/settings. This document focuses on health care settings, as well as other areas where TB transmission and other respiratory infectious diseases like COVID-19 are likely to occur. This includes prisons, informal settlements, networks of people living with HIV and AIDS, and mental health institutions. The importance of access to high quality, readily available TB diagnostic services in implementing TB infection control practices cannot be overstated. A fundamental strategy of good infection prevention and control is to screen patients for the infectious diseases, find those presumed to have the infection, separate potentially infectious patients, diagnose rapidly, and initiate care immediately, thereby eliminating the source of infection.

The adoption of safe practices by healthcare workers to control the spread of infection associated with TB and other IRDs will improve their ability to provide care and mitigate threats caused by unnecessary disruption to health care services in the event of an epidemic.

Dr Patrick Amoth, EBS

Ag. Director General, Ministry of Health

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LIST OF ABBREVIATIONS

ACH	Air changes per hour
AFB	Acid fast bacilli
AIDS	Acquired Immunodeficiency Syndrome
AMR	Anti-microbial resistance
ARV	Antiretroviral
BCG	Bacille Calmette-Guerin
BSC	Biological Safety Cabinets
CB-DOTS	Community Based Directly Observed Therapy
CDC	Centres for Disease Control and Prevention
CRDR	Centre for Respiratory Diseases Research
COVID-19	Coronavirus Disease 2019
CQI	Continuous Quality Improvement
NTRL	National Tuberculosis Reference Laboratory
DOT	Directly Observed Therapy
DTC	Diagnostic testing and counseling
FFP2	Filtering face-piece
GSU	General Service Unit
HCW	Health Care Worker
HEPA	Highly Efficient Particulate Air Filters
HIV	Human Immunodeficiency Virus
IPC	Infection Prevention and Control
IPT	Isoniazid Preventive Therapy
KEMRI	Kenya Medical Research Institute
KNCV	Royal Netherlands tuberculosis foundation
KNH	Kenyatta National Hospital
LTBI	Latent TB Infection
MCH/FP	Maternal and Child Health / Family Planning

MERS	Middle East Respiratory Syndrome
MDR-TB	Multidrug Resistant Tuberculosis
MoH	Ministry of Health
NTLD UNIT	National Tuberculosis, Leprosy and Lung Disease Unit
OPD	Outpatient Department
PATH	Program for Appropriate Technology in Health
PDSA	Plan Do Study Act
PLWHA	People living with HIV AIDS
PARP	Powered Air-Purifying Respirator
SARS	Severe Acute Respiratory Syndrome
SDPs	Service Delivery Points
TB	Tuberculosis
TB CAP	TB Control Assistance Program
UV	Ultraviolet
UV-C	Ultraviolet-C
UVGI	Ultraviolet Germicidal Irradiation
VCT	Voluntary Counseling and Testing
WHO	World Health Organization
WITs	Work Improvement Teams
XDR–TB	Extensively Drug Resistant Tuberculosis

Chapter One

1.0 Introduction

Infectious respiratory diseases, which comprise of both acute respiratory illnesses (ARIs) and chronic respiratory illnesses (e.g. Tuberculosis) are the leading cause of morbidity and mortality from infectious disease in the world. Almost four million people die from ARIs each year, with 98% of these deaths due to complications of lower respiratory tract infections. ARIs are one of the most frequent causes of consultation or admission to healthcare facilities, particularly in pediatric services. Tuberculosis (TB) seldom presents as an ARI. However, its spread has been associated with health care and is a major global health concern. Infectious Respiratory Diseases that have epidemic or pandemic potential e.g. the COVID-19 pandemic, and may pose a public-health risk, warrant special precautions and preparedness.

This document provides recommendations and other information relating to Infection Prevention and Control (IPC) measures for infectious respiratory diseases in health-care settings, with specific emphasis on diseases that have the potential for rapid spread and may cause epidemics or pandemics (or both).

1.1 Background Information

Many of the microorganisms that cause respiratory (breathing) diseases are spread by droplets that come from coughing and sneezing. These germs usually spread from person to person when uninfected persons are in close contact with a sick person. Some people may become infected by touching something with these germs on it, and then touching their mouth or nose. Over the past decade, a major worldwide health concern has been the effects of respiratory viral epidemics, including Tuberculosis, avian influenza, H1N1 influenza, and most recently the coronavirus pandemic, and severe acute respiratory distress syndrome (SARS, caused by a coronavirus). Early recognition of the infectious diseases and application of source control, including respiratory hygiene, are administrative control measures aimed at reducing or preventing the dissemination of infectious agents from the source. Early identification, isolation and reporting of infectious respiratory infections of potential concern are therefore central to effective containment and treatment. To prevent the spread of respiratory illness in evacuation centers, clinicians and staff should try to identify ill persons and use appropriate infection control measures as soon as possible. People crowded together in places such as evacuation centers are vulnerable to outbreaks of respiratory illnesses. In some cases, such as with influenza, germs can spread very rapidly in these settings and may have important health consequences for residents and workers, particularly for persons who are at higher risk for complications from influenza.

The National TB Program aims at strengthening Infection Prevention and Control (IPC) capacity through technical guidance and ensuring implementation of safe practices at the health facility. Implementation of IPC practices are key to delivery of high-quality care for patients, and a safe working environment for health care workers.

This guideline provides a guide on the critical aspects of IPC measures. Its scope focuses on interventions that are aimed at reducing the risk of TB transmission and other infectious respiratory diseases. This document provides guidance for health care workers on some simple measures that can help implement infection and prevent disease transmission.

1.2 Tuberculosis

The source of TB infection is a person with active pulmonary TB. Patients with bacteriologically confirmed pulmonary TB spread TB bacilli in the community. The infectious tuberculosis patient expels microorganisms into the air in tiny droplets when talking, coughing, laughing, shouting, singing, or sneezing. These tiny droplets typically contain tubercle bacilli, which usually evaporate and cause the volume of water droplets to diminish in size, become droplet nuclei and remain suspended in the air for several hours or even days. If inhaled, a droplet nucleus is small enough in size (< 5mm) to reach an alveolus in the lung. A person who breathes in air including droplet nuclei containing tubercle bacilli will become infected with TB. Infected persons can develop active TB disease at any time. The risk of developing TB disease is high in the first few years following infection, and then decreases over a prolonged period. Various factors (e.g., HIV infection, diabetes, malnutrition) may trigger the progression of infection to disease by weakening the immune system. TB affects most tissues and organs except hair, nails, and teeth.

1.2.1 Latent TB Infection

Latent TB infection (LTBI) is a state of persistent immune response to stimulation by M. tuberculosis antigens with no evidence of clinical manifestation of active TB. It is estimated that approximately one-quarter of the world's population (about 1.3 billion people) have LTBI and 5-10% of these are at risk of progression to active TB disease over the course of their lives, most of them within the first five years after initial infection. When a person inhales the air that contains droplets with M. tuberculosis bacilli, most of the larger droplets become lodged in the upper respiratory tract (the nose and throat). However, smaller droplet nuclei may reach the small air sacs of the lung (the alveoli), where infection may begin. In the alveoli, some of the tubercle bacilli are killed, but a few multiply in the alveoli, enter the bloodstream, and spread throughout the body. Bacilli may reach any part of the body. Within 2 to 8 weeks, however, the body's immune system usually intervenes, stopping multiplication and further spread. The immune system is the system of cells and tissues in the body that protects the body from foreign substances. At this point, the person has LTBI. The risk of progression to active TB disease after infection depends on several factors, the most important being immunological status such as HIV, severe malnutrition, patients on immunosuppressive therapy, etc. Provision of TB Preventive Therapy (TPT) has proven itself an effective intervention to avert the development of active TB disease, with efficacy ranging from 60% to 90%.

1.2.2 TB and other Infectious Respiratory Diseases

Both Mycobacterium tuberculosis and other infectious respiratory diseases like SARS-CoV-2 interfere with host immunity and attack the respiratory system. Studies conducted have shown that TB infections possibly increase susceptibility to SARS-CoV-2 and increases the severity of the COVID-19. TB and COVID-19 exhibit similar routes of transmission, mainly through close contacts and through droplet nuclei of aerosols from individuals infected with the disease. During the COVID-19 pandemic, a large focus has been on the diagnosis of COVID-19 cases, while TB cases may be underestimated or their diagnosis delayed, which may cause progression of the disease and transmission. Tuberculosis and COVID-19 both require robust infection control strategies

1.3 Coronavirus Infections

A coronavirus is a kind of common virus that causes an infection in your nose, sinuses, or upper throat. There are seven known types of coronavirus infections that have the ability to make people sick. These range from mild to severe, depending on the virus type. This virus family is known to infect various animals and is also known to mutate easily. Sometimes coronavirus types that infect animals (including bats, civet cats, and camels) mutate to infect humans, and this can have deadly consequences. A mild-to-moderate coronavirus infection is like the common cold, as described by the Centre of Disease Control (CDC) and World Health Organization (WHO). Generally, individuals get sick from the four types of coronavirus that can cause milder infections. However, three types (COVID-19 - SARS-CoV-2, SARS and MERS) have the potential to lead to fatalities. Each of these types of coronavirus has led to a significant global outbreak.

1.3.1 Coronavirus/COVID-19 (SARS-CoV-2)

The global coronavirus COVID-19 outbreak of 2019 was caused by the most contagious strain of serious coronavirus. The WHO declared COVID-19 a pandemic on March 11. This led to an unprecedented closure of schools, businesses, and public life in most countries as different nations practiced social distancing to prevent widespread infection. COVID-19 (SARS-CoV-2 is the virus that causes the disease) is a potentially deadly respiratory infection that originated in Wuhan City, China, in December 2019. Once it developed, the virus spread quickly. As with other lung infections, people with COVID-19 may experience cough and fever, along with shortness of breath. There have been some reports of patients with stomach problems such as diarrhea and vomiting. Although many only experience mild/moderate symptoms (about 80%of those infected), others (about 20%) experience more severe symptoms, which may include pneumonia, severe acute respiratory syndrome, kidney failure, and death (about 1-3%). Prevention of the COVID-19 disease, or decreasing risk, is possible by avoiding contact with individuals diagnosed with the infection or people who have been in an outbreak area, isolation of infected individuals (quarantine), and strict handwashing techniques. Social distancing (keeping about 6 feet away from other people) may also be effective in reducing risk. Health care workers and caregivers should always consider infection prevention measures and protective equipment like gloves, gowns, and approved masks.

1.3.2 SARS (Severe Acute Respiratory Syndrome)

Severe acute respiratory syndrome (SARS) is a severe viral respiratory infection caused by coronavirus SARS-CoV. The SARS virus outbreak began in China in 2003 and spread worldwide, infecting over 8,000 people before it was contained. SARS virus spreads mainly through person-to-person contact. Since 2004, there have been no known SARS virus cases reported. SARS may cause fever, chills, muscle pain, shortness of breath, headache, and diarrhea. Most SARS patients go on to develop pneumonia. Recommended SARS prevention measures include: washing hands with soap and hot water, or an alcohol-based hand rub; wearing disposable gloves if contacting an infected person's body fluids or feces and throwing those gloves away immediately; wearing a surgical mask; washing personal utensils towels, bedding and clothes with soap and hot water; and disinfecting any household surfaces that may have come into contact with an infected person's sweat, saliva, mucus, vomit, stool or urine.

1.3.3 MERS (Middle East Respiratory Syndrome)

Middle East respiratory syndrome (MERS) is caused by coronavirus MERS-CoV. This viral infection was first reported in Saudi Arabia in 2012. The original source of the virus is unknown but is suspected to have come from camels. Only two patients have ever tested positive for MERS in the United States. Both worked in health care and had recently been to Saudi Arabia. MERS can cause a fever above 38°C with chills or shivering, sore throat, coughing up blood, difficulty breathing, vomiting, abdominal pain, diarrhea, and muscle aches. There is currently no vaccine or cure for MERS. The same preventative measures for other respiratory illnesses apply to MERS infection: wash hands or use an alcohol-based sanitizer; cover your nose and mouth when sneezing and throw the tissue away immediately; avoid touching eyes, nose and mouth with unwashed hands; avoid kissing, sharing food or drinks with sick people; and clean and disinfect contaminated surfaces such as doorknobs and bathroom countertops.

1.3.4 Swine Flu (H1N1)

Swine flu (H1N1) is a respiratory illness caused by the Influenza-A virus. A virus's genetics allow that particular virus to live inside a specific species, like a human, cat, dog, monkey, and others. The swine flu gets its name because the viruses that cause swine flu (H1N1 viruses) show genetic similarities to viruses that infect pigs. As with any seasonal flu, swine flu can cause fever, throat pain, a general feeling of being unwell (malaise), headache, chills, muscle pain, and joint pain. This lung infection may also cause vomiting and diarrhea. It is possible for swine flu to spread from pigs to humans, though this type of spread is most common among people in places like pig barns and livestock fair exhibits housing numerous live pigs. Usually, swine flu is spread from person to person though sneezing or kissing. H1N1 flu is typically contagious from one to seven days of the initial viral infection.

1.3.5 Bird Flu (Avian Flu H5N1)

Avian (bird) flu is an illness also caused by an Influenza-A virus. Most human illnesses from avian flu have been caused by the LPAI (low pathogenic avian flu) H7N9 and HPAI (high pathogenic avian flu) H5N1 variants that have genetic similarities to viruses found to infect birds. People infected with bird flu have often been in close contact with sick birds and their droppings, or in direct contact with someone else already infected with the bird flu virus. Bird flu can cause fever, difficulty breathing, diarrhea, headache, body aches, confusion, sore throat, and runny nose. Bird flu can be life threatening. About 40% of those infected with H7N9 and 50% of people infected with the H5N1 variant die from complications. The best way to prevent bird flu it is to avoid sources of exposure like contaminated poultry farms, aviaries, or coops.

1.4 Factors Contributing to the Risk of Infections

The probability that a person who is exposed to an infectious disease will become infected depends primarily on:

- The concentration of infectious droplet nuclei in the air, which is influenced by the number of organisms generated by a person with the disease, and the amount of ventilation in the area of exposure

- Duration of exposure to the infectious droplet nuclei
- Proximity to source of infectious droplet nuclei

Risk for TB and other infectious respiratory diseases' infection can be further characterized by patient factors, environmental factors, host (or recipient) factors and weak health system.

1.4.1 Patient Factors

The patient factors include:

- Disease in the lungs, airways or larynx like TB
- Presence of cough or other forceful expiratory symptoms like sneezing
- Presence of TB bacilli or other infectious respiratory diseases' virus in the sputum or saliva
- Presence and extent of cavitation in the lungs for TB or other infectious respiratory diseases
- Failure of the patient to cover the mouth and nose when coughing or sneezing (cough etiquette and respiratory hygiene)
- Untreated or delayed diagnosis of TB for DRTB or other infectious respiratory diseases

1.4.2 Environmental Factors

Environmental factors include:

- Exposure in relatively small, enclosed spaces
- Lack of adequate ventilation
- Re-circulation of air containing infectious droplet nuclei

1.4.3 Host Factors

- Immuno-suppression due to HIV infection, diabetes, cancer, malnutrition, and immuno- suppressive treatment increases the risk to infectious respiratory diseases including TB, COVID-19 e.t.c.
- Tobacco, alcohol and drug abuse may increase risk of TB infection and disease
- Extremes of age (very young and very old)

NB: Patients with drug-susceptible TB usually become noninfectious within two weeks after initiating appropriate treatment.

1.4.5 Vaccination

Vaccination has greatly reduced the burden of infectious diseases. Many vaccines are primarily intended to prevent disease and do not necessarily protect against infection. Some vaccines protect against infection as well. The threat constituted by the multiple outbreaks of avian influenza during the last few years and the recent COVID-19 pandemic has called for the development of flu vaccines with broader spectrum of efficacy, which could provide immunity against flu-virus pandemic. The recently WHO approved COVID-19 vaccines for the prevention of severe COVID-19 disease are currently recommended for use for people above 18 years of age.

The Bacille Calmette-Guérin (BCG) vaccine has existed for more than 80 years and is one of the most widely-used childhood vaccines. BCG has a documented protective effect against meningitis and disseminated TB in children. It does not prevent primary infection or reactivation of latent infection. The impact of BCG vaccination on transmission of TB is therefore limited. Few reports show protective efficacy following BCG vaccination in adults. BCG is contraindicated for persons with HIV and of limited use in preventing TB in health care workers.

1.4.6 Health System Factors

Health providers may contribute to infectious respiratory disease transmission by:

- Delaying diagnosis and initiation of therapy
- Failing to initiate treatment with an appropriate regimen
- Performing procedures that can induce coughing or cause aerosolization (e.g., sputum induction, bronchoscopy, etc.)

Patients with drug-resistant TB may respond to treatment more slowly and may remain smear/culture positive longer than other TB patients, thereby extending the period of time they may infect their contacts. The most important objective measure of improvement is conversion of the sputum smear or culture to negative.

1.5 Risk of Nosocomial Transmission of Infectious Respiratory Diseases to Health Care Workers

HCWs are at increased risk of nosocomial transmission in certain settings. These settings include areas where patient care is provided such as sputum induction rooms, outpatient waiting bays (or corridors), and medical wards, where undiagnosed patients with cough are in close contact with HCWs. Of particular importance is the reality that HIV care and treatment have expanded exponentially in recent years, often bringing highly susceptible individuals, presumptive TB, and patients in close proximity, thereby increasing risk of TB and other infectious respiratory diseases transmission. DR-TB poses an additional layer of risk to susceptible individuals. Other settings of concern include emergency rooms, wards, laboratories, and congregate settings such as correctional institutions (prisons, and detention centers), schools and drug rehabilitation centers.

