

Infection Control

CONTENTS

Introduction.....	16.2	Hospital Discharge	16.20
Purpose.....	16.2	Drug-susceptible tuberculosis disease.....	16.20
Policy	16.3	Multidrug-resistant tuberculosis disease	16.21
Hierarchy of Infection		Release settings.....	16.21
Control Measures	16.5	Residential Settings.....	16.22
Administrative controls.....	16.5	Administrative controls in the patient's home..	16.22
Environmental controls	16.7	Environmental controls in the patient's home..	16.23
Personal respiratory protection	16.8	Respiratory protection in the patient's home ...	16.23
Who Should Use a		Other residential settings.....	16.24
Mask or Respirator	16.11	Return to Work, School,	
Two-Step Tuberculin Skin Testing....	16.12	or Other Social Settings.....	16.25
Isolation	16.14	Drug-susceptible tuberculosis disease.....	16.25
Estimating infectiousness	16.15	Multidrug-resistant tuberculosis disease	16.26
Determining noninfectiousness.....	16.15	Tuberculosis Infection Control in	
Airborne Infection Isolation		Patient Care Facilities	16.27
in a Healthcare Facility.....	16.17	Transportation Vehicles.....	16.29
When to initiate airborne infection isolation	16.17	Patient self-transport	16.29
When to discontinue airborne infection		Transport by healthcare workers.....	16.29
isolation	16.18	Transport by emergency medical services.....	16.29
		Resources and References.....	16.30

Introduction

Purpose

Use this section to understand and follow national and Michigan guidelines to do the following:

- Review the hierarchy of infection control measures and know where to go for further information.
- Alert local public health staff to the basic differences between masks and respirators.
- Estimate patients' infectiousness and determine when patients are noninfectious.
- Determine when to isolate patients, when to discharge them from hospitals, and when to permit them to return to work, school, or other settings.
- Review how to implement infection control measures in residential settings, patient care facilities, and transportation vehicles.
- Consult with facilities that are implementing infection control measures, including two-step testing.

In the 2005 guidelines, "Controlling Tuberculosis in the United States: Recommendations from the American Thoracic Society, Centers for Disease Control and Prevention, and the Infectious Diseases Society of America," one of the recommended strategies to achieve the goal of reducing tuberculosis (TB) morbidity and mortality is the identification of settings in which a high risk exists for transmission of *Mycobacterium tuberculosis* and application of effective infection control measures.¹

As TB continues to decline in most areas of the United States, it is crucial that state and local public health agencies provide facilities with epidemiologic data on TB, as well as education and guidance in developing effective TB infection control programs.

Infection control measures are fundamental to reducing the spread of communicable diseases such as TB. Transmission of *M. tuberculosis* from person to person can occur in many locations, such as home, work, school, and healthcare facilities.² It is impossible to prevent all exposure; however, the goal is to reduce the amount of transmission.

Each agency's or facility's program should include a hierarchy of administrative controls, environmental controls, and personal respiratory protection. Because each patient care setting and patient's home is different, each program will incorporate a different combination of control activities. The extent to which each agency or facility implements its control activities is based on the results of its risk assessment. In areas where TB rates are lower, the TB risk is lower, and this should affect which elements of the TB infection control plan are utilized.

Policy

For infection control, state and local public healthcare agencies need to address TB control in these three areas:

1. Healthcare facilities, where persons with infectious TB disease would seek care^{3,4}
2. Congregate settings and residential facilities, whose residents are at increased risk for TB disease^{5,6}
3. The patient's home

To accomplish TB control activities, each local public healthcare agency should do the following:

1. Familiarize staff with the current Centers for Disease Control and Prevention (CDC) infection control guidelines for healthcare providers and settings.
2. Develop an infection control program for the county or state TB staff that addresses these issues:
 - a. Assignment of responsibility for the program
 - b. Risk assessment
 - c. Persons (if any) who need baseline testing, including TB screening and counseling
 - d. Education and training
 - e. Case management (if direct patient care is provided)
3. Designate a staff person to guide facilities that may need to set up TB infection control programs.



For roles and responsibilities, refer to the “Roles, Responsibilities, and Contact Information” topic in the Introduction.

State Laws and Regulations

[MI OSHA: Enforcement Policy and Procedures for Evaluating Occupational Exposure to TB](http://www.dleg.state.mi.us/wsh/docs/inst/gishd_com_05_2r2.doc) (May 22, 2007) can be found at http://www.dleg.state.mi.us/wsh/docs/inst/gishd_com_05_2r2.doc

Hierarchy of Infection Control Measures

There are three types of infection control measures. The first are administrative controls, which are primarily aimed at early identification, isolation, and appropriate treatment of infectious patients. The second are environmental controls, which focus on preventing the spread and reducing the concentration of infectious droplet nuclei in the air.⁷ The third is personal respiratory protection, which may provide additional protection for healthcare workers in high-risk settings such as isolation rooms and cough-inducing or aerosol-generating suites.

The activities described below are more relevant to infection control in healthcare or residential facilities. Home settings are discussed separately in the “Residential Settings” topic in this section.

Administrative Controls

Administrative control measures are the first of three levels of measures designed to reduce the risk of tuberculosis (TB) transmission. Administrative controls are the first level of infection control because they include a variety of activities to identify, isolate, and appropriately treat persons suspected of having TB disease.

