

Self-Study Modules on Tuberculosis

Contact Investigations for Tuberculosis

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

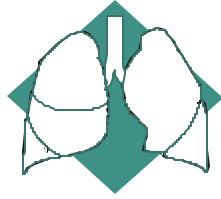
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Contact Investigations for Tuberculosis



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BACKGROUND

Contact investigations are a very good way to find people with TB infection and TB disease. In a contact investigation, people who were exposed to someone who has infectious TB disease (contacts) are identified and evaluated for TB infection and TB disease. Contacts are at high risk for infection with M. tuberculosis. If recently infected, contacts are also at high risk for developing TB disease. Therefore, it is important to identify and evaluate contacts so that they can be given treatment for disease if they have TB or given treatment for latent TB infection (LTBI) as appropriate to reduce their risk of developing TB disease.

In this module, you will learn about the goals of a contact investigation and the steps required to conduct one. A successful contact investigation includes these steps: a medical record review, an interview with the index patient, and a field investigation. When transmission may have occurred, these steps are followed by a risk assessment for M. tuberculosis transmission, decision making about the relative priority of contacts, and the testing of high-priority contacts (those with the greatest exposure or greatest risk of developing disease if infected). If any contacts have TB infection or TB disease, appropriate treatment and follow-up care are provided. The concentric circle approach can be used to decide whether to expand the testing to contacts who had less exposure to the index case. Finally, an evaluation of contact investigation activities should be conducted.

OBJECTIVES

After working through this module, you will be able to:

1. Define and explain the goals of a contact investigation.
2. Describe the situations in which a contact investigation should be done.
3. Describe how to prioritize a contact investigation.
4. Describe the steps in a contact investigation.
5. List the information that should be collected during the medical record review.
6. Describe the purposes of the interview with the index patient.



7. Describe the purposes of the field investigation.
8. List the factors that affect the risk of *M. tuberculosis* transmission.
9. Describe which contacts should be considered high-priority contacts.
10. Describe how contacts should be evaluated for TB infection and TB disease.
11. Describe the procedures for treatment and follow-up of contacts with TB infection or TB disease.
12. Describe the decision-making process about whether to expand testing.
13. Describe the concentric circle approach.
14. Describe why it is important to evaluate contact investigations.



NEW TERMS

Lists of new terms were introduced in each of the five core *Self-Study Modules on Tuberculosis* (Modules 1-5). Please refer to the core modules or their Glossary if you encounter unfamiliar terms related to TB that are not defined in this New Terms section.

Look for the following new terms in this module.

close contact – a person who had prolonged, frequent, or intense contact with a person with TB while he or she was infectious. Close contacts are more likely to become infected with *M. tuberculosis* than contacts who see the patient less often

concentric circle approach – a method of testing contacts in order of their exposure time (close vs. other-than-close) and their risk (high priority vs. low priority) with close contacts and other contacts at high risk of developing TB disease tested first; it includes contacts from environments where contact may have taken place (household or residential, work or school, and leisure or recreation environments)

contact investigation – a procedure for identifying people exposed to someone with infectious TB, evaluating them for latent TB infection (LTBI) and TB disease, and providing appropriate treatment for LTBI or TB disease (see **contacts**)

contacts – people exposed to someone with infectious TB disease, generally including family members, roommates or housemates, close friends, coworkers, classmates, and others (see **close contacts** or **other-than-close contacts**)

exposure to TB – time spent with or near someone who has infectious TB disease

field investigation – visiting the patient's home or shelter, workplace (if any), and the other places where the patient said he or she spent time while infectious. The purpose of the field investigation is to identify contacts and evaluate the environmental characteristics of the place in which exposure occurred

high-priority contacts – the contacts who are at most risk for TB infection or disease; contacts who are most likely to be infected and high-risk contacts (see **high-risk contacts**)



high-risk contacts – the contacts (either close or other-than-close) who are at a particularly high risk of developing TB disease if they become infected with *M. tuberculosis* (e.g., young children less than 4 years of age, HIV-infected and other immunosuppressed persons, and persons with certain medical conditions)

index patient – a person with suspected or confirmed TB disease who is the initial case reported to the health department. The index case may or may not be the source case (see **source patient**)

infection rate – the percentage of contacts with a similar amount of exposure (e.g., close, other-than-close) who have a newly identified positive skin test reaction (5 or more millimeters of induration)

latent TB infection (LTBI) – also referred to as TB infection. Persons with latent TB infection carry the organism that causes TB but do not have TB disease, are asymptomatic, and are noninfectious. Such persons usually have a positive reaction to the tuberculin skin test

local community – the geographic area where a person lives and spends time; may be a residential area or an ethnic community (i.e., groups of people who emigrated from the same geographic area)

other-than-close contacts – contacts with less intense, less frequent, or shorter durations of contact to the TB patient than close contacts (see **close contacts**)

open-ended questions – questions that cannot be answered with a simple “yes” or “no.” They are designed to elicit the patient’s knowledge, feelings, and beliefs by beginning with words such as “What,” “Why,” “Who,” “How,” and “When,” that demand an explanation; they are used to explore complex issues that do not have a finite or predetermined set of responses

period of infectiousness – time period during which a person with TB disease is capable of transmitting *M. tuberculosis*; usually estimated by determining the date of onset of the patient’s symptoms (especially coughing)

secondary case – a contact who has developed TB disease as a result of transmission from an index patient

skin test conversion for contacts – defined differently from a standard skin test conversion; for contacts, a skin test conversion is defined as a change from less than 5 mm on the initial skin test to a reaction of greater than or equal to 5 mm on the second test, 10 to 12 weeks after exposure

source case investigation – conducted to find the source of transmission when recent transmission is likely; used to determine who transmitted *M. tuberculosis* to an index patient or infected child or persons in the cluster of skin test conversions, whether this person is still infectious, whether the case of TB in this person was reported to the health department, and whether others were



infected by the source patient (see **source patient**)

source patient – a person with infectious TB disease who is responsible for transmitting *M. tuberculosis* to another person or persons. He or she is identified through either a contact or source case investigation and may or may not be the index patient (see **index patient**)

window period – the time span between the date of an initial tuberculin skin test with a negative reaction and the date of the follow-up tuberculin skin test that should take place 10 to 12 weeks after exposure; after the window period has ended, a repeat skin test should be administered to each contact who had an initial negative reaction

window period prophylaxis – the practice of providing treatment for latent TB infection to high-risk contacts (including young children under 4 years of age, and HIV-infected and other immunosuppressed persons) with an initial negative skin test reaction less than 10 to 12 weeks after their exposure; if the contact has a negative skin test reaction after the window period, treatment for latent TB infection is usually stopped (see **window period**)



READING MATERIAL

Goals of a Contact Investigation

What Is a Contact Investigation?

A **contact investigation** is a procedure for

- # Identifying people who were exposed to someone with infectious TB disease
- # Evaluating these people for **latent TB infection (LTBI)** and TB disease
- # Providing appropriate treatment for those with LTBI and TB disease

.....
 People exposed to someone with infectious TB disease are called the contacts of that person.

LTBI is also referred to as TB infection. Persons with latent TB infection carry the organism that causes TB but do not have TB disease, are asymptomatic, and are noninfectious. Such persons usually have a positive reaction to the tuberculin skin test.

People exposed to someone with infectious TB disease are called the **contacts** of that person; **exposure to TB** is time spent with or near such a person and is determined by the duration, proximity, and intensity of time spent with the person. Contacts generally include family members, roommates or housemates, close friends, coworkers, classmates, and others. Health care workers usually identify contacts by interviewing the person who has TB and by visiting the places where that person spends time regularly.



Note: Contacts are often given a medical evaluation and may receive treatment for LTBI or TB disease; however, in this module, we reserve the term “patient” for the **index patient**, a person with suspected or confirmed TB disease who is the initial case reported to the health department.

Why Is a Contact Investigation Important?

A contact investigation is important to find contacts who

- # Have TB disease so that they can be given treatment, and further transmission can be stopped
- # Have LTBI so that they can be given treatment for LTBI
- # Are at high risk of developing TB disease and may need treatment for LTBI until it becomes clear whether they have TB infection

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A contact investigation is important to find contacts who have TB disease so that they can be given treatment.
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The rate of having TB disease is 75 times higher among contacts than among the general population.
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Contacts are a high-priority group for treatment for LTBI because they are at high risk of being infected with *M. tuberculosis*, and if infected, they are at high risk of developing disease.
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Some contacts who become infected with *M. tuberculosis* develop TB disease before the contact investigation is started. Doing a contact investigation is one of the best ways to find people who have TB disease. Data indicate that seven to eight cases of TB disease are found for every 1000 contacts who are evaluated. The rate of having TB disease is 75 times higher among contacts than among the general population.

It is also important to find infected contacts who do not yet have TB disease, so that they can be given treatment for LTBI. Contacts are a high-priority group for treatment for LTBI because they are at high risk of being infected with *M. tuberculosis*, and if infected, they are at high risk of developing disease. On average, about 20% of contacts are found to have TB infection, but in some contact investigations as many as 80%–100% of the close contacts may be infected.



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For a contact investigation to be successful, infected contacts should begin and complete a regimen of treatment for LTBI.
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A successful contact investigation can interrupt transmission and prevent future cases of disease.
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High-risk contacts are contacts who are at a particularly high risk of developing TB disease if they have become infected with *M. tuberculosis*.
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A person with suspected or confirmed TB disease who is the initial case reported to the health department is called the index patient.
.....

It is not enough to simply find and test contacts of an infectious case. For a contact investigation to be successful, infected contacts should begin and complete a regimen of treatment for LTBI. Likewise, contacts with TB disease should begin and complete treatment for TB disease. A successful contact investigation can interrupt transmission and prevent future cases of disease.

High-risk contacts are contacts who are at a particularly high risk of developing TB disease if they have become infected with *M. tuberculosis*. Contacts who are less than 4 years of age or immunosuppressed, e. g., infected with the human immunodeficiency virus (HIV), or have certain other medical conditions (see page 64), should be given treatment for LTBI until it becomes clear whether they have actually been infected. Because such persons may quickly develop TB disease, it is very important to identify them as high-risk contacts and manage them accordingly.

When Is a Contact Investigation Done?

A person with suspected or confirmed TB disease who is the initial case reported to the health department is called the index patient. An index patient could be diagnosed in a health department clinic. More often, a TB case is reported to the health department by a hospital, laboratory, private clinician’s office, correctional facility, or other institution where the patient is diagnosed.



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In general, a contact investigation should be done whenever a patient is found to have or is suspected of having infectious TB disease.
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Infectiousness depends on a variety of factors, but is more likely when patients have cough, hoarseness, or other symptoms of pulmonary or laryngeal TB.
.....

In general, a contact investigation should be done whenever a patient is found to have or is suspected of having **infectious** TB disease (Table 6.1) (see Module 5, Infectiousness and Infection Control, for additional information). Infectiousness depends on a variety of factors, but is more likely when patients have

- # Cough
- # Hoarseness
- # Other symptoms of pulmonary or laryngeal TB

Other factors that increase the likelihood of infectiousness include

- # Positive acid-fast bacilli (AFB) sputum smear or culture results
- # A cavity on the chest radiograph
- # Inadequate or no treatment



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A contact investigation should be done when TB is confirmed or there is a high clinical suspicion of TB.

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Contact investigations for cases with negative AFB sputum smears are a lower priority than those with positive AFB sputum smears.

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Extrapulmonary TB does not carry any risk for transmission and contact investigations are not performed.

.....
Likewise, contact investigations are not performed for people with diseases caused by nontuberculous mycobacteria only, such as *M. avium* complex.

A contact investigation should be done when TB is confirmed or there is a high clinical suspicion of TB. While AFB sputum smear-negative TB disease usually indicates a lower bacterial burden than AFB smear-positive disease, and thus a lower risk of transmission, contact investigations for negative-smear cases usually should be conducted. Recent evidence suggests that transmission can occur in these AFB sputum smear-negative cases as well. Moreover, a negative AFB sputum smear may be the result of a poor quality sputum specimen. Contact investigations for cases with negative AFB sputum smears are a lower priority than those with positive AFB sputum smears (Table 6.1). Decisions about the prioritization of contact investigations should be made by supervisory clinical and management staff.

There are some instances in which contact investigations are **not** performed (Table 6.1). For example, extrapulmonary TB (without pulmonary TB) does not carry any risk for transmission and contact investigations are not performed.

Likewise, contact investigations are not performed for people with diseases caused by nontuberculous mycobacteria only, such as *M. avium* complex (Table 6.1). (Nontuberculous mycobacteria are not spread from person to person.) When information about the type of mycobacteria causing disease in a particular person is not available at the time the case is reported to the health department, a contact investigation should be initiated if TB is strongly suspected, especially if AFB sputum smears are positive. When the culture results are available and only nontuberculous mycobacteria are identified, the patient should be evaluated clinically to rule out TB disease, and the contact investigation is then usually stopped.



Table 6.1
When to Conduct and How to Prioritize Contact Investigations

Site	Bacteriology	Action	Priority
Pulmonary*/ laryngeal	AFB sputum smear-positive Culture positive	Conduct contact investigation	High
Pulmonary/ laryngeal	AFB sputum smear-positive Culture pending	Conduct contact investigation (if culture is not TB and clinical TB ruled out, stop contact investigation)†	High
Pulmonary/ laryngeal	AFB sputum smear-negative Culture positive	Conduct contact investigation	Lower than AFB sputum smear-positive
Pulmonary/ laryngeal	AFB sputum smear-negative Culture pending	Conduct contact investigation if strong clinical suspicion‡ (if culture is not TB and clinical TB ruled out, stop contact investigation)†	Lower than AFB sputum smear-positive
Pulmonary/ laryngeal	AFB sputum smear-negative Culture negative	Do not conduct a contact investigation if TB is ruled out	Low if “clinical TB”
Extrapulmonary	_____	Ensure pulmonary TB ruled out	NA

*Young children with TB disease are rarely infectious so a contact investigation is generally not conducted for them. However, young children with pulmonary TB disease should be evaluated for infectiousness and contact investigation may be warranted in some circumstances. A source case investigation should be conducted.

†Contact investigations are not performed for diseases caused by nontuberculous mycobacteria.

‡Strong clinical suspicion refers to a patient with symptoms and radiographic findings consistent with TB disease (and no other diagnosis to account for these findings).



Special laboratory tests (for example, nucleic acid amplification tests) have been used in some areas to more quickly detect *M. tuberculosis* complex.

.....
Young children with TB disease are rarely infectious, so a contact investigation is generally not conducted when a child is found to have TB disease.

In addition, young children with TB disease are rarely infectious, so a contact investigation is generally not conducted when a child is found to have TB disease (Table 6.1). (Although rare, it is possible for children to transmit *M. tuberculosis* to others and a contact investigation may be warranted in some circumstances.)

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When a young child has TB infection or disease, we know that *M. tuberculosis* was transmitted relatively recently.

However, when a young child has TB infection or disease, we know that *M. tuberculosis* was transmitted relatively recently. For example, a 2-year-old child with TB disease must have been exposed to someone with TB disease during the past 2 years. The person who is the source of this exposure is called the **source patient**. A source patient is a person with infectious TB disease who is responsible for transmitting *M. tuberculosis* to another person or persons. He or she is identified through either a contact or source case investigation and may or may not be an index patient.

.....
A source patient is a person with infectious TB disease who is responsible for transmitting *M. tuberculosis* to another person or persons.

In some situations, a **source case investigation** is conducted to find the source of TB transmission when recent transmission is likely. This is usually done when

- # A young child is found to have TB infection or disease
- # A severely immunosuppressed person who does not have a known history of TB infection is found to have TB disease
- # A cluster of tuberculin skin test conversions is found in a high-risk institution (for example, health care or correctional facility)



The purpose of a source case investigation is to determine

- # Who transmitted *M. tuberculosis* to the child, index patient, or persons in the cluster of skin test conversions
- # Whether this person is still infectious
- # Whether the case of TB in this person was reported to the health department
- # Whether any others were infected by the source patient

Prioritizing Contact Investigations

Setting priorities between two or more contact investigations is a decision that should be made by supervisory clinical and management staff based on the likelihood of infectiousness of index case patients (Table 6.1). If program resources are limited, priority for resources and staff time should be placed on identifying contacts and conducting follow-up with contacts

- # Who were exposed to the TB patients that are most likely to be infectious
- # Who are at highest risk for TB infection or TB disease

.....
 Setting priorities between two or more contact investigations is a decision that should be made by supervisory clinical and management staff based on the likelihood of infectiousness of index case patients.



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Decisions about prioritizing contact investigations depend on the circumstances and on the guidelines of the particular health department, and should be made by supervisory clinical and management staff.
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For example, a patient with pulmonary TB who was coughing for 3 months before receiving treatment and who has positive AFB sputum smears is much more likely to be infectious than a patient who has negative AFB sputum smears and who has rarely been coughing. Therefore, the first patient is a higher priority for a contact investigation. In addition, for a patient who lives in a residential shelter for people with AIDS, the priority for a contact investigation is also high because contacts infected with HIV are at very high risk of developing TB disease if exposed to and infected with *M. tuberculosis*. Thus, decisions about prioritizing contact investigations depend on the circumstances and on the guidelines of the particular health department, and should be made by supervisory clinical and management staff.

In some situations, a contact investigation should not be done. For example, time and resources are often not devoted to a contact investigation if the patient is found to have extrapulmonary TB only, with no risk of transmission. In some instances, however, a source case investigation is done for index patients with extrapulmonary TB (for example, when the index patient is a child).



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The contact investigation should be initiated no more than 3 working days after the case is reported to the health department.

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Close contacts should be examined within 7 working days after the index case has been diagnosed.

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The sooner contacts are identified and evaluated, and can begin appropriate therapy, the less likely it is that transmission will continue.

How Quickly Should a Contact Investigation be Carried Out?

A contact investigation should begin as soon as TB is diagnosed or strongly suspected in a patient. The contact investigation interview should be initiated **no more than 3 working days** after the case is reported to the health department. Close contacts should be examined **within 7 working days** after the index case has been diagnosed. A prompt contact investigation is important because some contacts, such as young children or HIV-infected and other immunosuppressed contacts, may develop TB disease very quickly after being exposed to and infected with *M. tuberculosis*.

High-risk contacts need timely treatment if they have been infected so they will not become ill with TB disease. Also, as time goes by, some contacts may become harder to locate; for example, homeless contacts can move frequently from shelter to shelter and contacts who are migrant workers often move from state to state. A prompt contact investigation increases the likelihood that all contacts will be found and evaluated. The sooner contacts are identified and evaluated, and can begin appropriate therapy, the less likely it is that transmission will continue.



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Laboratories, hospitals,
private clinicians, and other
groups serving people with
TB are required by law to
report this information to
local and state public health
departments.

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The health department is
legally responsible for
ensuring that a complete
contact investigation is done
for the TB cases reported in
its area.

.....

For a contact investigation to begin quickly, suspected and confirmed TB cases must be reported promptly to the health department. In fact, laboratories, hospitals, private clinicians, and other groups serving people with TB are required by law to report this information to local and state public health departments.

Who Is Responsible for a Contact Investigation?

The health department is legally responsible for ensuring that a complete contact investigation is done for the TB cases reported in its area. This includes

- # Identifying and evaluating contacts
- # Treating any contacts found to have TB disease
- # Offering treatment for LTBI to infected contacts
- # Monitoring adherence to prescribed regimens and ensuring a system is in place to assess completion of treatment

Occasionally, some steps of the investigation may be performed by people outside the health department, under the supervision of the health department. For example, if a patient in a hospital is found to have TB disease, infection control and employee health staff from the hospital may evaluate staff and some patients who were exposed, whereas the health department staff would evaluate contacts outside the institution. At a minimum, health department staff should work with hospital staff to plan the contact investigation and receive a report of the results (for example, the number of contacts identified, the number with newly documented infections, the number with TB disease, detailed treatment plans, and documentation of therapy administered and completed).



.....
A successful contact investigation requires the careful gathering and evaluation of detailed information.
.....

Steps in a Contact Investigation

A successful contact investigation requires the careful gathering and evaluation of detailed information, often involving many people. In general, contact investigations follow a process that includes these steps:

1. Medical record review
2. Patient interview
3. Field investigation
4. Risk assessment for *M. tuberculosis* transmission
5. Decision about priority of contacts
6. Evaluation of contacts
7. Treatment and follow-up for contacts
8. Decision about whether to expand testing
9. Evaluation of contact investigation activities

.....
Contact investigations do not always follow a predetermined sequence of events.
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Although these steps are presented in sequence for the purposes of this module, it is important to remember that contact investigations do not always follow a predetermined sequence of events.



