XI. INFECTION CONTROL

MODULE OUTLINE

1. Standards of Public Health Practice
2. Principles
3. Administrative Controls
    a) TB Risk Classification Assessment
    b) Health Care Worker Education and Training
4. Environmental Controls
    a) Primary Environmental Controls
    b) Secondary Environmental Controls
5. Respiratory Protection Controls
    a) Airborne (Respiratory) Precautions
    b) TB Infection Control in the Home
    c) TB Infection Control in Nontraditional Facility-Based Settings

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1. STANDARDS OF PUBLIC HEALTH PRACTICE

XI-1.	At a minimum, monthly monitoring of environmental controls (e.g., negative pressure rooms, HEPA filters, sputum induction rooms and UV lights, if applicable) is performed and documented.
XI-2.	TB program employees with direct patient contact are provided with personal protective equipment (PPE) and appropriate annual training.

2. PRINCIPLES

M. tuberculosis can be transmitted in virtually any setting. Clinicians should be aware that transmission has been documented in health care settings where health care workers (HCW's) and patients come in contact with persons with infectious TB who:

- Have unsuspected TB disease
- Have not received adequate or appropriate treatment
- Have not been separated from others

Public health departments should have an Infection Control Plan (ICP) that incorporates three (3) levels of controls:

1. Administrative controls
2. Environmental controls
3. Respiratory protection controls

The regional TB program staff should be familiar with and have access to the ICP utilized by the health departments in their jurisdiction.

3. ADMINISTRATIVE CONTROLS

The first and most important level of a TB infection control plan is the use of administrative measures to reduce the risk of exposure to persons who might have infectious TB disease.

Table XI-1 outlines administrative control activities.

Table XI-1. Administrative Control Activities

Administrative Control Activities
Administrative controls may consist of implementing the following activities: • Conducting a TB infection control risk assessment of the setting • Following a written Infection Control Plan to ensure prompt detection, separation from others (into a negative pressure room, if possible), and treatment of persons who have suspected or confirmed TB disease • Ensuring the availability of recommended laboratory processing, testing and reporting of results • Implementing effective work practices for managing patients who may have TB disease • Ensuring proper cleaning, sterilization, or disinfection of equipment that might be contaminated (e.g., nebulizer) • Educating, training, and counseling HCW's, patients, and visitors about TB infection and TB disease • Testing and evaluating employees who are at risk for exposure to TB disease • Using posters and signs to remind patients and staff of proper cough etiquette (covering mouth when coughing) and respiratory hygiene • Coordinating efforts between local health department and high-risk health-care and congregate settings • Monitoring and maintenance of environmental and radiation safety controls, if applicable • Monitoring of compliance with the provisions of the health department Infection Control Plan and reporting of compliance issues for resolution

TB Risk Classification Assessment

Health care settings should conduct an evaluation of the risk of TB transmission. The TB Risk Assessment determines the type of administrative, environmental, and respiratory protection controls needed, by examining the:

- Number of patients with TB disease in the setting
- Promptness of detection, isolation, and evaluation of patients with suspected or confirmed TB disease
- Evidence of transmission of *M. tuberculosis* in the setting
- Community rate of TB disease

Health care settings should perform a Risk Classification as part of the facility TB Risk Assessment to determine the need for a TB testing program for health care workers (HCW's)

and the frequency of testing, regardless of the likelihood of encountering persons with TB disease (**Refer to Table XI-2**).

Reference:

1. CDC. Guidelines for Preventing the Transmission of *Mycobacterium* tuberculosis in Health-Care Settings. MMWR 2005; 54 (No. RR-17). http://www.cdc.gov/mmwr/pdf/rr/rr5417.pdf

Table XI-2: TB Risk Classifications

Risk Classification	Need for Testing	Frequency of Testing
Low risk	Should be used for settings in which persons with TB disease are not expected to be encountered.	Exposure to *M. tuberculosis* in these settings is unlikely, and further testing is not needed unless exposure has occurred.
Medium risk	Should be used for facilities in which the risk assessment has determined that HCW's will possibly be exposed to persons with TB disease.	Repeat testing should be done annually.
Potential ongoing transmission	Should be temporarily assigned to any setting where there is evidence of person-to-person transmission of *M. tuberculosis* in the past year.	Testing should be repeated every 8 to 10 weeks until there is no evidence of ongoing transmission.

