

Self-Study Modules on Tuberculosis

5 Infectiousness and Infection Control



Module 5: Objectives

At completion of this module, learners will be able to:

1. Describe the factors that determine the infectiousness of a TB patient
2. Describe the main goals of a TB infection-control program
3. Describe the three levels of control measures that are the basis of an effective TB infection-control program
4. Describe the purpose and the characteristics of a TB airborne infection isolation (AII) room
5. Describe the circumstances when personal respirators should be used

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Module 5: Overview

- Infectiousness
- TB Infection Control
 - TB Infection Control Measures
 - TB Risk Assessment
 - Infection Control in Nontraditional Facility-Based Settings
 - TB Infection Control in the Home
- Case Studies

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Infectiousness

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Infectiousness (1)

- Infectiousness is directly related to number of tubercle bacilli TB patients expel into air
- TB patients generally expel more tubercle bacilli if their cough produces a lot of sputum
- Only people with TB of the lungs, airway, or larynx are infectious

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Infectiousness (2)

Factors generally associated with infectiousness:

• Presence of cough	• Not covering mouth when coughing
• Lung cavity	• Not receiving adequate treatment
• Acid-fast bacilli on sputum smear	• Undergoing cough inducing procedures
• TB of lungs, airway, or larynx	• Positive sputum cultures

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Infectiousness (3)

- Infectiousness appears to decline rapidly after adequate treatment is started; however:
 - How quickly infectiousness declines varies from patient to patient (weeks to months)
 - Patients with drug-resistant TB may not respond to initial drug regimen; meaning they may remain infectious for longer

Infectiousness (4)

- Patients can be considered non-infectious when they meet all of the following criteria:
 - Received adequate treatment for 2 weeks or longer
 - Symptoms have improved
 - 3 consecutive negative sputum smears from sputum collected in 8-24 hour intervals (at least one early morning specimen)

Infectiousness (5)

- Children are less likely than adults to be infectious
 - Children generally do not produce a lot of sputum when they cough
- Young children can still transmit TB if they exhibit signs of infectiousness



Infectiousness Study Question 5.1

List 7 factors that affect the infectiousness of a TB patient. (pg. 7)

Infectiousness Study Question 5.2

Why does the site of disease affect the infectiousness of a TB patient? (pg. 7)

Infectiousness Study Question 5.3

When can a TB patient be considered noninfectious? List all 3 criteria. (pg. 7)

TB Infection Control

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TB Infection Control (1)

- Infection control is an important strategy to prevent the spread of TB
 - Several outbreaks of TB in health care settings, including multidrug-resistant TB (MDR TB) and extensively drug-resistant TB (XDR TB), have occurred
- All health care and congregate settings should implement TB infection-control measures

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TB Infection Control (2)

- TB is most likely to be transmitted when health care workers (HCWs) and patients come in contact with persons who:
 - Have unsuspected TB disease
 - Are not receiving adequate treatment
 - Have not been isolated from others

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TB Infection Control (3) Role of the Health Department

- Health department TB control programs should:
 - Ensure each of their clinics develop a TB infection-control program
 - Provide consultation about TB infection control to other health care and congregate settings

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TB Infection Control (4) Role of the Health Department

- Health departments should specifically assist health care settings with:
 - Reporting confirmed or suspected TB cases
 - Conducting contact investigations
 - Ensuring a plan for TB patients to receive follow-up care after discharge
 - Testing, surveillance, and outbreak investigations

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TB Infection-Control Program (1)

- Main goals of a TB infection-control program are to ensure early and prompt:
 - Detection of TB disease
 - Isolation of people who have or are suspected of having TB disease (airborne precautions)
 - Treatment of people who have or are suspected of having TB disease

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TB Infection-Control Program (2) Detection of TB disease

- HCWs should suspect TB disease in anyone with any of these symptoms:
 - Persistent cough
 - Bloody sputum
 - Weight loss or loss of appetite
 - Fever
 - Night sweats



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TB Infection-Control Program (3) Detection of TB disease

- When a health care worker suspects that a patient has TB disease, the patient should be:
 - Placed in an area away from other patients and evaluated
 - Given a surgical mask to wear
 - Given tissues and asked to cover nose and mouth when coughing or sneezing

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TB Infection-Control Program (4) Airborne Precautions

- Airborne precautions should be taken for any person who has signs or symptoms of TB disease
- If facility has an **AI** room, TB suspects and TB patients should be placed there
- Health care settings, such as TB clinics, should implement a respiratory-protection program

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TB Infection-Control Program (5) Treatment

- Patients diagnosed with TB should start treatment immediately
- DOT should be used to ensure adherence



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TB Infection Control Study Question 5.4

Under what circumstances is TB most likely to be transmitted in health care facilities? (pg. 15)

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TB Infection Control Study Question 5.5