Study Questions 6.1-6.3

6.1. What is a contact investigation?

6.2. What are three reasons why a contact investigation is important?

6.3. For which TB cases should a contact investigation be conducted?

Answers on pages 105-106.



Study Questions 6.4-6.6

6.4. For which TB cases should a source case investigation be conducted?

6.5. What is the purpose of a source case investigation?

6.6. How quickly should a contact investigation be carried out?

Answers on pages 106-107.



Case Study 6.1

Jung Hu is a 3-year-old child who has been diagnosed with TB meningitis. Jung and his parents immigrated from China one year ago, along with his paternal grandmother. Jung does not have pulmonary or laryngeal TB disease, and a sputum specimen collected by gastric aspirate does not show any acid-fast bacilli (AFB). Jung's TB disease is reported to the health department and he is started on an appropriate TB drug regimen.

Should a contact investigation be done with Jung as the index patient? Why or why not?

Should a source case investigation be done? What would be the purpose of this investigation?

Answers on page 120.



Case Study 6.2

You are a clinical TB case manager at a busy clinic in Smith County. Three new TB cases have been assigned to you. You need to review their charts and assign them to contact investigators.

1. Mr. Garcia is a 35-year-old agricultural worker diagnosed by a local private physician with extrapulmonary TB of the kidneys. He lives with his wife and 3 children (5 years, 3 years, and 9 months old) in a small, rented house in a rural part of the county. He rides to work every day in a van with 7 other agricultural workers.
2. Mr. James is a 72-year-old widower who lives alone on the south side of town. He drives himself to the local retirement center 2 miles from his house for bingo and poker four times a week. He was recently evaluated by the retirement center physician because he complained of a productive cough, shortness of breath, fatigue, and weight loss. He is AFB sputum smear-positive and his culture is pending. His chest x-ray shows a cavity in the right upper lobe. He started a four-drug regimen.
3. Mrs. Osaka is a 25-year-old woman who recently arrived from Japan. She was seen in the Smith County Clinic complaining of shortness of breath, a weak nonproductive cough, fatigue, and weight loss. Her AFB sputum smear was negative and her culture is pending. She lives with her husband and parents in a large apartment off Broadway. She is currently unemployed. She started a four-drug regimen.

For which case(s) should a contact investigation be conducted?

How should the case(s) be prioritized in terms of conducting a contact investigation?

Answers on pages 121-122.



Medical Record Review

.....
 Knowing about the patient's infectiousness helps health care workers decide which contacts are at risk.

.....
 Information should be collected about the patient's disease, symptoms, test results, x-ray results, and treatment.

What Information Should Be Collected?

The first step in a contact investigation is to review the TB patient's medical record and ask the clinician for information to determine whether the patient has been infectious and, if so, when. Knowing about the patient's infectiousness helps health care workers decide which contacts are at risk. Sometimes this also requires talking to the hospital's infection control nurse, reviewing the laboratory record, or talking to the patient directly (see Module 8, Tuberculosis Surveillance and Case Management in Hospitals and Institutions, for more detailed information on medical record reviews).

The following information should be collected about the patient:

- # Site of TB disease
- # TB symptoms and approximate date symptoms began
- # Sputum smear and culture results, including the dates of specimen collection
- # Results of nucleic acid amplification testing (if available)
- # Chest x-ray results and date
- # TB treatment (medications, dosage, and date treatment was started)
- # Method of treatment administration (DOT or self-administered)



For suspected TB cases the following information should also be collected:

- # Medical risk factors that may increase the risk for development of TB disease (see Module 1, Transmission and Pathogenesis of Tuberculosis)
- # History of tuberculin skin test results
- # History of previous treatment for TB disease or TB infection

Patients are more likely to be infectious if they

- # Have **pulmonary or laryngeal TB**
- # Are **coughing** (especially if they are producing a lot of sputum)
- # Have **positive sputum AFB** smear results and a **positive culture** for *M. tuberculosis*
- # Have chest x-ray results showing a **cavity** in the lung
- # Have had **no treatment** or have recently started treatment

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Patients are more likely to be infectious if they have pulmonary or laryngeal TB, are coughing, have positive sputum AFB smears or cultures, have a cavity in the lung, or have had no treatment.
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Determining the period of infectiousness can help focus the contact investigation efforts on those persons who were exposed while the patient was infectious.

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The beginning of the infectious period is usually estimated by determining the date of onset of the patient’s symptoms (especially coughing).

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The period of infectiousness ends when symptoms have improved, the patient has been receiving adequate treatment for at least 2 to 3 weeks, and the patient has had three consecutive negative sputum smears from sputum collected on different days.

.....

The Period of Infectiousness

The **period of infectiousness** is the time period during which a person with TB disease is capable of transmitting *M. tuberculosis*. Determining the period of infectiousness can help focus the contact investigation efforts on those persons who were exposed while the patient was infectious. There is no universal, well-established method to determine the period of infectiousness. The beginning of the infectious period is usually estimated by determining the date of onset of the patient’s symptoms (especially coughing). Sometimes when it is difficult to obtain a reliable history from the patient about the onset of symptoms, the beginning of the infectious period is estimated to be earlier than the onset of symptoms. **Estimating the period of infectiousness should be done by clinical and supervisory staff after a complete assessment of the information available.**

The period of infectiousness ends when **all** the following criteria are met:

- # Symptoms have improved
- # The patient has been receiving adequate treatment for at least 2 to 3 weeks
- # The patient has had three consecutive negative sputum smears from sputum collected on different days

The medical record review is summarized in Table 6.2 (see Module 5, Infectiousness and Infection Control, for detailed information on infectiousness; see Module 8, Tuberculosis Surveillance and Case Management in Hospitals and Institutions, for more information on medical record reviews).



Table 6.2
Medical Record Review

Information Collected During the Review	Conditions that Increase Likelihood of Infectiousness and Relative Priority of Contact Investigation
Site of TB disease	Pulmonary or laryngeal TB disease
TB symptoms and approximate date symptoms began	Coughing , producing a lot of sputum Hoarseness (may indicate laryngeal TB)
Sputum smear and culture results, including the dates of specimen collection	Positive AFB smear results <i>M. tuberculosis</i> identified in the culture
Chest x-ray results	Cavity in the lung
TB treatment, date treatment started, and method of administration	No treatment or recently started treatment



Study Questions 6.10-6.12

- 6.10. List seven types of information that should be collected during the medical record review.**
- 6.11. List five conditions that increase the likelihood that a patient is infectious.**
- 6.12. Define the period of infectiousness and discuss how it is estimated.**

Answers on pages 108-109.



Patient Interview

The Interview

The next step in the contact investigation is to interview the TB patient (Figure 6.1). In this section, the purpose of the contact investigation interview will be covered, as well as strategies to conduct effective interviews.

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If the health care worker does not communicate well enough with the patient, contacts who need evaluation and treatment may be missed.
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The patient interview is one of the most critical parts of the contact investigation, because the health care worker who interviews the patient serves as the main link between the health department and the contacts. If the health care worker does not communicate well enough with the patient to get accurate information about symptoms, places, and contacts, people who need evaluation and treatment may be missed.

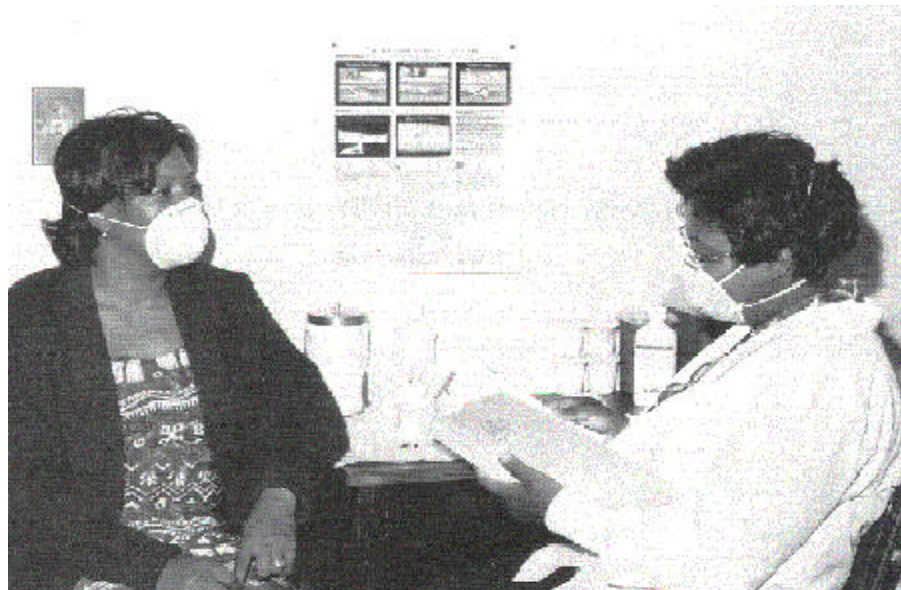


Figure 6.1 Health care worker interviewing a TB patient.



.....
 The initial interview should occur no more than 3 working days after the case is reported to the health department.

The initial interview should occur **no more than 3 working days** after the case is reported to the health department because it is possible that some contacts may have already developed infectious TB disease. Also, as time goes by, some contacts may be harder to locate. If TB is diagnosed in the hospital, the health care worker should visit the patient in the hospital before the patient is discharged. Health care workers should remember to follow infection control precautions while visiting a potentially infectious TB patient. These precautions may include wearing a personal respirator (see Module 5, Infectiousness and Infection Control).

.....
 The three main reasons to interview the TB patient are to find out more about the patient's symptoms, the places where the patient spent time, and the patient's contacts.

Purpose of Contact Investigation Interview

For a contact investigation, there are three main reasons to interview the TB patient:

- # To find out more about the patient's **symptoms** to help determine the period of infectiousness
- # To find out **places** where the patient spent time while he or she was infectious
- # To identify the patient's **contacts**, get locating information for the contacts, and find out how often and how long the contacts were exposed to the patient while he or she was infectious

.....
 The TB patient should be asked whether he or she has had TB symptoms, especially coughing, and how long those symptoms have been present.

Symptoms. The TB patient should be asked whether he or she has had TB symptoms, especially coughing, and how long those symptoms have been present. This will help determine how long the patient was infectious. The patient might relate the onset of symptoms to certain events such as birthdays, holidays, or major news reports. The health care worker may be able to obtain information from the patient by using these prompts. With the patient's approval, family members or other persons who live with the patient may be interviewed to help estimate when the symptoms began.



.....
The patient should be asked to identify all of the places he or she has been since the symptoms began.
.....

Places. The patient should be asked to identify all of the places he or she has been since the symptoms began, especially places where the patient spent the most time. The easiest way to do this is to ask the patient to go over his or her daily routine. Common places include the patient’s home or shelter, workplace (including car pools), school, places of worship, soup kitchens, and places where the patient spends his or her free time, such as friends’ houses, restaurants, or bars. Some patients may live or work in more than one place, and some may be homeless or may have spent time in a correctional facility.

In general, there are three different types of places where patients may spend most of their time (Figure 6.2):

- # Household or residence
- # Work or school
- # Leisure or recreation environments

It is important that patients be asked questions about all three types of places, not just questions regarding the household or other residence.

.....
The patient should be asked about places he or she has gone less frequently.
.....

After being asked to review his or her daily routine, the patient should be asked about places he or she has gone less frequently, even places that don't seem important enough for the patient to mention (such as meetings, parties, vacations, or family gatherings) or places that the patient may be reluctant to mention. Getting a complete and accurate list of places should become easier for interviewers as they gain experience in conducting contact investigations.

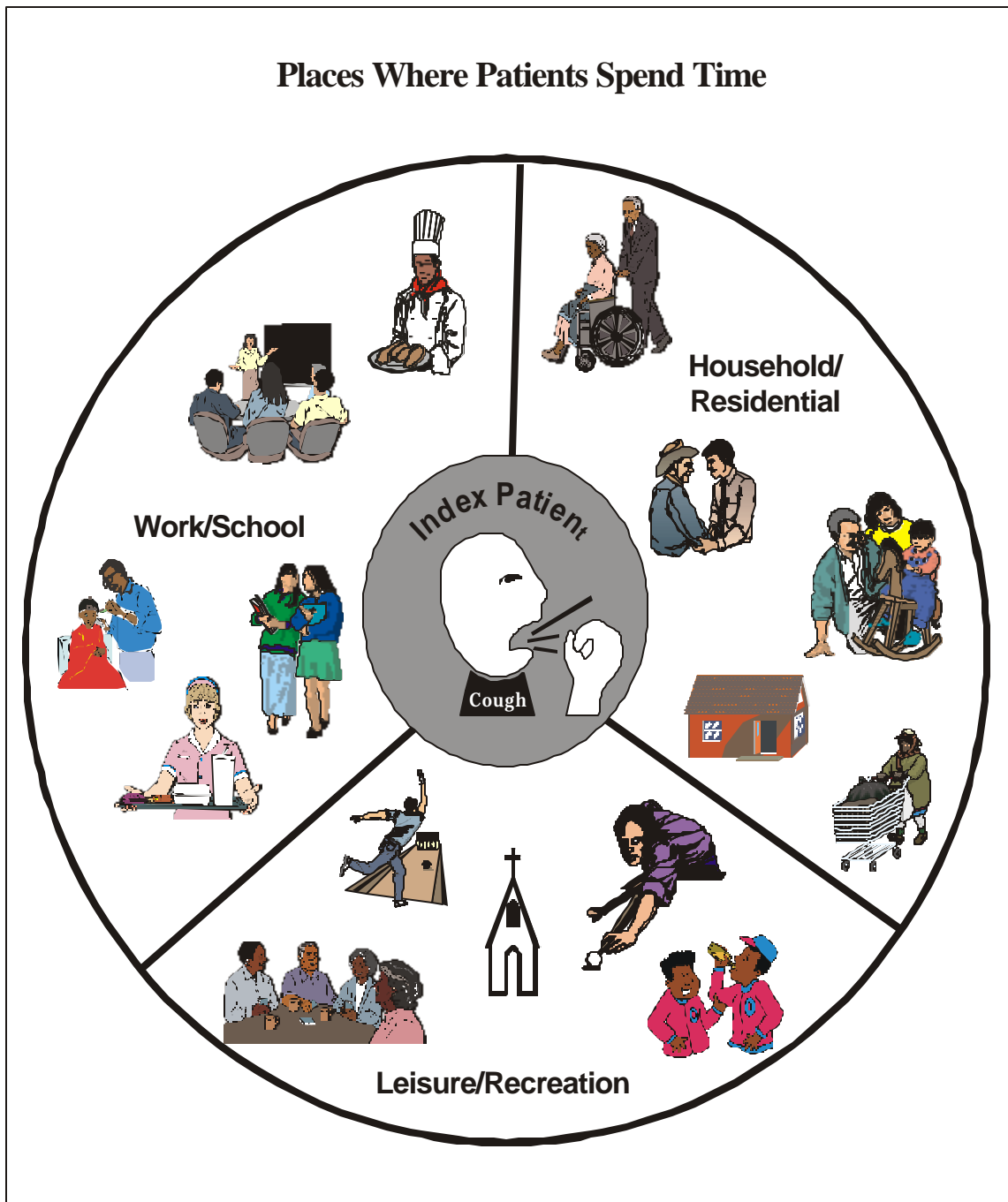


Figure 6.2 The three different types of places where patients spend most of their time: (1) household or residential; (2) work or school; (3) leisure or recreation.



.....
The patient should also be asked about the characteristics of each place, including the size of the place, time spent in the place, and whether the windows were open or closed
.....

In addition, the patient should also be asked about the characteristics of each place, including the size of the place, time spent in the place, and whether the windows were open or closed. This information is important for assessing the risk that *M. tuberculosis* was transmitted in each place. When it is possible, the health care worker should visit each place after the interview to get an accurate idea of the amount of risk, especially the extent of ventilation.

.....
Nearly every TB patient has at least one contact; the number of contacts can range from one to several hundred.
.....

Contacts. The patient should be asked to give the names of people he or she spent time with in each of the places, especially people he or she sees every day or shares sleeping space with. Nearly every TB patient has at least one contact; the number of contacts can range from one to several hundred, depending on living quarters, workplace, and other circumstances.

.....
The interviewer should assure the patient that all information, including the patient's name, will be kept confidential.
.....

The interviewer should be aware that some patients may be reluctant to identify some or all of their contacts. For example, a patient may not want to identify people who use illegal drugs with him or her, may not want to identify people who reside in the United States illegally, or simply may not want his or her friends to know that he or she has TB. The interviewer should be sensitive to the patient's fears, explain the importance of testing the contacts, and assure the patient that all information, including the patient's name, will be kept confidential.

.....
The patient may not give the names of all contacts, but usually the health care worker can identify more contacts when he or she visits each place.
.....

The patient should also be asked where each contact can be found, so that the contacts can be notified about their possible exposure to TB and asked to come to the health department for testing. The patient may not give the names of all contacts, but usually the health care worker can identify more contacts when he or she visits each place. For example, homeless patients often do not know the names of their contacts. If possible, the patient should be re-interviewed later on to identify more contacts.



A patient interview checklist can assist the health care worker with obtaining the right information on symptoms, places, and contacts. A sample checklist of topics to cover in a patient interview is shown in Figure 6.3.

.
A good contact investigation form can assist the health care worker in obtaining important information on the TB patient, as well as on the identified contacts.
.

A good contact investigation form can assist the health care worker in obtaining important information on the TB patient, as well as on the identified contacts. Forms used in contact investigations will vary from setting to setting. Table 6.3 summarizes some important information that should be collected during contact investigations. Figure 6.4 is an example of a contact investigation form that contains some of the elements listed in Table 6.3.



Patient Interview Checklist

- # Patient's name
- # Patient's address and phone number (if any) or names of shelters
- # Location and date of interview
- # Household members or others present at interview (name, age, relationship to patient, address)
- # Patient's symptoms
- # Approximate date when each symptom started and ended (if applicable)
- # Places the patient has been since symptoms began
 - 9 Household or residence
 - 9 Work or school
 - 9 Leisure or recreation activities
- # Description of patient's daily routine
 - 9 Transportation to/from work and type of work
 - 9 Daytime/evening/nighttime/weekend activities
- # Other regular activities (not daily)
- # Other sites visited less regularly during period of infectiousness (e.g., trips, vacations, holiday activities)
- # Contacts identified (organized by site)
 - 9 Household members (especially those who share the same sleeping space)
 - 9 Frequent guests or visitors to the home (including visitors of other family members)
 - 9 Coworkers, school classmates
 - 9 Friends and other social contacts
 - 9 Girlfriends or boyfriends and other sexual partners

Figure 6.3 Sample checklist for a patient interview.



Table 6.3
Example of Elements for Data Collection Forms for Contact Investigation

Index patient identifying information	Index patient medical information
<ul style="list-style-type: none"> # Name # Address # Phone # Date of birth # Employment, school, or group living situation # Sex # Race/ethnicity 	<ul style="list-style-type: none"> # Site of disease # Symptoms (date of onset) # Chest x-ray # Bacteriology (smear and culture) results # Assessment of risk of transmitting <i>M. tuberculosis</i> # TB medication
Contact identifying information and risk factors	Contact evaluation and follow-up information
<ul style="list-style-type: none"> # Name # Address # Date of birth (age) # Sex # Relationship to contact # Setting of exposure (home/residence/work/school/leisure) # Date of last contact with infectious case # Hours of exposure # Close/casual contact status # Risk that transmission occurred (high, low) # Living situation # Race/ethnicity # Country of origin # Language # HIV status # Other immunosuppression (i.e., diabetes, cancer, etc.) # Substance abuse # Homelessness 	<ul style="list-style-type: none"> # Previous documented tuberculin skin test (TST) (date, mm result) # Initial TST dates placed, read, mm results # Follow up TST dates placed, read, mm results # Chest x-ray, date, results (normal, abnormal, cavitory) # Symptoms # Treatment for LTBI recommended (date, regimen) # Reason treatment for LTBI not recommended # Start date for treatment for LTBI # Stop date for treatment for LTBI # Stop reason # Completion status for treatment for LTBI



Contact Investigation if Patient Dies or Cannot be Located

.....
If the patient has died before the contact investigation interview is initiated, a member of the patient’s household (or another person who is knowledgeable about the places where the patient may have potentially exposed others) should be interviewed as a proxy for the patient.
.....