Health care workers are at higher risk of contracting infectious respiratory diseases at the workplace during screening, diagnosis, and care due to;

- Frequent and direct patient contact
- Duration of contact with patient
- Missed diagnosis leading to frequent contact with patients
- Exposure during sample collection, processing and other procedures
- Working in an environment with limited or no infection control measures in place
- HIV status and other immunosuppressive conditions among health care workers

NB: Undiagnosed and untreated TB patients pose the greatest threat to HCWs

1.6 Infection Prevention and Control for Infectious Respiratory Diseases

Infection prevention and control (IPC) in the health care settings is an important step forward in the efforts to prevent transmission of infectious respiratory diseases. Good IPC practices which include administrative, environmental, and respiratory controls that can make the healthcare environment safer by protecting patients, clients, HCWs, and community from tuberculosis. Additionally, IPC becomes more important in control against transmission of drug resistant TB (DR-TB).

Chapter Two

2.0 Infection Prevention and Control

Infection prevention and control (IPC) is a critical component and primarily focuses on decreasing the risk of TB, COVID-19 and other infectious respiratory diseases transmission. IPC in the health care settings is therefore an important step towards prevention of transmission of TB, COVID-19 and other infectious respiratory diseases. Good IPC practices include administrative, environmental, and respiratory controls that can make the healthcare environment safer by protecting clients, HCWs, and community from other infectious respiratory diseases.

Healthcare facilities are places where sick people congregate, creating many opportunities for micro-organisms to spread between patients, visitors and healthcare workers. Medical care is also increasingly complex, with multiple, invasive procedures increasing the risk of developing healthcare-associated infections (HAI). Many of these infections are preventable. Research has proven that IPC programmes can make healthcare safer and more affordable by preventing the suffering, loss of life, and cost caused by healthcare-associated infection.

Additionally, IPC becomes more important in control against transmission of drug resistant TB (DR-TB).

2.1 Infection Prevention and Control Measures

Infection prevention and control measures should be based on a careful assessment of risk for transmission of infectious respiratory diseases in the facility or other settings.

The goals of effective infection control programs are to:

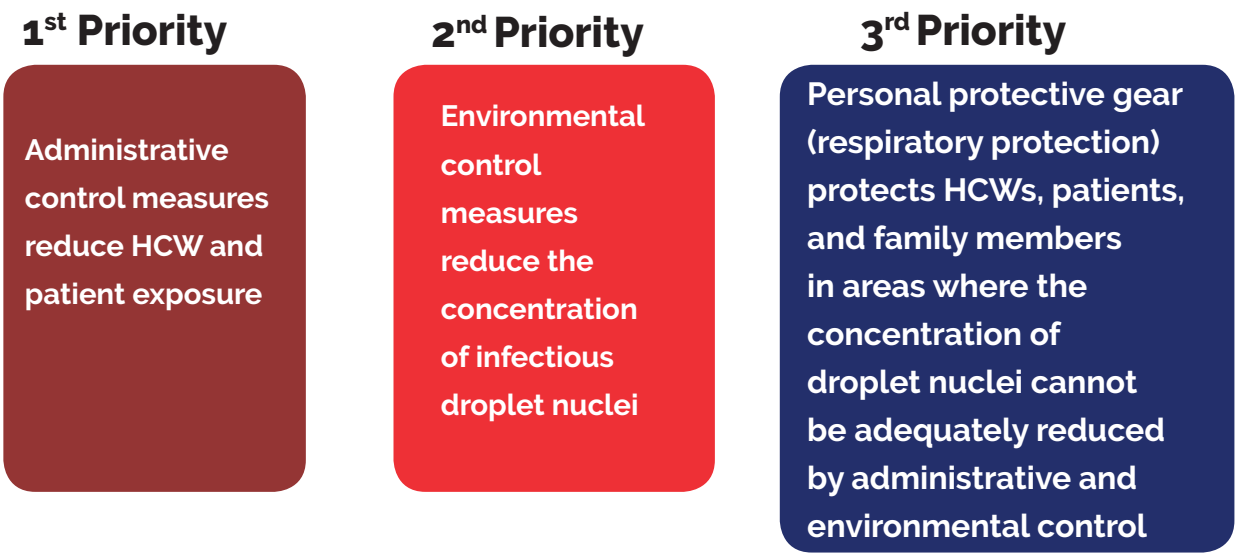
1. Separate and fast track those who are suspected of having infectious respiratory diseases
2. Detect the disease early and promptly
3. Treat all patients diagnosed with infectious respiratory diseases
4. Screen all contacts of confirmed cases

2.1.1 Infection Prevention and Control Measures

There are three levels of infection control measures: administrative (managerial) control measures, environmental control measures, and personal protective equipment (respiratory protection).

Administrative control measures are the most important among the three levels. Environmental control measures and personal protective equipment (respiratory protection) will not work in the absence of solid administrative controls.

Each level operates at a different point in the infection control process:



2.2 Administrative (Managerial and Policy) Control Measures

Administrative measures are defined as the managerial or work practices (e.g., triaging, early diagnosis, prompt isolation or separation of presumptive TB and other respiratory diseases, prompt initiation of treatment and minimize aerosol-generating procedures) to significantly reduce the risk of transmission by preventing the generation of droplet nuclei or reducing exposure.

They include:

1. **Hand Hygiene**

   Importance of handwashing will be reinforced to reduce the spread of communicable and infectious diseases (within the context of TB and other infectious respiratory diseases) through policies, regulations innovations and behaviour change strategies. Hand hygiene by either handwashing with running water and soap or hand rub by use of alcohol-based rub (ABHR) shall be available at all service delivery points (SDPs). Hand washing stations will be made available for patients and health care workers at all SDP. Hand washing messages will be strategically placed to ensure correct hand washing procedures are followed. Hand hygiene audits shall be routinely done by use of the WHO hand hygiene checklist.

2. **Triage**

   Upon entry into the health facility, a member of the medical staff should identify patients, community health workers, healthcare workers, persons attending healthcare facilities, or other persons in settings with a high risk of transmission with a cough as soon as possible and direct them to a separate waiting area, educate on cough hygiene, and screen for TB and other respiratory diseases.

3. Controlled flow of movement within the facility

Inside the TB and isolation departments, circulation of patients and attendants should be controlled. Encourage patients/attendants to spend as much time as possible outdoors if weather permits or in areas that are open.

In addition,

- Have visible signage on entry doors to chest clinic and isolation wards/facilities that forbid visitors to enter
- Limit visitation duration to isolation facilities
- Encourage visits outside the building, especially for contagious patients
- Have visiting areas well identified with appropriate signage
- Have SOPs on client flow in different departments
- Before any visit, the drive provider should provide information on transmission risk, including the usage of respirators if caregivers need to go in high-risk areas, such as smear-positive, drug-resistant TB (DR-TB), re-treatment smear-positive inpatient, isolation, quarantine units, and areas or clinics where diagnosis of TB and other infectious respiratory diseases is being undertaken
- Restrict entry for persons most at risk of infection including young children, the elderly, the immunocompromised, and other comorbidities
- Avoid contact with known index cases or restrict movement of potentially infectious TB and respiratory disease patients to areas where they may infect other patients within the hospital set up, and vice versa

4. Triaging of hospitalized patients

Care for TB and other infectious respiratory diseases is primarily an ambulatory care, and patients should preferably be treated as outpatients. Hospitalization should be limited to critically unwell patients. TB and isolation wards must be separated from the other wards in the health facility. Ideally, within the TB and isolation wards, patients should be placed in single rooms. If this is not possible, cohort isolation must be implemented, and different sections should be labelled according to the degree of contagiousness (smear/culture/nasopharyngeal or oropharyngeal swab status) and risk of resistance.

The following is one scheme of separation. It does involve the use of some single isolation rooms (all facilities with TB and other infectious respiratory disease inpatient facilities should have isolation rooms. If none exists, a very high priority is to establish one). Refer to the TB isolation policy.

Smear-positive patients with proven or suspected DR-TB, including chronic cases and re- treatment cases that are likely to have DR-TB, should have single isolation rooms. It is particularly important not to mix DR-TB patients with other patients. Where possible, presumptive TB cases should not be hospitalized for diagnosis. If hospitalization is necessary, these patients need isolation rooms. Never put a known DR-TB patient who is not receiving DR-TB medications in a general ward.

There are four key components to good work practice (and administrative) controls. These include:

a) TB and other infectious respiratory diseases infection, prevention, control and risk assessment

b) Development of a facility infection prevention control plan

c) Patient and healthcare worker management

d) Infrastructure management i.e., clinics, laboratory and pharmacy

a) TB and other infectious respiratory disease infection, prevention, control and risk assessment

At facility and community levels, infection prevention and control assessment entails an initial and ongoing evaluation of the risk of TB transmission and other infectious respiratory diseases.

The infection control assessment should cover the following topics:

- Review of the statistical reports on TB and other infectious respiratory diseases in the community and facility
- Identification of the most at-risk settings within the facility, and prioritizing them for initial efforts to put IPC measures in place to prevent TB and other infectious respiratory diseases
- Identification of categories of HCWs who are immunocompromised that need to be included in TB or other infectious respiratory diseases screening programs and redeployed to areas with minimal risk. All HCWs are at risk of contracting TB and other infectious respiratory diseases and should be screened as per the National Guidelines
- Identification of mechanisms to prompt detection and reporting of presumptive TB episodes and other infectious respiratory diseases transmission in the facility and community

b) TB and other infectious respiratory diseases infection, prevention and control plan

All relevant stakeholders should be involved in the development and review of the TB and other infectious respiratory diseases IPC plan.

This plan should be implemented and monitored according to its recommendations.

The plan should include:

- Description of the incidence of TB, TB/HIV and other infectious respiratory diseases in the facility
- Assessment of HCW training needs and training plan
- Administrative policies with regard to triage and screening, referral and diagnosis, separation and isolation
- Using and maintaining environmental controls
- Policy on the training and use of respiratory protection
- Area-specific infection control recommendations
- Description of roles and responsibilities for implementation and monitoring the infection control plan
- Timeline and budget

Composition of IPC Committee (County, Subcounty and Facility Level)

IPC team should include and not limited to:

- Medical Superintendent/ Facility-in-charge Chairperson
- IPC Focal Person - Secretary
- Clinician
- Epidemiology
- Public Health Officer
- Quality Improvement Focal Person
- Laboratory
- Medical engineering
- Occupational health
- Health Records Person

IPC team should be responsible for all aspects of the facility TB and other infectious respiratory diseases IPC plan development, implementation and review. The IPC Team should choose the IPC focal person who will follow up to ensure implementation of IPC work plan

c) Patient and healthcare worker management

Steps for patient management to prevent transmission of TB and other infectious respiratory diseases in community and health care settings.

Steps for Patient Management to prevent transmission of TB and other infectious respiratory diseases in the Community and health care settings.		
Step	**Action**	**Description**
1.	Screen and Triage	Early identification and detection of presumptive TB patients or confirmed TB disease and other infectious respiratory diseases is the first step in IPC. Patients with cardinal symptoms or who report being under investigation or treatment for TB and other infectious respiratory diseases are identified and prioritized for care. These patients should not be allowed to wait in the queue with other patients.
2.	Education	Educating the above-mentioned persons identified through screening, cough etiquette and respiratory hygiene. This includes instructing them to cover their noses and mouths when coughing or sneezing, and when possible providing facemasks, handkerchiefs or tissues to assist them in covering their mouths and nose.
3.	Special waiting areas	Patients who are identified should be directed to another well-ventilated waiting area/room away from other patients and provided with a surgical mask or tissues to cover their mouth and nose while waiting.
4.		• Appropriate treatment should be initiated in accordance with National TB and other infectious respiratory diseases guidelines at the earliest time possible. • Directly observed therapy (DOT plus) to ensure adherence to treatment. • Follow-up and monitor patients in accordance with National TB and other infectious respiratory diseases guidelines. • Trace contacts of index TB and other infectious respiratory diseases patients for diagnosis and appropriate treatment as per national guidelines. • Additional investigations for better management in case of comorbidities and drug susceptibility. • Patients should be linked to TB and other infectious respiratory diseases clinics within the facility or other facilities for continuum of care. For inpatient and outpatient settings, coordinate a discharge plan with the patient for continuity of care

5.	Investigate for TB or refer	Diagnostic tests should be done onsite or, if not available onsite, the facility should have an established link with a diagnostic and treatment site to which symptomatic patients can be referred.
6.	Discharge Plan	For inpatient and outpatient settings, coordinate a discharge plan with the patient (including a patient who is a HCW with TB/ other infectious respiratory disease) and the TB-control program of the local, Sub County or provincial health facilities. If applicable, co-management of patients with HIV or other diseases should be coordinated with the applicable local, Sub County or provincial health facilities. **N/B: For MDR-TB, identify trained HW in referral sites who will be able to manage the patient according to the national multi-drug-resistant TB guidelines.**

2.3 Environmental Control Measures

These are measures that are used to reduce the concentration of droplet nuclei in the air. Such measures include maximizing natural ventilation and controlling the direction of airflow through infrastructural designs. In Kenya, opening windows and doors is the most commonly practiced form of environmental control, especially in resource limited settings.

The following are the six main principles of environmental control measures

A. Facility design
B. Dilution (e.g., Ventilation systems)
C. Filtration (e.g., HEPA filters)
D. Purification (e.g., UVGI Systems)
E. Environmental cleaning, disinfection, and sterilization
F. Healthcare waste management

A. Facility Design

The design should take into consideration the following:

1. **Patient flow pattern should minimize cross infection by triaging, physical distancing or barriers, etc. This can be achieved through:**
    - Minimizing congested situations
    - Providing areas for triaging of potentially infectious patients
    - Providing isolation rooms/wards for infectious respiratory diseases

2. **Maximize natural ventilation**

The following should be put into consideration while designing physical structures and set up to minimize cross infections of infectious respiratory diseases:

- Direction of prevailing wind flow
- Placement and sizes of doors, windows and corridors
- Health care staff should be mindful of the direction of airflow to ensure the patient is closest to the exhaust fans and the staff are closest to the clean air source. This arrangement should be done every morning
- Promotes airflow patterns from the least infected (health care worker) to the most infected (patients)
- Maximize natural draught through chimney affects, ventilation grills, open verandas
- Maintain the standard and regulations for patient waiting bays and corridors (Corridors and waiting bays should not be converted for other uses)

3. **Maximize availability of sunlight as a natural deterrent to growth of MTB and other respiratory infectious pathogens**

B. Air Dilution

This is the simplest, extremely effective, and least expensive technique. It reduces concentration of MTB and other infectious respiratory pathogens in the spaces by introducing clean air.

Dilution does not kill the MTB or even other respiratory pathogens, but reduces probability of transmission by dispersing the pathogens to non-infectious concentrations.

There are three types of air dilution mechanisms:

1. **Natural ventilation**

Natural ventilation is created by use of external airflows generated by wind or differences in temperature.

- It relies on open doors and windows
- It's unregulated in case of permanent openings
- The direction of wind may not be controlled nor change the flow of air

Natural air movement should be monitored since it can be used to determine the sitting arrangement in consultation rooms between patients and HCWs.

Simple natural ventilation may be optimized by maximizing the size of the opening of windows and doors and locating them on opposing walls.

Where possible, the use of natural ventilation should be maximized before considering other ventilation mechanisms.

2. Mechanical ventilation

Mechanical ventilation is created by use of mechanical devices that force air exchange and drive airflow. They range from simple table, floor, window and exhaust fans, to more complex high tech negative and positive pressure air handling units. These should direct the airflow towards an exit.

Other types of mechanical ventilation include:

- Sputum Booth
- Biosafety cabinets (BSC)
- Biosafety hoods or laminar flow cabinets
- Patients' tents/ waiting bay/consultation rooms/etc.
- Isolation rooms

Consider air calculation per room space is done accordingly.

Examples of mechanical pressure:

- Air flows from a higher to lower pressure area
- Lower pressure is maintained in the room resulting into air flow into room
- Keep doors and windows closed to maintain a unidirectional air flow
- The direction of airflow is controlled by creating a lower (negative) pressure in the area into which the flow of air is desired. Negative pressure is the approximate air-pressure difference between two areas

3. Mixed Mode

Well-designed, maintained and operated fans (mixed-mode ventilation) can help to obtain adequate dilution when natural ventilation alone cannot provide sufficient ventilation rates e.g., due to building structure, climate, regulations, culture, cost, and outdoor air quality.

C. Filtration

It's a method that involves removing infectious particles and brings back filtered air. This involves the use of High Efficiency Particulate Air cleaner (HEPA cleaner). This does not kill the infectious organisms but reduces the concentration in the air by trapping bacteria, viruses,

spores and dust achieving 99.97% clean air.

Change of filters is dependent on:

- Amount of contaminants
- Environmental conditions
- Airflow rate
- Type of filter media and manufacturers' instructions
- Location in ventilation system

D. Purification

Purification is the process of getting rid of impurities from the air. It involves the use of Ultraviolet Germicidal Irradiation (UVGI) to inactivate and destroy infectious organisms.