How can the health department assist health care settings in preventing the spread of TB? (pg. 15)

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TB Infection Control Study Question 5.6

What are the main goals of a TB infection-control program? (pg. 15)

TB Infection Control Study Question 5.7

What would make a health care worker suspect that a patient has TB disease? (pg. 16)

TB Infection Control Study Question 5.8

What should be done when a health care worker suspects that a patient has TB disease? (pg. 16)

TB Infection Control

TB Infection Control Measures

TB Infection Control Measures (1) Hierarchy of Infection Control



Administrative Controls



Environmental Controls



Respiratory Protection

TB Infection Control Measures (2)

Three levels of control measures:

- **Administrative controls:** managerial measures to reduce risk of exposure to *M. tuberculosis*
- **Environmental controls:** engineering systems to prevent the spread of and reduce the concentration of infectious *M. tuberculosis* droplet nuclei in air
- **Respiratory-protection controls:** personal protection to further minimize risk for exposure to *M. tuberculosis*

TB Infection Control

TB Infection Control Measures Administrative Controls

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Administrative Controls (1)

- Administrative controls:
 - First and most important level of TB infection-control program
 - Goal is to reduce risk of exposure to persons who might have TB disease

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Administrative Controls (2)

- Administrative control activities:
 - Assigning someone responsibility for TB infection control
 - Conducting TB risk assessment
 - Developing and implementing written TB infection control plan
 - Ensuring availability of prompt laboratory processing, testing, and reporting of results

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Administrative Controls (3)

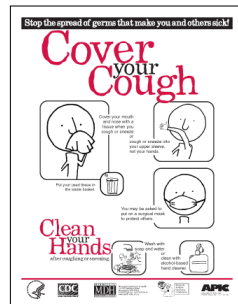
- Administrative control activities (cont.):
 - Implementing effective work practices for managing patients who may have TB
 - Ensuring proper cleaning and sterilization or disinfection of equipment
 - Educating, training, and counseling HCWs about TB
 - Testing and evaluating workers who are at risk for TB or may be exposed to TB

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Administrative Controls (4)

- Administrative control activities (continued):
 - Using posters to remind patients of proper cough etiquette
 - Coordinating efforts between health departments and high risk settings



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TB Infection Control

TB Infection Control Measures Environmental Controls

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Environmental Controls

- Second level of infection-control program
- Consist of technologies that are designed to remove or inactivate airborne *M. tuberculosis*
 - Ventilation technologies
 - High efficiency particulate air filtration (HEPA)
 - Ultraviolet germicidal irradiation (UVGI)

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Ventilation Technologies (1)

- Ventilation is the movement of air in a building and the replacement of air inside with air from outside
- Ventilation technologies include:
 - Natural ventilation
 - Mechanical ventilation

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Ventilation Technologies (2) Natural Ventilation

- Doors and windows should be open
- Fans can be used to distribute air
- HCW should sit near fresh air source
- Can be useful for nontraditional settings that do not have a central ventilation system



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Ventilation Technologies (3) Mechanical Ventilation

- Refers to the use of technological equipment to circulate and move air
- Consists of two types of technologies
 - Local exhaust ventilation
 - General ventilation
- Should be used by hospitals, TB clinics, and other settings where TB patients are expected

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Ventilation Technologies (4) Mechanical Ventilation

- Local exhaust ventilation
 - Stops airborne contaminants from spreading into general environment
 - Includes external hoods, booths, and tents
 - Should be used for cough-inducing procedures

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Ventilation Technologies (5) Mechanical Ventilation

- General ventilation systems:
 - Dilute contaminated air
 - Remove contaminated air
 - Control airflow patterns in patient and procedure rooms (e.g., negative pressure in AII room)

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Ventilation Technologies (6) Mechanical Ventilation

- **AII rooms are designed to prevent spread of droplet nuclei expelled by patient**
 - Negative pressure
 - Clean air flows from corridors into AII room
- **Air cannot escape AII room**
 - Exhausted outdoors or passed through filter

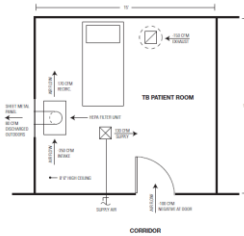


Image credit: Francis J. Curry National TB Center

HEPA Filters

- **HEPA filters are special filters used to remove droplet nuclei from air**
- **Must be used when releasing air from:**
 - Local exhaust ventilation booths to surrounding area
 - AII room to general ventilation system

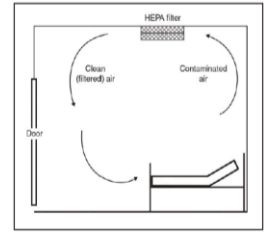


Image credit: Francis J. Curry National TB Center

UVGI

- **UVGI is air cleaning technology that consists of lamps that give off UV light, which can kill tubercle bacilli**
- **Should be used with other infection control measures**
- **UV light can be harmful to skin and eyes**