Occasionally, a contact investigation will need to be conducted without an interview with an index patient. The patient may have died, may be difficult to locate, or may be psychologically unfit to participate in a contact investigation interview. In such cases, it is still important that a contact investigation be conducted to identify contacts who may have been exposed to TB. For example, if the patient has died before the contact investigation interview is initiated, a member of the patient’s household (or another person who is knowledgeable about the places where the patient may have potentially exposed others) should be interviewed as a proxy for the patient.

Likewise, if a health care worker is unable to locate a known infectious TB patient, but knows some of the places where the infectious patient may have exposed others, the contact investigation should be initiated. For example, if a homeless individual with untreated infectious TB cannot be located but is known to frequent a particular shelter, health department staff may decide it is necessary to inform the shelter management about the index case’s TB status in order to initiate timely contact follow-up.

When information must be revealed about a case without prior permission in order to protect public health, consultation should be made with a supervisor or TB controller to obtain approval to breach confidentiality. The approval should be documented in the patient record.



Study Questions 6.13-6.15

- 6.13. When should a patient interview be done?**
- 6.14. List three reasons why the TB patient should be interviewed for a contact investigation.**
- 6.15. When conducting a contact investigation interview, from what three types of places should TB patients be asked to identify contacts?**

Answers on pages 109-110.



Strategies for Conducting Effective Interviews

For the patient interview to be effective and successful, a health care worker should

- # Explain to the patient the importance of the contact investigation for preventing and controlling TB
- # Ensure that the interview takes place under conditions that encourage effective communication
- # Establish the foundation for a good relationship with the patient based on mutual trust and understanding
- # Begin an assessment of the patient's knowledge, feelings, and beliefs about TB and educate the patient
- # Ask open-ended questions
- # Have a clear understanding of the interview's objectives
- # Plan the interview so that each objective is given adequate time
- # Listen to the patient's concerns about TB and its treatment
- # Share information freely with the patient



.....
The health care worker should explain to the patient the goals of the contact investigation and why it is important to identify all possible contacts.

.....

.....
Contacts who have TB disease can begin treatment to get better as well as prevent further transmission.

.....

.....
Contacts who have LTBI can be given treatment for LTBI to prevent them from getting TB disease.

.....

The initial interview provides a good opportunity for the health care worker to gather information from the patient. However, the health care worker should keep in mind that as patients first learn of their new TB diagnosis, they may not be ready to give or receive detailed information. The patient may be overwhelmed and may be experiencing fear over the diagnosis of TB disease. Likewise, the patient may still be very sick and unable or unwilling to participate fully in a patient interview. The health care worker should be aware of these factors that can affect the initial patient interview and should plan accordingly to educate patients and schedule follow-up interviews.

Explain the importance of the contact investigation interview. The health care worker should explain to the patient the goals of the contact investigation and why it is important to identify all possible contacts. For example, the health care worker should explain to the patient that a contact investigation is important to find contacts who may be family, friends, coworkers, etc., who may have TB disease or TB infection and who may need treatment. Contacts who have TB disease can begin treatment to get better as well as prevent further transmission. Contacts who have LTBI can be given treatment for LTBI to prevent them from getting TB disease. The patient should be told about his or her right to privacy and the measures that will be taken to maintain confidentiality (see Module 7, Confidentiality in Tuberculosis Control, for further information).

**Conditions that encourage effective communication.**

When the health care worker first meets a patient, he or she should introduce himself or herself, clearly stating his or her title and role with the TB program and the purpose of the interview. If the patient and the health care worker do not speak the same language, an interpreter should be used (see Module 9, Patient Adherence to Tuberculosis Treatment, for additional information on working with interpreters). Because it is important to make the patient as comfortable as possible, the health care worker should ensure that the interview takes place under conditions that encourage effective communication. These conditions include

- # Arranging for privacy and maintaining confidentiality and assuring the patient that all information will be kept private
- # Creating an environment relatively free of distractions and interruptions
- # Listening attentively and respectfully to the patient (for example, sit down near the patient and use open, relaxed body language)
- # Being objective and nonjudgmental (for example, be patient, not accusatory, and never show frustration)



.....
Understanding the patient's
point of view is very
important.
.....

Understanding the patient's point of view is very important. It is important to

- # Maintain open, frank communication with the patient
- # Listen and try to understand the patient's knowledge, beliefs, and feelings about TB disease and treatment
- # Be open minded about the patient's beliefs and cultural expectations
- # Recognize and address the patient's fears about the illness
- # Communicate clearly so that the patient can understand the messages
- # Treat the patient with dignity and respect
- # Provide needed information and education
- # Maintain the patient's confidence

.....
It is very important to
establish a trusting
relationship with the patient.
.....

Establishing a trusting relationship. It is very important to establish a trusting relationship with the patient. Trust implies a firm reliance by the patient on the integrity, ability, and character of the health care worker. If a patient trusts or has confidence in his or her health care worker, he or she is more likely to be willing and able to follow instructions and advice and to cooperate in the contact investigation. The initial interview is a good time to begin to develop trust. In all likelihood the establishment of a true trusting relationship between the health care worker and the patient will develop over time through various interactions that will test the relationship. However, the foundation from which a trusting relationship can be established begins at the initial interview.

.....
If a patient trusts or has
confidence in his or her
health care worker, he or she
is more likely to be willing
and able to follow
instructions and advice and to
cooperate in the contact
investigation.
.....



.....
By bringing his or her health problem to the attention of a health care worker, the patient is entrusting personal and private information to the health care worker.
.....

By bringing his or her health problem to the attention of a health care worker, the patient is entrusting personal and private information to the health care worker. As the health care worker interviews the patient, the patient may divulge information about lifestyle choices and risky, even illegal behaviors, such as injection drug use. In addition, some patients may reveal that they reside in the United States illegally and fear being reported to immigration authorities. It is extremely important that the health care worker safeguard patient information and assure the patient that this information will not be shared with authorities or prevent the patient from receiving health services (see Module 7, Confidentiality in Tuberculosis Control). The time and concern taken with the patient at the initial interview serves to establish rapport and mutual trust, critical factors in ensuring collaboration and cooperation with contact investigation as well as adherence to follow-up visits.

.....
It is critical to determine the patient's level of understanding about TB and then work from this basis toward developing an accurate understanding. To be certain that the patient has an accurate understanding, the health care worker should ask the patient what he or she has understood.
.....

Educating the patient. The patient may have little or no knowledge of TB or may have misconceptions about TB. It is therefore critical during the interview for the health care worker to first determine the patient's level of understanding about TB and then work from this basis toward developing an accurate understanding. To be certain that the patient has an accurate understanding, the health care worker should ask the patient what he or she has understood. At this time, it may be necessary to spend extra time addressing any particular concerns the patient may have.



Open-ended questions. During the interview the health care worker will ask the patient many questions. One way that the health care worker can learn more about the patient’s symptoms, the places the patient has spent time while infectious, and the contacts who may have been exposed to the patient is through the use of open-ended questions.

.....
An open-ended question is one that cannot be answered with a simple “yes” or “no.”
.....

An open-ended question is one that cannot be answered with a simple “yes” or “no.” Open-ended questions are designed to elicit the patient’s knowledge, feelings, and beliefs by beginning with words that demand an explanation, like

- # What?
- # Why?
- # Who?
- # When?
- # How?

In addition, phrases that begin with “Tell me about” or “Explain to me” may be helpful in eliciting information. Such questions are used when a health care worker needs to explore complex issues that do not have a finite or predetermined set of responses.

The questions in Table 6.4 are examples of open-ended questions that can be used in the contact investigation. These open-ended questions may assist health care workers assessing the patients understanding of TB, as well as in identifying contacts who may have been exposed to an infectious TB patient.



Table 6.4
Examples of Open-Ended Questions for Contact Investigation

- # **What** symptoms do you have?
- # **When** did your symptoms begin?
- # **How** long have you had these symptoms?
- # **Who** are the people who visit your home?
- # **What** places do you go to on a daily basis?
- # **What** is your daily routine?
- # **How** do you get to work?
- # **Who** do you ride to work with?
- # **What** is the room like where you spend most of your time at work?
- # **Who** are the people you spend time with at work, at church, etc.?
- # **Who** are the people you see every day?
- # **What** do you do in your free time?
- # **What** are your hobbies?
- # **Who** do you sleep with each night?
- # **Where** else do you sleep?
- # **Where** did you go on vacation?

Open-ended questions such as these are useful during the contact investigation interview. They are a starting point only. The health care worker should ask many more questions about the names and locations of the possible contacts and ensure that all contacts are notified and scheduled for testing.



.....
The health care worker and the patient should decide who will notify the contacts and make appointments for them to receive TB testing at the health department.

.....

.....
If the health care worker is going to notify the contacts, he or she should assure the patient that the contacts will not be told who identified them as a contact.

.....

.....
The health care worker should schedule a follow-up interview with the patient to identify more contacts.

.....

Completing the Interview

Before completing the interview, the health care worker and the patient should decide who will notify the contacts. Some TB patients prefer to notify their contacts themselves, especially when the contacts are family members or close friends. Others prefer that the health care worker notify the contacts.

Again, the patient’s confidentiality is very important. If the health care worker is going to notify the contacts, he or she should assure the patient that the **contacts will not be told who identified them as a contact**. Either way, the health care worker should get the names and locations of the contacts and ensure that all contacts are notified and scheduled for testing.

Potential barriers of the contacts to complying with testing should be identified through discussion with the patient. For example, if it is determined that a contact is unlikely to appear at the health department for testing, the health care worker may decide to conduct testing in the field.

The health care worker should realize that the patient may not be able to recall all of the names of possible contacts at the initial interview, especially if the interview occurs around the same time as the diagnosis. The health care worker should provide the patient with an opportunity to provide other contacts as they are remembered. The health care worker can encourage the patient to phone the health department if he or she remembers other contacts. In addition, **the health care worker should schedule a follow-up interview with the patient to identify more contacts**.



Study Questions 6.16-6.18

- 6.16. What are some strategies the health care worker can use to conduct effective interviews?**
- 6.17. What are four conditions that encourage effective interviews?**
- 6.18. If the patient is not able to recall all of his or her contacts at the initial interview, what can the health care worker do to obtain more information about contacts?**

Answers on pages 110-111.



Case Study 6.3

Matilda Landers is a 73-year-old resident at the Washington County Nursing Home who has been hospitalized for a serious respiratory illness. She has been reported to the health department as a suspected TB case, and you are the health care worker assigned to conduct a contact investigation. You have conducted a medical record review and found the following information.

Site of TB disease: laryngeal TB suspected

TB symptoms: hoarseness, cough, fatigue, weight loss

Smear results: AFB positive (3+) on 5/23/99

Culture results: pending

Chest x-ray results: cavity in left upper lobe

TB treatment: four-drug regimen begun on 5/24/99

**# What additional information is needed to establish the period of infectiousness?
How will you get this information?**

What other information will you ask for when you conduct a patient interview with Ms. Landers?

Answers on pages 122-123.



Field Investigation

.....
 Doing a field investigation means visiting the patient’s home or shelter, workplace (if any), and the other places where the patient spent time while infectious.

.....
 During field visits, the health care worker should observe environmental characteristics, identify additional contacts, and look for evidence of other contacts who are not present.

.....
 Field visits are also used to interview and skin test close contacts, educate the contacts, and refer contacts who have TB symptoms for evaluation.

What Is a Field Investigation?

The next step is to conduct a **field investigation**. This means visiting the patient’s home or shelter, workplace (if any), and the other places where the patient said he or she spent time while infectious. The field investigation is important and should be done even if the patient interview has already been conducted. The purpose of the field investigation is to identify contacts and evaluate the environmental characteristics of the place in which exposure occurred. The field investigation may provide additional information for the risk assessment and identify additional contacts. During field visits, the health care worker should

- # **Observe environmental characteristics** such as room size, crowding, and ventilation, to estimate the risk of TB transmission
- # **Identify additional contacts** (especially children) and their locating information, such as phone numbers and addresses
- # **Look for evidence of other contacts** who may not be present at the time of the visit (Figure 6.5) (for example, pictures of others who may live in or visit the house, shoes of others who may live in the house, or toys left by children)
- # **Interview and skin test close contacts** who are present and arrange for reading of the results
- # **Educate the contacts** about the purpose of a contact investigation, the basics of transmission, the risk of transmitting *M. tuberculosis* to others, and the importance of testing, treatment, and follow-up for TB infection and disease



- # **Refer contacts who have TB symptoms** to the health department for a medical evaluation, including sputum collection



Figure 6.5 The health care worker is conducting a field investigation. She is looking for evidence of other contacts (for example, pictures of others who may live in or visit the house, shoes of others who may live in the house, or toys left by children).

.....
Health care workers should remember to follow infection control precautions while visiting a potentially infectious TB patient.
.....

Health care workers should remember to follow infection control precautions while visiting a potentially infectious TB patient at home or in any other location. These precautions may include wearing a personal respirator (see Module 5, Infectiousness and Infection Control).



.
Health care workers should
become familiar with policies
and recommendations of
local law enforcement
agencies and health
department administration
regarding personal security.
.

Another critical consideration during field investigations is safety. Health care workers should become familiar with policies and recommendations of local law enforcement agencies and health department administration regarding personal safety. Current information on local high-risk areas for crime can be very valuable in planning and conducting safe field visits. General safety precautions that are recommended for the health care worker include

- # Wearing an identity badge with a current photo
- # Working in pairs when visiting a potentially dangerous area
- # Informing someone of your itinerary and expected time of return, especially if you anticipate problems



Study Questions 6.19-6.21

6.19. What is a field investigation?

6.20. List six tasks a health care worker should perform during a field investigation.

6.21. List three general safety precautions that are recommended for the health care workers who conduct field investigations.

Answers on pages 112-113.



Case Study 6.4

Carmen is a 24-year-old TB patient. She was recently diagnosed with TB by the medical director of the college health center on campus. Carmen is not from the United States. She lives with her aunt and is taking classes at the local college. Susan, the health care worker, is conducting a field investigation. Susan has already conducted a patient interview with Carmen while she was in the hospital. In the interview, Carmen only identified her aunt, as well as three friends from college as contacts. Refer back to Figure 6.5 on page 50 and use the photo to assist in answering the following question.

Based on what is visible in the photo on page 50, is there evidence of any possible contacts in Carmen's house other than her aunt?

Answer on pages 123-124.



Risk Assessment for *M. tuberculosis* Transmission

.....
Assessing the risk of transmission helps determine which contacts should be given high priority for testing and evaluation.

.....
The risk of transmission depends on three main factors: the infectiousness of the TB patient, the environmental characteristics of each place, and the characteristics of the contact's exposure.

.....
Estimating the period of infectiousness helps determine which contacts have actually been exposed to TB.

Risk of Transmission

Based on the information obtained during the medical record review, the patient interview, and the field investigation, the risk that *M. tuberculosis* was transmitted in each place and the risk to the individual contacts in that place must be assessed. Assessing this risk is crucial because it helps determine which contacts should be given high priority for testing and evaluation. The risk of transmission depends on three main factors:

- # The **infectiousness** of the TB patient
- # The **environmental characteristics** of each place
- # The characteristics of the contact's **exposure**

Infectiousness of the TB Patient

The infectiousness of the TB patient as a factor for *M. tuberculosis* transmission is dependent upon the duration of time over which the patient was infectious, as well as the estimated degree of infectiousness. The degree of infectiousness is estimated from information on the patient's symptoms, sputum smear results, and other conditions affecting infectiousness that should have been collected during the medical record review and the patient interview. The greater the degree of infectiousness, the more likely transmission will occur. Estimating the period of infectiousness and determining the degree of infectiousness were covered earlier on pages 24-25.



.....
The risk of transmission in a particular place depends on the concentration of infectious droplet nuclei in the air.

.....
The concentration of droplet nuclei depends on three environmental characteristics: the size of the room, the amount of ventilation, and presence of air cleaning systems.

.....
The risk of transmission is high when an infectious TB patient is in a small, enclosed space that is crowded.

.....
In rooms with good ventilation, the concentration of droplet nuclei is lower, and the risk of transmission is lower.

Environmental Characteristics

The risk of transmission in a particular place depends on the concentration of infectious droplet nuclei in the air — that is, the number of droplet nuclei in a certain amount of air. The greater the concentration of droplet nuclei, the more likely that TB organisms have been transmitted. The patient’s infectiousness affects the number of droplet nuclei generated. In addition, the concentration of droplet nuclei in a room depends on three environmental characteristics (Figure 6.6):

- # Size of the room
- # Amount of ventilation
- # Presence of air cleaning systems

Size of the room. The risk of transmission is high when an infectious TB patient spends time in a small, enclosed space. It is also high when many people are crowded together in close physical proximity to each other. The risk of transmission is lower when an infectious patient is in a very large room that is not very crowded.

Amount of ventilation. In a room that is well ventilated (for example, a room with an open window or an air ventilation system), fresh air comes into the room, diluting the concentration of droplet nuclei. Also, some of the droplet nuclei in the room may be carried outside. Therefore, in rooms with good ventilation the concentration of droplet nuclei, and therefore the risk of transmission, is lower. In rooms that receive no ventilation, the risk of transmission is increased.

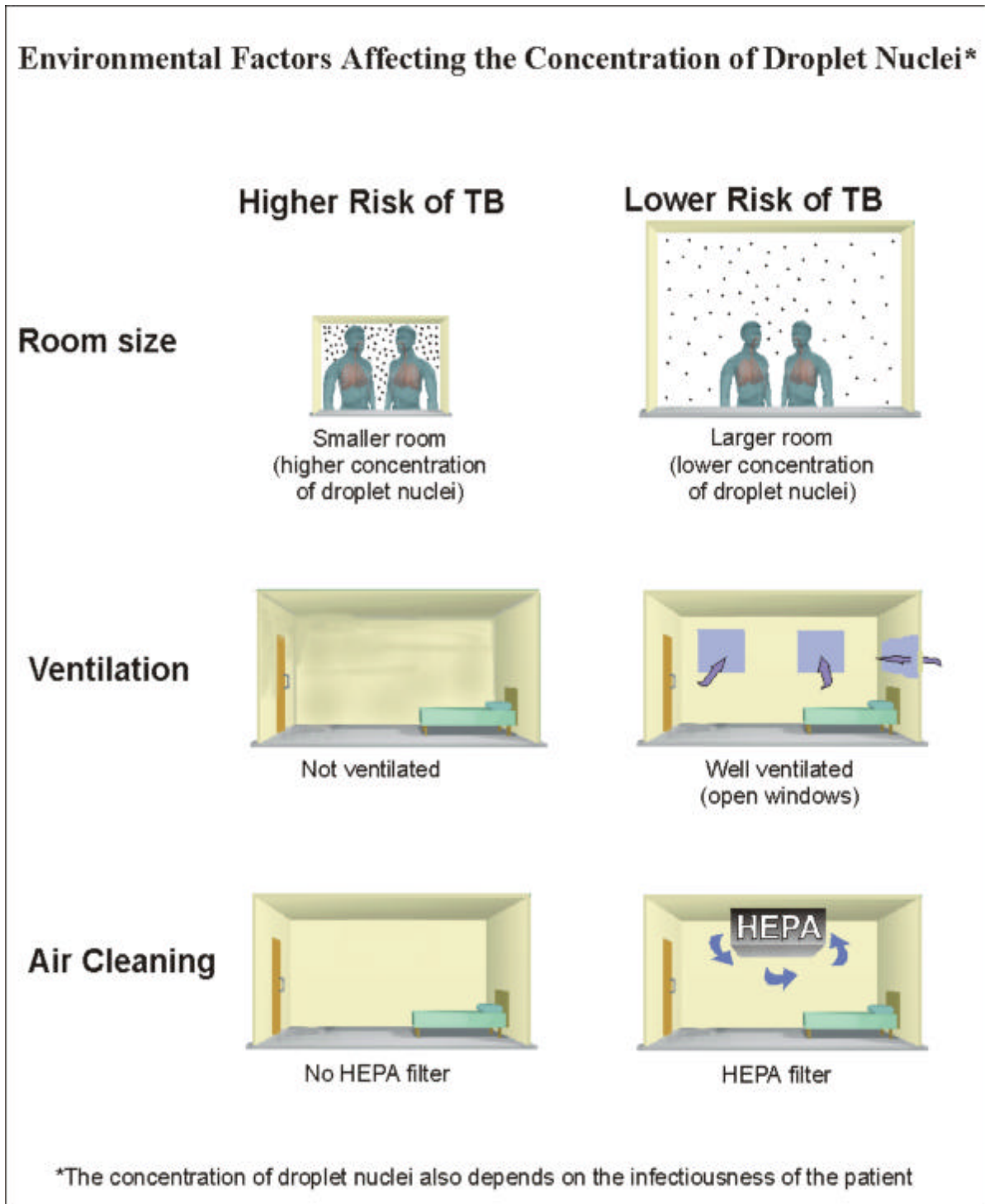


Figure 6.6: Environmental factors affecting the concentration of droplet nuclei



.....
Infectious droplet nuclei can be removed from the air by HEPA filters or killed by ultraviolet lights.
.....