How much UVGI do we need to kill M. tuberculosis and other respiratory pathogens?

- The target is to destroy 90% of the pathogen colony formation
- This is achieved by irradiating ultraviolet C of density of at least 100 J/M2
- This can be measured using a photometer or a radiometer

Maintenance of UVGI

- Monthly cleaning of dust from lamps with 96% alcohol solution
- Lamps should not last more than 2 years as the UVGI output will fall below 20%
- Relative Humidity in air must not be above 65%
- For safety, UVGI lamps need parabolic mirrors to reduce unnecessary scattering

E. Environmental Cleaning, Disinfection and Sterilization

Cleaning removes germs from surfaces, but disinfection aims to kill or inactivate harmful microorganisms but leaves some microbes intact. Sterilization aims at killing all the microbes.

It is important to ensure that cleaning, disinfection and sterilization procedures are followed consistently and correctly. All surfaces in healthcare facilities should be routinely cleaned, disinfected and sterilized, especially high-touch surfaces, and whenever visibly soiled or if contaminated.

In settings where presumed or confirmed TB and other infectious respiratory disease patients are accessing services or are admitted, the frequency of these procedures depends on type of patient areas and surfaces.

Detailed guidance on environmental cleaning and disinfection in the context of COVID-19 is available from WHO[1].

Cleaning and disinfection:

Principles of cleaning a facility:

- Use cleaning products that are: efficient, safe and cost effective
- Perform routine cleaning
- Choose cleaning methods and develop written schedules based on the type of surface and amount of dirt present
- Use caution signs
- No dry sweeping and dusting in clinical areas
- Clean high touch surfaces daily e.g., door handles, telephones, and taps using a clothing soaked in a disinfectant
- Frequency of cleaning is determined by the risk of contamination (at least daily)
- Cleaning tools are to be cleaned, disinfected, and dried between uses
- Clean progressing from the least soiled areas to the most soiled areas and from high to low areas
- Use of friction is the best way to physically remove dirt, debris, and microorganisms
- Clean all furniture as it could be contaminated

**Required: Clean before any disinfection procedure*

There are 2 types of Disinfection, which are:

- Chemical disinfection for general equipment and laboratory services.
- Physical

If there are inadequate or insufficient administrative control measures, environmental control measures will not eliminate the risk.

a) Chemical Disinfection

This includes the use of:

- Detergents (liquid or powdered)

1 https://www.who.int/publications/i/item/WHO-2019-nCoV-IPC-2020.4

- 0.5% Chlorine solutions made from chlorine products:
    1. Sodium hypochlorite
    2. Calcium hypochlorite
    3. Sodium dichloroisocyanurate tablets
- Ethyl or isopropyl alcohol (70-90%) (used on items that might react to water)
- Improved hydrogen peroxide

Chlorine loses strength with time, so prepare new chlorine solutions everyday. Chlorine solutions need to be stored safely in closed containers. Keep the chlorine solution in a shaded area away from direct sunlight as it weakens chlorine solution.

b) Phenol

- Should be used at a concentration of 2% to 5% in water
- These compounds are used for the decontamination of surfaces (triclosan, chloroxylenol, orthophenylphenol are commonly used antiseptics)
- Iodophors
- Should be used at concentrations of 3% to 5%
- Iodophors are useful for mopping up spills.

Using Chlorine Powder:

$$\left[\frac{\%\ chlorine\ desired}{\%\ chlorine\ in\ powder}\right] \times 1000 =$$

Example:

To make a strong (0.5%) solution from 35% chlorine powder

$$\left[\frac{0.5\%\ chlorine\ desired}{35\%\ chlorine\ in\ powder}\right] \times 1000 = 14.2\ grams$$

Dissolve **14.2 grams** of chlorine powder for each liter of water

Making Chlorine Solution cont.

How to make chlorine solutions for environmental disinfection

Example I - Using Liquid Bleach

Chlorine in liquid bleach comes in different concentrations. Any concentration can be used to make a dilute chlorine solution by applying the following formula:

$$\left[\frac{\text{\% chlorine in liquid bleach}}{\text{\% chlorine desired}}\right] - 1 = \text{Total parts of water for each part bleach†}$$

Example: To make a 0.5% chlorine solution from 3.5%‡ bleach:

$$\left[\frac{3.5\%}{0.5\%}\right] - 1 = 7 - 1 = 6 \text{ parts water for each part bleach}$$

Therefore, you must add 1 part 3.5% bleach to 6 parts water to make a 0.5% chlorine solution.

† "Parts" can be used for any unit of measure (e.g. ounce, litre or gallon) or any container used for measuring, such as a pitcher.

‡ In countries where French products are available, the amount of active chlorine is usually expressed in degrees chlorum. One degree chlorum is equivalent to 0.3% active chlorine.

c) Physical Disinfection

This includes filtration, pasteurization, and microwave.

Cleaning equipment

- Personal protective equipment (PPE)
- Cleaning cart or mopping buckets (at least two)
- Floor mop
- Small bucket or bowl
- Cleaning cloths
- Cleaning solutions

NB: Have designated cleaning tools (bucket, mop and cloth) for the isolation room

General cleaning

- Put on PPE (Gloves, gown/apron, facial protection as necessary)
- Cleaning starts with equipment then surfaces and finally the floor.
- Clean equipment using detergents with a cleaning cloth, then disinfect if necessary) and rinse

- Using detergent mixed with water in a bucket/bowl clean equipment, disinfect and rinse them
- Use detergent to clean surfaces, disinfect and then rinse
- Clean the floor using detergent
- Use a clean bucket for the disinfectant to disinfect the clean floor
- Rinse the floor with clean water and leave to dry

Clean the cleaning tools and allow to dry for next use

Managing linens and laundry

- Disinfect reusable PPEs (scrub suits, plastic apron, goggles, heavy duty boots, heavy duty gloves) with 0.5% chlorine solution, clean with water and soap, then rinse with clean water
- Decontaminate patients' clothes/linen using 0.5% chlorine solution then clean with water and soap, then rinse with clean water
- With approval of the patient, burn heavily soiled clothes and provide new clothes to the patient
- Where burning is not possible, soak heavily soiled linen in 1% chlorine for 15 minutes before cleaning

Clean with soap and water, rinse and disinfect with chlorine 0.5% solution for 5 minutes and rinse

Isolation room cleaning

- This is done during isolation, after discharge or transfer of patient
- Aims at removing organic materials, reduce and eliminate microbial contamination
- Supervised by infection control person and clinical staff
- Wearing appropriate PPE, clean, disinfect, and rinse equipment, every surface and floor

NB: Chlorine-based solution at 0.5% concentration is preferred for sporicidal effect, easily available and cheap

- Dispose of the waste as per provided guidelines
- Remove PPE and perform hand hygiene
- On discharge allow ample time at least four hours (if possible) for room ventilation preferably by natural air
- Set the room for use by another patient
- Clean an occupied room at least three times a day (more frequent if required)

Sterilization:

It is the process of rendering items free of all living microorganisms, including spores. There are two methods that are commonly used for sterilization as per the IPC national guidelines:

Heat sterilization

Chemical sterilization

F. Waste Management

Healthcare waste is a potential reservoir of pathogenic microorganisms and requires appropriate, safe, and reliable handling. Safe management of healthcare waste is a key issue in controlling and reducing healthcare associated infections (HAIs).

This refers to all the waste from healthcare facilities, medical research facilities, and laboratories. It may be in the form of solid or liquid.

Key Steps in Waste management:

1. Waste avoidance and Minimization
2. Segregation
3. Decontamination
4. Packaging and labeling
5. Handling and storage
6. Containment
7. Transport
8. Treatment or destruction
9. Disposal

There should be a person or persons responsible for the organization and management (collection, storage, and disposal) of waste. Waste management should be conducted in coordination with the infection-control team.

The purpose of proper waste management is to:

- Protect people who handle waste items from accidental injury
- Prevent the spread of infection to patients, clients, and HCWs
- Prevent the spread of infection to the local community
- Safely dispose of hazardous materials (HAZMATs)

Waste from healthcare facilities can be broadly classified into two categories as hazardous and non-hazardous.

It is estimated that approximately 85% of the waste generated in health facilities is non-

hazardous. 15% of waste which comprises infectious waste is potentially infectious or toxic if it is not disposed of properly.

Waste handling

- Always wear personal protective equipment
- A minimum of gloves, heavy duty apron and boots
- Maintain segregation patterns and NEVER re-sort waste
- Keep written records of the quantities received and treated
- Collect and remove waste daily from healthcare settings.

Waste storage

- Designate an area/room within the health facility for holding the waste containers
- Waste should be segregated and stored according to hazardous levels as per public health guidelines
- Highly infectious waste e.g., waste from COVID patients should be disinfected immediately before storage
- Storage time must not exceed 24 hours
- Mark storage areas with the biohazard symbol

Waste storage requirements

- Waste must be stored in a secure location to restrict access to unauthorized persons and secure against scavengers
- Waste must be secured from weather e.g., rain
- Storage area should be easily accessible from all points of waste generation

Transportation to treatment/disposal sites

- All bins and bags must be closed/lids in place when being transported
- All waste handlers MUST wear PPEs when handling medical waste
- Bins must not touch the body of carrier
- On site transport: wheelbarrow, trolley, hand cart (mkokoteni), etc.
- If by hands, bags must always be carried by their top. Once done, wash your hands properly
- Transport each waste category separately

Treatment and disposal of healthcare waste

There are several ways of disposing healthcare waste, these include:

1. Chemical decontamination
2. Autoclaving and shredding
3. Microwaving and Shredding
4. Incineration
5. Safe High temperature burning (Burning chamber)

Environmental Impact

Treatment and disposal of healthcare waste may pose health risks indirectly through the release of pathogens and toxic pollutants into the environment.

- The disposal of untreated health care wastes in landfills can lead to the contamination of drinking, surface, and ground water if those landfills are not properly constructed.
- The treatment of health care wastes with chemical disinfectants can result in the release of chemical substances into the environment if those substances are not handled, stored, and disposed of in an environmentally sound manner.
- Incineration of waste has been widely practiced, but inadequate incineration or the incineration of unsuitable materials results in the release of pollutants into the air and in the generation of ash residue. Incinerated materials containing, or treated with, chlorine can generate dioxins and furans, which are human carcinogens and have been associated with a range of adverse health effects. Incineration of heavy metals or materials with high metal content (in particular lead, mercury, and cadmium) can lead to the spread of toxic metals in the environment.
- Only modern incinerators operating at 850-1100˚C and fitted with special gas-cleaning equipment are able to comply with the international emission standards for dioxins and furans.
- Alternatives to incineration such as autoclaving, microwaving, steam treatment integrated with internal mixing, which minimize the formation and release of chemicals or hazardous emissions should be given consideration in settings where there are sufficient resources to operate and maintain such systems and dispose of the treated waste.

2.4 Personal Protective Equipment among Health Care Providers, Patients and the Communities

2.4.1 Respiratory protection

These strategies all serve to reduce, but do not eliminate, the possibility of exposure to respiratory pathogens. The appropriate use of PPE serves to further reduce the risks of transmission of respiratory pathogens to healthcare workers, patients, and the community from exposure to body substances or from droplet or airborne organisms in the line of duty providing

or seeking services. The use of PPE should be defined by policies and procedures addressing isolation precautions. Their effectiveness depends on adequate and regular supplies, adequate staff training, proper hand hygiene and, in particular, appropriate human behaviour. All these controls are connected and should be harmonized to promote an institutional culture of safety. They include: gloves, aprons, gowns, head cover, surgical masks, respirators, and protective eyewear.

Respiratory protection is an important aspect for protecting HCWs against HAIs emanating from respiratory pathogens. It goes hand in hand with administrative and environmental measures. This measure is important in high-risk areas such as isolation centers for persons confirmed with infectious respiratory diseases e.g., COVID-19 isolation centers, sample collection centers for infectious respiratory diseases, MDR treatment centres, centers handling presumptive TB and MDR specimens, surgical centers handling bronchoscopy and autopsy, sputum induction and other aerosol–generating procedures plus people handling disposal waste from the laboratory and wards.

Type of Recommended Protective Equipment and Recommended Use

Type of PPE	Recommended use	Primary protects
Gloves	• When there is a reasonable chance of hands coming in contact with blood or other body fluids, mucous membranes, or non- intact skin • Before performing invasive medical procedures, for example, when inserting vascular devices such as peripheral venous lines • Before handling contaminated waste items or touching contaminated surfaces	Service providers
Headcovers, gowns or aprons	• When performing invasive procedures during which tissue beneath the skin is exposed • When handling immunocompromised patients • When handling patients with infectious disease • When handling contaminated waste	Service providers, patients

N-95 masks	• When handling patients with airborne or droplet infections/providing a service in a high-risk area • When doing aerosol generating procedures	Service providers, visitors who are visiting patients with infectious respiratory diseases, and caregivers
Surgical/ Procedural masks	• When performing invasive procedures (non-aerosol generating) • When handling patients/ clients seeking services • When handling medical waste	Patients, laboratory staff
Goggles or glasses	• Situations in which splashing of blood, body fluids, secretions, or excretions are likely	Service providers and laboratory staff
Closed boots or shoes	• Situations in which sharp instruments, or in which spillage or infectious agents are likely • When handling immunocompromised patients	Service providers
Protective Coveralls (one piece suit)/ HAZMAT suit	• Working in higher risk areas e.g., isolation facilities, sample collection sites	Service providers

2.4.1.1 The role of surgical or procedure masks and respirators in respiratory protection

1. Surgical or procedure masks

There are important differences between a surgical or procedure mask and a respirator.

Surgical or procedure masks (cloth or paper):

- Do prevent the spread of microorganisms from the wearer (e.g., surgeon, clients with infectious respiratory infections, etc.) to others by capturing the large wet particles near the nose and mouth and limiting the distance aerosols expelled when coughing, sneezing, and talking.

- May provide a limited level of protection to the wearer (e.g., HCW, patient, family member) from inhaling infectious droplet nuclei in the air; however, they are not designed to be of high filtration efficiency or with a tight face seal.

Use of surgical or procedure masks for clients

- Surgical masks are used by the clients to prevent transmission of droplets during exhalation - coughing, sneezing, talking, or singing.
- However, it is still paramount to educate the clients and their care givers on cough etiquette practices such as covering the mouth using tissues or clothes, not spitting on the floor, and proper disposal of soiled tissues.
- Clients and HCW education regarding the importance and appropriate use of wearing surgical masks should accompany their distribution.

Surgical mask

2. N-95 for health care workers

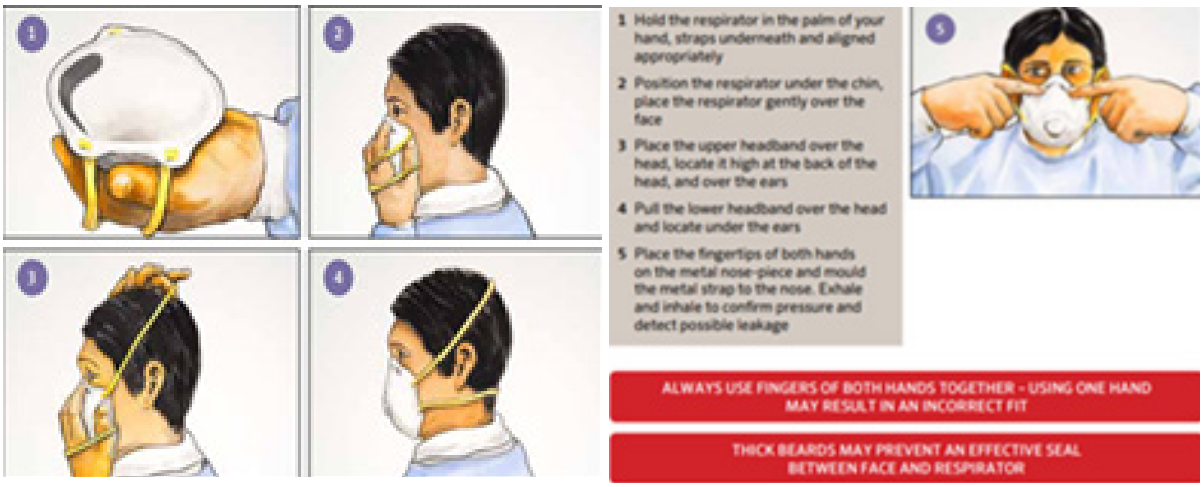
N-95 are a special type of respirator that provide 94-95% filtration efficiency against 0.3-0.4 micrometer particles.

- They should be closely fitted to the face to prevent leakage around the edges
- If the respirator is not worn correctly, infectious droplet nuclei can easily enter a person's airways, potentially resulting in infection
- Wearing and fitting a respirator properly
- The N-95 masks can be re-used repeatedly for several weeks (up to 2 weeks) if they are properly stored before disposal
- Respirators should be stored in a clean dry location devoid of humidity, dirt and filter damage
- Plastic bags should never be used to store N95 masks as they retain humidity

N-95

3. **Respirator fit testing:**

Place the respirator over your nose and under your chin. If the respirator has two straps, place one strap below the ears and one strap above. If you are wearing a hat, it should go over the straps.