Upper-air UVGI in a dormitory

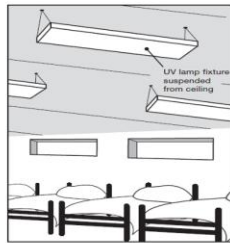


Image credit: Francis J. Curry National TB Center

TB Infection Control

TB Infection Control Measures Respiratory-Protection Controls

Respiratory-Protection Controls (1)

- **Third level of infection-control that includes:**
 - Implementing a respiratory-protection program
 - Training health care workers on respiratory-protection
 - Educating patients on respiratory hygiene

Respiratory-Protection Controls (2) Personal Respirators

- **Respirators filter out droplet nuclei**
- **Should be used in:**
 - TB AII rooms
 - Cough-inducing procedure rooms
 - Ambulances transporting infectious TB patients
 - Homes of infectious TB patients

Respiratory-Protection Controls (3) Personal Respirators

- Important that respirator fits properly:

- Fit test used to determine which respirator to wear
- User seal check should be done each time a respirator is put on



Health care worker undergoing a fit test
Image credit: Paul Jensen

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Respiratory-Protection Controls (4) Personal Respirators

- Respirators that can be used to protect against *M. tuberculosis*:

- Nonpowered respirators with N95, N99, N100, R95, R99, R100, P95, P99, and P100 filters
- Powered air-purifying respirators (PAPRs) with high-efficiency filters



Image credit: Greg Knobloch

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Respiratory-Protection Controls (5) Respirators and Surgical Masks

- Important to understand difference between respirators and surgical masks

- Respirators protect individuals from inhaling droplet nuclei
- Surgical masks stop droplet nuclei from being exhaled into air by infectious TB patients or suspects

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Respiratory-Protection Controls (6) Respirators



Health care worker wearing a personal respirator

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Respiratory-Protection Controls (7) Surgical Masks



Patient wearing a surgical mask

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TB Infection-Control Study Question 5.9

What are the three levels of control that form the basis of a TB infection-control program?

(pg. 16)

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Administrative Controls Study Question 5.10

List 5 administrative control measures that should be taken in health care settings to reduce the risk of exposure to persons who may have TB disease. (pg. 30)

Environmental Controls Study Question 5.11

Where should sputum induction, bronchoscopy, or other cough-inducing procedures be done? (pg. 30)

Environmental Controls Study Question 5.12

What is a TB AII room? What are the important characteristics of an AII room? (pg. 30)

Ventilation Systems Study Question 5.13

How do ventilation systems help prevent the spread of TB? (pg. 31)

Ventilation Systems Study Question 5.14

Give 4 examples of settings where personal respirators should be used. (pg. 31)

Respiratory Protection-Controls Study Question 5.15

What is the difference in use between a respirator and a surgical mask? (pg. 31)

TB Infection Control

TB Risk Assessment

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TB Risk Assessment (1)

- Administrative control measure
- Helps to inform infection control plan
- Determines types of controls needed for setting
- Serves as an initial and ongoing monitoring and evaluation tool for infection-control program
- Helps determine frequency of employee testing

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TB Risk Assessment (2)

- Risk assessment examines many factors, including:
 - Number of patients with TB disease in setting
 - Promptness of detection, isolation, and evaluation of patients with suspected or confirmed TB
 - Evidence of transmission of *M. tuberculosis* in setting
 - Community rate of TB disease

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TB Risk Classification

- Low risk
 - Persons with TB disease are not expected to be encountered
- Medium risk
 - Possible exposure to persons with TB disease
 - Possible exposure to clinical TB specimens
- Potential ongoing transmission
 - Setting where there is evidence of person-to-person transmission of *M. tuberculosis* in past year

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TB Testing Frequency

TB Risk Classification	Frequency for TB Testing
Low Risk	<ul style="list-style-type: none"> • Conduct baseline test when health care worker is hired • No further testing needed unless exposure occurs
Medium Risk	<ul style="list-style-type: none"> • Conduct baseline test when health care worker is hired • Repeat test annually
Potential Ongoing Transmission	<ul style="list-style-type: none"> • Conduct baseline test when health care worker is hired • Repeat test every 8-10 weeks until there is no evidence of ongoing transmission

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TB Infection Control

Infection Control in Nontraditional Facility-Based Settings

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Special Considerations (1)

- Nontraditional facility-based settings where TB patients receive care should establish and follow an infection-control program
- Includes settings such as:
 - Nursing homes
 - Correctional facilities
 - Homeless shelters
 - Drug treatment centers
 - Emergency medical services
 - Home-based health care
 - Outreach settings

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Special Considerations (2) Correctional Facilities