Air cleaning systems. Infectious droplet nuclei can be removed from the air if the air is filtered through high-efficiency particulate air (HEPA) filters. Alternatively, the tubercle bacilli contained in the droplet nuclei can be killed by ultraviolet lights (see Module 5, Infectiousness and Infection Control). These features, which are used in many hospitals and in some shelters, clinics, correctional facilities, and drug treatment centers, may lower the risk of *M. tuberculosis* transmission.

.....
The length and closeness of exposure between the patient and a particular contact are the key factors in assessing the contact's risk of becoming infected.
.....

Characteristics of the Contact's Exposure

The length and closeness of exposure between the patient and a particular contact are the key factors in assessing the contact's risk of becoming infected. Contacts at higher risk are those who

- # Frequently spend a lot of time with the patient
- # Have been physically close to the patient

.....
Close contacts are more likely to become infected with *M. tuberculosis* than contacts who see the patient less often.
.....

Close contacts. Close contacts are persons who had prolonged, frequent, or intense contact with a person with TB while he or she was infectious. Close contacts are more likely to become infected with *M. tuberculosis* than contacts who see the patient less often, especially if time is spent together in small or crowded, poorly ventilated places. Close contacts usually include anyone who has been physically close to the patient, such as anyone who has shared a house or room with the patient or has frequently spent time with the patient (i.e., recreation, leisure, work, or school). **Close contacts are also found in places other than the household of the patient.**

.....
Close contacts are also found in places other than the household of the patient.
.....



The factors affecting the risk of transmission are summarized in Table 6.5. When it is unclear whether a contact is at higher risk according to these factors (for example, if the exposure may or may not have occurred before the period of infectiousness), it is better to be cautious and consider the contact at higher risk.

Table 6.5
Factors Affecting the Risk of TB Transmission

Factor	Contacts at Higher Risk
Infectiousness of the TB patient	Contacts exposed to patients with a high degree of infectiousness based on the following factors # Laryngeal or pulmonary TB # AFB sputum smear-positive # Cavitory disease on chest x-ray # Cough # Positive culture for <i>Mycobacterium tuberculosis</i>
Environmental characteristics	Contacts exposed to the patient in # Small or crowded rooms # Areas that are poorly ventilated # Areas without air-cleaning systems
Characteristics of the contact's exposure	Contacts who # Frequently spend a lot of time with the patient # Have been physically close to the patient



Study Questions 6.22-6.25

- 6.22. What three main factors should be considered in the risk assessment for TB transmission?**
- 6.23. Why is it important to know the period of infectiousness?**
- 6.24. Name three environmental characteristics that would put contacts at higher risk of infection.**
- 6.25. Which contacts are at higher risk of becoming infected?**

Answers on pages 113-114.



Case Study 6.5

A health care worker has just interviewed a 47-year-old TB patient, Derrick Jones. Derrick has had a cough for about 2 months and started treatment for TB disease 3 days ago. He lives alone in a small apartment on 41st Street. He is currently unemployed, but in the past 2 months he has worked the night shift with two other employees at the convenience store on 39th Street. During the day, Derrick goes to friends' apartments nearby or stays in his apartment to watch TV. He often goes to the local bar in his neighborhood with his friends Reggie and Melvin. He usually eats at one of two restaurants—the 39th Street Diner or Susie's Kitchen.

His girlfriend, Tonya, is present at the interview and is aware that Derrick is being treated for TB. Derrick says she spends the night several times a week and often brings her 2-year-old son. When Tonya leaves, Derrick says that another girlfriend, Kelly, has stayed over about 10 times in the past 2 months. Last month, Derrick spent several days at Kelly's house, where she lives with her mother.

Based on this information, who are the potential contacts? Which contacts are at higher risk for infection and why?

While the health care worker is at Derrick's apartment for the interview, what else should be done?

Answers on pages 124-125.



Decision About Priority of Contacts

.....
To use time and resources wisely, the contact investigation should be focused on the contacts who are most at risk.

.....

High-Priority Contacts

To use time and resources wisely, the contact investigation should be focused on the **high-priority contacts**, the contacts who are most at risk for developing TB infection or TB disease. In other words, the highest priority for testing should be given to

Contacts who are most likely to be infected based on the risk that *M. tuberculosis* was transmitted

Contacts who are at high risk of developing disease if infected, including young children less than 4 years of age, HIV-infected and other immunosuppressed persons, and persons with certain medical conditions (Table 6.6, page 64).

.....
Close contacts usually include people who had close, regular, prolonged contact with the TB patient while he or she was infectious, especially in small, poorly ventilated places.

.....

Contacts Most Likely to be Infected

These are people who had close, regular, prolonged contact with the TB patient while he or she was infectious, especially in small, poorly ventilated places. These contacts are classified as **close contacts**, and usually include people who have shared a house or room with the patient or spent time with the patient frequently during the period of infectiousness. Contacts with less intense, less frequent, or shorter durations of contact to the TB patient are classified as **other-than-close contacts**, and they generally should be given a lower priority for testing.

.....
Contacts with less intense or less frequent exposure are classified as other-than-close contacts, and they should be given a lower priority for testing.

.....



.....
The priority given to a contact can change over time as new information is collected and old information is updated and revised.
.....

It is not always possible to easily classify contacts as “close” or “other-than-close” right away because the health care worker may continue to receive information as the contact investigation continues. Contacts who are considered to have the most exposure to the patient should receive highest priority and contacts who have the least exposure should be given the lowest priority based on available information. The priority given to a contact can change over time as new information is collected and old information is updated and revised. Decisions about the prioritization of contact investigations should be made by supervisory and clinical staff. For example

- # A family member who lives in the same home or apartment as the patient is a close contact; a family member or friend who lives elsewhere but visits for a few hours every other week is an other-than-close contact
- # Likewise, the coworker of an infectious TB patient who works alongside the patient each day for several hours in a small restaurant kitchen is a close contact; a delivery person who brings produce to the restaurant 2 days a week and is exposed to the patient for 15 minutes each time is an other-than-close contact
- # A person who drinks with the patient at the local bar for a few hours three times a week is a close contact; a person who plays pool with the patient two times each month is an other-than-close contact



.....
A very low priority contact would be someone who met the patient once or twice briefly during the period of infectiousness.

.....

A very low priority contact would be someone who met the patient once or twice briefly during the period of infectiousness. If there is evidence that close contacts have been infected, then other-than-close contacts may be tested.

By using the factors included in Table 6.6 to assess a contact's risk of becoming infected, it should be possible to define a group of close contacts: those persons who are most likely to have been infected.

Contacts at High Risk of Developing TB Disease if Infected

.....
People with certain conditions should be given high priority for TB testing, regardless of whether they are close contacts or other-than-close contacts.

.....

Some conditions, such as HIV infection, immunosuppressive therapy, and low body weight, increase the risk that TB infection will progress to TB disease (see Module 1, Transmission and Pathogenesis of Tuberculosis). Contacts with these conditions should be given high priority for TB testing, regardless of whether they are close contacts or other-than-close contacts. Young children less than 4 years of age should also be given high priority for testing, because they can develop serious forms of TB disease very quickly after infection.

The high-priority contacts for testing are summarized in Table 6.6.



Table 6.6
High-Priority Contacts for Testing

Contacts Most Likely to Be Infected (Close Contacts)	Contacts at High Risk of Developing TB Disease Once Infected
<ul style="list-style-type: none"># Contacts exposed to patients with a high degree of infectiousness based on the following factors:<ul style="list-style-type: none">9 Laryngeal or pulmonary TB9 AFB sputum smear-positive9 Cavitory disease on chest x-ray9 Cough9 Positive culture for <i>Mycobacterium tuberculosis</i># Contacts exposed to patients in<ul style="list-style-type: none">9 Small or crowded rooms9 Areas that are poorly ventilated9 Areas without air-cleaning systems# Contacts who<ul style="list-style-type: none">9 Frequently spend a lot of time with the patient9 Have been physically close to the patient	<ul style="list-style-type: none"># Contacts who are young children less than 4 years of age# Contacts with any of these conditions:<ul style="list-style-type: none">9 HIV infection9 Injection of illicit drugs9 Diabetes mellitus9 Silicosis9 Prolonged corticosteroid therapy9 Immunosuppressive therapy9 Certain types of cancer9 Severe kidney disease9 Certain intestinal conditions9 Low body weight (10% or more below ideal)



Study Questions 6.26-6.28

6.26. Which contacts should be classified as close contacts and are most likely to be infected?

6.27. Which contacts are at high risk of developing TB disease if infected?

6.28. Which contacts should be considered high-priority contacts for testing?

Answers on pages 114-115.



Case Study 6.6

You are in charge of the contact investigation for 35-year-old Hector Gonzalez, who is strongly suspected of having pulmonary TB disease. One week ago, Hector came to the health department complaining of night sweats, a 10-pound weight loss, and a persistent cough that has lasted about a month. His sputum smears were positive for AFB, and he started four-drug treatment for TB disease.

When you interviewed Hector 3 days ago, you found out that he lives with his 32-year-old wife, Mimi; two sons, Luis, 2, and Javier, 4; and his mother-in-law, Alma, 65. Hector's cousin, Henry, has stopped by the house a few times in the past month. Hector informed you that Henry has been HIV positive for 2 years.

Hector rides to work every day with his friend Joe. The ride lasts about half an hour. Hector works in a car assembly plant. About 100 employees work in the main room with Hector, but the room is divided into several sections. There are 20 people in Hector's section, and 4 of these people are assigned to work closely with Hector. Hector eats lunch outside every day with these 4 coworkers.

About twice a week and on weekends, Hector goes to a small neighborhood bar located in the basement of a building. At the bar, Hector spends most of the time talking to the bartender.

Which contacts would you consider close contacts?

Which contacts would you evaluate first (the high-priority contacts)?

Answers on pages 125-126.



Evaluation of Contacts

.....
 TB testing should be done in an orderly manner, starting with the highest-priority group of contacts.

.....
 Contacts should be evaluated for TB infection and TB disease with at least a medical history and a Mantoux tuberculin skin test.

.....
 Any contact who has TB symptoms should be given both a chest x-ray and a sputum examination.

What Does the Evaluation Include?

Evaluation of TB contacts should be done in an orderly manner, starting with the highest-priority group of contacts. Contacts should be evaluated for LTBI and TB disease. This evaluation includes at least

- # A medical history and
- # A Mantoux tuberculin skin test (unless there is a previous documented positive reaction)

For immunosuppressed contacts or contacts who are under 4 years of age, the evaluation should also include a chest x-ray, regardless of skin test result, because of the possibility of a false-negative reaction to the tuberculin skin test and risk of early progression to TB disease if infected (see Module 3, Diagnosis of Tuberculosis Infection and Disease).

In addition, any contact who has TB symptoms should be given both a chest x-ray and a sputum examination.

Medical History

Contacts should be asked about their

- # History of TB infection or disease
- # Documented previous tuberculin skin test results
- # Previous treatment for TB infection or disease
- # Previous exposure to TB
- # Risk factors for developing TB disease
- # Current symptoms of TB



.....
Contacts should be questioned about risk factors for HIV and offered counseling and testing if their HIV status is not known and they are at risk.

.....

.....
A reaction of 5 or more millimeters of induration is considered positive for contacts.

.....
.....

During a contact investigation, people who have a positive reaction to a tuberculin skin test should be further evaluated for TB disease, regardless of whether or not they were vaccinated with BCG.

.....

Contacts should be questioned about risk factors for HIV and offered counseling and testing if their HIV status is not known and they are at risk.

Mantoux Tuberculin Skin Test

All high-priority contacts should be given a Mantoux tuberculin skin test; a **reaction of 5 or more millimeters of induration is considered positive for contacts**. Some contacts may indicate that they have been vaccinated with BCG. BCG (bacillus Calmette-Guérin) is a vaccine for TB disease that is used in developing countries. However, it is rarely used in the United States because studies have shown that it is not completely effective. People who have been vaccinated with BCG may have a positive reaction to the tuberculin skin test even if they do not have TB infection. This is called a false-positive reaction. There is no reliable way to distinguish a positive tuberculin reaction caused by a vaccination with BCG from a reaction caused by true TB infection. **During a contact investigation, people who have a positive reaction to a tuberculin skin test should be further evaluated for TB disease, regardless of whether or not they were vaccinated with BCG** (see Module 3, Diagnosis of Tuberculosis Infection and Disease).

Contacts who have a previously documented positive tuberculin skin test should not receive another skin test, but should be evaluated for symptoms of TB disease, and asked about any history of treatment for TB infection or TB disease, and may need a chest x-ray. Depending on the results of the evaluation, some of these contacts may be candidates for treatment for LTBI or TB disease.



.....
The time span between the date of an initial skin test with a negative reaction and the date that is 10 to 12 weeks after exposure is called the window period.
.....

Contacts who are skin tested less than 10 to 12 weeks after their last exposure to a patient with infectious TB may have a false-negative reaction, because they may not yet be able to react to the tuberculin. It takes 2 to 12 weeks after TB infection for the body's immune system to react to tuberculin. For this reason, contacts of someone with infectious TB disease who have a negative initial skin test reaction should be retested 10 to 12 weeks after the last contact with the person who has TB disease. The time span between the date of an initial skin test with a negative reaction and the date that is 10 to 12 weeks after exposure is called the **window period. After the window period has ended, a repeat skin test should be administered to each contact who had an initial negative reaction.**

For example, a contact whose last exposure to TB occurred on July 1 has an initial negative skin test reaction on August 1, only 4 weeks after his or her exposure. This contact should have a repeat test between September 15 and October 1, or 10 to 12 weeks after exposure. The contact's window period is from August 1 through October 1 (Figure 6.7).

.....
Infants under 6 months of age may have a false-negative skin test reaction.
.....

As with adults, children should be retested 10 to 12 weeks after exposure. Infants under 6 months of age may have a false-negative skin test reaction because their immune systems are not yet able to react to tuberculin. Infants need careful clinical evaluation.

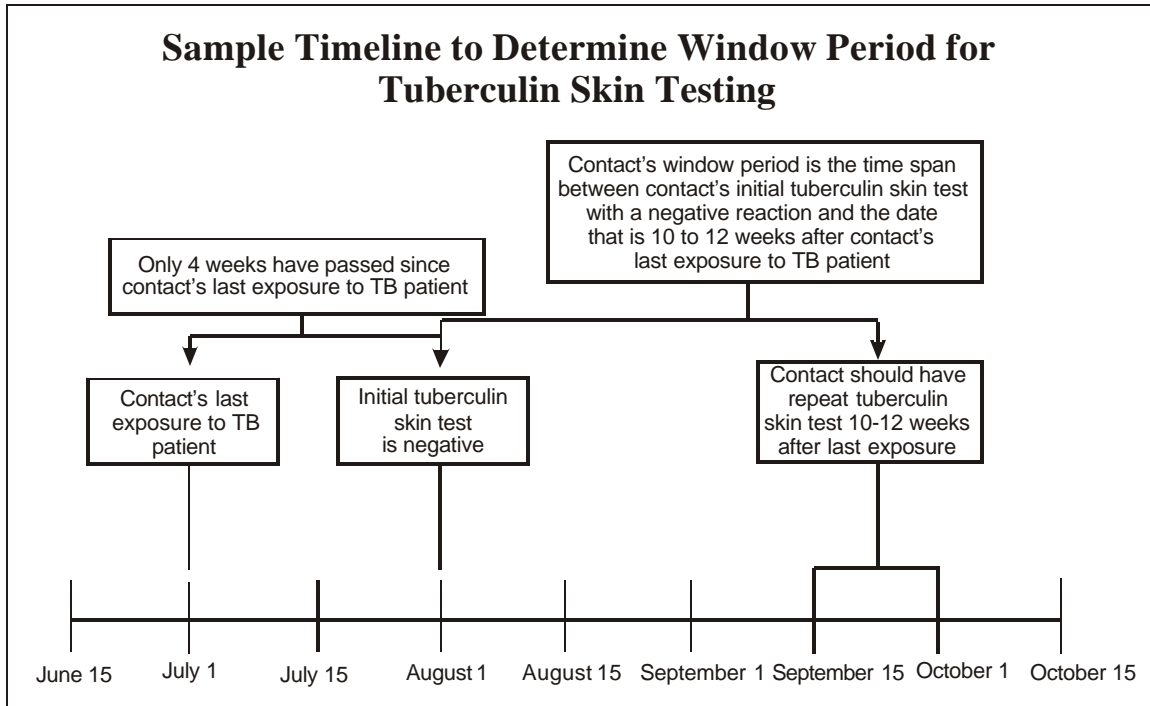


Figure 6.7 Sample timeline to determine window period.

.....
All contacts who have a positive skin test reaction should be given a chest x-ray.
.....

Chest X-ray

All contacts who have a positive skin test reaction with an induration greater than 5 mm or who report any TB symptoms should be given a chest x-ray. The purpose of the chest x-ray is to rule out the possibility of TB disease and to look for signs of old TB disease before treatment for LTBI is started. The results of a chest x-ray alone cannot confirm that a person has TB disease; smear and culture evaluations are necessary if the chest x-ray results are abnormal.



.....
Contacts who have TB symptoms, are HIV-infected, or have other immunosuppressed conditions, or are under 4 years of age should also have a chest x-ray at the same time the initial skin test is done.
.....

Certain contacts should have a chest x-ray to evaluate for TB disease **at the same time** the initial skin test is done, including those who

- # Have TB symptoms
- # Are HIV-infected or have other immunosuppressed conditions
- # Are under 4 years of age

Because of their high risk of quickly developing TB disease, HIV-infected and other immunosuppressed contacts and young children may already have TB disease by the time of the contact investigation.

.....
Other high-risk close contacts that may be considered for treatment of LTBI need a chest x-ray to exclude TB disease.
.....

In addition, if many close contacts have a positive skin test reaction, other high-risk close contacts may be considered for treatment for LTBI even if the initial skin test reaction is negative. This is especially true if the initial skin test was given during the window period or if a false-negative reaction is suspected. Such persons need a chest x-ray to exclude the possibility of TB disease before they begin treatment for LTBI.

Sputum Examination

.....
Any contact who has an abnormal chest x-ray or TB symptoms should have three sputum specimens collected, regardless of his or her skin test reaction.
.....

Any contact who has an abnormal chest x-ray or who has TB symptoms should have three sputum specimens collected on different days for smear and culture examination, regardless of his or her tuberculin skin test reaction. The results of the smear examination can be used to help determine the person's infectiousness, although a negative smear does not rule out the possibility of TB disease (see Module 3, Diagnosis of Tuberculosis Infection and Disease).



Study Questions 6.29-6.32

- 6.29. For all high-priority contacts, what procedures should be done during evaluation?**
- 6.30. In what situation should tuberculin testing of contacts be repeated?**
- 6.31. Which contacts should be given a chest x-ray?**
- 6.32. What is the purpose of a sputum examination and when should one be done?**

Answers on pages 115-116.



Case Study 6.7

The high-priority contacts you identified in Case Study 6.6 (page 66) for Hector Gonzalez, a patient suspected of having TB disease, were

- # Household members: Mimi (wife), Luis and Javier (sons), Alma (mother-in-law)
- # Close friend: Joe
- # Four coworkers who work closely with Hector
- # Bartender at the local bar
- # Hector's cousin Henry, who has HIV infection

These contacts (a total of 11) are being tested by the contact investigation team. Five weeks have passed since the contacts were last exposed to Hector while he was infectious.

- # Which contacts should be evaluated with a medical history and skin test? Which contacts also should be given a chest x-ray?

None of the contacts had TB symptoms. The skin test results were as follows:

Newly identified positive reaction: Mimi, 32 (11 mm); Javier, 4 (13 mm)

Negative reaction: Luis, 2 (0 mm); Alma, 65 (3 mm); Joe (3 mm); Henry, HIV+ (0 mm); Coworker A (2 mm); Coworker B (0 mm); Coworker C (0 mm); Coworker D (3 mm); the bartender (0 mm)

- # What follow-up testing and treatment are needed for contacts with a positive skin test reaction?