2.4.2. Protection in high-risk areas

Respirators should be worn by all personnel entering high-risk areas such as bronchoscopy rooms, sputum induction rooms, MDR-TB and or other infectious respiratory diseases' isolation facilities, people handling specimens, chest clinic, and when collecting samples from clients presumed to have infectious respiratory diseases.

The use of powered air purifying respirator (PAPR) is also recommended where high-risk procedures are performed, for they are cost-effective and are re-usable and do not require fit testing.

2.5 Increasing Awareness of TB and other Infectious Respiratory illnesses

There has been an increase in TB and other infectious respiratory illnesses burden among healthcare providers and the community. In addition to this, it has also been documented that people in close proximity are at high risk; not only health care providers, but also any staff, including volunteers, who have contact with persons with TB or other infectious respiratory diseases and who have not yet been diagnosed and started on treatment. PLWHA in these roles are at particular risk of rapid progression to TB disease if they become infected or re-infected due to exposure to M. tuberculosis in the facility. They should be included in all training programs. A third group in congregate setting, correctional institutions, and drug rehabilitation centers that have also been documented to have higher rates of infectious respiratory infection and disease progression than the general population.

The infection prevention and control measures recommended in this policy should reduce the time people with undiagnosed infectious respiratory diseases spend in health care settings and should improve ventilation and thus dilution of any respiratory pathogens in the environment. Nevertheless, the risk to staff will never be zero, and an additional aspect of protecting staff is promoting early recognition of infectious respiratory diseases and standard treatment.

It is recommended that staff be investigated for infectious respiratory diseases free of charge if they have a cough for two weeks or more. The IPC plan should list designated staff members who should be contacted to initiate infectious respiratory diseases investigations and reinforce that all services are confidential. Deployment of healthcare workers with chronic illnesses and immuno-compromised should be deployed to high-risk areas with caution as they are liable to developing and progressing infectious respiratory diseases.

2.6 Increasing Access to Voluntary HIV Counseling and Testing and DTC

Healthcare providers and the community members should be encouraged to know their HIV status. This could be achieved through providing accessible, acceptable, confidential VCT, including periodic retesting, to staff.

HIV-infected healthcare providers and the community members are at increased risk of developing TB disease if exposed in the workplace, and additional precautions should be taken to protect them. Immuno-compromised health care providers should be given opportunities to work in areas with a lower risk of exposure to TB and should be provided with isoniazid preventive therapy (IPT) where indicated.

Education directed to healthcare workers concerning HIV testing must be linked to their role in educating patients and communities about the benefits of testing and knowing one's HIV status. This may further reduce stigma.

Chapter Three

3.1 Laboratory Component

KEY HIGHLIGHTS

- Sputum microscopy is a low-risk activity; Biosafety Cabinets are not mandatory for performing direct sputum-smear microscopy.
- The most important factor in the prevention of acquired laboratory TB or other infectious respiratory diseases is good technique on the part of the individual health care provider. Specialized equipment may aid good laboratory practice but does NOT replace it.

Respirators and surgical masks are not the same. Surgical masks provide no effective respiratory protection from aerosols and must not be used in the place of respirators.

Laboratory IPC for other infectious respiratory diseases

Highlights of SARS-CoV-2

- All procedures must be performed based on risk assessment and only by personnel with demonstrated capability, in strict observance of any relevant protocols at all times.
- Initial processing (before inactivation) of specimens should take place in a validated biological safety cabinet (BSC) or primary containment device.
- Non-propagative diagnostic laboratory work (for example, sequencing, nucleic acid amplification test [NAAT]) should be conducted at a facility using heightened control measures similar to Biosafety Level 2 (BSL-2).
- Point of care (POC), near-POC assays and antigen detection rapid diagnostic tests (Ag-RDTs) can be performed on a bench without employing a BSC, when the local risk assessment so dictates, and proper precautions are in place.
- Propagative work (for example, virus culture or neutralization assays) should be conducted in a containment laboratory with inward directional airflow (heightened control measures/BSL-3).
- Appropriate disinfectants with proven activity against enveloped viruses should be used (for example, hypochlorite [bleach], alcohol, povidoneiodine, chloroxylenol, chlorhexidine, benzalkonium chloride).

Laboratory facilities are designated as:

- Basic – Biosafety Level 1(Smear microscopy for AFB, GeneXpert)
- Basic –Biosafety Level 2 (Smear microscopy for AFB, GeneXpert, LPA)
- Containment – Biosafety Level 3 (Smear microscopy for AFB, GeneXpert, LPA, culture and phenotypic DST, COVID testing)
- Maximum containment – Biosafety Level 4 (Marburg virus, Ebola virus, etc.)

Biosafety level designations are based on a composite of the design features, construction, containment facilities, equipment, practices, and operational procedures required for working with agents from the various risk groups.

3.1 Risk level and laboratory areas

The entry area should be reserved for 'clean' activities. 'Dirty' activities should be furthest away from the entry.

- Low-risk activities include: administration, hand-washing station, microscopy, GeneXpert, consumables and reagent storage, staining
- Moderate-risk activities include: culture processing and media inoculation
- High-risk activities include: handling positive cultures, identification of MTB, DST, preparing DNA extracts from positive cultures

RISK LEVEL	LABORATORY ACTIVITIES	ASSESSMENT OF RISK	SAFETY EQUIPMENT
Low risk	Direct sputum microscopy, preparation of specimens for the Xpert MTB/RIF assay	Low risk of generating infectious aerosols from specimens, low concentration of infectious particles	Handwashing/eye wash station Alcohol based hand rub (ABHR)
Moderate risk	Processing and concentration of specimens for inoculation on primary culture media, direct molecular testing on processed sputum by a line probe assay	Moderate risk of generating infectious aerosols from specimens, low concentration of infectious particles	Handwashing/eye wash station Alcohol based hand rub (ABHR) Biosafety cabinet (BSC) Autoclave

High risk	Culture manipulation for identification, phenotypic DST, or a line probe assay on cultures, Molecular assay for highly infectious agents e.g., COVID	High risk of generating infectious aerosols from cultures, high concentration of infectious particles	Handwashing/eye wash station Alcohol based hand rub (ABHR) Biosafety cabinet (BSC) Autoclave Biosafety level 3 lab

3.2 Risk assessment for laboratories

Decisions about the most appropriate biosafety measures for a specific laboratory should be undertaken using an approach based on risk assessment that considers the different types of procedures performed by the laboratory.

The risk-assessment approach for laboratory considers:

- The bacterial load of materials (such as sputum specimens and cultures), and the viability of TB bacilli
- Route of transmission of microorganisms
- Whether the material handled and the manipulations required for each procedure are likely to generate infectious aerosols

The number of manoeuvres for each technique that may potentially generate aerosols

- The workload of the laboratory and individual staff members
- The location of the laboratory
- The epidemiology of the disease and the patient population served by the laboratory
- The level of experience and the competence of the laboratory's personnel
- The health of the laboratory's personnel (especially those that are immuno-compromised)

Safety precaution in sputum smears preparation

The major risk of TB infection in the laboratory is associated with inhalation of aerosols generated by laboratory processes. Minimizing their production is the most effective means of staying safe.

- Sputum microscopy is a low-risk activity; biosafety cabinets are not mandatory for performing direct sputum-smear microscopy.
- With good microbiological technique, direct sputum-smear microscopy entails a low

risk of generating infectious aerosols, and such procedures may therefore be performed on an open bench, provided that adequate ventilation can be assured (Tuberculosis Laboratory Biosafety Manual).

- Where good laboratory practices are used, risk of infection to laboratory technicians is very low during smear preparation.
- A higher risk of infection exists when collecting sputum specimens from clients.
- Aerosols may be produced in the TB laboratory when handling leaking specimens, opening sample containers, and preparing smears. When care and appropriate techniques are used, handling sputum presents a minimal risk of acquiring infection to a technician.
- For laboratory staff, the greatest risk of infection involves sputum collection. People with presumptive TB may cough and in doing so, spread TB bacilli in tiny droplets in the air which may infect others when they are inhaled. Precautions must be taken to minimize this exposure.
- The laboratory technician is at considerably more risk when sputum is processed for culture and drug susceptibility testing. These procedures require shaking and centrifugation.
- Consequently, special equipment such as biological safety cabinets, which are costly to purchase and maintain, are required. However, this equipment is not justified in the AFB smear microscopy laboratory.

Proper collection of sputum:

- If a coughing patient comes into the laboratory, ask them to cover their mouth.
- Wherever possible, collect specimens outside where air movement will rapidly dilute infectious droplets and UV rays from the sun will rapidly inactivate TB bacilli.
- NEVER collect sputum specimens in laboratories, toilets, waiting rooms, reception rooms, or any other enclosed space. Always stand well clear and upwind when a patient is collecting a sputum sample.

Sputum collection areas:

Designated sputum collection areas should be clearly marked and wherever possible, outside in open air where bacilli will naturally be dispersed by wind rather than in a closed room where the concentration of bacilli will be high.

Designated sputum collection areas can be established with instructions on steps in collecting a good sputum sample posted on the wall.

Collecting and handling specimens safely for other infectious respiratory diseases

For healthcare providers collecting specimens or working within 6 feet of clients suspected to be infected with SARS-CoV-2, maintain proper infection prevention and control and use recommended personal protective equipment (PPE), which includes an N-95 or higher-level respirator (or facemask if a respirator is not available), eye protection, gloves, and a gown, when collecting specimens.

For healthcare providers who are handling specimens, but are not directly involved in collection (e.g., self-collection) and not working within six feet of the patient, follow standard IPC precautions. Healthcare providers are recommended to wear face mask at all times while in the healthcare facility.

PPE use can be minimized through patient self-collection while the trained healthcare provider maintains at least 6 feet of separation.

Handling bulk-packaged sterile swabs properly for upper respiratory specimen collection

Sterile swabs for upper respiratory specimen collection may be packaged in one of two ways:

Individually wrapped (preferred when possible)

Bulk packaged

Bulk-packaged swabs may be used for specimen collection. However, care must be exercised to avoid SARS-CoV-2 contamination of any of the swabs in the bulk-packaged container.

Transport of samples for all infectious respiratory diseases

- Ensure that healthcare workers who collect specimens from patients with infectious respiratory diseases wear appropriate PPE
- Place specimens for transport in leak-proof specimen bags that have a separate sealable pocket for the specimen (i.e., a plastic biohazard specimen bag), with the patient's label on the specimen container, and a clearly written request form.
- Ensure that personnel who transport specimens are trained in safe handling practices and spill decontamination procedures.
- Ensure that laboratories in healthcare facilities adhere to best biosafety practices according to the type of organism being handled.

For infectious respiratory diseases of potential concern, implement the recommendations given above for all infectious respiratory illnesses plus the following measures:

- Deliver all specimens by hand whenever possible. Do not use pneumatic-tube systems to transport specimens.
- State the name of the suspected infectious respiratory illness of potential concern clearly on the accompanying request form. Notify the laboratory as soon as possible that the specimen is being transported.

Rationale

All specimens should be regarded as potentially infectious, and healthcare workers who collect or transport clinical specimens should adhere rigorously to Standard Precautions, to minimize the possibility of exposure to pathogens

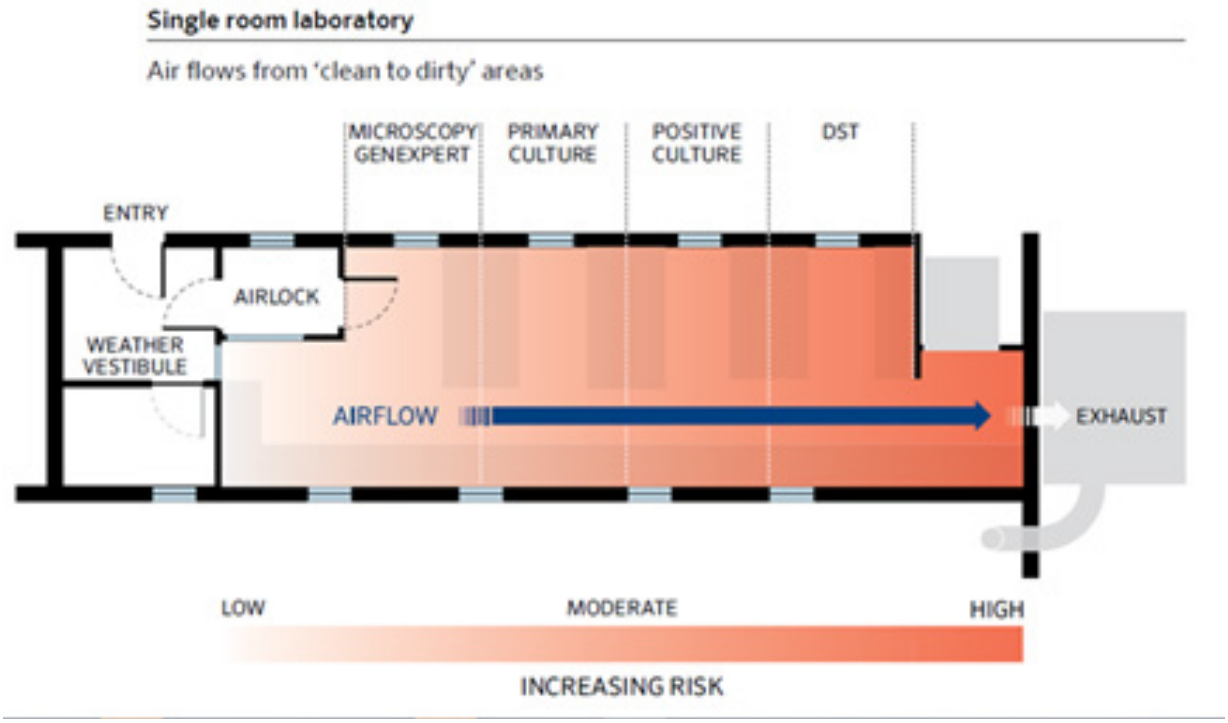
NB: Reference should be made to relevant guidelines for sample collection of other identified respiratory pathogens as per MoH recommendations as and when they are made available

Laboratory arrangement: The laboratory should be a well-ventilated area with restricted access.

Air movement:

- Directional airflow helps reduce risk. It is created using a negative pressure gradient.
- Air should move from the entry, where low risk activities take place, to the end of the laboratory where the highest risk activities occur.

Establish airflow in working areas that will direct potentially infectious particles away from personnel. Air must be exhausted into a remote area. An extraction fan can be useful to vent air from a smear preparation area with poor ventilation that is closed off due to extreme climatic conditions.



Gloves:

Disposable gloves only are to be worn within the laboratory.

DO NOT RE-WEAR USED GLOVES

Several pairs of gloves will be used each day; a sufficient supply must be readily available.

Gloves must be worn for all procedures that involve contact with specimens or laboratory items used in handling specimens or cultures. There should be single use of gloves for every procedure.

Allergic reactions such as skin rash (dermatitis) and hypersensitivity reactions may occur in staff wearing latex gloves (powdered and non-powdered). Alternative glove materials include vinyl and nitrile which rarely cause allergic reactions.

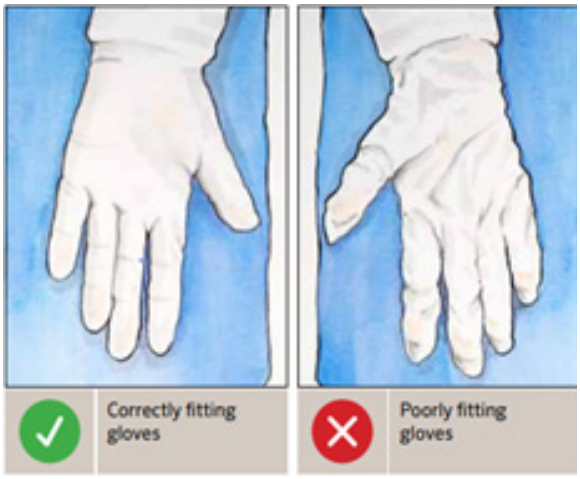
Do not move out of the laboratory wearing gloves

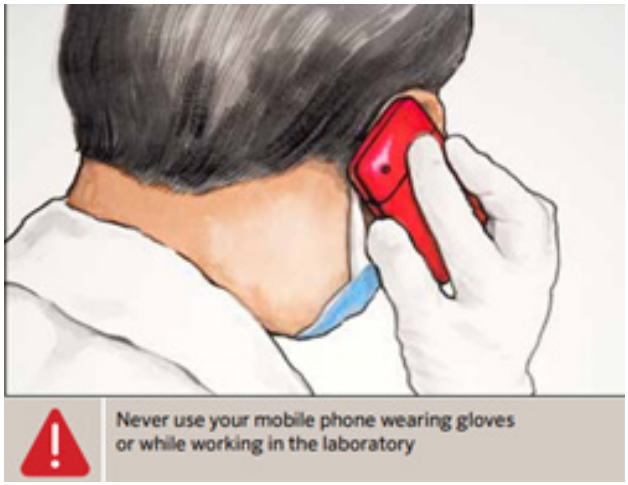
Wearing gloves:

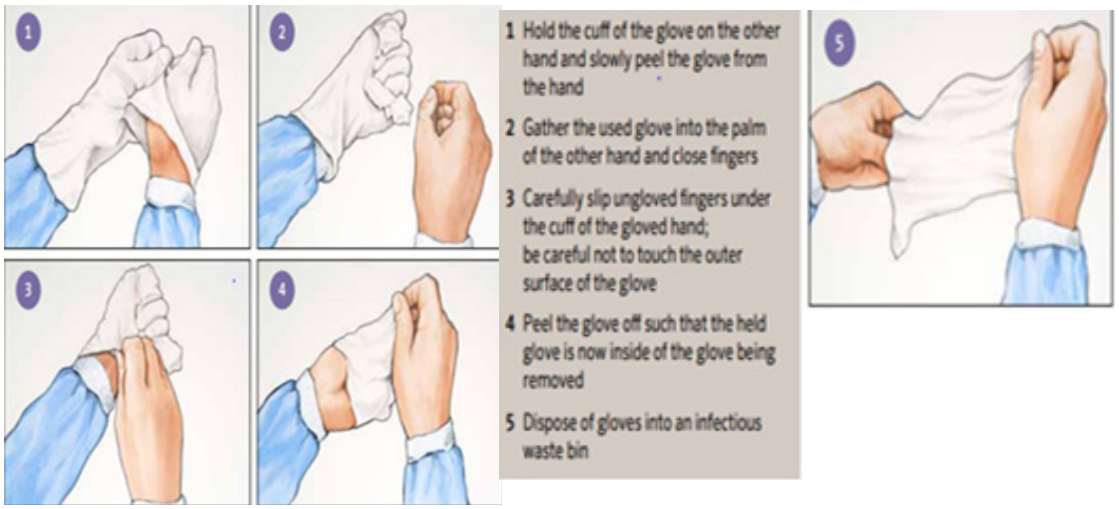
Different sizes of gloves must be available (small, medium, large). Poorly fitting gloves reduce the dexterity of the fingers and increase the risk of glove contamination and accidents.