Reference:

1. CDC. Core Curriculum on Tuberculosis: What the Clinician Should Know, 2013. www.cdc.gov/tb/education/corecurr/default.htm

The Centers for Disease Control and Prevention (CDC) recommends that facilities be classified as **medium** risk if cough-inducing procedures (e.g., natural/coughed sputum collection, sputum induction and/or administration of aerosolized medications) are performed on patients who may have TB disease. On this basis, TTBEP Central Office recommends:

- Health department sites where cough-inducing procedures are performed (e.g., administration of aerosolized medications, collection of natural/coughed sputum specimens, sputum induction procedures) are classified as "medium risk;" these sites include all regional TB clinics (and may include primary care clinics); and
- Baseline risk assessment and two-step TB skin testing (TST) (**Refer to Module II. Screening and Testing for TB Infection**) for all health care workers (HCWs) upon hire, annual symptom screening (not TB testing) for all HCWs, and annual TB skin testing for HCWs assigned to these clinic sites.

Health Care Worker Education and Training

HCW education and training on TB infection and TB disease is an essential part of an Infection Control Plan and can increase adherence to TB infection control measures. Health department settings should conduct and document an annual evaluation for follow-up education and training based on the:

- Number of untrained or new HCWs
- Changes in the organization and services of the health department setting
- Availability of new TB infection control information

References:

1. CDC. Guidelines for Preventing the Transmission of Mycobacterium tuberculosis in Health-Care Settings MMWR 2005; 54 (No. 17). www.cdc.gov/tb/education/corecurr/default.htm
2. CDC. Core Curriculum on Tuberculosis: What the Clinician Should Know, 2013. www.cdc.gov/tb/education/corecurr/default.htm

4. ENVIRONMENTAL CONTROLS

The second level of infection control is the use of environmental controls to prevent the spread of disease by reducing the concentrations of infectious droplet nuclei in the air. Environmental controls include:

- Primary environmental controls
- Secondary environmental controls

At a minimum, monthly monitoring of environmental controls (e.g., negative pressure rooms, HEPA filters, sputum induction rooms and UV lights, if applicable) is performed and documented (**Standard of Public Health Practice XI-1**).

Table XI-3 outlines primary and secondary environmental controls.

Table XI-3: Environmental Controls

Primary Environmental Control	Secondary Environmental Control
Controls the source of infection by using local exhaust ventilation and diluting & removing contaminated air by using general ventilation • Uses natural ventilation (e.g., open doors, windows) • Uses mechanical ventilation equipment to circulate and move air in a building • Uses local exhaust ventilation (e.g., hoods, tents, or booths)	Controls airflow in areas adjacent to the source and cleans air • Controls the airflow to prevent contamination of air in areas adjacent to the source (e.g., negative pressure /airborne infectious isolation room [AII]) • Cleans the air by using high efficiency particulate air (HEPA) filtration or ultraviolet germicidal irradiation (UVGI)

Reference:

1. CDC. Core Curriculum on Tuberculosis: What the Clinician Should Know. 2013. http://www.cdc.gov/tb/education/corecurr/pdf/corecurr_all.pdf (adapted)

Primary Environmental Controls

Ventilation is the movement and the replacement of air in a building with air from the outside or with clean, recirculated air. When fresh air enters a room, it dilutes the concentration of particles in room air, such as droplet nuclei. There are two (2) types of ventilation:

- **Natural ventilation** relies on cross ventilation in a building designed for good air exchange:
  - Operable window, door, or skylight that is kept open as often as possible. Sample signage can be found at: http://www.currytbcenter.ucsf.edu/sites/default/files/ic_book_2011.pdf http://www.cdc.gov/globalaids/resources/pmtct-care/docs/tb-tools/tbic_windowsticker.pdf http://www.cdc.gov/globalaids/resources/pmtct-care/docs/tb-tools/tbic_doorsticker.pdf
  - Fans can be used to help distribute the air (staff should sit near the fresh air source and patients should sit near the exhaust location)
  - Cough etiquette and respiratory hygiene should be encouraged to further reduce risk. Sample signage can be found at: http://www.currytbcenter.ucsf.edu/sites/default/files/ic_book_2011.pdf
- **Mechanical ventilation** refers to the use of equipment to circulate and move air in a building. Mechanical ventilation consists of local exhaust ventilation and general ventilation:
  - Local exhaust ventilation stops airborne contaminants before they spread into the general environment. Local exhaust ventilation includes the use of:
    - External hoods
    - Sputum booths
    - Tents
  - General ventilation systems maintain air quality in the health department setting by:
    - Diluting contaminated air
    - Removing contaminated air
    - Controlling airflow patterns in the patient's procedure room or setting (e.g., negative pressure/airborne infectious isolation rooms)

Local exhaust ventilation should be used for cough-inducing and aerosol-generating procedures (i.e., natural/coughed sputum collection, sputum induction and/or administration of aerosolized medications). If local exhaust ventilation cannot be used, these procedures should be performed in a negative pressure room.

If a negative pressure room is not available, the procedures should be performed outdoors and away from:

- People
- Windows
- Air intakes

When collecting sputum specimens in the health department (by induction or natural/coughed collection), the staff should adhere to the following infection control measures:

- Ensure employees are successfully fit-tested for use of an N95 respirator prior to performing sputum collection/induction procedures
- Ensure employees wear a N95 respirator when performing sputum collection/induction at any site (i.e., in a health department clinic or the patient's home)
- Obtain specimens in a sputum induction booth, negative pressure room, or outside the building
- Give patient verbal instructions, and written if available, regarding correct sputum specimen collection
- Instruct patient to remain in the negative pressure room or sputum booth until coughing subsides, and if infectious, to properly don (put on) a surgical mask before leaving the space
- Apply appropriate signage on the door outside the negative pressure room or room housing the booth during and after sputum collection/induction, warning persons not to enter and what time it will be safe to enter without a N95 respirator. Sample signage can be found at: http://www.currytbcenter.ucsf.edu/sites/default/files/ic_book_2011.pdf
- Allow sufficient time to elapse for removal of airborne contaminates before another patient enters the booth or negative pressure room. A sample room clearance time calculation worksheet can be found at: http://www.currytbcenter.ucsf.edu/sites/default/files/ic_book_2011.pdf
- Ensure employees wear a N95 respirator when entering a negative pressure room or sputum induction booth which has been used for the purpose of sputum induction. This includes the time required for the airborne contaminants to be removed from the room or booth.

One characteristic of a negative pressure/airborne infectious isolation room is the negative pressure relative to other parts of the facility. Properly functioning isolation space under negative pressure causes air to flow from the corridors into the isolation room. The air from the isolation room cannot escape to the other parts of the health department when the door is closed and the ventilation system is operating properly. (**Refer to Table IX-4**).

Table XI-4: Practices for Negative Pressure/Airborne Infectious Isolation (AII) Rooms in Health Care Settings

Practices for Negative Pressure/Airborne Infectious Isolation Rooms in Health-Care Settings
• Keep doors and windows to negative pressure/airborne infectious isolation rooms closed when occupied by a person with suspected infectious TB • Maintain at least one negative pressure/airborne infectious isolation room, if possible • Check negative pressure by monitoring and recording the direction of airflow on a **monthly** basis, and **daily** when the room is in use • Perform diagnostic and treatment procedures in a negative pressure/airborne infectious isolation room • Ensure patients and clinic staff adhere to respiratory isolation precautions • Schedule patients with suspected and confirmed infectious TB disease for clinic visits when fewer HCW's and no other high-risk patients are present • Provide a surgical mask for patients with suspected or confirmed infectious TB disease during transport, in waiting areas, and when others are present • Review environmental control maintenance procedures and logs to determine if maintenance is being conducted properly and regularly

Reference:

1. CDC. Core Curriculum on Tuberculosis: What the Clinician Should Know, 2013 (adapted). www.cdc.gov/tb/education/corecurr/default.htm