Answers on pages 126-127.



Case Study 6.7 (Continued)

Should any follow-up testing or treatment be given to contacts with a negative skin test reaction at this time?

Which contacts should receive a repeat skin test? When should the repeat test be performed?

Answers on pages 127-128.



Treatment and Follow-up for Contacts

Treatment

The following contacts should be evaluated for treatment for LTBI:

- # Contacts who have a positive tuberculin skin test reaction and no evidence of TB disease
- # High-risk contacts who have a negative tuberculin skin test reaction, such as children under 4 years of age, HIV-infected people, and other high-risk contacts who may develop TB disease very quickly after infection

.....
 Recently infected contacts are a high-priority group for treatment for LTBI because they are at high risk of developing TB disease.

.....

.....
 Some contacts who have a negative skin test reaction should be evaluated for treatment for LTBI, after TB disease has been ruled out.

.....

Contacts recently infected with *M. tuberculosis* are a high-priority group for treatment for LTBI because they are at high risk of developing TB disease. (The highest risk of developing TB disease is in the first 2 years after infection.)

Some contacts who have a negative tuberculin skin test reaction (less than 5 millimeters of induration) should be evaluated for treatment for LTBI, after TB disease has been ruled out. These contacts include children under 4 years of age, HIV-infected and other immunosuppressed people, and others who may develop TB disease very quickly after infection.



Window period prophylaxis is treatment for LTBI given to high-risk contacts with a negative skin test reaction less than 10 to 12 weeks after their exposure.

High-risk contacts (including children under 4 years of age) with a negative skin test reaction less than 10 to 12 weeks after their exposure should start treatment for LTBI and be retested after the window period ends. This is called **window period prophylaxis**. If the second skin test reaction is negative, treatment for LTBI is usually stopped. If the second skin test reaction is positive, they should continue taking treatment for LTBI. Infants younger than 6 months of age should be evaluated as discussed previously.

HIV-infected contacts or other immunosuppressed contacts may be given a full course of treatment for LTBI, regardless of their skin test results.

HIV-infected contacts or other immunosuppressed contacts may be given a full course of treatment for LTBI, regardless of their skin test results, because of the possibility of a false-negative skin test result. This is particularly true when there is evidence of transmission to other contacts with a similar degree of exposure and likelihood of a false-negative skin test result.

Contacts who have a positive sputum smear or chest x-ray results suggestive of current TB disease should begin treatment for TB disease (see Module 4, Treatment of Tuberculosis Infection and Disease).



Testing, treatment, and follow-up for contacts are summarized in Figures 6.8, 6.9, and 6.10, which present diagrams for

- # Contacts 4 years of age or older
- # Contacts under 4 years of age
- # Immunosuppressed contacts

.....
The ultimate goal of the contact investigation: complete treatment for LTBI or TB disease for infected or sick contacts.
.....

The following diagrams are presented as guides only, and are not meant to substitute for careful consideration of each contact’s risk of exposure, infection, and progression to disease. It is important to always keep in mind the ultimate goal of the contact investigation: treatment for contacts with LTBI or TB disease. Throughout the process of testing, treatment, and follow-up, appointment keeping and adherence to prescribed therapy should be monitored closely (see Module 9, Patient Adherence to Tuberculosis Treatment, for further information).

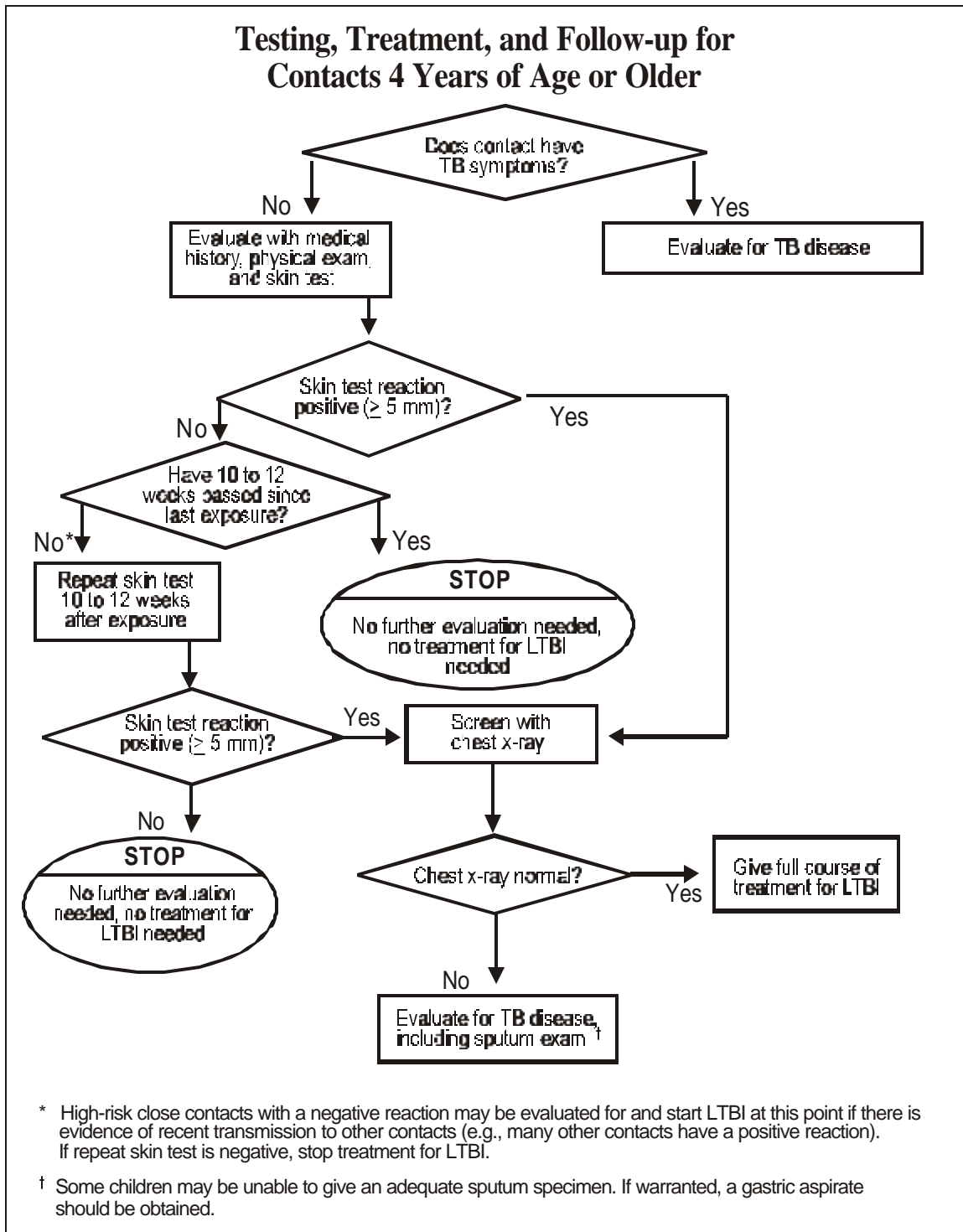


Figure 6.8 Testing, treatment, and follow-up for contacts 4 years of age or older.

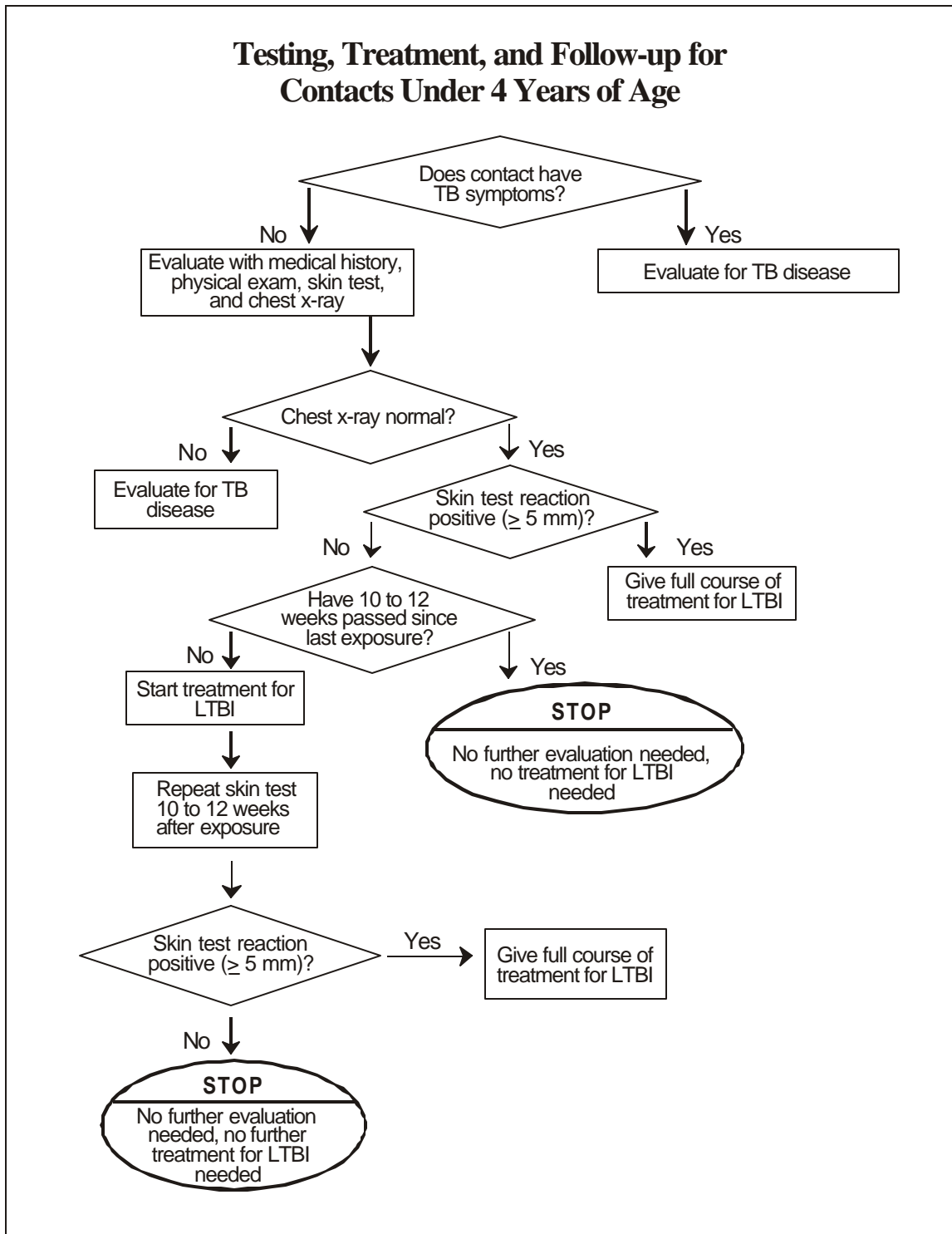


Figure 6.9 Testing, treatment, and follow-up for contacts under 4 years of age.

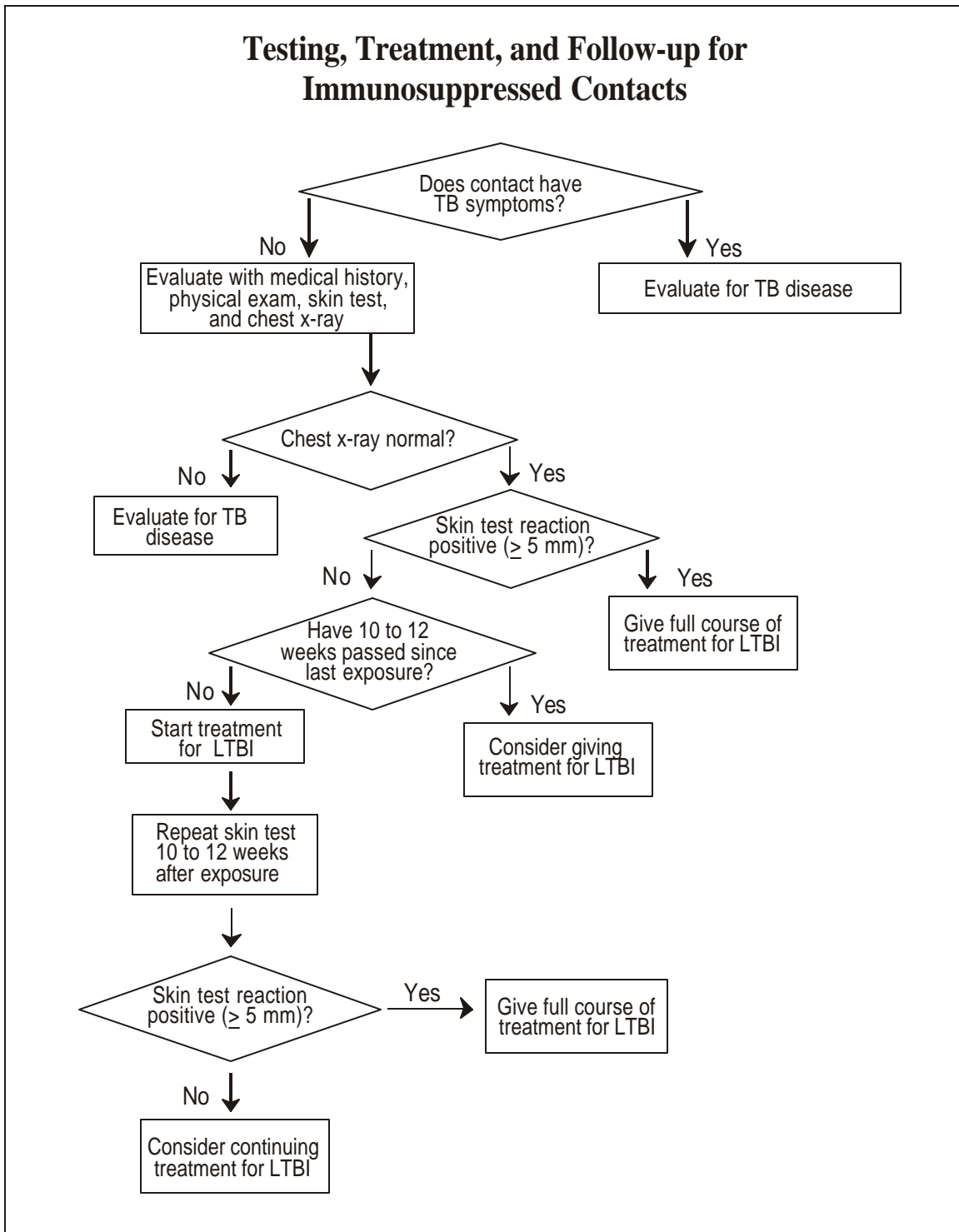


Figure 6.10 Testing, treatment, and follow-up for immunosuppressed contacts.



Study Questions 6.33-6.34

6.33. Which contacts should be evaluated for treatment for LTBI?

6.34. What is window period prophylaxis and when should it be used?

Answers on page 116.



Decision About Whether to Expand Testing

.....
 Results of testing should be evaluated for evidence of recent transmission, such as a high level of TB infection among contacts, infection in a young child, a skin test conversion in a contact, or a secondary case of TB disease.

.....
 The percentage of contacts who have a newly identified positive skin test reaction (5 or more millimeters of induration) is called the infection rate for that group of contacts.

Evidence of Recent Transmission

After the highest-priority group has been evaluated for TB infection and disease, the contact investigation staff should evaluate the results of testing for **evidence of recent transmission**. Evidence of recent transmission is provided by any of the following factors:

- # A high infection rate among contacts
- # Infection in a young child
- # A skin test conversion in a contact
- # A secondary case of TB disease

An evaluation of this evidence will help determine whether testing should expand.

Infection Rate

The percentage of contacts with a similar amount of exposure (e.g., close, other-than-close) who have a newly identified positive skin test reaction (5 or more millimeters of induration) is called the **infection rate** for that group of contacts. (Contacts who had a previously documented positive skin test reaction before being exposed to the TB patient should be excluded from this percentage.)



To calculate the infection rate among a given group of contacts, the health care worker should follow these steps:

1. Determine the number of contacts with newly identified positive skin tests.

Subtract the number of contacts with a documented previous positive skin test from the total number of contacts with a positive skin test (new or previously documented)
2. Next, determine the total number of contacts without a documented previous positive skin test.

Subtract the number of contacts with a documented previous positive skin test from the total number contacts
3. Finally, determine the infection rate.

Divide the number of contacts with a new positive skin test by the total number of contacts without a documented previous positive skin test

Multiply by 100; the resulting percentage is the infection rate for the group of contacts

For an example of how to determine the infection rate, see Figure 6.11.



Example of Determining the Infection Rate

Example: Eleven contacts were identified for a reported TB case. One contact had a documented previous positive skin test. The other 10 contacts did not have documented previous skin tests. These 10 contacts were recently tested in connection with the contact investigation; 7 had a positive reaction and 3 had a negative reaction.

Summary:

11 contacts were identified

1 contact had a documented previous positive skin test

10 contacts had no documented previous skin test

7 of the 10 contacts had a newly identified previous positive skin test

3 of the 10 contacts had a newly identified negative skin test

1. Determine the number of contacts with a newly identified positive skin test.

Subtract the number of contacts with a documented previous positive skin test from the total number of contacts with positive skin tests (new or previously documented)

8 contacts with positive skin tests (new or previously documented)

-1 contact with a documented previous positive skin test

7 contacts with newly identified positive skin tests

2. Next, determine the total number of contacts without a documented previous positive skin test.

Subtract the number of contacts with a documented previous positive skin test from the total number contacts

11 total number of contacts identified

-1 contact with a documented previous positive skin test

10 contacts without a documented previous skin test

3. Finally, determine the infection rate.

Divide the number of contacts with a newly identified positive skin test by the total number of contacts without a documented previous positive skin test

Multiply by 100; the resulting percentage is the infection rate for the group of contacts

$\frac{7 \text{ contacts with a new positive skin test}}{10 \text{ contacts without a documented previous skin test}} \times 100 = 70\% \text{ Infection rate}$

Figure 6.11 Example of determining the infection rate.



.....
For the purpose of a contact investigation, a contact's local community is the geographic area where he or she lives and spends time.
.....

For the purpose of a contact investigation, a contact's **local community** is the geographic area where he or she lives and spends time. This may be a residential area or an ethnic community (e.g., groups of people who emigrated from the same geographic area). Recent TB transmission is probable when the infection rate in a group of contacts is greater than the level of skin test positivity in the local community (based on health department data or estimates, if available).

.....
When TB infection or disease occurs in young children, given their age, there is reason to suspect recent transmission.
.....

Infection in Young Children

When TB infection or disease occurs in young children, given their age, there is reason to suspect recent transmission. Infected children younger than 4 years of age and children with certain medical conditions are at increased risk of progression to TB disease. A positive tuberculin skin test reaction in a child always warrants careful assessment. A positive tuberculin reaction in a child with recent BCG vaccination may be difficult to interpret. However, if recent exposure has occurred, it is likely that the reaction is due to true TB infection (see Module 3, Diagnosis of Tuberculosis Infection and Disease).

.....
A skin test conversion for a contact is defined differently from a standard skin test conversion.
.....

Skin Test Conversions for Contacts

A skin test conversion for a contact is defined differently from a standard skin test conversion. The American Thoracic Society (ATS) defines a standard skin test conversion as a previous negative skin test reaction increasing 10 mm or more within a 2-year period. This definition of a standard skin test conversion typically applies to periodic surveillance of tuberculin-negative persons likely to be exposed to tuberculosis. For example, the definition for a standard skin test conversion is used for persons who undergo regular (e.g., yearly) skin testing as part of a skin testing program at a health care facility or other setting.



.....
 A skin test conversion for contacts is defined as a change from less than 5 mm on the initial skin test to a reaction of greater than or equal to 5 mm on the second test, 10 to 12 weeks after exposure.

.....
 When a contact has developed TB disease as a result of transmission from an index patient, this is called a secondary case of TB.

.....
 A contact investigation should be conducted immediately around any source case or secondary case or cases discovered during another investigation.

A skin test conversion for contacts is defined as a change from less than 5 mm on the initial skin test to a reaction of greater than or equal to 5 mm on the second test, 10 to 12 weeks after exposure. Any contact who has a skin test reaction of 5 mm or more on either the initial test or the follow-up test (10 to 12 weeks after exposure) should be evaluated for treatment for LTBI.