Removing gloves:

- Discard used gloves in the appropriate waste container
- Once gloves are removed, wash your hands immediately with running soap and water and dry them or use alcohol-based hand rub







Laboratory Coats and Gowns:

Laboratory Coats must be worn at all times when working in the laboratory and appropriate sizes should be provided.

Gowns should be tied at the back, not the front, and be made from water-resistant materials to avoid liquids soaking into the gown.

Laboratory coats must NOT be worn or cleaned outside the laboratory.

Reusable gowns must be autoclaved (121˚C for 15 minutes) before being taken away for cleaning.

For re-usable gowns, there should be at least three gowns available per staff member:

1. In-use
2. Being cleaned
3. Ready for use

Gowns should be changed weekly or after an obvious spill occurs.

Gowns must be available in appropriate size.

Qualities:

- Ties at the neck and waist
- Full cover to the front
- Elasticized cuffs at least 30mm
- Long enough such that the gown fully covers the lap when sitting down
- Non-absorbent material

NEVER carry laboratory coats home.

Laboratory coats are open at the front and may have short or long sleeves.

Masks:

One of the greatest false beliefs is that a standard surgical mask will protect the wearer from becoming infected with infectious respiratory illnesses e.g., TB, COVID-19. These masks are made from porous material that will not trap some microorganisms e.g., TB bacilli, and have an extremely poor fit creating large gaps between the face and mask.

Surgical masks provide no respiratory protection from aerosols and must not be used in a laboratory setting.

Respirators:

Respirators must filter >95% of infectious particles greater than 0.2µm in size. N-95 and FFP2 respirators meet the requirements and are lightweight, disposable devices that cover the nose and mouth.

Both FFP2 and N95 respirators may be 'valved' or 'unvalved':

- 'Valved' respirators allow expired air to move easily from the lungs to the environment but closes when breathing in occurs
- 'Unvalved' respirators do not have a valve

Respirators are not usually required for work in a TB culture laboratory. However, they must be worn when setting up DST. They can be reused provided that they are properly worn, stored and cared for.

If respirators are used, staff must be:

- Instructed on correct use
- Taught on how to care for a respirator

Appropriate Disinfectants:

Phenolic agents (5% phenol in water or a phenolic disinfectant product diluted as per label) are excellent disinfectants for cleaning up sputum spills and for decontaminating equipment and single use items prior to disposal. Fresh household bleach (5% sodium hypochlorite) diluted 1:10 with water can also be used as a general disinfectant. Bleach solution works well for cleaning up blood spills; however, it is somewhat less effective than phenolic agents against TB. It is important that bleach dilutions be made fresh since they lose potency with time. 70% alcohol is a good agent for cleaning bench tops.

Chlorine based disinfectants and hydrogen peroxide (6%) can be used to disinfect contaminated surfaces.

All chlorine on the surfaces shall subsequently be removed after 30 minutes as it is caustic and may damage equipment.

NB: Chlorine solution loses its potency with time so it should be prepared daily or when required.

Safe disposal of infectious waste

CATEGORY OF LABORATORY WASTE MATERIAL	TREATMENT
Uncontaminated (non-infectious) material	Can be reused, recycled or disposed of as general municipal waste
Contaminated sharps (hypodermic needles, scalpels, knives, and broken glass)	Must be collected in puncture-proof containers fitted with covers and treated as infectious

Contaminated material for reuse or recycling	Must be first decontaminated (chemically or physically) and then washed; thereafter it can be treated as uncontaminated (noninfectious) material
Contaminated material for disposal	Must be decontaminated onsite OR stored safely before transportation to another site for decontamination and disposal
Contaminated material for incineration	Must be incinerated onsite OR stored safely before transportation to another site for incineration
Liquid waste (including potentially contaminated liquids) for disposal in the sanitary sewer system	Should be decontaminated before disposal in the sanitary sewer

All infected materials should be disposed of in a biohazard bag, autoclaved, and discarded by one of the following methods:

- Incineration
- Burying

To protect the surrounding population, the laboratory must dispose of waste safely. Incineration is usually the most practical way for safe destruction of laboratory waste. If incineration cannot be arranged, discard the waste in a deep pit of at least 1.5-meter depth. If an autoclave is available, place infected materials inside and follow procedures for safe and adequate sterilization.

Ventilated Cabinets

Ventilated Cabinets include laboratory fume hoods and biological safety cabinets. The details of these devices follow:

1. **Laboratory fume hoods**

This type of environmental control is designed for the purpose of worker protection (no protection of the environment or the product [specimen/culture]). These devices, like biological safety cabinets, are designed to minimize worker exposures by controlling emissions of airborne contaminants (including aerosols) through the following:

- The full or partial enclosure of a potential contaminant source.
- The use of airflow velocities to capture and remove airborne contaminants near their point of generation.
- The use of air pressure relationships that define the direction of airflow into the cabinet.

2. Biological Safety Cabinets (BSC)

BSCs are categorized as Class I, Class II, or Class III.

Class I

Class I BSCs draw unfiltered room air through the front opening, passing it over the work surface, and expelling it through an exhaust duct and through a HEPA filter.

Class I BSCs protect the worker but do not protect the work area against contamination because unfiltered room air is drawn into the cabinet and over the work surface.

Class II

Class 2 BSCs draw around 70% of purified air from the HEPA filter above the work area and around 30% air through the front grille.

Class II provides protection for the user, environment, and the work area. There are four types of BSC Class II: A1, A2, B1, and B2. The most suitable for all TB work is the type A2.

Class III

Also known as glove boxes, generally they are installed only in maximum containment laboratories.

One of the most persistent myths held by laboratory staff the world over is that a BSC provides complete protection from the infectious material it contains. This is not true!!!

Poor technique when using a BSC will expose you to potential infection.

- A BSC can maintain the level of sterility you create; it cannot produce it by itself
- Your actions must always complement the operation of the BSC
- You prevent cross-contamination by using safe working practice

All manipulations of potentially infectious materials, including those that may cause splashes, droplets, or aerosols of infectious materials (for example, loading and unloading of sealed centrifuge cups, grinding, blending, vigorous shaking or mixing, sonic disruption, opening of containers of infectious materials whose internal pressure may be different from the ambient pressure) should be performed in appropriately maintained and validated BSCs or primary containment devices, by personnel with demonstrated capability.

Certification of BSCs

To check its performance your BSC must be certified at least annually.

A qualified Biosafety Engineer must assess the BSC using an accepted national or international standard.

Responsibilities

It is the responsibility of the engineer to decontaminate the BSC before inspection.

It is the responsibility of the laboratory manager to organize certification and to advise staff that the BSC may be safely used.

It is the responsibility of the county management to support annual certification of biosafety cabinets

BSC certification is required:

- Before first use of a newly installed BSC
- Annually
- When a BSC is moved within the laboratory
- Whenever a HEPA filter is replaced
- Whenever components within the plenum are replaced

Once certification is done, it must be displayed on the BSC.

Chapter Four

4.0 Infection prevention in special settings

4.1. Infection prevention at radiology departments

Appropriate placement of patients with TB in an isolation room reduces the risk of infection and disease to HCWs. The patient should be explained to and instructed to wear a surgical mask at all times while being wheeled out from the isolation room in the ward to the radiology department.

4.2. Drug Resistant TB (DR-TB)

There is a risk of severe morbidity and mortality to HIV-infected persons from DR-TB. Therefore, persons with known DR-TB should receive routine care outside of normal HIV care settings.

The healthcare workers working with DR-TB patients should take necessary preventive precautions.

The community should be well educated about TB infection, prevention and control. TB patients to spend minimal time with children. DR-TB care providers at community level should be sensitized on risk of transmission and be provided with basic protective equipment. DR-TB patient should be provided with basic personal protective equipment for use in the home setting with vulnerable groups like children under five, elderly and chronic ill people.

4.3. Other Infectious Respiratory Infections in the Community

TB and respiratory infections control activities and measures used in healthcare facilities also apply to households. All stakeholders must be involved; policy makers, community leaders, patients and their families have to appreciate the importance of TB and other respiratory infectious diseases control at community and household levels.

Awareness on reduction of TB and other infectious respiratory diseases in the community should be enhanced through screening, early identification, and referral of persons with symptoms for screening in the healthcare setting. Health education should be given to clients, family, and community on the signs and symptoms of respiratory infectious diseases and the need to support clients on treatment so that they complete their regimens effectively to avoid drug resistance and recurrence. Patients with infectious respiratory diseases e.g., DR-TB, COVID-19, etc. should be advised to spend as much time as possible outdoors (to minimize contact with other people), sleep in a separate room, to wear appropriate masks at all times, to practice cough etiquette (to cover their mouth when they cough), proper hand washing, proper disposal of soiled paper tissues, cleaning and disinfection of surfaces and linen.

Practices to reduce the spread of TB and other infectious respiratory diseases should include the following:

- Buildings should be adequately ventilated, particularly places where people with infectious respiratory diseases such as TB spend considerable time (natural ventilation may be sufficient to provide adequate ventilation)
- Anyone who coughs should be educated on cough etiquette and should follow such practices always
- Those in congregate settings such as correctional facilities, refugee and asylum centres should use respiratory hygiene measures independent of the burden of disease. They should wear face masks at all times
- Respiratory hygiene must be implemented at all times and use of surgical masks in particular are of utmost importance in waiting rooms, during client transport, and in any situation that can lead to temporary exposure to a respiratory disease

4.4. Infection Control Measures in Special Settings

These are special settings in the community that are of high risk and call for special attention as far as infectious respiratory diseases are concerned.

They include congregate settings such as:

- Prisons and remand cells
- Informal settlements (slums)
- Refugee and internally displaced persons (IDP) camps
- Learning institutions (schools, colleges)
- Security forces training camps (military, General Service Unit (GSU), police, National Youth Service (NYS) etc.

Prisons and remand cells

Infectious respiratory diseases are spread more readily in congregate settings such as prisons, remands, informal settlement, and public transport. This is because of the longer duration of potential exposure, crowded environment, poor ventilation, and limited access to healthcare services.

All inmates on admission should be screened for infectious respiratory diseases.

The prison and remand cells should follow and implement infectious respiratory diseases guidelines. There is need for active advocacy and sensitization of relevant ministry and departments for the implementation of infectious respiratory diseases infection control guidelines in the prisons.

Informal settlements (slums)

To reduce infectious respiratory diseases transmission in the informal settlements, there is need to have adequate sensitization and advocacy on proper ventilation on the existing structures/ housing and practice of cough etiquette and appropriate social distancing. The implementation of community infection control guidelines should be emphasized. Screening, acute case finding, contact and defaulter tracing should be highly emphasized in such settings.

Learning institutions and security forces training camps

Learning institutions should embrace IPC guidelines which should be incorporated in the school health program. The institutions should adopt and own IPC environmental measures among others.

In the context of schools and learning settings, we consider measures that can contribute to limit the exposure to the disease and reduce the probability of its transmission amongst pupils, students, teachers and none- teaching staff at school. These measures include but not limited to setting up of hand hygiene stations, use of surgical/ face masks, proper classroom ventilation and appropriate social distancing.

Public services transport

- Matatus, buses, and trains
- Air transport

IPC guidelines should be implemented in public transport sectors. There should be adequate ventilation by opening windows on both sides of the vehicles or applying mechanized ventilation. Advocacy and sensitization with different ministries and the community is required for this to succeed. Airline services should implement IPC guidelines. Transportation of clients with infectious respiratory diseases from one facility to another should be by well ventilated means of transport with personal respiratory protective devices.

Health education and adherence to MoH guidelines for all infectious respiratory diseases should be emphasized at all special settings.

Chapter Five

5.0 Infection Control and Isolation

Patients with TB or other infectious respiratory diseases in the community should be adequately educated on the importance of adhering to treatment e.g., DOTs and DOTs plus strategy for those with TB, towards enhanced infection prevention and control. This can be complemented by the community where treatment supporters are engaged in to assist the patient in drug adherence and provide holistic care (psychological, spiritual, and social support). However, application of DOTs for TB may consider alternatives to face-to-face outpatient visits using telemedicine (e.g., telephone consultations or cell phone videoconference) to provide clinical support without direct contact with the patient. Patients who do not adhere to the above may require isolation care.

Isolation is the creation of a barrier—mechanical or spatial—to prevent the transmission of infectious diseases to or from a patient and to reduce the risk of transmission to other patients, HCWs, and visitors. Isolation is used to prevent the transmission of infectious diseases that are spread by both contact and airborne routes.

5.1 Types of Isolation

- **Protective:** Protects vulnerable patients with poor immune systems from contracting disease from the environment. For example, patients who may be receiving chemotherapy or organ transplants.
- **Source isolation:** Patients identified as carrying microorganisms that could cause other patients to become ill if it was passed onto them. For example, patients with transmissible infections through contact and air. Four isolation precaution categories include:
    - Air-borne isolation precautions
    - AFB isolation precautions
    - Droplet isolation Precautions
    - Contact isolation Precautions

Isolation can take place at the facility or at home depending on the client meeting the requirements of infection prevention and control guidelines.

Isolation for TB and other infectious respiratory diseases may be applied in the following situations. However, in all cases, voluntary isolation is preferable, and patients should be counselled and given adequate information, support, and community-based care should be attempted first depending on the scenario at hand:

- A known TB patient who has refused effective treatment and all reasonable measures (counselling, health education, community support) to ensure adherence have been attempted and proven unsuccessful

- A known TB patient who has agreed to ambulatory treatment but lacks the capacity to institute infection control at home. This includes TB patients who are infectious
- A known TB patient who has other comorbidities and/or severe health conditions that require in-patient care. This includes MDR TB, pre-XDR-TB and XDR-TB and drug users.

5.2 Principles of Isolation

- Avoid moving and transporting patients out of the room or area unless medically necessary. If transport is required, use predetermined transport routes to minimize exposure for staff, other patients and the community in general.
- Ensure health workers who are transporting this patient perform hand hygiene and wear appropriate PPE.
- Frequently clean and disinfect surfaces as well as linen.

(Criteria for Isolation of TB patients is referenced in TB isolation policy, while for COVID is in the COVID-19 isolation guidelines)

5.3 Responsibilities and Authority in Isolation

5.3.1 National Level

At the national level, the MoH has the ultimate responsibility and authority for ensuring the availability, dissemination, and use of IPC and isolation policies and guidelines. The National Infection Prevention and Control Committee (NIPCC) within the MoH in collaboration with relevant departments and stakeholders shall be responsible for monitoring, reviewing, and updating the IPC and isolation guidelines

5.3.2 County and Sub-County Levels

It is the responsibility of the county and sub-county health management teams (C/SCHMTs) to monitor the facilities under their control for use of and compliance with Isolation practices. The CHMT is also responsible for ensuring that adequate and appropriate resources are available for support of IPC and isolation practices within these facilities. In coordination with the community representatives, the county and sub-county levels should raise awareness in the communities about the isolation policy.

5.3.3 Health Care Facility

At the health care facility level, the implementation of isolation is linked to the general IPC and IPC for TB and other infectious respiratory diseases. The Facility IPC Committee through the leadership of the IPC focal person should monitor, coordinate, and evaluate its implementation. The IPC focal person should ensure: adequate supply of IPC equipment and commodities, on-the-job training of other HCWs in the health care facility, monitoring IPC practices and reporting IPC activities to the sub-county.

5.3.4 Healthcare Workers (HCWs)

Each HCW at the individual level is responsible and accountable for effective and efficient implementation of the IPC and isolation policies and guidelines at all times in her/his duty station. Healthcare providers should collaborate in the timely and appropriate application of isolation.