An effective TB infection control plan contains measures for reducing the spread of TB that are appropriate to the risk of a particular setting.⁸ Every healthcare setting should have a TB infection control plan that is part of an overall infection control program.⁹ A written TB infection control plan helps to ensure prompt detection, airborne precautions, and treatment of persons who have suspected or confirmed TB disease.¹⁰

- **In TB infection control programs for settings in which patients with suspected or confirmed TB disease are expected to be encountered**, develop a written TB infection control plan that outlines a protocol for the prompt recognition and initiation of airborne precautions for persons with suspected or confirmed TB disease, and update it annually.¹¹
- **In TB infection control program for settings in which patients with suspected or confirmed TB disease are NOT expected to be encountered**, develop a written TB infection control plan that outlines a protocol for the prompt recognition and transfer of persons who have suspected or confirmed TB disease to another healthcare setting. The plan should indicate procedures to follow to separate persons with suspected or confirmed infectious TB disease from other persons in the setting until the time of transfer. Evaluate the plan annually, if possible, to ensure that the setting remains one in which persons who have suspected or confirmed TB disease are not encountered and that they are promptly transferred.¹²

Administrative Activities¹³

Key activities to reduce the risk of transmission include the following:

1. **Assign responsibility** to a specific person for designing, implementing, evaluating, and maintaining a TB infection control program for that facility.
2. **Conduct a risk assessment.** The risk level of a particular facility is the basis for determining all other activities and will result in each facility having a plan designed specifically for that facility.
3. **Develop, implement, and enforce policies and procedures** to ensure early identification, evaluation, and treatment of infectious cases of TB.
4. **Provide prompt triage** and management in the outpatient setting of patients who may have infectious TB.
5. **Promptly initiate and maintain TB isolation** for persons who may have infectious TB and are admitted to an inpatient setting.
6. **Plan effectively for the discharge** of the patient, coordinating between the local public health agency and the healthcare provider.
7. **Implement environmental controls.** Develop, install, maintain, and evaluate the effectiveness of engineering controls.
8. **Implement a respiratory protection program.** Develop, initiate, install, maintain, and evaluate the effectiveness of the respiratory protection program.
9. **Implement precautions for cough-inducing procedures.** Develop, implement, and enforce policies and procedures to ensure adequate precautions when performing cough-inducing procedures.
10. **Educate and train healthcare workers** about TB.
11. **Counsel and screen healthcare workers.** Develop and implement counseling and screening program for healthcare workers in regard to TB disease and latent TB infection (LTBI).
12. **Promptly evaluate possible episodes of TB transmission.**
13. **Coordinate activities** between the state and local public healthcare agencies.

Environmental Controls

TB is caused by an organism called *Mycobacterium tuberculosis*. When a person with infectious TB disease coughs or sneezes, tiny particles called droplet nuclei that contain *M. tuberculosis* are expelled into the air.¹⁴ Environmental controls are used to prevent the spread and reduce the concentration of infectious droplet nuclei.¹⁵ Each facility should use different combinations of environmental controls, based on the results of its risk assessment.

It is important to note, however, that without strong administrative controls, environmental controls are ineffective because cases would not be recognized or managed appropriately.

Table 1 describes the three main types of environmental controls.

Table 1: THREE TYPES OF ENVIRONMENTAL CONTROLS

Most Effective Control	Ventilation <ul style="list-style-type: none">▪ Controls direction of air flow to prevent contamination of air in areas surrounding a person with infectious tuberculosis (TB).▪ Dilutes and removes contaminated air.▪ Exhausts contaminated air to the outside.
Supplementary Controls	High-efficiency particulate air (HEPA) filtration <ul style="list-style-type: none">▪ Cleans the air of infectious droplet nuclei. Ultraviolet germicidal irradiation (UVGI) <ul style="list-style-type: none">▪ Kills or inactivates TB bacilli in the air.

Personal Respiratory Protection

Although administrative controls and environmental controls are most effective in controlling the spread of TB, they do not eliminate the risk of transmission entirely. Personal respiratory protection, the third level of infection control, is also used in higher-risk settings.

The purpose of a respirator is to reduce exposure by filtering out TB bacilli from room air before the air is breathed into a person's lungs. Respirators used for TB control should be approved for TB use by the National Institute for Occupational Safety and Health (NIOSH).

It is recommended that healthcare provider staff and visitors use personal respiratory protective equipment in settings that may be at higher risk for TB transmission, such as the following:

- Rooms where infectious TB patients are being isolated
- Areas where cough-inducing or aerosol-generating procedures are performed
- Other areas, which should be identified in the facility's risk assessment, where administrative and environmental controls are not likely to protect persons from inhaling infectious droplet nuclei

It is important to note that the precise level of effectiveness (of respiratory protection) in protecting healthcare workers from *M. tuberculosis* transmission in healthcare settings has not been determined.¹⁶



Surgical-type masks are to be used by persons who are infectious or are suspected cases of TB disease when they are out of TB respiratory isolation. The purpose of the mask is to reduce transmission by reducing the number of TB bacilli coughed out into the room air. The infectious patient should not wear a respirator. For more information, see Table 2: **Using Masks and Respirators.**

When TB respirators are used, a respiratory protection program should be developed and enforced.¹⁷ For more information regarding respiratory protection programs, see the Centers for Disease Control and Prevention's (CDC's) "Guidelines for Preventing the Transmission of *Mycobacterium tuberculosis* in Health-care Settings, 2005" (*MMWR* 2005;54[No. RR-17]:75–79) at this hyperlink: <http://www.cdc.gov/mmwr/pdf/rr/rr5417.pdf> .