Secondary TB Cases

When a contact has developed TB disease as a result of transmission from an index patient, this is called a **secondary case** of TB. Contacts of infectious cases who have new positive skin test reactions are at high risk of developing TB disease because they have been recently infected.

It is also possible that the index patient developed TB disease as a result of exposure to a person who still has infectious TB disease. The index patient may identify a contact who was the initial source of his or her TB disease. In this instance, the contact is considered the source of transmission for the index patient; if the source case has not been reported to the health department, this should be done. **A contact investigation should be conducted immediately around any source case or secondary case or cases discovered during another investigation.**



.....
 Evidence of recent
 transmission may be
 provided by one or more of
 the factors discussed.

Making the Decision to Expand Testing

Evidence of transmission may be provided by one or more of the factors discussed above. When there is evidence of transmission in the first group of close contacts tested, the likelihood increases that *M. tuberculosis* has also been transmitted to contacts with less exposure than the close contacts. Therefore, the testing should be expanded to these contacts. In the example (Figure 6.11), if any of the seven contacts with a newly identified positive skin test reaction is a young child or has a negative reaction on the first skin test and a positive reaction on the test 10 to 12 weeks after exposure (i.e., skin test conversion for contacts), there is evidence that *M. tuberculosis* was transmitted. In addition, if any of the contacts had TB disease, it is likely to be the result of recent transmission.

The interpretation of the infection rate can be more difficult. In our example (Figure 6.11) the infection rate in the first group of contacts was 70% (Figure 6.11). This is much higher than the 5%-10% rate estimated for most populations without risk factors, and also higher than the 25% rate that may be seen in some populations with risk factors (e.g., correctional inmates). Frequently, the health department may not have data on the expected infection rates from different communities and populations. In addition, decisions about expanding contact investigations when the close contacts are from countries with a high incidence of TB may be even more difficult because of a high expected rate of previous infection from exposure in their country of birth. Decisions about expanding contact investigations to the next group of contacts should be made by clinical and supervisory staff based on an assessment of all available information.



.....
If there is NO evidence of recent TB transmission among close contacts, then testing should not be expanded to the next group of contacts.
.....

If there is NO evidence of recent *M. tuberculosis* transmission among close contacts, that is,

- # If the infection rate is lower than or similar to the level of infection in the community
- # No young children have a positive skin test reaction
- # No contact skin test conversions have occurred
- # No contacts have TB disease

then testing should NOT be expanded to the next group of contacts. Decisions about expanding contact investigations should be made by supervisory clinical and management staff.

.....
If there IS evidence of recent transmission, the next-highest-priority group should be evaluated.
.....
.....
The investigation should expand to the next group of contacts each time there is evidence of transmission in the group being tested.
.....

If there IS evidence of recent transmission, the next-highest-priority group should be evaluated. The investigation should expand to the next group each time there is evidence of transmission in the group being tested. This should be done as soon as it becomes clear that transmission has probably occurred (e.g., a strong suspicion of TB disease in a contact or several skin test conversions among the last group tested). Once the infection rate in the group being tested is about the same as the infection rate in the local community and there are no other factors indicating recent transmission, testing should be stopped (Figure 6.12).

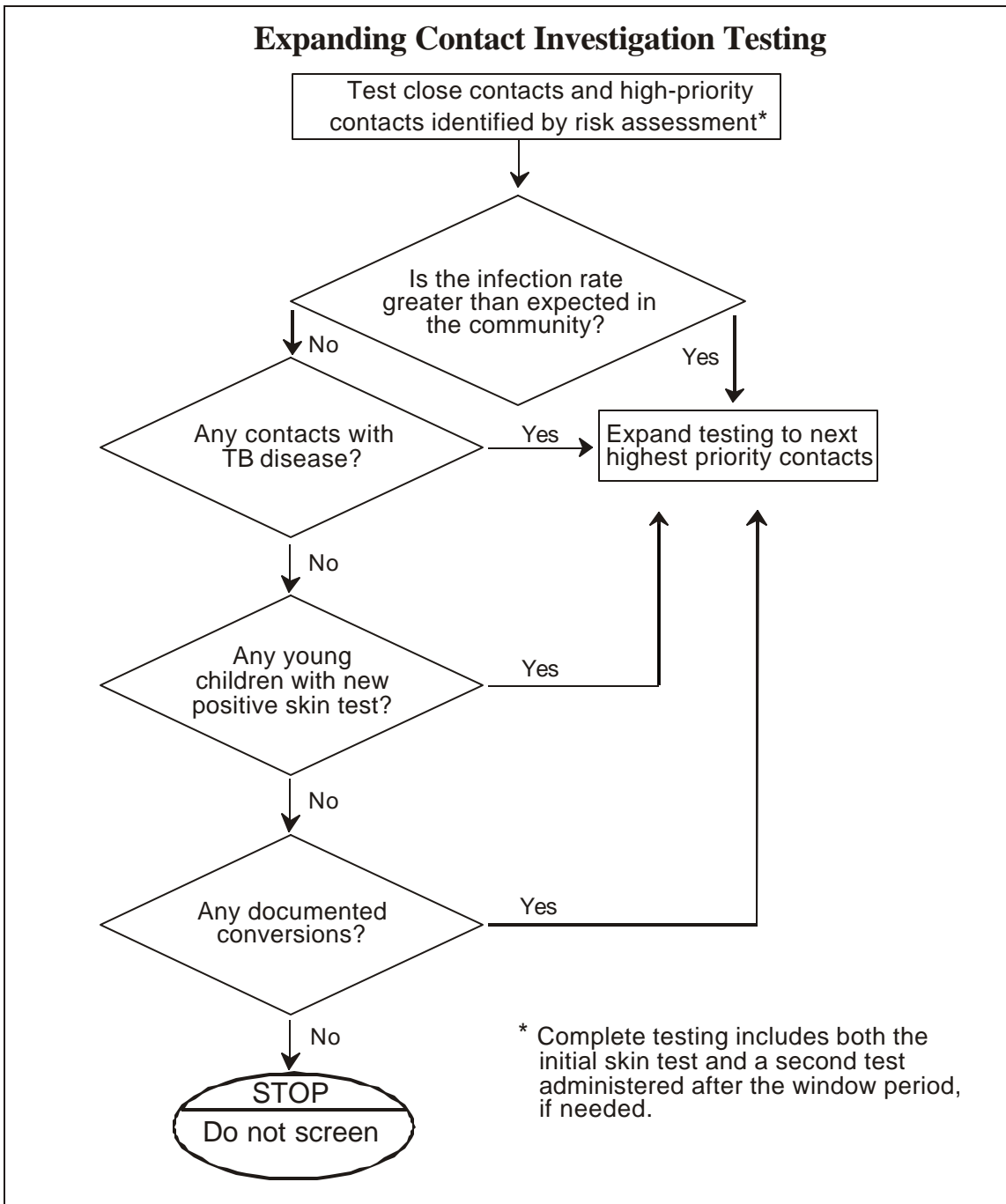


Figure 6.12 Expanding contact investigation testing.



The evaluation of data collected from contact investigations is a complicated process requiring careful interpretation and consideration of available evidence. The particular circumstances of each case (e.g., number of contacts involved, their age, their susceptibility to TB disease) need to be carefully considered in order to expand testing to include all those likely to be at risk.

Concentric Circle Approach

The concentric circle approach (Figure 6.13) is a method of testing contacts in order of their exposure time (close vs. other-than-close) and risk (high priority vs. low priority), with the close contacts and other contacts at high risk of developing TB disease tested first. In this approach, the original TB patient (the index case) is at the center. The circle is divided into three concentric rings to represent the three levels of risk: close (high risk), other-than-close (medium risk), and other-than-close (low risk). The circle is also divided, like a pie, into segments that represent the three types of environment where the contact may have taken place:

.....
The concentric circle approach is a method of testing contacts in order of their exposure time and their risk; it includes contacts from environments where contact may have taken place (household or residential, work or school, and leisure or recreation environments).
.....

- # Household or residential
- # Work or school
- # Leisure or recreation environments

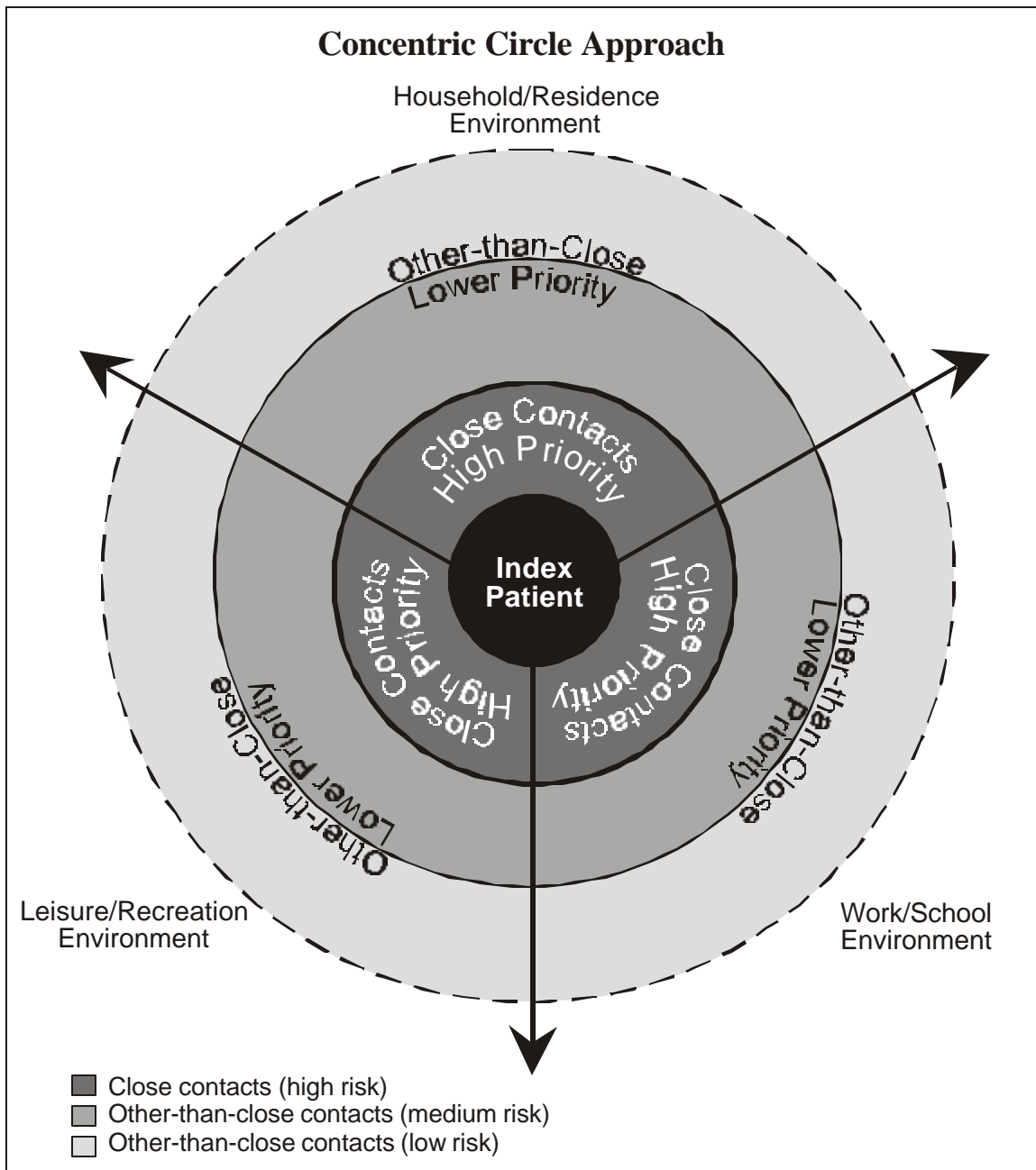


Figure 6.13 Concentric circle approach. Adapted from Etkind SC. Contact tracing in tuberculosis. In: Reichman L, Hershfield E, eds. *Tuberculosis: A Comprehensive International Approach*. New York: Marcel Dekkar;1993:283.



.
The highest-priority group consisting of close contacts and people at high risk of developing TB disease is in the closest circle and should be tested first.
.

The highest-priority group, consisting of close contacts and of people at high risk of developing TB disease, is the circle closest to the index circle. This means that this group is tested first. Close contacts can be found in each segment of the concentric circle (i.e., household or residential, work or school, and leisure or recreation environments). It is essential to test close contacts in all segments of the concentric circle, not just the household segment. Each of the circles represents groups of contacts, with the highest-priority groups nearest to the center and the lowest-priority groups farthest from the center. If there is evidence of transmission in one group, then the next outer circle of contacts should be tested, until there is no longer evidence of transmission.

Determining the level of the exposure of contacts or what “circle” or priority a given contact is for a contact investigation should be determined by supervisory clinical and management staff.

.
People with little or no exposure to the patient should not be sought out for testing unless there is evidence of transmission among contacts with more exposure.
.

Sometimes people who were not identified as close contacts come to the health department for evaluation or are present during field investigation and testing because they think they might have been exposed to the TB patient.



.....
Requests to expand contact investigations in institutional settings where data show transmission did not occur with close contacts are often driven by fear and misunderstanding of the risk of *M. tuberculosis* transmission.
.....

Likewise, when contact investigations are conducted in an institutional setting (school or worksite), decisions about expanding a contact investigation may be guided by principles other than those discussed previously, which are largely based on observing the number of documented new infections. For example, health departments may be requested to test all the employees or students in a specific setting, even if data show transmission did not occur with close contacts and thus the other contacts are not considered at risk for TB infection. Requests to expand contact investigations in institutional settings where data show transmission did not occur with close contacts are often driven by fear and misunderstanding of the risk of *M. tuberculosis* transmission. Decisions about expanding testing in these situations should be made by supervisory clinical and management staff.

.....
As the contact investigation progresses, the health care worker should make sure that all contacts who were scheduled for testing did receive initial tests and attend the follow-up appointments.
.....

As the contact investigation progresses, the health care worker should make sure that all contacts who were scheduled for testing received initial tests and attended the follow-up appointments (that is, skin test reading and, if needed, chest x-ray or sputum exam). The adherence of the index case and of any contact with TB disease should be monitored to ensure completion of adequate therapy. In addition, it is important to monitor the adherence of contacts who begin a regimen of treatment for LTBI.

.....
It is important to monitor the adherence of contacts who begin a regimen of treatment for LTBI.
.....



Study Questions 6.35-6.37

6.35. What factors show evidence of recent TB transmission?

6.36. How is the infection rate calculated for a group of contacts?

6.37. What is the concentric circle approach?

Answers on pages 117-118.



Evaluation of Contact Investigation Activities

.....
To complete the investigation, an evaluation should be conducted with or by a supervisor.
.....

The Evaluation

To complete the investigation, an evaluation of the contact investigation activities should be conducted with or by a supervisor to determine such things as

- Were an appropriate number of contacts identified?
- Were the highest-priority contacts located and tested?
- Was the contact investigation performed in all settings: household or residence, work or school, and leisure or recreational environments?
- Was the contact investigation expanded appropriately?
- Were contacts completely evaluated (including second skin test if needed) and given appropriate therapy if they had TB infection or disease?
- How many infected contacts completed a regimen of treatment for LTBI?
- Did all identified cases complete an adequate treatment regimen?

The answers to these questions will help determine how successful the contact investigation has been.



Information from individual contact investigations will be compiled and evaluated by management staff as part of ongoing program evaluation activities. The results of these program evaluations are used to

- # Determine effectiveness
- # Identify areas in need of improvement
- # Prioritize program activities and resources

Program evaluation is a critical component of any program. Evaluation of program performance is important to ensure that program resources and priorities are being used effectively on the highest priority activities.

.....
Effective and successful contact investigations can help prevent additional cases of TB infection and disease and reduce further transmission of *M. tuberculosis*.
.....

TB prevention and control efforts should be targeted to the groups at highest risk for TB infection, as well as to the groups at highest risk for progression from TB infection to TB disease. Contacts of infectious cases of TB are one such high-risk group. Effective and successful contact investigations can help prevent additional cases of TB infection and disease and reduce further transmission of *M. tuberculosis*.



Study Questions 6.38-6.39

6.38. List seven questions that should be answered in an evaluation of a contact investigation.

6.39. As part of program evaluation activities, what will the results of a contact investigation help management staff determine?

Answers on pages 118-119.



SUMMARY

A contact investigation is a procedure for

- # Identifying people who were exposed to someone with infectious TB disease
- # Evaluating these people for latent TB infection (LTBI) and TB disease
- # Providing appropriate treatment for those with LTBI and TB disease

A contact investigation is important to find contacts who

- # Have TB disease so that they can be given treatment, and further transmission can be stopped
- # Have LTBI so that they can be given treatment for LTBI
- # Are at high risk of developing TB disease and may need treatment for LTBI until it becomes clear whether they have TB infection

A person with suspected or confirmed TB disease who is the initial case reported to the health department is called the index patient. A contact investigation should be done whenever a person is found to have or is suspected of having infectious TB disease, and it should be started as soon as TB is diagnosed or strongly suspected in a patient. The health department is legally responsible for ensuring that a complete contact investigation is done for the TB cases reported in its area. For a contact investigation to be successful, infected contacts should begin and complete a regimen of treatment for LTBI. A successful contact investigation can interrupt transmission and prevent future cases of disease.

A contact investigation should be done when TB is confirmed or there is a high clinical suspicion of TB. While AFB sputum smear-negative TB disease usually indicates a lower bacterial burden than AFB smear-positive disease, and thus a lower risk of transmission, contact investigations for negative-smear cases usually should be conducted.

There are some instances in which contact investigations are not performed. For example, extrapulmonary TB (without pulmonary TB) does not carry any risk for transmission and contact investigations are not performed. Likewise, contact investigations are not performed for people with diseases caused by nontuberculous mycobacteria only, such as *M. avium* complex. In addition, young children with TB disease are rarely infectious, so a contact investigation is generally not conducted when a child is found to have TB disease.



In some situations, a source case investigation is conducted to find the source of TB transmission when recent transmission is likely. This is usually done when

- # A young child is found to have TB infection or disease
- # A severely immunosuppressed person who does not have a known history of TB infection is found to have TB disease
- # A cluster of tuberculin skin test conversions is found in a high-risk institution (for example, health care or correctional facility)

In general, there are three different types of places where patients may spend most of their time.

- # Household or residence
- # Work or school
- # Leisure or recreational environments

A contact investigation involves these steps:

- 1. Medical record review.** The first step in a contact investigation is to review the TB patient's medical record and ask the clinician for information to determine whether the patient has been infectious and, if so, when. Knowing about the patient's infectiousness helps health care workers decide which contacts are at risk. The health care worker collects information about the site of TB disease, the patient's TB symptoms, sputum smear and culture results, results of nucleic acid amplification testing (if available), chest x-ray results, TB treatment, and method of TB administration. In addition, the period of infectiousness should be determined. The period of infectiousness is the time period during which a person with TB disease is capable of transmitting *M. tuberculosis*. Determining the period of infectiousness can help focus the contact investigation efforts on those persons who were exposed while the patient was infectious. There is no universal, well-established method to determine the period of infectiousness. The beginning of the infectious period is usually estimated by determining the date of onset of the patient's symptoms (especially coughing).
- 2. Patient interview.** The next step in the contact investigation is to interview the TB patient. The patient interview is one of the most critical parts of the contact investigation, because the health care worker who interviews the patient serves as the main link between the health department and the contacts. If the health care worker does not communicate well enough with the patient to get accurate information about symptoms, places, and contacts, people who need evaluation and treatment may be missed.



- 3. Field investigation.** The next step is to conduct a field investigation. This means visiting the patient's home or shelter, workplace (if any), and the other places where the patient said he or she spent time while possibly infectious. The field investigation is important and should be done even if the patient interview has already been conducted. The purpose of the field investigation is to identify contacts and evaluate the environmental characteristics of the place in which exposure occurred. The field investigation may provide additional information for the risk assessment and identify additional contacts.

The health care worker visits the places where the patient spent time in order to observe environmental characteristics; identify additional contacts; look for evidence of other contacts; interview and skin test contacts who are present; educate contacts about the purpose of contact investigation, the basics of transmission, the risk of transmitting tuberculosis, and the importance of testing, treatment, and follow-up for TB infection and disease; and refer contacts who have TB symptoms to the health department for a medical evaluation including sputum collection.