Nursing personnel should be responsible for the following:

- Informing the patient's clinician when a patient's condition warrants isolation
- Verifying the clinician's order to institute isolation
- Explaining procedures and the need for isolation to the patient and family
- Preparing a well-ventilated room or area for isolation with all the necessary equipment
- Notifying the IPC lead person of the patient in isolation within 24 hours of the suspicion or confirmation of an infectious disease
- Displaying a STOP sign clearly in the patient's isolation area
- The clinician is the one responsible for instituting isolation. In the absence of a clinician, the nurse-in-charge institutes isolation

5.3.5 Community and Community Representatives

Individual members of communities have a responsibility for complying with IPC practices and infectious respiratory diseases community dialogues at the community level. Community representatives should collaborate with relevant departments to enhance compliance through identification and referral of patients in need of isolation.

5.4 Standard/Specification/Location of Isolation Rooms to be Followed.

There are two types of isolation rooms both classified as AIA-Airborne Infection Isolation room:

1. Atmospheric type-naturally ventilated, and
2. Negative pressure isolation room-mechanically ventilated

Standard

The structural standards are from NUFURT architectural data.

General configuration

1. Single patient rooms without ante room - not self-contained (recommended size 12m squared)
2. Single patient room with ante room - self-contained (recommended size 13m square)
3. Single patient room with ante room - has assisted bath (22m square)

Room Fittings and finishes

1. Medical Wash hand basin recommended
2. Medical gases, oxygen and vacuum
3. Recommended non-porous glazed floor for ease of cleaning and decontamination
4. Walls smooth and non-porous for ease of cleaning and decontamination
5. Recommended ceilings should be non-porous to avoid fungal growth
6. Recommended windows should be double glazed for temperature and noise control
7. Recommended to use antifungal and antibacterial paints

Ventilation

Ventilation recommended should be of 12 air changes per hour (ACH) or better.

The standard is ASHRAE/CDC/OSHA-American Standards for heat refrigeration and air-conditioning.

Negative Pressure Isolation Rooms

a) Air Flow Volume differentials - minimum requirement is 50 CFM/cubic feet per minute or 10% of supply air, whichever is the greater

b) Negative pressure differentials - 0.001''/inches of water gauge

c) Negative pressure monitoring should be continuous

d) Ante room pressurization to be positive to Isolation room

e) Ante room ventilation at least 10 ACH

f) Minimum air velocity under the door is 100FPM/feet per minute

g) Air distribution - recommended supply from ceiling (clean air) and exhausted near the floor the floor (dirt air)

h) Exhaust discharge is recommended to be on roof 25ft from air supplies and openings or to be HEPA filtered

• **HEPA filters are recommended for both supply and exhaust**

Specification

Location

1. Atmospheric type-naturally ventilated

    - Should be standalone - detached from the other buildings
    - Distance between the isolation rooms from the neighbouring structure should be not less than the height of the tallest neighbouring structure
    - Openable windows not less than 20% of floor area
    - Openable windows should be aligned to the prevailing wind flow

2. Negative pressure isolation room-mechanically ventilated

    - Can be located in any part of the facility
    - The key thing is patient flow patterns are put in place to avoid cross infections, nosocomial transmission including to HCW and visitors and overcrowding and assisting triaging of patients.

3. Standards for Ultraviolet germicidal irradiation (UVGI) fittings

UVGI is recommended for both natural and mechanical ventilated but not to replace ventilation

- Upper Room UVGI To be fitted at least not less than 12 feet from the floor Ceiling to have special paint non-reflective to UVGI (reflectivity <10%) Air humidity <65% UVGI fittings to have parabolic mirrors or shields to avoid scattering UVGI lamp fittings to have OZONE filter at 185 nanometres The lamp to produce 254 nanometre UVC intensities approximately 50 microwatts per centimetre square at one metre
- Lower Room UVGI To be fitted not more than 2 feet from floor level All the above apply except for the paint
- Induct UVGI Recommended for both supply and exhaust To be the unshielded type

Note: Adequate safety notices to be placed at appropriate places

Chapter Six

Monitoring and Evaluation of Key Areas

Periodic supervision of the measures outlined in the IPC plan.

Surveillance of active infectious respiratory diseases rates among HCWs in the health facility

Review medical records of a sample of infectious respiratory diseases patients seen in the facility to evaluate the following outcome measures:

- Time interval from admission to suspicion of infectious respiratory diseases
- Time interval from suspicion of infectious respiratory diseases to ordering sputum for AFB for TB smears and sample collection for other infectious respiratory diseases
- Time interval from ordering to the collection of sputum for TB or samples for other infectious respiratory diseases
- Time interval from the examination of the smear for TB or samples for other infectious respiratory diseases to the reporting of results
- Time interval from the return of laboratory results to the initiation of treatment

ANNEXES

Annex A: Administrative Control Measures for Sub-County and County Referral Healthcare Facility

Sub-county level measures (community networks, dispensaries, health centers, and hospitals)	County referral level measure These additional measures apply to referral-level facilities
Identification of the person(s) responsible for the assessment, implementation and monitoring of TB-IC plan	Identification of the person(s) or team – such as the IPC team who would be responsible to assist in the assessment, the implementation and monitoring of IPC for TB and other infectious respiratory diseases' plan
Assessment of at-risk settings for acquiring *M. tuberculosis* infection	*When medically allowable, encourage out-patient infectious respiratory diseases management
Infection prevention and control for TB and other infectious respiratory diseases Plan	*In-patient management and isolation policies
HCW training and IPC for TB and other infectious respiratory diseases sensitization	*Isolation of drug-resistant TB (DR-TB) and extensively drug resistant TB (XDR-TB) as long as cultures are positive. Isolation of confirmed cases of other infectious respiratory diseases
Access to HIV C&T	*Enforcing isolation policies
Early identification and diagnosis Active Case Finding (ACF)	*Special areas and topics in infection, prevention and control: active case finding, radiology, sputum collection and cough-inducing procedures, sample collection sites/areas, bronchoscopy suites, surgical suites, intensive care areas, immuno-suppression and infectious respiratory diseases
Patient education	Evaluating infection control interventions, surveillance for infectious respiratory diseases, disease/infection among HCWs
Sputum/sample collection	
Triage and evaluation of presumptive infectious respiratory diseases	
Flowchart path of inpatients and outpatients, including functional procedures	
Infectious respiratory diseases patients in the health post or clinic	
Reducing exposure in the laboratory	

***Should be implemented at the sub-county hospital facilities**

Annex B. Sample of Infection Prevention and Control Plan

A. The plan will include, but not be limited to, the following policy areas:

1. Identification of responsible coordinators at all levels for the implementation of IPC for TB and other infectious respiratory diseases plan.

2. Screening patients to identify persons with symptoms of infectious respiratory diseases or who report being under investigation or treatment for infectious respiratory diseases. Carry out contact tracing of sputum positive PTB including DR-TB and XDR-TB and for clients who test positive for other infectious respiratory diseases.

3. Providing facemasks or tissues to persons with symptoms of infectious respiratory diseases ("presumptive infectious respiratory diseases") or who report being under investigation or treatment for infectious respiratory diseases ("Presumptive infectious respiratory diseases clients or cases"), and providing waste containers for disposal of tissues and masks.

4. Placing Presumptive infectious respiratory diseases clients and cases in a separate waiting area.

5. Triaging Presumptive Infectious respiratory diseases clients and cases to the front of the line to expedite their receipt of services in the facility.

6. Referring Presumptive infectious respiratory diseases clients to infectious respiratory diseases diagnostic services and confirming that infectious respiratory diseases cases are adhering with treatment.

7. Using and maintaining environmental control measures.

8. Educating staff periodically on signs and symptoms of infectious respiratory diseases including DR- TB, specific risks for TB for HIV-infected persons, and need for diagnostic investigation for those with signs or symptoms of infectious respiratory diseases.

9. Training and educating staff on infectious respiratory diseases control, and the infection prevention and control plan for TB and other infectious respiratory diseases.

10. Sensitizing and educating the community on infectious respiratory diseases burden, infection prevention and control for TB and other infectious respiratory diseases.

11. Adequate budgeting and timely implementation of the activities.

12. Monitoring and evaluation of the infectious respiratory diseases infection and control implementation plan.

B. The facility will implement each policy by following the procedure(s) that accompany it.

Policy and Procedures

Purpose: Early identification, separation, referral of patients and receipt of services, for clients with respiratory symptoms is essential in preventing the spread of infectious respiratory diseases (i.e., TB, infectious respiratory illness e.g., SARS)

IPC Focal Person: Has the responsibility for overseeing the Implementation of these policies and its procedures, and reports to (sub-county health management teams, etc.).

Policy 1: Screening patients to identify persons with respiratory symptoms or recent history of infectious respiratory disease.

Procedures:

1. Display information at the entrance of the facility directing clients with respiratory signs and symptoms to report to the designated areas for screening.

   A designated staff should screen all adults and children for respiratory symptoms.

   All coughers and those with a recent history of TB and or other infectious respiratory diseases should be triaged and given priority. These patients should not line up for long periods to register or obtain services.

2. Many combinations of symptoms have been recommended as sensitive and specific for TB and other infectious respiratory diseases. A simple screen is

   "Are you coughing?" If patient answers" yes,"

   Investigate for TB (presumptive TB)

   Investigate for other infectious respiratory illnesses

To determine whether a patient may be under investigation or a diagnosed case of infectious respiratory diseases, who may still be infectious, ask:

"Are you being investigated or on infectious respiratory diseases treatment?"

If the answer is "yes," the screen classifies the patient as presumptive infectious respiratory diseases client or confirmed case of infectious respiratory diseases, and s/he should be managed as described in the procedures under policies 2 – 5 below.

3. As for patients who are not identified as presumptive infectious respiratory diseases clients or case on the initial symptoms screen enter an examination room with the clinician, nurse, or counselor, they should again be screened by asking the simple screening questions.

Those who report a cough of any duration or who are being investigated or treated for infectious respiratory diseases should be managed under policies 2 – 5 below. Staff seeing patients in examination rooms should report patients they find to be presumptive infectious respiratory diseases clients or case to the infection control officer in a timely manner so that factors contributing to the potential exposure can be documented and corrected.

Policy 2: **Instructions on cough hygiene**

Procedures:

Presumptive infectious respiratory diseases clients or cases should immediately be informed about the importance of cough hygiene, are to be handed tissues (or pieces of cloth), and instructed to cover their mouths and noses when they cough. Alternatively, patients can be given a face mask and asked to wear it while in the facility. Patients should also be instructed to dispose of used tissues or masks in identified no-touch receptacles, and not on the ground. When tissues, cloths or face masks are not available, clients should be instructed to lift their arm up and cover their nose and mouth with the inner surface of the arm or forearm when they cough or sneeze.

No-touch receptacles for disposal of used tissues and masks should be available in all waiting areas.

Patients should be advised to wash their hands with soap before leaving the facility.

Policy 3: **Placing presumptive infectious respiratory diseases clients and cases in a separate waiting area**

Procedures

A staff should direct or escort the patient to a separate waiting area. This special waiting area should have the highest natural ventilation possible. Patients should be assured of their place in the line for registration and/or services.

Policy 4: **Triaging Presumptive infectious respiratory diseases clients and cases to the head of the line to receive services in the facility**

Procedures

Presumptive infectious respiratory diseases clients and cases should be moved to the front in the queue of the line for whatever services they want or need, e.g., VCT, medication refills, or medical investigation. This reduces the duration of potential exposure of infectious respiratory diseases to other clients while they wait in the facility and may also be an incentive to disclose information during screening.

Policy 5: **Referring Presumptive infectious respiratory diseases to respective diagnostic services**

Procedures

1. The designated staff to counsel patients about how to obtain infectious respiratory diseases diagnostic services in the facility
2. Patients should be referred to laboratory, (infectious respiratory diseases diagnostic center) with a duly filled laboratory request form specifying the test to be done
3. The diagnostic lab is to ensure that patients are instructed on how to produce and collect sputum at a designated collection point
4. The diagnostic center should provide instruction on how the patient will receive/collect the Laboratory result

Policy 6: **Using and maintaining environmental control measures**

Procedures

1. The designated staff to check on environmental control measures and maintain a log of monitoring and maintenance.
2. Doors and windows should in their proper position (open or closed as called for in the plan).
    - Doors and windows should be open when natural ventilation is the primary environmental control to allow for the free movement of air (e.g., across room, from window to door, or vice versa).
    - Generally, all doors and windows should be closed when using mechanical ventilation to ensure air movement in a controlled manner (air from supply vent and from slots either under or in door toward the exhaust vent).
3. Fans should be checked on a monthly basis to ensure they are clean, are pulling (or pushing) the correct amount of air, and are pulling (or pushing) air in the correct direction.

Policy 7: **Specific for TB and HIV services - providing confidential TB and HIV services to health care workers and staff**

Procedures

1. Healthcare workers and all other staff working at the facility should be educated about the signs and symptoms of TB and encouraged to seek investigations promptly if they develop symptoms and signs suggestive of TB.
2. Healthcare workers and other staff should be informed about the special specific risks for TB and HIV-infected persons (see section on Training of staff).
3. Healthcare workers and staff should be encouraged to undergo HIV testing and given information on relevant HIV care resources.
4. Staff training should include reduction of stigma of TB and HIV.

5. Healthcare Workers and staff who develop TB disease or diagnosed with HIV should be given preference to work in areas which are less infectious
6. Staff who develop TB disease to return to work when determined to be no longer infectious after:
    - Having completed at least two weeks of standard anti-TB therapy; and
    - Exhibiting clinical improvement; and
    - They should be supervised and monitored on treatment until cured

Policy 8: **Training of staff on all aspects of infectious respiratory diseases and the infection prevention and control plan for TB other infectious respiratory diseases**

Procedures

1. The IPC focal person to provide on-job training CMEs to new staff as they are hired and to maintain a log indicating who has had initial training.
2. The IPC focal person to ensure annual training to all staff and to maintain a log indicating who has been trained. This may be incorporated into a broader training topic or be stand-alone infection prevention and control training for TB and other infectious respiratory diseases.
3. As per WHO IPC guidelines HCWs should be trained annually nationally, regionally for all levels of staff.

Policy 9: **Monitoring the infectious respiratory diseases infection control plan's implementation**

Procedures

1. Determine the frequency of the infection control plan
    - Monitoring and evaluation should be done frequently, perhaps monthly or bi-monthly at initial stages
    - When procedures are running well, less frequent evaluation will be necessary – at a minimum, biannually
2. Evaluate the screening process
    - Were patients with cough missed when entering the facility and only detected at a later time or in the examination room?
    - What correctable factors were associated with these potential exposures?
3. Evaluate the success of referrals to the infectious respiratory diseases diagnostic center
    - Did referred patients access care?
    - Did referred patients have a confirmed infectious respiratory disease?
    - What changes in screening or referral process should be made, if any?

4. Evaluate the training process

    - Did all new staff receive training on infection prevention and control for TB and other infectious respiratory diseases during their induction?
    - Did all staff receive annual re-training on infection prevention and control for TB and other infectious respiratory diseases?

5. Revise the infection control plan to reflect changes in staff responsibilities, policies, and procedures

6. Develop a plan for correcting inappropriate practices or failure to adhere to institutional policies

    - Identify incentives to participate fully and adhere to policies
    - Identify corrective actions if policies are not followed

Annex C. Sample monitoring tools

_____ has the responsibility for overseeing the evaluation of the infection prevention and control policies for TB and other infectious respiratory diseases, its procedures and submit reports (Head of the NTLD Program, county Health management teams sub-county management team).

_____ has the responsibility for filling out the infectious respiratory diseases treatment register and presumptive infectious respiratory diseases clients register on a daily basis, entails entering the date, names of patients diagnosed or presumptive infectious respiratory diseases clients on daily basis.

has the responsibility for conducting follow up on patients referred to an infectious respiratory diseases diagnostic facility and recording the outcomes of their investigation in the log.

_____has the responsibility to summarize and present the results of the screening process to relevant management and staff periodically.

Presumptive infectious respiratory diseases register e.g., presumptive TB register

TB Case and Presumptive TB Log

Date	Patient Name	Case or Presumptive TB (c/s)	Missed at intake?* (y/n)

*Missed at intake = symptoms or history detected only after patient enters private room with clinician or counselor instead of upon entry to the facility; or after numerous visits while symptomatic yet undetected: y=yes, n=no.

**Outcomes: TB diagnosed or confirmed=TB; TB ruled out after diagnostic investigation=not TB; did not present to referral facility for investigation=NS (not seen).

Staff IPC training log for TB and other infectious respiratory diseases

Staff Name	Start Date	Date first IPC training	Date annual training	Date annual training	Date annual training

Annex D: IPC assessment for TB and other infectious respiratory diseases

The purpose of this evaluation is to assess:

- The extent to which infection control policies and guidelines exist
- Knowledge and practices related to basic infection control measures for TB and other infectious respiratory diseases

The assessment is targeted to both NTLD Program, NASCOP program county and sub-county staff.

The results will be analyzed to identify areas in which additional technical assistance is needed both national and county for TB and other infectious respiratory diseases/HIV program implementation.