CDC guidelines recommend that healthcare facilities conduct annual training regarding multiple topics for healthcare workers (HCWs), including the nature, extent, and hazards of TB disease in the healthcare setting. The training can be conducted in conjunction with other related training regarding infectious disease associated with airborne transmission.

In addition, training topics should include the following:

1. Risk assessment process and its relation to the respirator program, including signs and symptoms used to indicate that respirators are required in certain areas and the reasons for using respirators
2. Environmental controls used to prevent the spread and reduce the concentration of infectious droplet nuclei
3. Selection of a particular respirator for a given hazard (See “Selection of Respirators” on p. 78 of the CDC guidelines at this hyperlink: <http://www.cdc.gov/mmwr/pdf/rr/rr5417.pdf> .)
4. Operation, capabilities, and limitations of respirators
5. Cautions regarding facial hair and respirator use
6. Occupational Health and Safety Administration (OSHA) regulations regarding respirators, including assessment of employees' knowledge

Trainees should be provided opportunities to handle and wear a respirator until they become proficient. Trainees should also be provided with copies or summaries of lecture materials for use as references and instructions to refer all respirator problems immediately to the respiratory program administrator.¹⁸

A fit test is used to determine which respirator fits the user adequately and to ensure that the user knows when the respirator fits properly. Fit testing provides a means to determine which respirator model and size fits the wearer best and to confirm that the wearer can don the respirator properly to achieve a good fit. Periodic fit testing for respirators used in TB environments can serve as an effective training tool in conjunction with the content included in employee training and retraining.¹⁹

The CDC recommends that, after a risk assessment to validate the need for respiratory protection, a healthcare facility should perform fit testing during the initial respiratory protection program training and periodically thereafter in accordance with federal, state, and local regulations.²⁰ Additional fit testing should be considered in the following situations: 1) risk of transmission of *M. tuberculosis*, 2) changes in facial features of the wearer, 3) development of a medical condition that would affect respiratory function, 4) change in the appropriate physical characteristics of the respirator (despite the same model number), or 5) change in the model or size of the assigned respirator.²¹

OSHA addresses general respiratory protection requirements and the need for the following:

- Respiratory protection program
- Amended medical evaluation
- Training and recordkeeping
- Annual fit testing
- Fit checking

For regulations in your area, refer to state and local regulations and contact your local OSHA office.²²

Who Should Use a Mask or Respirator

Using masks and respirators properly can reduce transmission of *Mycobacterium tuberculosis* and exposure to TB. Refer to Table 2: **Using Masks and Respirators** to determine when to use masks and respirators.

Table 2: USING MASKS AND RESPIRATORS²³

Mask (a regular "surgical" mask*)	Respirator (NIOSH-approved, N-95 or higher*)
<p>Purpose To reduce transmission by capturing infectious droplet nuclei that an infectious patient releases before they get into the air.</p>	<p>Purpose To reduce exposure by filtering infectious droplet nuclei out of the air, before wearers breathe the air into their lungs.</p>
<p>Who should wear a mask?</p> <ul style="list-style-type: none"> Patients with infectious TB or suspected infectious TB 	<p>Who should wear a respirator?</p> <ul style="list-style-type: none"> Staff Visitors to TB isolation rooms (keep these visitors to a minimum)
<p>A patient should wear a mask in a hospital setting when:</p> <ul style="list-style-type: none"> Suspected of having infectious TB and not yet placed in respiratory isolation Leaving a respiratory isolation room for any reason <p>Note: Infectious patients should NOT wear masks when in their TB isolation rooms.</p> <p>A patient should wear a mask in a health clinic setting when:</p> <ul style="list-style-type: none"> Not in a TB isolation room Returning to the clinic for evaluation 	<p>A staff person or visitor should wear a respirator in a hospital or clinic setting when:</p> <ul style="list-style-type: none"> Entering a TB isolation room Performing cough-inducing or aerosol-generating procedures Unlikely to be protected by administrative or environmental controls
<p>A patient should wear a mask in a transportation setting when:</p> <ul style="list-style-type: none"> Traveling in a vehicle with other persons 	<p>A staff person or visitor should wear a respirator in some transportation settings when:</p> <ul style="list-style-type: none"> Riding in a vehicle with a patient with infectious TB
<p>In the patient's home:</p> <p>Note: Infectious patients do NOT need to wear a mask when they are in their homes.</p>	<p>A staff person or visitor* should wear a respirator in a patient's home when:</p> <ul style="list-style-type: none"> Visiting the infectious patient inside the home/residence <p>Note: There should NOT be any visitors (excluding protected healthcare workers) to the home until the patient is released from TB isolation.</p>
<p>Definition of abbreviations: NIOSH = National Institute for Occupational Safety and Health; TB = tuberculosis. * There are some devices, such as the 3M 1860, which are both N95 respirators and surgical masks.</p>	

Source: CDC. Guidelines for preventing the transmission of *Mycobacterium tuberculosis* in health-care facilities, 2005. *MMWR* 2005;54(No. RR-17):38–40.