- 4. Risk assessment for TB transmission.** Using information about the patient's period of infectiousness, the environmental characteristics of the places where the patient spent time, and the characteristics of the contacts' exposure, the health care worker assesses the risk of TB transmission. Contacts who spent time with the patient during the period of infectiousness are at higher risk for exposure and infection, especially if they had close, prolonged exposure in a small or crowded, poorly ventilated area. Also contacts exposed to patients with a high degree of infectiousness are at risk for TB transmission.

- 5. Decision about priority of contacts.** To use time and resources wisely, the contact investigation should be focused on the high-priority contacts, the contacts who are most at risk for developing TB infection or TB disease. In other words, the highest priority for testing should be given to

- # Contacts who are most likely to be infected, based on the risk that *M. tuberculosis* was transmitted

- # Contacts who are at high risk of developing disease if infected, including young children less than 4 years of age, HIV-infected and other immunosuppressed persons, and persons with certain medical conditions. Contacts with less intense or less frequent exposure are classified as other-than-close contacts, and they should be given a lower priority.

- 6. Evaluation of contacts.** Contacts should be evaluated for LTBI and TB disease. This evaluation includes at least a medical history and a Mantoux tuberculin skin test (unless there is a previous documented positive reaction). For immunosuppressed contacts or contacts under 4 years of age, the evaluation should also include a chest x-ray. Any contact who has



TB symptoms should be given both a chest x-ray and sputum examination. Contacts with a negative initial skin test reaction to a skin test given less than 10 to 12 weeks postexposure should be retested after the window period.

7. Treatment and follow-up for contacts. The following contacts should be evaluated for treatment for LTBI:

- # Contacts who have a positive tuberculin skin test reaction and no evidence of TB disease
- # High-risk contacts who have a negative tuberculin skin test reaction, such as children under 4 years of age, HIV-infected people, and other high-risk contacts who may develop TB disease very quickly after infection

High-risk contacts (including children under 4 years of age) with a negative skin test reaction less than 10 to 12 weeks after their exposure should start treatment for LTBI and be retested after the window period ends. This is called window period prophylaxis. If the second skin test reaction is negative, treatment for LTBI is usually stopped. If the second skin test reaction is positive, they should continue taking treatment for LTBI. Contacts who have a positive sputum smear or chest x-ray results suggestive of current TB disease should begin treatment for TB disease. The adherence of all patients receiving TB treatment for LTBI or treatment for TB disease should be monitored closely.

8. Decision about whether to expand testing. Contacts should be tested in the order of their exposure time and risk, starting with the highest-priority group. This method is called the concentric circle approach. Evidence of recent TB transmission among the high-priority contacts, such as a high infection rate (percentage of contacts with a similar amount of exposure who have a newly identified positive skin test reaction), TB infection in a young child, a documented contact skin test conversion, or a secondary case of TB, determines whether the next group of contacts should be screened. Decisions about expanding contact investigations to the next group of contacts should be made by clinical and supervisory staff based on an assessment of all available information. If there is NO evidence of recent TB transmission, then testing should NOT be expanded to the next group of contacts. If there IS evidence of recent transmission, the next highest priority group should be evaluated. The investigation should expand to the next group each time there is evidence of transmission in the group being tested. The particular circumstances of each case need to be carefully considered in order to expand testing to include all those likely to be at risk.

9. Evaluation of contact investigation activities. To complete the investigation, an evaluation should be conducted with or by a supervisor to determine such things as

- # Were an appropriate number of contacts identified?



- # Were the highest-priority contacts located and tested?
- # Was the contact investigation performed in all settings: household or residence, work or school, and leisure or recreational environments?
- # Was the contact investigation expanded appropriately?
- # Were contacts completely evaluated (including second skin test if needed) and given appropriate therapy if they had TB infection or disease?
- # How many infected contacts completed a regimen of treatment for LTBI?
- # Did all identified cases complete an adequate treatment regimen?



Additional Reading

American Thoracic Society/Centers for Disease Control. Diagnostic standards and classification of tuberculosis. *Am Rev Respir Dis.* 1990;142:725-735.

American Thoracic Society/Centers for Disease Control. Control of tuberculosis in the United States. *Am Rev Respir Dis.* 1992;146:1623-1633.

Centers for Disease Control and Prevention. Tuberculosis control laws — United States, 1993: recommendations of the Advisory Council for the Elimination of Tuberculosis (ACET). *MMWR.* 1993;42(RR-15):1-28.

Centers for Disease Control and Prevention. Screening for tuberculosis and tuberculosis infection in high-risk populations: recommendations of the Advisory Council for the Elimination of Tuberculosis (ACET). *MMWR.* 1995;44(RR-11):1-17.

Daley CL, Small PM, Schechter GF, et al. An outbreak of tuberculosis with accelerated progression among persons infected with the human immunodeficiency virus. *N Engl J Med.* 1992;326:231-235.

Etkind SC. Contact tracing in tuberculosis. In: Reichman L, Hershfield E, (eds): *Tuberculosis: A Comprehensive International Approach.* New York: Marcel Dekkar; 1993, pp 275-289.

Effective Tuberculosis Interviews: A Course on Interviewing and Communications Skills. This is a 3-day, interactive course designed to be taught by supervisory TB staff or other staff in state and local health departments. The purpose of the course is to improve interviewing and communications skills among new health department staff assigned to interview TB patients and suspects, conduct field investigations, foster patients' adherence to treatment, and assist with directly observed therapy. For more information on the availability of this course in your area, please ask your local TB program manager.

How to be "Streetwise"— and Safe. National Crime Prevention Council and Federal Protective Service. Brochure NCPB-002. (Can be ordered by calling 1-800-548-0325.)

Leonhardt KK, Gentile F, Gilbert BP, Aiken M. A cluster of tuberculosis cases among crack house contacts in San Mateo County, California. *Am J Pub Health.* 1994;84(11):1834-1836.

Lewis ID, Hallburg JC. Strategies for Safe Home Visits. *Urban Health.* 1980;9(6):40-41.



ANSWERS TO STUDY QUESTIONS

6.1. What is a contact investigation? (page 6)

A contact investigation is a procedure for

- # Identifying people who were exposed to someone with infectious TB disease
- # Evaluating these people for latent TB infection (LTBI) and TB disease
- # Providing appropriate treatment for those with LTBI and TB disease

6.2. What are three reasons why a contact investigation is important? (pages 7-8)

A contact investigation is important to find contacts who

- # Have TB disease so that they can be given treatment, and further transmission of TB can be stopped
- # Have LTBI so that they can be given treatment for LTBI
- # Are at high risk of developing TB disease and may need treatment for LTBI until it becomes clear whether they have TB infection

It is not enough to simply find and test contacts of an infectious case. For a contact investigation to be successful, infected contacts should begin and complete a regimen of treatment for LTBI. Likewise, contacts with TB disease should begin and complete treatment for TB disease. A successful contact investigation can interrupt transmission and prevent future cases of disease.

6.3. For which TB cases should a contact investigation be conducted? (pages 9-10)

A contact investigation should be done whenever a patient is found to have or is suspected of having infectious TB disease. Infectiousness depends on a variety of factors, but is more likely when patients have cough, hoarseness, or other symptoms of pulmonary or laryngeal TB. Other factors that increase the likelihood of infectiousness include positive AFB sputum smear or culture results, a cavity on the chest radiograph, and inadequate or no treatment. It is very important that a contact investigation be conducted for such persons, because they are likely to have infected others.



A contact investigation should be done when TB is confirmed or there is a high clinical suspicion of TB. While AFB sputum smear-negative TB disease usually indicates a lower bacterial burden than smear-positive disease, and thus a lower risk of transmission, contact investigations for negative-smear cases usually should be conducted. Recent evidence suggests that transmission can occur in AFB sputum smear negative cases as well.

There are some instances in which contact investigations are **not** performed. For example, extrapulmonary TB (without pulmonary TB) does not carry any risk for transmission and contact investigations are not performed.

Likewise, contact investigations are not performed for people with diseases caused by nontuberculous mycobacteria only, such as *M. avium* complex. (Nontuberculous mycobacteria are not spread from person to person.)

6.4. For which TB cases should a source case investigation be conducted? (page 12)

In some situations, a source case investigation is conducted to find the source of TB transmission when recent transmission is likely. This is usually done when

- # A young child is found to have TB infection or disease
- # A severely immunosuppressed person who does not have a known history of TB infection is found to have TB disease
- # A cluster of tuberculin skin test conversions is found in a high-risk institution (for example, health care or correctional facility)

6.5. What is the purpose of a source case investigation? (page 13)

The purpose of a source case investigation is to determine

- # Who transmitted *M. tuberculosis* to the child, index patient, or persons in the cluster of skin test conversions
- # Whether this person is still infectious
- # Whether the case of TB in this person was reported to the health department
- # Whether any others were infected by the source patient

**6.6. How quickly should a contact investigation be carried out?** (page 15)

A contact investigation should begin as soon as TB is diagnosed or strongly suspected in a patient. The contact investigation interview should be initiated no more than 3 working days after the case is reported to the health department. Close contacts should be examined within 7 working days after the index case has been diagnosed. A prompt contact investigation is important because some contacts, such as young children or HIV-infected and other immunosuppressed contacts, may develop TB disease very quickly after being exposed to and infected with *M. tuberculosis*. High-risk contacts need timely treatment if they have been infected so they will not become ill with TB disease. Also, as time goes by, some contacts may become harder to locate; for example, homeless contacts can move frequently from shelter to shelter and contacts who are migrant workers often move from state to state. A prompt contact investigation increases the likelihood that all contacts will be found and evaluated. The sooner contacts are identified and evaluated, and can begin appropriate therapy, the less likely it is that transmission will continue.

6.7. Who is responsible for a contact investigation? (page 16)

The health department is legally responsible for ensuring that a complete contact investigation is done for the TB cases reported in its area. Occasionally, some steps of the investigation may be performed by people outside the health department, under the supervision of the health department.

6.8. What is included in a contact investigation? (page 16)

The contact investigation includes

- # Identifying and evaluating contacts
- # Treating any contacts found to have TB disease
- # Offering treatment for LTBI to infected contacts
- # Monitoring adherence to prescribed regimens and ensuring a system is in place to assess completion of treatment

6.9. What are the nine steps in a contact investigation? (page 17)

A successful contact investigation requires the careful gathering and evaluation of detailed information by a process that includes these steps:



1. Medical record review
2. Patient interview
3. Field investigation
4. Risk assessment for *M. tuberculosis* transmission
5. Decision about priority of contacts
6. Evaluation of contacts
7. Treatment and follow-up for contacts
8. Decision about whether to continue testing
9. Evaluation of contact investigation activities

Although these steps are presented in sequence, for the purposes of this module, it is important to remember that contact investigations do not always follow a predetermined sequence of events.

6.10. List seven types of information that should be collected during the medical record review. (page 23)

The following information should be collected about the patient:

- # Site of TB disease
- # TB symptoms and approximate date symptoms began
- # Sputum smear and culture results, including the dates of specimen collection
- # Results of nucleic acid amplification testing (if available)
- # Chest x-ray results and date
- # TB treatment (medications, dosage, and date treatment was started)
- # Method of treatment administration (DOT or self-administered)



6.11. List five conditions that increase the likelihood that a patient is infectious. (page 24)

Patients are more likely to be infectious if they

- # Have pulmonary or laryngeal TB
- # Are coughing (especially if they are producing a lot of sputum)
- # Have positive sputum AFB smear results and a culture positive for *M. tuberculosis*
- # Have chest x-ray results showing a cavity in the lung
- # Have had no treatment or have recently started treatment

6.12. Define the period of infectiousness and discuss how it is estimated. (page 25)

The period of infectiousness is the time period during which a person with TB disease is capable of transmitting *M. tuberculosis*. Determining the period of infectiousness can help focus the contact investigation efforts on those persons who were exposed while the patient was infectious. There is no universal, well-established method to determine the period of infectiousness. The beginning of the infectious period is usually estimated by determining the date of onset of the patient's symptoms (especially coughing). Sometimes when it is difficult to obtain a reliable history from the patient about the onset of symptoms, the beginning of the infectious period is estimated to be earlier than the onset of symptoms. Estimating the period of infectiousness should be done by clinical and supervisory staff after a complete assessment of the information available.

The period of infectiousness ends when all the following criteria are met:

- # Symptoms have improved
- # The patient has been receiving adequate treatment for 2 to 3 weeks
- # The patient has had three consecutive negative sputum smears from sputum collected on different days

6.13. When should a patient interview be done? (page 29)

The initial interview should occur no more than 3 working days after the case is reported to the health department because it is possible that some contacts may have already developed infectious TB disease. Also, as time goes by, some contacts may be harder to locate. If TB is diagnosed in the hospital, the health care worker should visit the patient



in the hospital before the patient is discharged. Health care workers should remember to follow infection control precautions while visiting a potentially infectious TB patient. These precautions may include wearing a personal respirator.

6.14. List three reasons why the TB patient should be interviewed for a contact investigation. (page 29)

For a contact investigation, there are three main reasons to interview the TB patient:

- # To find out more about the patient's symptoms to help determine the period of infectiousness
- # To find out places where the patient spent time while he or she was infectious
- # To identify the patient's contacts, get locating information for the contacts, and find out how often and how long the contacts were exposed to the patient while he or she was infectious

6.15. When conducting a contact investigation interview, from what three types of places should TB patients be asked to identify contacts? (page 30)

In general, there are three different types of places where patients may spend most of their time:

- # Household or residence
- # Work or school
- # Leisure or recreation environments

6.16. What are some strategies the health care worker can use to conduct effective interviews? (page 39)

For the patient interview to be effective and successful, a health care worker should

- # Explain to the patient the importance of the contact investigation for preventing and controlling TB
- # Ensure that the interview takes place under conditions that encourage effective communication
- # Establish the foundation for a good relationship with the patient based on mutual trust and understanding



- # Begin an assessment of the patient's knowledge, feelings, and beliefs about TB and educate patient
- # Ask open-ended questions
- # Have a clear understanding of the interview's objectives
- # Plan the interview so that each objective is given adequate time
- # Listen to the patient's concerns about TB and its treatment
- # Share information freely with the patient

6.17. What are four conditions that encourage effective interviews? (page 41)

Because it is important to make the patient as comfortable as possible, the health care worker should ensure that the interview takes place under conditions that encourage effective communication. These conditions include

- # Arranging for privacy and maintaining confidentiality and assuring the patient that all information will be kept private
- # Creating an environment relatively free of distractions and interruptions
- # Listening attentively and respectfully to the patient (for example, sit down near the patient and use open, relaxed body language)
- # Being objective and nonjudgmental (for example, be patient, not accusatory, and never show frustration)

6.18. If the patient is not able to recall all of his or her contacts at the initial interview, what can the health care worker do to obtain more information about contacts? (page 46)

The health care worker should realize that the patient may not be able to recall all of the names of possible contacts at the initial interview, especially if the interview occurs around the same time as the diagnosis. The health care worker should provide the patient with an opportunity to provide other contacts as they are remembered. The health care worker can encourage the patient to phone the health department if he or she remembers other contacts. In addition, the health care worker should schedule a follow-up interview with the patient to identify more contacts.



6.19. What is a field investigation? (page 49)

A field investigation means visiting the patient's home or shelter, workplace (if any), and the other places where the patient said he or she spent time while infectious. The field investigation is important and should be done even if the patient interview has already been conducted. The purpose of the field investigation is to identify contacts and evaluate the environmental characteristics of the place in which exposure occurred. The field investigation may provide additional information for the risk assessment and identify additional contacts.

6.20. List six tasks a health care worker should perform during a field investigation. (pages 49-50)

During field visits, the health care worker should

- # **Observe environmental characteristics** such as room size, crowding, and ventilation, to estimate the risk of TB transmission
- # **Identify additional contacts** (especially children) and their locating information, such as phone numbers and addresses
- # **Look for evidence of other contacts** who may not be present at the time of the visit (for example, pictures of others who may live in or visit the house, shoes of others who may live in the house, or toys left by children)
- # **Interview and skin test close contacts** who are present and arrange for reading of the results
- # **Educate the contacts** about the purpose of a contact investigation, the basics of transmission, the risk of transmitting *M. tuberculosis* to others, and the importance of testing, treatment, and follow-up for TB infection and disease
- # **Refer contacts who have TB symptoms** to the health department for a medical evaluation, including sputum collection



6.21. List three general safety precautions that are recommended for the health care workers who conduct field investigations. (page 51)

- # Wearing an identity badge with a current photo
- # Working in pairs when visiting a potentially dangerous area
- # Informing someone of your itinerary and expected time of return, especially if you anticipate problems

6.22. What three main factors should be considered in the risk assessment for TB transmission? (page 54)

The risk of transmission depends on three main factors:

- # The infectiousness of the TB patient
- # The environmental characteristics of each place
- # The characteristics of the contact's exposure

Assessing this risk is crucial because it helps determine which contacts should be given higher priority for testing and evaluation.

6.23. Why is it important to know the period of infectiousness? (page 25, 54)

It is important to estimate the period of infectiousness because it helps determine which contacts have actually been exposed to TB. Contacts who spent time with the patient during the period of infectiousness are at higher risk for exposure and infection.

6.24. Name three environmental characteristics that would put contacts at higher risk of infection. (page 55)

The risk of TB transmission in a particular place depends on the concentration of infectious droplet nuclei in the air — that is, the number of droplet nuclei in a certain amount of air. The patient's infectiousness affects the concentration of droplet nuclei. In addition, the concentration of droplet nuclei depends on three environmental characteristics:



- # Size of the room
- # Amount of ventilation
- # Presence of air cleaning systems

Contacts are at higher risk of infection in a small, enclosed or crowded room that receives no fresh air. This is especially true if there are no air cleaning systems present.

6.25. Which contacts are at higher risk of becoming infected? (pages 58, 64)

The following contacts are at higher risk for significant TB exposure, and so are most likely to become infected:

- # Contacts exposed to patients with a high degree of infectiousness based on the following factors: laryngeal or pulmonary TB, AFB sputum smear-positive, cavitory disease on chest x-ray, cough, positive culture for *Mycobacterium tuberculosis*
- # Contacts exposed to the patient in small or crowded rooms, areas that are poorly ventilated, or areas without air-cleaning systems
- # Contacts who frequently spend a lot of time with the patient, or have been physically close to the patient

6.26. Which contacts should be classified as close contacts and are most likely to be infected? (page 61)

People who had close, regular, prolonged contact with the TB patient while he or she was infectious, especially in small, poorly ventilated places are close contacts and are most likely to be infected with TB. These contacts are classified as close contacts, and usually include people who have shared a house or room with the patient or spent time with the patient frequently during the period of infectiousness. Contacts with less intense, less frequent, or shorter durations of contact to the TB patient are classified as other-than-close contacts, and they generally should be given a lower priority for testing.

6.27. Which contacts are at high risk of developing TB disease if infected? (page 63)

Some conditions (HIV infection, injection of illicit drugs, diabetes mellitus, silicosis, prolonged corticosteroid therapy, immunosuppressive therapy, certain types of cancer, severe kidney disease, certain intestinal conditions, and low body weight) increase the risk that TB infection will progress to TB disease. Contacts with these conditions should be given high priority for TB testing, regardless of whether they are close contacts or



other-than-close contacts. Young children less than 4 years of age should also be given high priority for testing, because they can develop serious forms of TB disease very quickly after infection.

6.28. Which contacts should be considered high priority contacts for testing?
(pages 61-63)

Close contacts (see answer 6.26) and contacts who are at high risk of developing disease if infected (see answer 6.27). Testing for TB infection and disease should begin with these high-priority contacts.

6.29. For all high-priority contacts, what procedures should be done during evaluation?
(page 67)

Evaluation of TB contacts should be done in an orderly manner, starting with the highest-priority group of contacts. Contacts should be evaluated for LTBI and TB disease. This evaluation includes at least

- # A medical history and
- # A Mantoux tuberculin skin test (unless there is a previous documented positive reaction)

For immunosuppressed contacts or contacts who are under 4 years of age, the evaluation should also include a chest x-ray, regardless of skin test result, because of the possibility of a false-negative reaction to the tuberculin skin test and risk of early progression to TB disease if infected.

In addition, any contact who has TB symptoms should be given both a chest x-ray and a sputum examination.

6.30. In what situation should tuberculin testing of contacts be repeated? (page 69)

Contacts who are skin tested less than 10 to 12 weeks after their last exposure to a patient with infectious TB may have a false-negative reaction, because they may not yet be able to react to the tuberculin. It takes 2 to 12 weeks after TB infection for the body's immune system to react to tuberculin. For this reason, close contacts of someone with infectious TB disease who have a negative initial skin test reaction should be retested 10 to 12 weeks after the last contact with the person who has TB disease. The time span between the date of an initial skin test with a negative reaction and the date that is 10 to 12 weeks



after exposure is called the window period. After the window period has ended, a repeat skin test should be administered to each contact who had an initial negative reaction.