Secondary Environmental Controls

Secondary environmental controls consist of:

- Controlling the airflow to prevent contamination of air in areas adjacent to the source (negative pressure/airborne infectious isolation room)
- Cleaning the air by using high-efficiency particulate air (HEPA) filtration or ultraviolet germicidal irradiation (UVGI) (**Refer to Table XI-3**)

HEPA filters can be used to filter droplet nuclei from the air and must be used when discharging air from:

- Local exhaust ventilation booths or enclosures directly into the surrounding room or area
- Negative pressure/airborne infectious isolation rooms into the general ventilation system (e.g., in settings in which the ventilation system or building configuration makes venting the exhaust to the outside impossible)

The health department should follow the manufacturer's instructions for maintenance of all HEPA filters, including the operation, cleaning, and frequency of filter changes. Keep a record of all maintenance and monitoring.

UVGI is an air-cleaning technology that consists of the use of special lamps that give off ultraviolet germicidal irradiation. The lamps are used to inactivate the tubercle bacilli contained in the droplet nuclei. Overexposure to UV light can be harmful to the skin and eyes. The health department should follow the manufacturer's instructions for maintenance, including the operation, cleaning, and bulb replacement. Keep a record of all maintenance and monitoring.

5. RESPIRATORY PROTECTION CONTROLS

Respiratory protection controls are the third level of a TB infection control plan and consists of the use of personal protective equipment (PPE) in situations that pose a high risk for exposure to TB disease. Health department settings that use respiratory protection controls are required by Occupational Safety and Health Administration (OSHA) to develop, implement, and maintain a respiratory protection program. TB program employees with direct patient contact are provided with personal protective equipment (PPE) and appropriate annual training (**Standard of Public Health Practice XI-2**).

The use of respiratory protection can further reduce risk for exposure of HCW's to droplet nuclei expelled into the air. The following measures can be taken to reduce risk of exposure:

- Implement a respiratory protection program
- Train health department employees on respiratory protection
- Educate patients on respiratory hygiene and the importance of cough etiquette
- Provide annual respiratory fit testing for health department employees who provide direct patient care to TB patients

Respiratory protection should be used in all settings where direct patient care is provided to TB patients. These settings may include:

- TB negative pressure/airborne infectious isolation rooms
- Rooms where cough-inducing or aerosol-generating procedures are done
- Ambulances and other vehicles transporting infectious TB disease patients
- Homes of infectious TB disease patients (for HCW's; other persons should not visit the homes of infectious persons)

It is important that respirators fit different face sizes and features properly. It is also important to understand the difference between respirators and surgical masks.

- Respirators are designed to protect HCW's and other individuals from inhaling droplet nuclei, and should not be worn by the patient. Follow the manufacturer's user instructions for the use and care of the respirator. (Refer to the N95 respirator package insert)
- Surgical masks are designed to reduce the number of droplets being exhaled into the air by persons with infectious TB disease when they breathe, talk, cough, or sneeze. Surgical masks should not be worn by the HCW.

NOTE: Upon identifying a person with suspected or confirmed TB disease in the clinic, the HCW should promptly provide a surgical mask to the individual and ensure that the mask is properly worn.

Reference:

1. CDC. Core Curriculum on Tuberculosis: What the Clinician Should Know, 2013. www.cdc.gov/tb/education/corecurr/default.htm (adapted)

Airborne (Respiratory) Precautions

Airborne precautions should be **initiated** for any person who:

- Has signs or symptoms of TB disease (suspected TB) **or**
- Who has documented infectious TB disease and remains infectious in spite of treatment

When a person(s) with suspected or confirmed infectious TB disease present to the health department, the person should be placed in an area away from other patients (respiratory isolation):