Two-Step Tuberculin Skin Testing

Two-step testing is used to improve the interpretation of tuberculin skin tests (TSTs), especially in persons who are required to undergo periodic testing. Two-step testing should be used for the **initial** skin testing of adults who will be retested periodically, such as healthcare workers.²⁴

In some persons who are infected with *Mycobacterium tuberculosis*, delayed-type hypersensitivity to tuberculin may wane over the years. When these persons are skin tested many years after their infection, they may have a negative reaction.

However, the skin test may have stimulated (boosted) their ability to react to tuberculin, causing a positive reaction to subsequent tests. This boosted reaction may be misinterpreted as a new infection. The booster phenomenon may occur at any age, but its frequency increases with age and is highest among older persons. Boosted reactions may occur in persons infected with nontuberculous mycobacteria or in persons who have had a prior bacille Calmette-Guérin (BCG) vaccination.

A positive reaction to the second test should be interpreted as evidence for infection with *M. tuberculosis*. On the basis of this second test result, the person should be classified as previously infected and cared for accordingly. This would not be considered a skin test conversion.

If the first and second test results are negative, the person should be classified as uninfected. In these persons, a positive reaction to any subsequent test is likely to represent new infection with *M. tuberculosis* (a skin test conversion).

Schedule appointments for two-step testing as shown below.



Refer to the topics on administration, measurement, and interpretation of the tuberculin skin test in the Diagnosis of Latent Tuberculosis Infection section.

Table 3: FOUR APPOINTMENT SCHEDULE FOR TWO-STEP TESTING

Appointments	Tasks
First appointment	Apply the first tuberculin skin test (TST).
Second appointment 48 to 72 hours after applying the first TST	Measure the reaction. <ul style="list-style-type: none"> ▪ If the reaction is negative, schedule a third appointment. ▪ If the reaction is positive, do not repeat the TST. Obtain a chest radiograph.
Third appointment 1 to 3 weeks after measurement of the first TST	Re-apply the TST. <ul style="list-style-type: none"> ▪ Use the same dose and strength of tuberculin. Inject the tuberculin on the other forearm, or at least 5 cm from the original test site. ▪ If the reaction is negative and the patient returns over a week after the first TST was applied, apply the second TST.
Fourth appointment 48 to 72 hours after applying the second TST	Measure the reaction. <ul style="list-style-type: none"> ▪ If the reaction is negative, classify the individual as uninfected. ▪ If the reaction is positive, obtain a chest radiograph.



For more information on two-step testing, refer to the CDC's "Guidelines for Preventing the Transmission of *Mycobacterium tuberculosis* in Health-care Facilities, 2005" (*MMWR* 2005;54[No. RR-17]) at this hyperlink:

<http://www.cdc.gov/mmwr/pdf/rr/rr5417.pdf> .

Isolation

To reduce disease transmission, a patient with tuberculosis (TB) disease may need to be isolated or have activities restricted.

Isolation: Isolation is used when people are ill. Isolation of people who have a specific illness separates them from healthy people and restricts their movement to stop the spread of that illness. Isolation allows for the focused delivery of specialized health care to people who are ill, and it protects healthy people from getting sick. People in isolation may be cared for in their homes, in hospitals, or at designated healthcare facilities. Isolation is a standard procedure used in hospitals today for patients with TB. In most cases, isolation is voluntary; however, many levels of government (federal, state, and local) have the basic legal authority to compel isolation of sick people to protect the public.²⁵

Restricted Activities: Until determined to be noninfectious, the patient is not permitted to return to work, school, or any social setting where the patient could expose individuals to airborne bacteria.

Quarantine: Although TB control programs have used the word “quarantine” interchangeably with “isolation” and “restricted activities,” the word “quarantine” properly used is not a term applicable to TB control. Quarantine applies to people who have been exposed and may be infected but are not yet ill. Separating exposed people and restricting their movements is intended to stop the spread of illness. Quarantine is not an appropriate TB control measure for asymptomatic, exposed individuals.²⁶



For information on diagnosis and laboratory tests, refer to the sections on diagnosis of tuberculosis disease and latent tuberculosis infection. For information on guidelines for infection control in the patient’s residence, group settings, and during transportation of a patient, see the subtopics that follow.

Estimating Infectiousness

In general, patients who have suspected or confirmed TB disease and who are not on antituberculosis treatment should be considered infectious if characteristics include the following:

- Presence of cough
- Cavitation on chest radiograph
- Positive acid-fast bacilli (AFB) sputum smear result
- Respiratory tract disease with involvement of the lung or airways, including larynx
- Failure to cover the mouth and nose when coughing
- Undergoing cough-inducing or aerosol-generating procedures (e.g., sputum induction, bronchoscopy, airway suction)²⁷

If a patient with one or more of these characteristics is on standard multidrug therapy with documented clinical improvement, usually in connection with smear conversion over several weeks, the risk of infectiousness is reduced.²⁸

Determining Noninfectiousness

Use the following criteria as general guidelines to determine when during therapy a patient with pulmonary TB disease has become noninfectious. Decisions about infectivity of a person on treatment for TB should depend on the extent of illness and the specific nature and circumstances of the contact between the patient and exposed persons. These guidelines can and should be modified on a case-by-case basis by a qualified public health officer.