- Medical settings within correctional facilities should:
 - Classify as medium risk or higher
 - Test all staff annually
 - Implement a respiratory-protection program with at least one AII room

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Special Considerations (3) Correctional Facilities

- Medical settings within correctional facilities should (cont.):
 - Have inmates with suspected or confirmed TB disease wear surgical mask when transported
 - Establish and maintain a tracking system for inmate testing and treatment

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Special Considerations (4) Homeless Shelters

- Should observe the same TB infection-control measures as outpatient clinics
- Several factors in shelter environment can influence likelihood of TB transmission:
 - Crowdedness of shelter
 - Ventilation system of shelter

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Special Considerations (5) Emergency Medical Services (EMS)

- EMS workers should be included in TB testing program based on risk for the setting
- Persons with infectious TB who are transported in ambulance should wear surgical mask
- Drivers, health care workers, and other staff should consider wearing a respirator
- Ambulance should allow for maximum amount of outdoor air to be circulated in vehicle

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Special Considerations (6) Long-Term Care Facilities (LTCFs)

- LTCFs (e.g., hospices and nursing homes) should:
 - Symptom screen and possibly test new employees and residents
 - Have administrative and environmental controls IF they accept patients with infectious TB
- Persons with TB disease who are non-infectious can stay in LTCFs and do not need AII room

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TB Infection Control

TB Infection Control in the Home

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TB Infection Control in the Home (1) Patient Returning Home

- TB patients and TB suspects may be sent home after starting treatment, even though they may be infectious

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TB Infection Control in the Home (2) Patient Returning Home

- Criteria for patient to return home:
 - Follow-up plan with local TB program
 - Patient on TB treatment and DOT arranged
 - No infants or children under 4 years or persons with immunocompromising conditions in home

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TB Infection Control in the Home (3) Patient Returning Home

- Criteria for patient to return home (cont.):
 - All household members have already been exposed to TB patient
 - Patient is willing to not travel outside of home until sputum smear results are negative

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TB Infection Control in the Home (4) Patient Returning Home

- TB patients and members of household should take steps to prevent spread of TB
- Patients with TB should be instructed to:
 - Cover mouth and nose with tissue when coughing or sneezing
 - Sleep alone
 - Not have visitors until noninfectious

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TB Infection Control in the Home (5) Health Care Workers (HCWs)

- HCWs should:
 - Be trained in detecting TB signs and symptoms
 - Take precautions to protect themselves:
 - Instruct patient to cover mouth when coughing
 - Wear personal respirator
 - Collect sputum in well-ventilated areas
 - Participate in TB testing and prevention programs

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TB Risk Assessment Study Question 5.16

What are 3 different TB risk classifications that can be assigned to health care settings?
(pg. 40)

TB Risk Assessment Study Question 5.17

Depending on risk classification, how often should health care settings test workers for TB?
(pg. 40)

TB Infection Control in the Home Study Question 5.18

What precautions should a health care worker take when visiting the home of a TB patient who may be infectious? *(pg. 40)*

Case Studies

Module 5: Case Study 5.1

For each of the following situations, decide whether the patient should be considered infectious or non-infectious, and explain why.
(pg. 8)

Module 5: Case Study 5.1 Question 5A

Two weeks ago, Mr. Lopez had a sputum smear that was positive; since then no sputum specimens have been tested. Mr. Lopez started self-administered TB treatment 7 days ago. He still has a cough.

Module 5: Case Study 5.1
Question 5A: Answer

Module 5: Case Study 5.1
Question 5B

Ms. Nguyen, a patient with pulmonary TB, has been receiving DOT treatment for 6 weeks and no longer has symptoms of TB. She has had three sputum smears. The first one was positive, but the last two were negative.

Module 5: Case Study 5.1
Question 5B: Answer

Module 5: Case Study 5.1
Question 5C

Mr. Martin started DOT treatment for pulmonary TB in April. His symptoms went away and his sputum smears were negative in May. However, the outreach worker was unable to locate him on June 5th and has not been able to contact him since that time. Mr. Martin returned to the TB clinic today, August 2, and is coughing.

Module 5: Case Study 5.1
Question 5C: Answer

Module 5: Case Study 5.2 (1)

You are checking patients into the TB clinic. An elderly man comes to the desk and says he was told to come and get checked because one of his friends has TB. You notice that he looks sick and is coughing frequently. The waiting room is full of patients, and you know it will probably be more than an hour before the physician can see him. (pg. 17)

Module 5: Case Study 5.2 (2)

- What should you do?

Module 5: Case Study 5.3 (1)

You are sent to deliver directly observed therapy (DOT) to a woman who started treatment last week for suspected pulmonary TB. Her sputum smear results are not back yet. You are asked to collect another sputum specimen while you are at the woman's home. (pg. 41)

Module 5: Case Study 5.3 (2)

- What precautions should you take?