6.31. Which contacts should be given a chest x-ray? (pages 70-71)

All contacts who have a positive skin test reaction with an induration greater than 5 mm or who report any TB symptoms should be given a chest x-ray.

Certain contacts should have a chest x-ray to evaluate for TB disease at the same time the initial skin test is done, including those that

- # Have TB symptoms
- # Are HIV-infected or have other immunosuppressed conditions
- # Are under 4 years of age

6.32. What is the purpose of a sputum examination and when should one be done? (page 71)

Any contact who has an abnormal chest x-ray or who has TB symptoms should have three sputum specimens collected on different days for smear and culture examination, regardless of his or her tuberculin skin test reaction. The results of the smear examination can be used to help determine the person's infectiousness, although a negative smear does not rule out the possibility of TB disease.

6.33. Which contacts should be evaluated for treatment for LTBI? (page 75)

The following contacts should be evaluated for treatment of LTBI:

- # Contacts who have a positive tuberculin skin test reaction and no evidence of TB disease
- # High-risk contacts who have a negative tuberculin skin test reaction, such as children under 4 years of age, HIV-infected people, and other high-risk contacts who may develop TB disease very quickly after infection

6.34. What is window period prophylaxis and when should it be used? (page 76)

High-risk contacts (including children under 4 years of age) with a negative skin test reaction less than 10 to 12 weeks after their exposure should start treatment for LTBI and be retested after the window period ends. This is called window period prophylaxis. If



the second skin test reaction is negative, treatment for LTBI is usually stopped. If the second skin test reaction is positive, they should continue taking treatment for LTBI. Infants younger than 6 months of age should be evaluated as discussed previously.

6.35. What factors show evidence of recent TB transmission? (page 82)

Evidence of recent transmission is provided by any of the following factors:

- # A high infection rate among contacts
- # Infection in a young child
- # A skin test conversion in a contact
- # A secondary case of TB disease

An evaluation of this evidence will help determine whether testing should expand.

6.36. How is the infection rate calculated for a group of contacts? (pages 83-84)

To calculate the infection rate among a given group of contacts, the health care worker should follow these steps:

1. Determine the number of contacts with newly identified positive skin tests.
 - # Subtract the number of contacts with a documented previous positive skin test from the total number of contacts with a positive skin test (new or previously documented)
2. Next, determine the total number of contacts without a documented previous positive skin test.
 - # Subtract the number of contacts with a documented previous positive skin test from the total number contacts
3. Finally, determine the infection rate.
 - # Divide the number of contacts with a new positive skin test by the total number of contacts without a documented previous positive skin test
 - # Multiply by 100; the resulting percentage is the infection rate for the group of contacts



6.37. What is the concentric circle approach? (pages 90-92)

The concentric circle approach is a method of testing contacts in order of their exposure time (close vs. other-than-close) and risk (high priority vs. low priority), with the close contacts and other contacts at high risk of developing TB disease tested first. In this approach, the original TB patient (the index case) is at the center. The circle is divided into three concentric rings to represent the three levels of risk: close (high risk), other-than-close (medium risk), and other-than-close (low risk). The circle is also divided, like a pie, into segments that represent the three types of environment where the contact may have taken place:

- # Household or residential
- # Work or school
- # Leisure or recreation environments

The highest-priority group, consisting of close contacts and of people at high risk of developing TB disease, is circle closest to the index circle. This means that this group is tested first. Close contacts can be found in each segment of the concentric circle (i.e., household or residential, work or school, and leisure or recreation environments). It is essential to test close contacts in all segments of the concentric circle, not just the household segment. Each of the circles represents groups of contacts, with the highest-priority groups nearest to the center and the lowest-priority groups farthest from the center. If there is evidence of transmission in one group, then the next outer circle of contacts should be tested, until there is no longer evidence of transmission.

6.38. List seven questions that should be answered in an evaluation of a contact investigation. (page 96)

To complete the investigation, an evaluation should be conducted with or by a supervisor to determine such things as

- # Were an appropriate number of contacts identified?
- # Were the highest-priority contacts located and tested?
- # Was the contact investigation performed in all settings: household or residence, work or school, and leisure or recreational environments.
- # Was the contact investigation expanded appropriately?



- # Were contacts completely evaluated (including second skin test if needed) and given appropriate therapy if they had TB infection or disease?
- # How many infected contacts completed a regimen of treatment for LTBI?
- # Did all identified cases complete an adequate treatment regimen?

6.39. As part of program evaluation activities, what will the result of a contact investigation help management staff determine? (page 97)

Information from individual contact investigations will be compiled and evaluated by management staff as part of ongoing program evaluation activities. The results of these program evaluations are used to

- # Determine effectiveness
- # Identify areas in need of improvement
- # Prioritize program activities and resources



ANSWERS TO CASE STUDIES

6.1. Jung Hu is a 3-year-old child who has been diagnosed with TB meningitis. Jung and his parents immigrated from China one year ago, along with his paternal grandmother. Jung does not have pulmonary or laryngeal TB disease, and a sputum specimen collected by gastric aspirate does not show any acid-fast bacilli (AFB). Jung's TB disease is reported to the health department and he is started on an appropriate TB drug regimen.

Should a contact investigation be done with Jung as the index patient? Why or why not?

A contact investigation should be done whenever an index patient is found to have or is suspected of having infectious TB disease.

Jung has extrapulmonary disease and has no AFB in his sputum. Moreover, children with TB disease are rarely infectious, so a contact investigation should not be done with Jung as the index patient.

Should a source case investigation be done? What would be the purpose of this investigation?

In this situation a source case investigation may be done to find the person who transmitted TB to Jung. When a child has TB infection or disease, we know that TB was transmitted relatively recently. In Jung's case, he is 3 years old, so he must have been exposed to someone with TB disease during the past 3 years. The person who is the source of this exposure is called the source patient. In this case, the source patient may be a family member or friend (here or in China) with infectious, possibly untreated TB disease. A source case investigation should be conducted to determine

Who transmitted *M. tuberculosis* to Jung

Whether this person is still infectious

Whether the case of TB in this person was reported to the health department

Whether any others (especially young children) were infected by the source patient



6.2. You are a clinical TB case manager at a busy clinic in Smith County. Three new TB cases have been assigned to you. You need to review their charts and assign them to contact investigators.

- 1. Mr. Garcia is a 35-year-old agricultural worker diagnosed by a local private physician with extrapulmonary TB of the kidneys. He lives with his wife and 3 children (5 years, 3 years, and 9 months old) in a small, rented house in a rural part of the county. He rides to work every day in a van with 7 other agricultural workers.**
- 2. Mr. James is a 72-year-old widower who lives alone on the south side of town. He drives himself to the local retirement center 2 miles from his house for bingo and poker four times a week. He was recently evaluated by the retirement center physician because he complained of a productive cough, shortness of breath, fatigue, and weight loss. He is AFB sputum smear-positive and his culture is pending. His chest x-ray shows a cavity in the right upper lobe. He started a four-drug regimen.**
- 3. Mrs. Osaka is a 25-year-old woman who recently arrived from Japan. She was seen in the Smith County Clinic complaining of shortness of breath, a weak nonproductive cough, fatigue, and weight loss. Her AFB sputum smear was negative and her culture is pending. She lives with her husband and parents in a large apartment off Broadway. She is currently unemployed. She started a four-drug regimen.**

For which case(s) should a contact investigation be conducted?

Both Mr. James and Mrs. Osaka should have contact investigations performed.

Mr. Garcia has extrapulmonary TB so a contact investigation is not needed.

How should the case(s) be prioritized in terms of conducting a contact investigation?

Mr. James is a high priority for a contact investigation. His is more likely to be infectious because he is AFB sputum smear-positive. His chest x-ray reveals a cavity in the right upper lobe, and he has a productive cough.

Mrs. Osaka is a lower priority for contact investigation because she is AFB sputum smear-negative, and her culture is pending.



Mr. James, who has positive AFB sputum smears and a productive cough, is much more likely to be infectious than Mrs. Osaka, who has negative AFB sputum smears and a weak unproductive cough.

- 6.3. Matilda Landers is a 73-year-old resident at the Washington County Nursing Home who has been hospitalized for a serious respiratory illness. She has been reported to the health department as a suspected TB case, and you are the public health worker assigned to conduct a contact investigation. You have conducted a medical record review and found the following information.**

Site of TB disease: laryngeal TB suspected

TB symptoms: hoarseness, cough, fatigue, weight loss

Smear results: AFB positive (3+) on 5/23/99

Culture results: pending

Chest x-ray results: cavity in left upper lobe

TB treatment: four-drug regimen begun on 5/24/99

- # What additional information is needed to establish the period of infectiousness?
How will you get this information?**

The period of infectiousness is the time period during which a person with TB disease is capable of transmitting *M. tuberculosis*. Determining the period of infectiousness can help focus the contact investigation efforts on those persons who were exposed while the patient was infectious. There is no universal, well-established method to determine the period of infectiousness. The beginning of the infectious period is usually estimated by determining the date of onset of the patient's symptoms (especially coughing). Ms. Landers should be asked to estimate the date her symptoms began. The clinician caring for Ms. Landers or the nursing home staff may also provide information about the patient's infectiousness; if a baseline skin test or chest x-ray was performed when Ms. Landers entered the home, this may be helpful.

The period of infectiousness ends when all the following criteria are met:

- # Symptoms have improved
- # The patient has been receiving adequate treatment for at least 2 to 3 weeks
- # The patient has had three consecutive negative sputum smears from sputum collected on different days



What other information will you ask for when you conduct a patient interview with Ms. Landers?

For the contact investigation, there are three main reasons to interview Ms. Landers:

- # To find out more about her symptoms to help determine the period of infectiousness
- # To find out places where she spent time while she was infectious
- # To identify her contacts, get the contacts' addresses (if available), and find out how often and how long the contacts were exposed to Ms. Landers while she was infectious

The health care worker should explain the goals of the contact investigation and why it is important to know the names of contacts, whether fellow residents, staff, or visitors. If she may have been infectious before entering the home, Ms. Landers may need to identify contacts at a former residence. Ms. Landers should be told about her right to privacy and the measures that will be taken to maintain confidentiality. In addition, the interview is a good opportunity for the public health worker to get to know Ms. Landers, educate her about TB, look for factors that may affect her adherence to treatment, and arrange follow-up visits with the health department. If Ms. Landers is not mentally able to do the interview, family members, friends, and nursing staff at the home may be asked to help identify contacts.

When information must be revealed about a case without prior permission in order to protect public health, consultation should be made with a supervisor or TB controller to obtain approval to breach confidentiality. The approval should be documented in the patient record.

6.4. Carmen is a 24-year-old TB patient. She was recently diagnosed with TB by the medical director of the college health center on campus. Carmen is not from the United States. She lives with her aunt and is taking classes at the local college. Susan, the health care worker, is conducting a field investigation. Susan has already conducted a patient interview with Carmen while she was in the hospital. In the interview, Carmen only identified her aunt, as well as three friends from college as contacts. Refer back to Figure 6.5 on page 50 and use the photo to assist in answering the following question.

- # Based on what is visible in the photo on page 50, is there evidence of any possible contacts in Carmen's house other than her aunt?**



The health care worker should notice that there are pictures of children and others who were not mentioned in the patient interview. In addition, the health care worker should notice the toys and children's shoes on the floor. There is also a pair of men's boots on the floor. Carmen has not mentioned other contacts in the house. However the pictures, shoes, and toys suggest that there may be other people who live in or visit the house. If additional contacts are identified they should be considered for evaluation.

- 6.5. A health care worker has just interviewed a 47-year-old TB patient, Derrick Jones. Derrick has had a cough for about 2 months and started treatment for TB disease 3 days ago. He lives alone in a small apartment on 41st Street. He is currently unemployed, but in the past 2 months he has worked the night shift with two other employees at the convenience store on 39th Street. During the day, Derrick goes to friends' apartments nearby or stays in his apartment to watch TV. He often goes to the local bar in his neighborhood with his friends Reggie and Melvin. He usually eats at one of two restaurants—the 39th Street Diner or Susie's Kitchen.**

His girlfriend, Tonya, is present at the interview and is aware that Derrick is being treated for TB. Derrick says she spends the night several times a week and often brings her 2-year-old son. When Tonya leaves, Derrick says that another girlfriend, Kelly, has stayed over about 10 times in the past 2 months. Last month, Derrick spent several days at Kelly's house, where she lives with her mother.

Based on this information, who are the potential contacts? Which contacts are at higher risk for infection and why?

- # The two coworkers at the convenience store
- # Friends whom Derrick visits at home, and anyone else who lives in their house
- # Reggie, Melvin, and other people who regularly go to the local bar with Derrick
- # The bartender
- # Waiters, waitresses, or friends at the two restaurants
- # Tonya and her son
- # Kelly and her mother

Close contacts, or people who had close, prolonged exposure to Derrick while he was infectious, are more likely to become infected than contacts who see Derrick less often. Tonya and her son are probably the most at risk because they frequently stay in



Derrick's apartment. Kelly and her mother are also at risk because Derrick stayed at their house during the time he was probably infectious. In addition, the friends he spends the most time with — probably Reggie and Melvin — would be considered close contacts.

While the health care worker is at Derrick's apartment for the interview, what else should be done?

The health care worker should

- # Note environmental characteristics, such as room size, crowding, and ventilation, to estimate the risk of TB transmission
- # Identify any additional contacts
- # Look for evidence of other contacts who may not be present
- # Interview Tonya and her son, if they are present, and give them tuberculin skin tests. Ask Tonya whether she or her son has had any TB symptoms
- # Educate Derrick and Tonya about how TB is spread, explain why a contact investigation is important, and educate them about testing, treatment, and follow-up for TB infection and TB disease
- # Refer Tonya and her son, if they have TB symptoms, to the health department for a medical evaluation, including sputum collection

6.6. You are in charge of the contact investigation for 35-year-old Hector Gonzalez, who is strongly suspected of having pulmonary TB disease. One week ago, Hector came to the health department complaining of night sweats, a 10-pound weight loss, and a persistent cough that has lasted about a month. His sputum smears were positive for AFB, and he started four-drug treatment for TB disease.

When you interviewed Hector 3 days ago, you found out that he lives with his 32-year-old wife, Mimi; two sons, Luis, 2, and Javier, 4; and his mother-in-law, Alma, 65. Hector's cousin, Henry, has stopped by the house a few times in the past month. Hector informed you that Henry has been HIV positive for 2 years.

Hector rides to work every day with his friend Joe. The ride lasts about half an hour. Hector works in a car assembly plant. About 100 employees work in the main room with Hector, but the room is divided into several sections. There are 20 people in Hector's section, and 4 of these people are assigned to work closely with Hector. Hector eats lunch outside every day with these 4 coworkers.



About twice a week and on weekends, Hector goes to a small neighborhood bar located in the basement of a building. At the bar, Hector spends most of the time talking to the bartender.

Which contacts would you consider close contacts?

- # Household members: Mimi, Luis, Javier, Alma
- # Close friend: Joe
- # Four coworkers who work closely with Hector
- # Bartender at the local bar, especially because the bar was small and enclosed in the basement

Which contacts would you screen first (the high-priority contacts)?

All of the close contacts mentioned above, as well as Henry. Although Henry did not have close or frequent exposure to Hector, he is at high risk for developing TB disease because of his HIV infection. Therefore, he should be considered a high-priority contact, and he should be screened along with the first group of contacts.

6.7. The high-priority contacts you identified in Case Study 6.6 for Hector Gonzalez, a patient suspected of having TB disease, were

- # **Household members: Mimi (wife), Luis and Javier (sons), Alma (mother-in-law)**
- # **Close friend: Joe**
- # **Four coworkers who work closely with Hector**
- # **Bartender at the local bar**
- # **Hector's cousin Henry, who has HIV infection**

These contacts (a total of 11) are being screened by the contact investigation team. Five weeks have passed since the contacts were last exposed to Hector while he was infectious.

Which contacts should be evaluated with a medical history and skin test? Which contacts also should be given a chest x-ray?

Every contact should be screened with a medical history and a Mantoux tuberculin skin test. In addition, Luis (because he is under 4 years of age) and Henry (because he is HIV positive) each should be screened with a chest x-ray.



This is because they are at high risk of quickly developing TB disease if infected and may already have TB disease by the time of the contact investigation.

None of the contacts had TB symptoms. The skin test results were as follows:

Newly identified positive reaction: Mimi, 32 (11 mm); Javier, 4 (13 mm)

Negative reaction: Luis, 2 (0 mm); Alma, 65 (3 mm); Joe (3 mm); Henry, HIV+ (0 mm); Coworker A (2 mm); Coworker B (0 mm); Coworker C (0 mm); Coworker D (3 mm); the bartender (0 mm)

What follow-up testing and treatment are needed for contacts with a positive skin test reaction?

Both contacts who have a positive skin test reaction — Mimi and Javier — should be given a chest x-ray to rule out the possibility of TB disease. If the chest x-ray is normal, they should complete a full course of treatment for LTBI. If the chest x-ray is abnormal, they should be evaluated for TB disease, including a sputum examination.

Should any follow-up testing or treatment be given to contacts with a negative skin test reaction at this time?

Yes. Because they are at high risk of quickly developing TB disease if infected, Henry and Luis should start treatment for LTBI if their chest x-rays are normal and they have no TB symptoms. Because their last exposure to Hector while he was infectious occurred only 5 weeks ago, their skin-test results may be false-negative reactions. They should be given treatment for LTBI, or window period prophylaxis, until 10 to 12 weeks from their last exposure, when they should have a repeat skin test. If their chest x-rays are abnormal, they should be evaluated for TB disease, including a sputum examination.

Which contacts should receive a repeat skin test? When should the repeat test be performed?

Henry and Luis should be retested 10 to 12 weeks after they were last exposed to Hector. If Luis' second skin test reaction is negative, he can stop taking treatment for LTBI. If his second skin test reaction is positive, Luis should complete a full course of treatment for LTBI. Because he is HIV infected, Henry may be given a complete course of treatment for LTBI, regardless of the second skin test reaction.



All of the other contacts who have a negative skin test reaction — Alma, Joe, the bartender, and the four coworkers — should be retested 10 to 12 weeks after they were last exposed to Hector while he was still infectious. Anyone who has a positive reaction to the second skin test should complete a full course of treatment for LTBI after TB disease has been ruled out.

6.8. The contacts tested in Case Study 6.7, page 73, were retested 12 weeks after their last exposure to Hector while he was infectious. Luis and Henry were given window period prophylaxis during the window period. The results of repeat skin testing of contacts with an initial negative reaction are as follows:

<u>Contact conversions:</u>	<u>Negative reactions:</u>	<u>Initial Positive Reaction</u>
Coworker A (11 mm)	Alma (4 mm)	Mimi (11 mm)
The bartender (10 mm)	Joe (2 mm)	Javier (13 mm)
Luis (8 mm)	Henry (0 mm)	
	Coworker B (3 mm)	
	Coworker C (0 mm)	
	Coworker D (4 mm)	

What was the infection rate in this group of contacts? Don't forget to include contacts with an initial positive reaction (see page 73).

Five contacts had either a newly identified positive skin test reaction on the initial test or a documented conversion on the repeat test; a total of 11 were screened. No contacts had a documented previous skin test.

$$[5 \div 11] \times 100 = 45\%$$

The expected infection rate in Hector's community is about 12%. Is there any evidence of TB transmission in the first group of contacts?

Yes. There are no cases of TB disease, but the infection rate in the group of contacts is higher than the level in the community. Other evidence of recent TB transmission is provided by the three documented skin-test conversions (in Coworker A, the bartender, and Luis). In addition, Luis' infection is evidence of TB transmission because Luis is a young child.



Should testing be expanded to the next group of contacts?

Testing should be expanded to the next group of contacts because there is evidence of recent TB transmission. This should have been done as soon as there was evidence that transmission had occurred (for example, when Javier, a young child, had a positive skin test reaction). The next group of contacts screened should include

People who work in the same section with Hector at the plant (other than the four who were already tested)

People who go to the neighborhood bar regularly

If there is evidence of transmission in this group of contacts, testing should be expanded to include the 100 people in the plant's main room and other identified contacts with a similar level of exposure.