- The patient has negligible likelihood of multidrug-resistant TB (no known exposure to multidrug-resistant tuberculosis and no history of prior episodes of TB with poor compliance during treatment).
- The patient has received standard multidrug antituberculosis therapy for two to three weeks. (For patients with AFB sputum smear results that are negative or rarely positive, the threshold for treatment is four to seven days.)
- The patient has demonstrated complete adherence to treatment (e.g., is receiving directly observed therapy).
- The patient has demonstrated evidence of clinical improvement (e.g., reduction in the frequency of cough or reduction of the grade of the AFB sputum smear result).

- All close contacts of the patient have been identified, evaluated, advised, and, if indicated, started on treatment for latent TB infection. This criterion is critical, especially for children younger than five years of age and persons of any age with immunocompromising health conditions such as human immunodeficiency virus (HIV) infection.
- While in the hospital for any reason, patients with pulmonary TB should remain in airborne infection isolation until the following occurs:
 - Receipt of standard multidrug antituberculosis therapy
 - Demonstrated clinical improvement
 - Three consecutive AFB-negative smear results from sputum specimens collected eight to 24 hours apart, with at least one being an early morning specimen

Hospitalized patients returning to a congregate setting (e.g., a homeless shelter or detention facility) should have three consecutive AFB-negative smear results of sputum specimens collected more than eight hours apart before being considered noninfectious.²⁹ At least one of these specimens should be collected early in the morning.

Airborne Infection Isolation in a Healthcare Facility

In airborne infection isolation (AII), the patient is placed in an AII room, usually within a hospital or healthcare facility. The main characteristics of an AII room (for new or renovated buildings) are that it has negative air pressure relative to the hall and 12 or more air exchanges per hour, of which at least two exchanges are outside air. For existing structures, six or more air exchanges per hour are acceptable.³⁰

The decisions to initiate and discontinue isolation should be made in consultation with the infection control professional (infection preventionist), the physician, and the local health department. If needed, the Michigan TB Control program is available for consultation at (517) 335-8165. Isolation decisions should be made on a case-by-case basis.

When to Initiate Airborne Infection Isolation

Suspected cases of laryngeal or pulmonary TB should be isolated immediately, before AFB sputum smear results are available.

Initiate TB All precautions for any patient who meets the criteria in Table 4.

Table 4: INITIATION OF AIRBORNE INFECTION ISOLATION³¹

Criteria for Initiation of Airborne Infection Isolation		
The patient has signs or symptoms of pulmonary, laryngeal, or multidrug-resistant tuberculosis (MDR-TB) disease.	OR	<ul style="list-style-type: none">▪ The patient has documented infectious pulmonary, laryngeal tuberculosis (TB) disease or MDR-TB disease. <p style="text-align: center;">AND</p> <ul style="list-style-type: none">▪ The patient has not completed treatment.

Source: CDC. Guidelines for preventing the transmission of *Mycobacterium tuberculosis* in health-care settings, 2005. *MMWR* 2005;54(No. RR-17):16, 44.



Patients with suspected or confirmed MDR-TB should remain in an All room throughout their hospitalization or until culture conversion is documented, regardless of sputum smear results.

When to Discontinue Airborne Infection Isolation



Prior to discontinuing isolation, the infection control professional (infection preventionist), the physician, and the local health department should be consulted. If needed, the Michigan TB Control program is available for consultation at (517) 335-8165. High-risk patients should be carefully evaluated before discontinuing isolation. Hospitalized patients with suspected or confirmed MDR-TB should remain in an All room throughout their hospitalization.

Suspected Tuberculosis Disease

For patients placed in All due to suspected infectious TB disease of the lungs, airway, or larynx, All can be discontinued when the criteria in Table 5 are met.

Table 5: DISCONTINUATION OF AIRBORNE INFECTION ISOLATION OF PATIENTS WITH SUSPECTED TUBERCULOSIS³²

Criteria for Discontinuing Airborne Infection Isolation: Suspected Case of Tuberculosis of the Lungs, Airway, or Larynx		
Infectious tuberculosis (TB) disease is considered unlikely.	AND	<p>Either</p> <ul style="list-style-type: none"> ▪ Another diagnosis is made that explains the clinical syndrome. <p>OR</p> <ul style="list-style-type: none"> ▪ The patient has 3 negative acid-fast bacilli (AFB) sputum smear results,* has been on treatment delivered as directly observed therapy, and has demonstrated clinical improvement.
<p>* Each of the 3 sputum specimens should be collected 8 to 24 hours apart, and at least 1 should be an early morning specimen (because respiratory secretions pool overnight). Generally, this will allow patients with negative AFB sputum smear results to be released from All in 2 days.³³</p>		
	<p>While in the hospital for any reason, patients with pulmonary TB should remain in airborne infection isolation until they (1) are receiving standard multidrug antituberculosis therapy; (2) have demonstrated clinical improvement; and (3) have had 3 consecutive AFB-negative smear results of sputum specimens collected 8 to 24 hours apart, with at least 1 being an early morning specimen.³⁴</p>	
	<p>Because patients with TB disease who have negative AFB sputum smear results can still be infectious, patients with suspected disease who meet the above criteria for release from All should not be released to an area where other patients with immunocompromising conditions or children <5 years are housed.³⁵</p>	

Sources: CDC. Guidelines for preventing the transmission of *Mycobacterium tuberculosis* in health-care settings, 2005. *MMWR* 2005;54(No. RR-17):16, 43; ATS, CDC. Controlling tuberculosis in the United States: recommendations from the American Thoracic Society, CDC, and the Infectious Diseases Society of America. *MMWR* 2005;54(No. RR-12):9.