National Level

No	Question	Response or Code	Additional Comments
1	**Country:** **Name of Respondent:** **Respondent Title:** **Program: Circle one: NTLD** **Program NAP** **Date Form Completed (dd/mm/yyyy):**		
2	How many administrative Sub Countys currently exist?		
3	Is there a designated national TB/HIV coordinating committee? (0=No, 1=Yes)		
4	Does the **NTLD UNIT** national manual address TB infection, prevention and control? (0=No, 1=Yes)		
5	Is there a written national policy that addresses TB infection control? ***(0=No, 1=Yes)*** If yes, describe it (who developed? Target audience? Status of implementation?)		

6	Has this national policy been disseminated? ***(0=No, 1=Yes)***		
7	Has training on implementation of this national policy been conducted? ***(0=No, 1=Yes)***		
8	Has the implementation of this national policy been evaluated? ***(0=No, 1=Yes)***		
9	Request copy of most recent annual report/statistical profile.		

Sub County Level

No.	Question	Response or Code	Additional Comments
1	Sub County: Name of Respondent: Respondent Title: Date Form Completed (dd/mm/yyyy):		
2	What is the total number of TB clinic sites in the Sub County?		
3	How many TB patients were reported in the last quarter? Last year same quarter? Sub County population:	Qtr _ _____ Yr _ ### ___	
4	What is the total number of HIV care and treatment sites providing ARV treatment in the Sub County?		
5	Do HIV care and treatment sites in the Sub County screen patients for active TB? (0=no, 1=yes) If YES, how? Obtain pt encounter from.		
6	How many of the TB sites and HIV care and treatment sites are co-located? Describe co-location		

7	Is there a Sub County-level TB/HIV coordinator? (0=No, 1=Yes)		
8	Has training on TB infection control been provided…? (0=no, 1=yes)	9.1 For staff in HIV care and treatment programs 9.2 For staff in TB clinics 9.3 For staff in Hospitals	
9	Is there a Sub County policy on TB infection control? (0=No, 1=Yes) If yes, request a copy.		
10	Do facilities in the Sub County report on the number of TB cases among HCWs in the Sub County? (0=No, 1=Yes) If yes, request a copy.		

Facility level

	Question	**Response or Code**	**Additional comments**
General information			
1	Type of facility? (*1. Ministry of public health and sanitation, 2. NGO (including faith-based), 3. other)*		
2	Type of facility? *(0=Chest clinic in primary health center, 1=Chest clinic in a hospital, 2=TB clinic (standalone)* *3= Out-Patient Department (OPD) clinic, 4=HIV care and treatment site 5=In-patient ward 6= Other)*		

3	Does this facility have a designated infection control officer? *(0=no, 1=yes)*		
4	How many full-time staff works at this clinic? (Doctors, nurses, counselors, pharmacists, cleaners etc.)?		
5	How many part time staff works at this clinic? (Doctors, nurses, counselors, pharmacists, etc.)?		
6	In the last year, how many staff members were diagnosed with infectious respiratory diseases?		

Administrative (workplace)			
1.	Has a facility risk assessment been conducted? *(0=no, 1=yes)*		
2.	Does this facility have a written infection control policy? *(0=no, 1=yes)* (if yes, OBTAIN a copy)		
3.	What training has staff received on infection prevention and control for TB and other infectious respiratory diseases?		
4.	Are staff screened for infectious respiratory diseases? If yes, how? (0=no, 1=yes)		
5.	Are staff offered confidential HIV counseling and testing? (0=no, 1=yes)		
6.	At peak time, describe the waiting area? What is the estimated waiting time from registration until seen by a nurse? (## min/hr)		
7.	What procedures are in place to identify patients observed to have chronic cough and to fast-track to diagnosis? "Cough officers?"		
8.	Are clients observed with chronic cough isolated in separate room or outside while waiting to see a nurse/doctor? (0=no, 1=yes)		

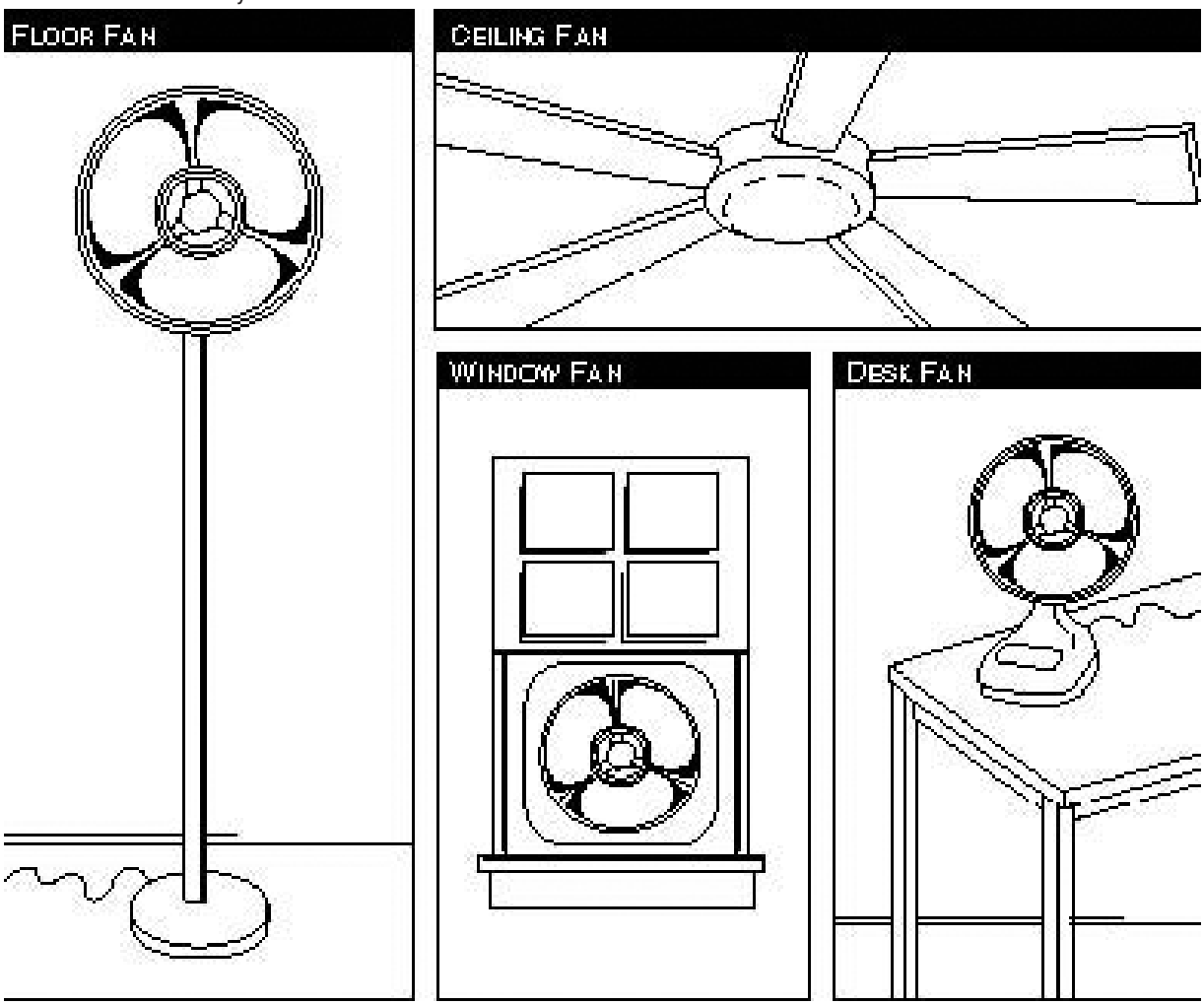
9.	Describe education procedures in-place for cough hygiene for presumptive infectious respiratory diseases clients / patients.		
10.	Are posters displaying cough hygiene prominently displayed? (0=no, 1=yes)		
11.	Review the path of the patient. Identify bottlenecks such as crowded interior waiting rooms, evaluate time separation and space separation, etc.		
12.	HIV care and treatment sites: do you screen patients for active infectious respiratory diseases? (0=no, 1=yes) If YES, how? Obtain pt encounter from.		
13.	What is the sputum (for TB)/sample turn-around time for specimens collected on presumptive infectious respiratory diseases? (## days)		
14.	In-patient: describe any cohort nursing practices observed.		
Respiratory Protection			
15.	Are surgical masks or tissue paper available for coughing patients who cannot be separated? (0=no, 1=yes)		
16.	Are NIOSH or CEN-rated respirators available for staff? If yes, describe when they are utilized. (0=no, 1=yes)		

Environmental controls			
1	Describe the natural ventilation: • In the waiting area • In the consultation room • On the ward (in-patient)		
2	Cross-ventilation for air movement: sketch placement windows and doors		
3	In-patient wards: are windows kept open at night? *(0=no, 1=yes)*		
4	Is there electricity at this facility? *(0=no, 1=intermittent, 2=yes)*		
5	If electricity is available, assess options to increase air mixing via use of fans.		

ANNEX E

1. Ventilation

Ventilation is the movement of air to achieve dilution and air exchange in a specific area. This process reduces the concentration of airborne/contact droplet nuclei. To reduce nosocomial risk, the most ideal situation would be one in which fresh air is constantly pulled into a room and the contaminated air is exhausted to the outside, such that the air in the room is changed several times every hour.



The most common way in such ventilation can be established is through the use of negative pressure ventilation, in which a room is kept at negative pressure relative to the surrounding area and air is drawn into the room from the corridor and exhausted directly outside. If designed properly, such rooms can be cost-effective. However, the equipment needed requires ongoing maintenance and the air exchange rate may be less that the average air exchange rate from well-designed natural ventilation. More feasible in most settings is the use of natural ventilation or of mechanical ventilation in which the movement of air is facilitated by the use of fans. However, if administrative policies are not in place to ensure windows are open, this environmental control is of minimal effectiveness. Table X shows the time necessary to clear the air of 90%, 99%, and 99.9% of airborne contaminants, in a well-mixed room. The recommended is 12-15 air changes per hour (ACH) designed to achieve 99% effectiveness.

Air changes per hour (ACH) and time required for removal efficiencies of 90%, 99%, an 99.9% of airborne contaminants*

ACH	Minutes required for removal efficiency†		
	90%	99%	99.9%
2	72	138	207
4	36	69	104
6	24	46	69
12	12	23	35
15	10	18	28
20	7	14	21
24	6	12	17
30	5	9	14
40	4	7	10
50	3	6	8
60	2	5	7
70	2	4	6
80	2	3	5
100	1	3	4
200	<1	1	2
400		<1	1

*This table can be used to estimate the time necessary to clear the air of airborne Mycobacterium tuberculosis after the source patient leaves the area or when aerosol-producing procedures are complete. †Time in minutes to reduce the airborne concentration by 90%, 99%, and 99.9%.

HIERARCHY OF VENTILATION

The hierarchy of ventilation for patient areas is:

A. Keep windows/doors open

B. Enlarge openings to >20% of floor space (>10% on opposing sides)

C. For new construction, design for proper natural ventilation

D. Well-designed exhaust-only ventilation

E. Well-designed general ventilation (supply and exhaust, no climate control)

F. Well-designed general ventilation (supply and exhaust, with climate control)

A) Natural ventilation

Ventilation is the movement of air in a building and replacement of air in a building with air from outside. Natural ventilation refers to fresh dilution air that enters and leaves a room or other area though openings such as open doors and/or windows. Natural ventilation is controlled when openings are deliberately secured open to maintain air flow. Unrestricted openings (i.e., cannot be closed) on opposite sides of a room provide the optimal natural ventilation. Propeller fans may be an inexpensive way to increase the effectiveness of natural ventilation, by increasing the mixing of airborne TB as well as assisting in the direction of air movement by pushing or pulling of the air.

Natural ventilation is controlled when openings are deliberately secured open to maintain air flow. Unrestricted openings (that cannot be closed) on opposite sides of a room provide the most effective natural ventilation.

Types of propeller fans

Propeller fans include:

- Ceiling fans,
- Small fans that sit on a desk or other surface,
- Fans that stand on the floor, and
- Fans mounted in a window opening.

Air mixing and removal

A propeller fan helps mix air in a room. Mixing of air will reduce pockets of high concentrations, such as in the corners of a room or in the vicinity of patients where natural ventilation alone is not enough. The total number of infectious particles in the room will not change with mixing; however, the concentration of particles near the source will be reduced, and the concentration in other parts of the room may increase.

If this dilution effect is combined with a way to replace room air with fresh air, such as by opening windows and doors, the result will be fewer infectious particles in the room.

A room with an open window, open door, and a fan will have less risk than an enclosed room with no fan, an enclosed room with a fan, or a room with an open window but no fan.

In addition, mixing may increase the effectiveness of other environmental controls.

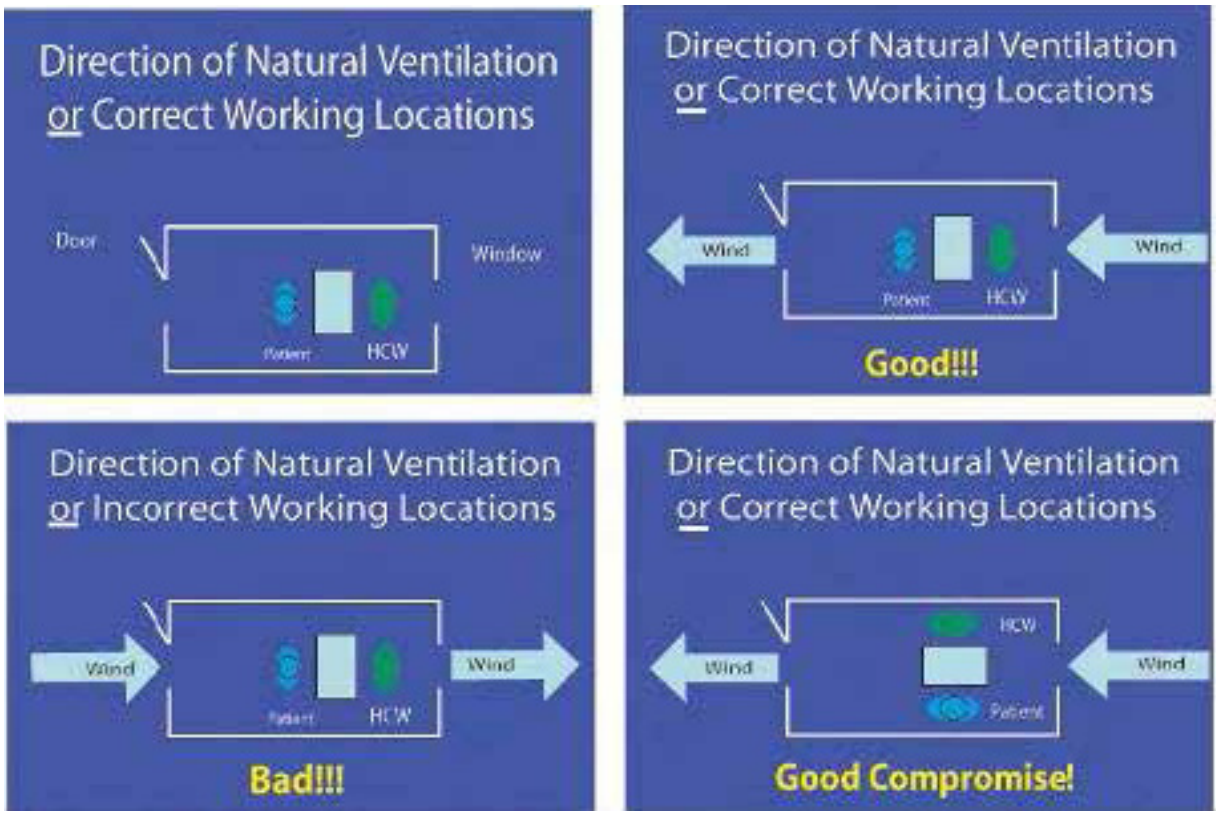
Directional airflow

If placed in or near a wall opening, propeller fans can also be used to enhance air movement into and out of a room.

Consider fans installed in the windows or through wall openings on the back wall of a building. The fans exhaust air outside, away from people or areas where air may come back into the building. If doors and windows in the front of the building are kept open, the overall effect should be to draw in fresh air through the front of the building and exhaust air through the rear. Healthcare staff should be mindful of the direction of airflow to ensure the patient is closest to the exhaust fans and the staff are closest to the clean air source. This arrangement should be done every morning.

With this arrangement, the risk that infectious respiratory diseases will be spread is greater near the back of the building; however, once the contaminated air is exhausted, dilution into the environment will be fast.

When fresh air enters a room, it dilutes the concentration of particles in room air, such as droplet nuclei containing respiratory pathogens. Natural ventilation can be used in medical wards or other sites in health facilities in temperate or tropical climates where windows can be left open. Natural ventilation can occur when a room or ward is an open construction type with free flow of ambient air in and out through open windows.



Maximizing natural ventilation patterns for the hospital, clinic, ward, or room is the simplest approach to achieving better ventilation. In temperate or tropical climates, waiting areas should be designed as open-air shelters with a roof to protect patients from sun and rain.