- Place a surgical mask on the patient and instruct them in the proper use. (Ensure a surgical mask is on the patient prior to entering the health department, when possible).
- Remove the patient from the waiting room immediately and escort them to a designated room containing a HEPA filter or a negative pressure room/airborne infection isolation (AII) room.
- Clerical staff should immediately notify the health department nursing staff of any potentially infectious patient in the waiting room.
- Employees are required to wear a N95 respirator when entering a room, including a negative pressure room, which is/has been occupied by a suspected or confirmed infectious TB patient. This includes the time required for the airborne contaminants to be removed from the room.
- Appropriate signage warning persons not to enter and what time it will be safe to enter either the clinic room or sputum induction booth without a respirator will be placed on the door outside the room. Sample signage can be found at: http://www.currytbcenter.ucsf.edu/sites/default/files/ic_book_2011.pdf
- Consult with the regional/metropolitan (metro) TB program staff or TB physician for further orders prior to the patient leaving the health department.

Employees who transport a suspected or confirmed infectious TB patient in a private or state government car should:

- Notify the destination facility of the patient's planned arrival time and of the appropriate precautions and continuity of treatment needs of the patient
- Wear a N95 respirator
- Place a surgical mask on the patient (Ensure that enough surgical masks are available for the entire journey. These masks should be changed when they become wet or torn)
- Place the patient in the back seat of the vehicle opposite the driver

- Open the window near the driver at least 2-4 inches in order to bring in outdoor air
- Similarly open the window next to the patient for air to flow out of the vehicle
- Set ventilation controls to the fresh air or vent setting, rather than the recirculation setting (set fan to high)
- Eat outdoors at stops
- Leave the vehicle unoccupied with the windows open for at least an hour after the end of the journey. Place a sign on the vehicle indicating when the car can be used again

If a suspected or confirmed infectious TB patient needs transporting by ambulance:

- Alert the ambulance service of the patient's infectious status
- Ambulances should allow for the maximum amount of outdoor air to be circulated in the vehicle
- Patient should wear a surgical mask
- Provider and driver should wear a N-95 mask

References:

1. CDC. Guidelines for Preventing the Transmission of *Mycobacterium* tuberculosis in Health-Care Settings. MMWR 2005; 54 (No. RR-17). www.cdc.gov/tb/education/corecurr/default.htm
2. CDC. Core Curriculum on Tuberculosis: What the Clinician Should Know, 2013, www.cdc.gov/tb/education/corecurr/default.htm
3. Curry International Tuberculosis Center. Tuberculosis Infection Control, A Practical Manual for Preventing TB, 2011 http://www.currytbcenter.ucsf.edu/TB_IC/docs/IC_book_2011.pdf

TB Infection Control in the Home

Patients who have suspected or confirmed TB disease are more likely to have already transmitted TB infection to members of their household before their TB disease was diagnosed and treatment was started. However, TB patients and members of their household should take steps to prevent the further spread of TB infection after they return home. HCW's who visit a TB patient in their home should take precautions to protect themselves from exposure to *M. tuberculosis* (**Refer to Table XI-5**).

Table XI-5: TB Infection Control in the Home

Steps that Patients Can Take to Prevent the Further Transmission of TB in the Home	Precautions for HCW's to Take to Protect Themselves from Exposure to *M. tuberculosis*
• Cover their mouth and nose when coughing or sneezing • Sleep alone and not in a room with other household members • Refrain from having visitors in the home until they are non-infectious	• Instruct patients to cover their mouth and nose with a tissue when coughing or sneezing • Wear a N95 respirator when visiting the home of a patient with infectious TB disease or when transporting a patient with infectious TB disease in a vehicle • Collect specimens in a well-ventilated area away from household members or outside of the dwelling

Reference:

1. CDC. Core Curriculum on Tuberculosis: What the Clinician Should Know, 2013. http://www.cdc.gov/tb/education/corecurr/pdf/corecurr_all.pdf (adapted)

TB Infection Control in Non-traditional Facility-Based Settings

All non-traditional facility-based settings where patients with TB disease receive care should establish and follow a TB infection control plan. These settings include, but are not limited to:

- Correctional facilities
- Homeless shelters
- Long-term care facilities
- Home-based health-care and outreach settings
- Emergency medical services (EMS)

Reference:

1. CDC. Core Curriculum on Tuberculosis: What the Clinician Should Know, 2013. www.cdc.gov/tb/education/corecurr/default.htm