Confirmed Tuberculosis Disease

A patient with drug-susceptible TB of the lung, airway, or larynx who is on standard multidrug antituberculosis treatment and who has had a significant clinical and bacteriologic response to therapy (e.g., reduction in cough, resolution of fever, and progressively decreasing quantities of AFB on smear results) is probably no longer infectious. However, because culture and drug susceptibility results are not usually known when the decision to discontinue AI is made, all patients with confirmed TB disease should remain in AI while hospitalized until all the criteria in Table 6 are met.³⁶

Table 6: DISCONTINUATION OF AIRBORNE INFECTION ISOLATION OF PATIENTS WITH CONFIRMED TUBERCULOSIS³⁷

**Criteria for Discontinuing Airborne Infection Isolation:
Hospitalized Patients with Confirmed, Drug-Susceptible Tuberculosis
of the Lungs, Airway, or Larynx**

- The patient has had 3 consecutive negative acid-fast bacilli (AFB) sputum smear results collected 8 to 24 hours apart, with at least 1 being an early morning specimen.
 AND
- The patient has received standard multidrug antituberculosis treatment by directly observed therapy (DOT).
 AND
- The patient has demonstrated clinical improvement.

Source: CDC. Guidelines for preventing the transmission of *Mycobacterium tuberculosis* in health-care settings, 2005. *MMWR* 2005;54(No. RR-17):43.

Hospital Discharge

The decisions to discharge an acid-fast bacilli (AFB) sputum smear-positive patient or an multidrug-resistant tuberculosis (MDR-TB) patient should be made in consultation with the infection control professional (infection preventionist), the physician, and the local health department. If needed, the Michigan TB Control program is available for consultation at (517) 335-8165.

Drug-Susceptible Tuberculosis Disease

If a hospitalized patient who has suspected or confirmed drug-susceptible TB disease is deemed medically stable (including patients with positive AFB sputum smear results indicating pulmonary TB disease), the patient may be discharged from the hospital before converting AFB sputum smear results to negative if all the criteria in Table 7 are met.³⁸

Table 7: HOSPITAL DISCHARGE OF PATIENTS WITH DRUG-SUSCEPTIBLE TUBERCULOSIS³⁹

Criteria for Hospital Discharge to Home: Patients with Suspected or Confirmed Drug-Susceptible Tuberculosis

- A specific plan exists for follow-up care with the local tuberculosis (TB) control program.
AND
- The patient has been started on a standard multidrug antituberculosis treatment regimen and directly observed therapy (DOT) has been arranged.
AND
- No children aged <5 years or persons with immunocompromising conditions are present in the household.
AND
- All immunocompetent household members have been previously exposed to the patient.
AND
- The patient is willing to remain inside the home except for healthcare-associated visits until the patient has negative acid-fast bacilli (AFB) sputum smear results.

Source: CDC. Guidelines for preventing the transmission of *Mycobacterium tuberculosis* in health-care settings, 2005. *MMWR* 2005;54(No. RR-17):43–44.

Multidrug-Resistant Tuberculosis Disease

Patients with suspected or confirmed MDR-TB disease should remain in the hospital in All until they meet all three of the criteria in Table 8.

Table 8: HOSPITAL DISCHARGE OF PATIENTS WITH MULTIDRUG-RESISTANT TUBERCULOSIS

Criteria for Hospital Discharge to Home: Patients with Suspected or Confirmed Multidrug-Resistant Tuberculosis

- The patient has had 3 consecutive negative acid-fast bacilli (AFB) sputum smear results collected 8 to 24 hours apart, with at least 1 being an early morning specimen.
 AND
- An appropriate treatment regimen has been devised and initiated.
 AND
- Suitable arrangements have been made so that the regimen can be continued and properly monitored on an outpatient basis, specifically by directly observed therapy (DOT).

Release Settings

Patients with suspected or confirmed infectious TB disease should not be released to healthcare settings or homes where the patient can expose others who are at high risk for progressing to TB disease if infected, such as HIV-infected persons or young children.⁴⁰ Hospitalized patients returning to a congregate setting (e.g., a homeless shelter or detention facility) should have three consecutive AFB-negative smear results of sputum specimens collected more than eight hours apart, with at least one being an early morning specimen, before being considered noninfectious.⁴¹

Patients who have positive AFB sputum smear results should **not** be directly discharged from the hospital to **any** of the following living environments:

- Congregate living site (e.g., shelter, nursing home, jail, prison, group home, another hospital)
- Living situation where infants and young children also reside
- Living situation where immunosuppressed persons (e.g., HIV-infected persons or those taking cancer chemotherapy) also reside
- Living situation where home health aides or other social service providers will be present in the home for several hours a day to care for the person or family member

Residential Settings

Patients suspected of having infectious tuberculosis (TB) either are diagnosed during an outpatient workup, or, if admitted to a hospital, are often sent home after starting treatment, even though they may still be infectious. Because patients are most likely to transmit TB to household members **before** TB has been diagnosed and treatment has rendered the patient noninfectious, it is important that TB patients and members of their households know what steps to take to prevent the spread of TB in the home until the patient becomes noninfectious.^{42,43}