Whenever possible:

- Waiting areas, sputum/sample collection areas, examination rooms, and wards should be "open" to the environment (e.g., established in covered open areas or in areas with open windows). Additionally, windows or other openings may be installed that would allow for more ventilation. Windows and openings should be placed on outer walls such that air moves to the outdoors, not into other wards or waiting areas. The open areas should be equal to at least 10% of the area of the room; >20% is preferable. For example, the minimum window opening for a 3m x 5m room (15 m2) would be a 1.5 m2 window, door, or other opening on opposing all.
- When ceiling fans are used, windows should also be left open since diluting and exchanging of the mixed air is the objective

The risk of respiratory pathogens transmission is greatest in an enclosed room that contains air with aerosolized infectious droplet nuclei. A room with an open window only at one end provides air exchange near the window; however, little air is exchanged a short distance from the window. A ceiling or mixing fan may help increase the overall removal of aerosolized infectious droplet nuclei. Ideally, the minimum acceptable condition is openings on opposite ends of a room (window-window, window-door).

b) Mechanical ventilation

In situations where natural ventilation is not feasible or is inadequate, mechanical ventilation can be used to reduce the concentration of infectious droplet nuclei in selected areas or rooms in the health care facility (e.g., patient rooms, waiting rooms, or examination rooms). It is important to use equipment with sufficient power to facilitate air entry into, and exhaust from, the room or area. In other words, if no air is allowed to enter the area, then it will be impossible to exhaust air. It is also important to attempt to direct air movement so that infectious droplet nuclei produced by coughing patients are exhausted away from others.

Directional air flow should be maintained from a "clean" area, across the HCW, across the patient, and to the outside (Figure 1). The area where air is entering should be located away from the exhaust area to avoid re-entry of contaminated air ("short-circuiting"). Finally, for mechanical ventilation to be acceptable to patients, HCWs, and visitors, the air must be tempered (heated or cooled).

Window fans are generally an inexpensive and feasible method of providing mechanical ventilation to direct air flow in many resource-limited settings. However, it is important to ensure that air flows across the room (i.e., through a door and out through a window, not in and out through the same window or vent).

Additional methods of mechanical ventilation, which require more resources, include mechanical exhaust systems that pump clean outside air into the building and then exhaust the contaminated room air back outside. Closed recirculation filtration systems, which take room air, filter it to remove infectious droplet nuclei, and then exhausts it back into the room, are effective but expensive and require considerable maintenance.

To create both negative pressure and air exchange, some controlled air leakage into the room is needed. The air leakage could be through a 2-3cm slot under the door or a grill near the bottom of the door. If possible, the efficiency of the air exchange in the room could be enhanced by use of a fan pulling air from the corridor and pushing it into the room. Note that the flow rate of the fan pushing air into the room should be 90% or less than the flow rate of the fan pulling air from the room and exhausting out-of-doors in order that negative pressure is maintained.

c) Monitoring of ventilation and ventilation systems

Checking natural ventilation

People can usually feel the existence or lack of air movement in a space. A ventilated space has a slight draft. In the absence of ventilation, air will feel stuffy and stale, and odors will linger. Use the following checklist to assess natural ventilation in your waiting areas and examination rooms:

Check air mixing and determine directional air movement in all parts of rooms or areas. One way to visualize air movement is to use incense sticks as described in these six steps:

- Hold two incense sticks together and light them.
- As soon as the incense starts to burn, blow out the flame. Now the incense should produce a continuous stream of smoke.
- Observe the direction of the smoke.
- Observe how quickly the smoke dissipates. This is a subjective test that may require some practice (see figure 2). It does not give a definite result but is useful for comparing one room or area to another.

- Check natural ventilation once a year after the prevailing wind patterns have been determined. Recheck if any changes in the physical environment are made and confirm procedures for ensuring free movement of air are followed.
- Keep records of all routine activities and dates.

Checking fans

- Check that all room fans are working and cleaned once a month. Use cloth or vacuum cleaner to remove dust and lint from fans, grilles, and ducts.
- Check that exhaust fans are working and cleaned once a month. Use cloth or vacuum cleaner to remove dust and lint from fans, grilles, and ducts. Clean ducts behind grilles as far back as can be reached.
- To check fans that have a grille, hold a tissue or piece of paper against the grille. If the exhaust fan is working, the tissue or paper should be pulled against the grille.
- Flow rates through exhaust fans and grilles can be measured using a simple velocity meter and a means to measure that velocity over a known cross-sectional area. The air flow rates can be calculated from simple velocity measurements (see Boxes 1 and 2).
- Air exchange rates (also called air-changes per hour) can be calculated as shown in boxes below. If mechanically ventilating a room, the fan should provide a minimum of six air exchanges per hour.
- Keep records of all routine activities and dates.

Box 1: Estimating air velocity
Measure 0.5 meter distance and mark it on a tabletop. Move your hand from one end to the other (0.5 meters) in one second. This is equivalent to 0.5 m/s. In order to have directional control of contaminants in air, one should have air moving at least 0.5 m/s.
Example air flow circulation: Fan, duct, or box opening: 0.5m high, 0.5m wide Area = 0.5m x 0.5m = $0.25m^2$ Average air velocity through fan, duct, or box opening: 2.5m/s Average flow rate = Average times $0.25m^2$ x 2.5m/s x 3600s/hour = $2.250m^3$/hour

Box 2. Example air exchange rate calculation

Window opening: 0.5 m high, 0.5 m wide Window area = 0.5 m x 0.5 m = 20.25 m^2

Average air velocity through window: 0.5 m/s Room dimensions: 3 m wide,

5 m deep, 3 and 3 m high Room volume = 3 m x 5 m x 3 m = 45 m

Average flow rate = Area of window times average air velocity.

25 m x 0.5 m/s

3x 3600 s/hour = 450 m /hour

Air exchange rate = Average flow rate divided by room volume 450 m /hour ÷ 45 m = 10 air exchanges per hour

Ventilation systems should be evaluated regularly to determine if they are functioning properly. The simplest evaluation includes the use of smoke (e.g., smoke tubes, incense, paper, etc.), a tissue, or a simple vinometer to monitor proper airflow direction. If window fans are being used to produce negative pressure, they should be checked frequently to ensure air movement is directional and is adequate. Evaluations should be documented in a maintenance record.

d) Special areas

Certain areas of the healthcare facility should be considered high risk and a priority if environmental control measures are implemented. These include infectious respiratory diseases isolation rooms, infectious respiratory diseases wards, general waiting areas, or other areas such as intensive care units where infectious respiratory diseases patients may be housed. Unless natural ventilation is excellent in these areas, mechanical ventilation with window fans to generate directional air flow should be strongly considered.

Other high-risk areas may include sputum induction or sample collection rooms, bronchoscopy suites, operating rooms, radiology, and autopsy suites (see Table 5.1). These areas should be considered high risk before, during, and after procedures. Since large rooms may have little or no air movement and may be difficult to ventilate, a smaller, well ventilated room should be considered for bronchoscopy or other high-risk procedures. Environmental control measures should only be implemented as a supplement to effective administrative control measures

Ultraviolet germicidal irradiation (UVGI)

In certain high-risk areas of a facility, use of natural and mechanical ventilation may not be feasible. In these situations, ultraviolet germicidal irradiation (UVGI) or room air cleaners with UVGI may provide a less expensive alternative to more expensive environmental control measures that require structural alterations of a facility. These measures may be particularly useful in larger wards, chest clinic waiting areas, or inpatient areas such as television or recreation rooms where infectious respiratory diseases patients congregate.

Effective use of UVGI ensures that respiratory pathogens, as contained in an infectious droplet, is exposed to a sufficient dose of ultraviolet-C (UV-C) radiation at 253.7 nanometers (nm) to result in inactivation. Because dose is a function of irradiance and time, the effectiveness of any application is determined by its ability to deliver sufficient irradiance for enough time to result in inactivation of the organism within the infectious droplet. Achieving a sufficient dose can be difficult with airborne inactivation because the exposure time can be substantially limited; therefore, attaining sufficient irradiance is essential.

Studies show that respiratory pathogens are inactivated if the organisms are exposed sufficiently to UVGI. The recommended efficiency is 90% destruction of colony formation. The major concerns about UVGI have been adverse reactions (e.g., acute and chronic cutaneous and ocular changes) in HCWs and patients from over exposure if the UVGI is not installed and maintained properly. If UVGI is to be used, guidelines as well as manufacturer's instructions regarding installation, cleaning, maintenance, and ongoing monitoring should be carefully consulted.

UVGI may be applied in several forms:

- In sputum/sample collection areas, bare bulbs can be used to irradiate the entire booth when it is not occupied
- If HCWs and patients are in the room, continuous upper air irradiation in which shielding placed below the UVGI sources prevents injury to patients, but the upper portion of the room is irradiated can be used
- Portable UVGI floor units also may be used
- An additional, more expensive option involves the use of UVGI in combination with a closed mechanical system

Continuous upper air irradiation is the most applicable of the above methods in most resource-limited settings. The advantage of this technology is that the upper air is continuously being irradiated; thus, it provides some protection to the HCW while the infectious patient is in the room. Two laboratory studies have shown a reduction by as much as 80% with incomplete air mixing. Thus, to be effective, this technology requires good air mixing to be effective. Furthermore, structural features such as ceiling height may limit the feasibility and usefulness of UVGI. If portable UVGI is used, attention should be paid to lamp placement, since corners may receive inadequate radiation.

The quality of UVGI lamps is very important. Usually, a good one will last 5,000 to 10,000 hours (7-14 months). After that, the irradiance may drop off. Responsibility should be assigned to ensure the lamps are cleaned and monitored properly to avoid adverse HCWs and patients' exposure, that air flow patterns maximize M. tuberculosis UVGI inactivation, and that UVGI output is adequate (maintenance and replacement of lamps).

2. Room Air Cleaners

In small rooms with a limited number of patients or in other small, enclosed areas, room air cleaners with HEPA filters may be a useful alternative to mechanical ventilation requiring structural changes or to UVGI. Room air cleaners with HEPA filters may be free-standing or may be permanently attached to floors or ceilings to minimize tampering. If possible, the units can be exhausted outdoors, thereby creating a negative pressure isolation room.

If portable room air cleaners are used, unrestricted airflow is essential; placing the unit close

to furniture or putting items on top of the units may compromise their function. Careful regular monitoring is essential.

Room air cleaners with other air-cleaning technologies are commercially available. However, the effectiveness of portable room air cleaners has not been evaluated adequately, and there is probably considerable variation in their effectiveness. HEPA or other filters may also be used in exhaust ducts or vents that discharge air from booths or enclosures into the surrounding room; however, one must ensure that the filters are replaced with identical filters. If a filter other than specified in the original design document is used, the flow rate may be adversely affected. In any application, HEPA or other filters should be installed carefully and maintained meticulously to ensure adequate function. Manufacturers of room-air cleaning equipment should provide documentation of the HEPA or other filter efficiency, or the efficiency of the novel air-cleaning technology, and the efficiency of the installed device in lowering room-air contaminant levels.

High risk areas for nosocomial respiratory pathogens transmission:

- Infectious respiratory diseases patient isolation areas/rooms
- Areas/rooms where sputum/samples are collected or induced
- Bronchoscopy suites Surgical suites Intensive care units Autopsy suites

Glossary and Abbreviations

Administrative control measures: defined as the managerial or work practices (e.g., early diagnosis and testing prompt isolation or separation of potentially infectious respiratory diseases patients, prompt initiation of appropriate treatment, minimize aerosol-generating procedures) to reduce significantly the risk of infectious respiratory diseases transmission by preventing the generation of droplet nuclei and limiting exposure to droplet nuclei.

Aerosol: liquid or solid particles dispersed in air that are of fine enough particle size (0.01 to 100 micrometres) to remain airborne for a period of time.

A **laboratory confirmed infectious respiratory diseases case** is one from whom a biological specimen is positive by smear microscopy, culture or WRD (such as Xpert MTB/RIF) for TB or a positive case from a sample collected from other infectious respiratory diseases. All such cases should be notified, regardless of whether treatment has started for either TB or for other infectious respiratory diseases.

A **clinically diagnosed infectious respiratory diseases case** is one who does not fulfill the criteria for bacteriological confirmation but has been diagnosed with active TB/other infectious respiratory diseases by a clinician or other medical practitioner who has decided to give the patient a full course of TB/infectious respiratory diseases treatment. This definition includes cases diagnosed on the basis of X-ray abnormalities or suggestive histology and extra pulmonary cases without laboratory confirmation. Clinically diagnosed cases subsequently found to be bacteriologically positive (before or after starting treatment) should be reclassified as bacteriologically confirmed

Acid-fast bacilli (AFB): rod-shaped bacteria that do not lose their stain when exposed to acid-alcohol mixture after the staining process, i.e., *Mycobacterium tuberculosis* and all mycobacterium.

Bacille Calmette-Guérin (BCG) vaccination: A live vaccine against TB derived from an attenuated strain of *Mycobacterium bovis*. Efficacious in prevention of disseminated forms of TB in children, of debatable efficacy against adult forms of TB.

Biological Safety Cabinet Class I (BSC I): cabinet that protects the worker and the environment from exposure to an aerosol by drawing air into the cabinet but provides no product (specimen/ culture) protection. It is similar in air movement to a chemical fume hood or ventilated cabinet but has a HEPA filter in the exhaust system to protect the environment. The exhaust air is either exhausted outside or recirculates into the room. Also see Laboratory Fume Hood.

Biological Safety Cabinets Class II (BSC II, Types A, B1, B2, and B3): cabinet that protects the worker, the environment, and the product (specimen/ culture) from exposure to an aerosol. Air flow is drawn around the worker into the front grille of the cabinet, which provides worker protection. In addition, the downward laminar flow of HEPA-filtered air provides product (specimen/ culture) protection by minimizing the chance of cross-contamination along the work surface of the cabinet. Because cabinet air exhaust is passed through a certified exhaust HEPA filter, it should be contaminant-free (environmental protection) and may be re-circulated back into the laboratory (Type a BSC) or exhausted out of the building (Type B BSC).

Personal protective equipment (PPE): personal protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers, which should be provided, used, and maintained in a sanitary and reliable condition wherever it is necessary by reason of hazards of processes or environment, biological hazards, chemical

hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact.

Presumptive infectious respiratory diseases refer to a patient who presents with symptoms or signs suggestive of infectious respiratory diseases

Respiratory protection: respiratory protective device used in healthcare setting which fits over the mouth and nose and are designed to protect against transmission of respiratory pathogens by reducing the number of inhaled infectious droplet nuclei.

Recirculation filtration system: more expensive option used in ventilation systems to remove droplet nuclei by a filtration system which then exhausts the air back into the room.

Referral level health care facility: defined as regional or national referral and university hospitals.

Respirators: special type of closely fitted device with the capacity to seal to the face and filter 0.3-0.4 micrometer particles with an efficiency of at least 94-95%, to prevent the wearer from inhaling infectious droplet nuclei.

Smoke tubes: device used to generate visible, non-hazardous smoke which can be used to monitor proper airflow direction and assist in assessing the proper function of ventilation systems

Symptom screen: A procedure used during a clinical evaluation in which patients are asked if they have experienced any departure from normal in function, appearance, or sensation related to infectious respiratory diseases (e.g., cough).

Surgical or procedure mask: cloth or paper mask that prevents the spread of micro-organisms from the wearer to others by capturing the large wet particles near the source (mouth); it may not provide protection from inhaling infectious droplet nuclei, such as *M. tuberculosis* (see Respirators). Surgical or procedure masks are also known as face masks.

Treatment after loss to follow-up patients, have previously been treated for infectious respiratory diseases e.g., TB and were declared *lost to follow-up* at the end of their most recent course of treatment. (These were previously known as *treatment after default* patients.)

Tuberculin skin testing (TST): intracutaneous injection of purified protein derivative (PPD) to identify persons who have been sensitized to mycobacterial antigens by infection with *M. tuberculosis*, non-tuberculous mycobacteria or administration of BCG.

Tuberculosis (TB): a clinically active, symptomatic disease caused by bacteria belonging to the *M. tuberculosis* complex (*M. tuberculosis*, *M. bovis*, *M. africanum*).

Infectious Respiratory Diseases: Upper or lower respiratory tract diseases, frequently infectious in etiology that can result in a spectrum of illnesses, ranging from asymptomatic or mild infection to Severe or fatal form of disease. The severity depends on the causative pathogen, and on environmental and host factors.

Infectious respiratory diseases screening: An administrative control measure in which evaluation for infectious respiratory diseases are performed through initial and serial screening of HCWs, as indicated. Evaluation might comprise TST, BAMT, Chest radiograph and symptom screening. See also symptom screen.

Symptom screen: A procedure used during a clinical evaluation in which patients are asked if they have experienced any departure from normal in function, appearance, or sensation related to infectious respiratory disease (e.g., cough).

Triage: The process of sorting people based on their need for immediate medical treatment as compared to their chance of benefiting from such care. Triage is done in emergency rooms, disasters and wars when limited medical resources must be allocated to maximize the number of survivors.

Ultraviolet germicidal irradiation (UVGI): defined as an environmental control measure to inactivate micro-organisms like *M. tuberculosis.* UVGI is a form of electromagnetic radiation with wavelengths between the blue region of the visible spectrum and the radiograph region, and is not visible (i.e., the blue glow from a UVGI lamp is not the germicidal wavelength). UV-C radiation (short wavelengths; range: 100–280 nm) can be produced by various artificial sources (e.g., arc lamps and metal halide lamps). The majority of commercially available UV lamps used for germicidal purposes are low-pressure mercury vapor lamps that emit radiant energy in the UV-C range, predominantly at a wavelength of 253.7 nm.

WHO: World Health Organization.

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