Administrative Controls in the Patient's Home

Establish a policy and procedure for managing infectious patients at home. To standardize care, the following information should be included:

- 1. Definition of key terms:** Infectious case and noninfectious case
- 2. Treatment of cases at home whenever possible:** Treat patients at home if their condition does not otherwise require hospitalization.
- 3. Window period treatment policy:** Ensure that candidates for window period treatment in the home have completed their evaluation and are on medication before they are discharged home (or as soon as possible if they were not hospitalized).
- 4. Education:** Educate infectious patients, family, care providers, and close contacts regarding the purpose of isolation, their responsibility to adhere to the isolation requirements, and the consequences of not voluntarily complying with isolation.
- 5. Home isolation agreements:** Have infectious patients in isolation sign a home isolation agreement. This document should include any legal consequences should they fail to voluntarily comply.

Environmental Controls in the Patient's Home

Generally, there are no special engineering recommendations. However, patients and their families can be advised to do the following:

- Have tissues available for patients to cover their mouths and noses when coughing or sneezing.
- Keep windows and doors open (weather permitting) to increase the ventilation and dilution of infectious droplet nuclei in the house.
- If a sputum sample needs to be collected at home, do so in a well-ventilated area away from other residents (e.g., bathroom with an exhaust fan). If possible, collect the sputum in an outdoor area away from open windows or doors.

Respiratory Protection in the Patient's Home

Patient: Mask

- Patients do not need to wear masks at home.
- Give patients regular surgical-type masks and advise them to wear them at medical appointments until they are no longer infectious.



For more information on the criteria for noninfectiousness, see the “Determining Noninfectiousness” topic in this section.

- Do not give patients respirators (N-95 or higher).

Healthcare Worker: Respirator

- Healthcare workers should wear respirators when entering the home or a closed area to visit with infectious patients.
- The respirators should be National Institute for Occupational Safety and Health (NIOSH)-approved (N-95 or higher).
- Healthcare workers should be provided with respirators after appropriate education and testing.

Other Residential Settings

Motels

Homeless persons with infectious TB may be housed in a motel that has outside access to rooms (not via hallways).

The motel manager must be advised of the following:

1. The patient is in respiratory isolation.
2. The manager should report to local public health agency staff if the manager becomes aware that the patient does not stay in the room or if the patient has guests.
3. The manager should advise motel staff that they are not to enter the room while the patient resides at the motel. (Arrangements should be made for weekly linen replacement in which the patient sets out linens that need to be replaced, and the staff knock on the door and leave the linens for the patient to make his or her own bed.)
4. Upon release from isolation, the room should be aired out for one day before staff enter to clean. Afterwards, routine cleaning done between guests is sufficient. There are no additional special cleaning requirements.
5. Local public health agency staff will be delivering medication to the patient (specify the frequency).
6. Arrangements have been made for food delivery to the patient.

Healthcare Facilities or Residential Settings

1. Patients with infectious TB should be in appropriate respiratory isolation (airborne infection isolation rooms) when housed in healthcare facilities or residential settings.
2. If a facility does not have the capability to provide appropriate respiratory isolation, the patient should be transferred to a facility that can accommodate respiratory isolation until the patient is noninfectious. Once noninfectious, the person may return to the original facility.

Return to Work, School, or Other Social Settings

The decision of when to allow a patient to return to work, school, or other social settings should be made in consultation with your local health department. The Michigan TB Control Program at (517) 335-8165 is also available for consultation.

The decision to permit a patient to return to work, school, or other social settings is based on the following:

- The characteristics of the patient with TB disease (e.g., whether the patient is likely to adhere to the regimen and follow treatment instructions)
- The characteristics of the TB disease itself (e.g., multidrug-resistant versus drug-susceptible TB, AFB sputum smear-positive versus smear-negative, cavitory versus noncavitory)
- The duration of current treatment (For example, the patient has received standard multidrug antituberculosis therapy for two-to-three weeks. However, for patients with sputum AFB smear results that are negative or rarely positive, the threshold for treatment is five-to-seven days.)⁴⁴
- The environment(s) to which the patient will be returning



Prior to notifying a patient that he or she is able to return to work or school, please consult with your local health department's TB control program. If needed, the Michigan TB Control Program at (517) 335-8165 is also available for consultation.

Drug-Susceptible Tuberculosis Disease

Patients with drug-susceptible TB are no longer considered infectious if they meet all the criteria in Table 9.

Table 9: RETURN TO WORK, SCHOOL, AND OTHER SETTINGS OF PATIENTS WITH DRUG-SUSCEPTIBLE TUBERCULOSIS⁴⁵

Criteria for Return to Work, School, or Other Social Settings: Patients with Suspected or Confirmed Drug-Susceptible Tuberculosis

- The patient is on adequate therapy.
AND
- The patient has had a significant clinical response to therapy.
AND
- The patient has had 3 consecutive negative acid-fast bacilli (AFB) sputum smear results collected 8 to 24 hours apart, with at least 1 being an early morning specimen.

Multidrug-Resistant Tuberculosis Disease

Regardless of their occupation, patients known or likely to have pulmonary MDR-TB may be considered for return to work or school only if they meet all four of the criteria in Table 10.

Table 10: RETURN TO WORK, SCHOOL, AND OTHER SETTINGS OF PATIENTS WITH MULTIDRUG-RESISTANT TUBERCULOSIS

Criteria for Return to Work, School, or Other Social Settings: Patients with Suspected or Confirmed Multidrug-Resistant Tuberculosis

- The resolution of fever and the resolution, or near resolution, of cough has occurred.
AND
- The patient is on current treatment with an antituberculosis regimen to which the strain is known or likely to be susceptible.*
AND
- The patient has had 3 consecutive negative acid-fast bacilli (AFB) sputum smear results collected 8 to 24 hours apart, with at least 1 being an early morning specimen.
AND
- The patient has had a negative culture for *Mycobacterium tuberculosis*.

*In addition, directly observed therapy (DOT) should be strongly encouraged for patients with MDR-TB.

Tuberculosis Infection Control in Patient Care Facilities

Patients with suspected tuberculosis (TB) may present for care in many different settings. The Centers for Disease Control and Prevention (CDC) has written a comprehensive set of guidelines for TB infection control in acute care hospitals and other medical settings.⁴⁶ In addition to the CDC guidelines, various professional organizations or state regulations may have guidelines for managing TB patients.

The main focus in establishing a TB infection control program at a patient care facility is to do the following:

1. Assign responsibility for managing the program to a designated staff position.
2. Perform and establish a TB risk assessment for the facility.
3. Develop the TB infection control plan based on the level of TB risk identified in the assessment.

The main purpose for having an effective TB infection control plan in a facility is to assure that the activities necessary for TB control are addressed and that policies and procedures are developed to protect the healthcare workers, other patients, and visitors in the facility.

Table 11: **Guidelines for Tuberculosis Infection Control** lists references that provide the information needed to conduct a TB risk assessment and write a TB infection control plan to establish policies and procedures for TB control activities for inpatient care facilities.



Call your local health department's TB control program or the Michigan TB Control Manager at (517) 335-8165 if you have any questions when consulting with institutions on infection control measures.

Table 11: GUIDELINES FOR TUBERCULOSIS INFECTION CONTROL

Guidelines for Tuberculosis Infection Control

The following settings are addressed in the "Guidelines for Preventing the Transmission of *Mycobacterium tuberculosis* in Health-care Facilities, 2005" (*MMWR* 2005;54[No. RR-17]) at this hyperlink: http://www.cdc.gov/tb/pubs/mmwr/Maj_guide/infectioncontrol.htm . Some settings have additional guidelines as noted below.

Inpatient Settings

- Emergency departments and urgent care settings
- Intensive care units
- Surgical suites
- Laboratories
- Bronchoscopy suites
- Sputum induction and inhalation therapy rooms
- Autopsy suites and embalming rooms

Outpatient Settings

- Tuberculosis (TB) treatment facilities
- Medical settings in correctional facilities: Prevention and Control of Tuberculosis in Correctional Facilities. (ACET) (*MMWR* 1996;45[No. RR-8]) at this hyperlink: http://www.cdc.gov/tb/pubs/mmwr/Maj_guide/Correctional.htm
- Medical offices and ambulatory care settings
- Dialysis units

Nontraditional Facility-Based Settings

- Homeless shelter clinics: Prevention and Control of Tuberculosis Among Homeless Persons (ACET) (*MMWR* 1992;41[No. RR-5]) at this hyperlink: <http://www.cdc.gov/mmwr/preview/mmwrhtml/00019922.htm>
- Emergency medical services
- Home-based healthcare and outreach settings
- Long-term care facilities (e.g., hospices, skilled nursing facilities): Prevention and Control of Tuberculosis in Facilities Providing Long-Term Care to the Elderly (*MMWR* 1990;39[No. RR-10]) at this hyperlink: <http://www.cdc.gov/mmwr/preview/mmwrhtml/00001711.htm>

Transportation Vehicles

To prevent the transmission of *Mycobacterium tuberculosis* while transporting patients, follow the respiratory precautions identified below.

Patient Self-Transport

1. The car windows should be opened, and any recirculating air controls should be turned off.
2. If possible, only household members should accompany the patient. Members of the patient's household who accompany the patient do not need to wear surgical masks.
3. If the only source for transport is a friend or relative who is not a member of the patient's household:
 - a. The person accompanying the patient should be given a respirator (N-95) to wear during transport (due to the confined space and risk of ongoing exposure).
 - b. The patient should sit in the back seat and wear a surgical mask.
 - c. The car windows should be opened, and any recirculating air controls should be turned off.
4. The patient should wear a surgical mask after leaving the vehicle.⁴⁷

Transport by Healthcare Workers

1. Healthcare workers should wear respiratory protection (N-95) while in the vehicle.
2. The patient should wear a surgical mask and sit in the back seat.
3. The car windows should be opened, and any recirculating air controls should be turned off.⁴⁸

Transport by Emergency Medical Services

Emergency medical services staff may have specialized vehicles that have the ability to separate the driver's compartment from the transport compartment and/or may be equipped with rear exhaust fans. Recommendations for these vehicles and staff are addressed in the Centers for Disease Control and Prevention (CDC) "Guidelines for Preventing the Transmission of *Mycobacterium tuberculosis* in Health-care Settings, 2005" (*MMWR* 2005;54[No. RR-17]:25–26, 88, 127) at this hyperlink:

<http://www.cdc.gov/mmwr/pdf/rr/rr5417.pdf> .

Resources and References

Resources

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