

# Chapter X: Contact Evaluation and Management

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## **A. Purpose of a Contact Investigation**

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In 1962, isoniazid (INH) was shown to be effective in preventing TB among household contacts to persons with active TB. Investigation and treatment of contacts became a strategy in the control and elimination of TB. Therefore, the purpose of contact investigations is to:

- Identify additional cases of active TB (on average 1-2% of contacts of infectious cases will have active TB)
- Evaluate those persons exposed to active pulmonary TB that may have become infected and treat those contacts appropriately (on average about 20-30% of contacts are infected).

The evaluation of contacts of infectious TB cases is one of the most productive methods of identifying adults and children with LTBI at high risk for progression to TB disease and persons in the early stages of TB disease.

## **B. Decision to Initiate a Contact Investigation**

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A decision to conduct a contact investigation depends on the presence of factors used to predict the likelihood of transmission.

### **1. Factors That Predict Likely Transmission of TB**

#### **a. Anatomical site of disease**

With limited exceptions, only patients with pulmonary or laryngeal TB can transmit their infection. For contact investigations, pleural disease is grouped with pulmonary disease because sputum cultures can yield *M. tuberculosis* even when no lung abnormalities are apparent on radiograph. Pleural TB, particularly in a child or young adult may be an indication of recent transmission, and an infectious source case may be found during the evaluation of contacts. Rarely, extrapulmonary TB causes transmission during medical procedures that release aerosols (e.g. autopsy, embalming, and irrigation of a draining abscess).

#### **b. Sputum bacteriology**

An individual with AFB positive sputa cultures and, in particular, AFB-positive sputa smears on microscopy, is considered more likely contagious than someone without.

#### **c. Radiographic findings**

Patients with lung cavities shown on chest x-rays are typically more infectious than patients with noncavitary pulmonary disease.

**e. Age**

Transmission from children younger than 10 years old is unusual, although it has been reported in association with those pulmonary forms typically seen in adults.

**f. HIV status**

TB patients who are HIV-infected with low (<200) CD4+ T-lymphocyte (CD4+ T-cell) counts frequently have chest x-rays that are not typical of pulmonary TB. In particular, they are more likely to have mediastinal adenopathy and less likely to have upper-lobe infiltrates and cavities. These atypical x-ray findings increase the potential for delayed diagnosis, which increases chance of transmission. However, HIV-infected patients who have pulmonary or laryngeal TB are, typically, as contagious as patients who are not HIV-infected. HIV-infected persons are at greater risk for TB activation than if they were HIV negative.

**g. Administration of effective treatment**

TB patients rapidly become less infectious after starting effective drug treatment. However, the exact rate of decrease cannot be predicted for individual patients. Patients with delays in diagnosis or delays in the initiation of effective treatment are more likely to transmit TB.

**2. Initiating a Contact Investigation**

The decision of whether or not to initiate a contact investigation should be made promptly after a report of suspected active TB disease is received by the health department. The decision to begin a contact investigation is based on several factors including the likelihood of active TB and the presence of contacts at high risk for progression to active TB. One goal of the initial contact investigation is to determine whether transmission has occurred to the closest contacts. Expanding the investigation to contacts with less exposure will lead to extensive contact investigations that should only be done when warranted.

A contact investigation should be promptly initiated if the patient has:

- culture-confirmed, pulmonary, laryngeal, or pleural TB
- sputa smears that are AFB-positive unless the organism is known to be a non-tuberculous mycobacterium (confirmed by culture or nucleic acid amplification - NAA testing, including the use of other rapid molecular testing such as Gene Xpert).

A contact investigation should also be considered when the patient has:

- a high likelihood for culture-positive TB despite negative sputa smears (e.g., started on empiric treatment for active TB)

- high-risk contacts (e.g., immunocompromised person, infants).

When sputa samples have not been collected, results from other types of respiratory specimens (gastric aspirates or bronchoalveolar lavage) may be taken into consideration and sometimes interpreted in the same way, but the data on smear status can transmission risk is based upon sputum specimens. Whenever feasible, sputum collection should be a priority before or during the initial days of TB treatment.

Contact investigations typically should not be initiated for contacts of patients who have suspected TB disease and minimal findings supporting a diagnosis of pulmonary TB. NAA testing will detect about 60% of culture-positive and AFB smear-negative cases. When a case is AFB smear-negative the results of NAA testing may be considered when deciding whether or not to initiate a contact investigation.

## **C. Investigating Source Case and Transmission Sites**

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Compiling comprehensive information about an index case is the foundation of a contact investigation. This information includes the disease characteristics, the onset date of the illness, names of contacts, locations where exposure occurred, and current medical factors such as initiation of effective treatment and drug susceptibility results.

### **1. Determining the Infectious Period**

Determining the infectious period focuses the investigation on those contacts most likely to be at risk for infection and sets the timeframe for testing contacts. Because the start of the infectious period cannot be determined with precision by available methods, a practical estimation is necessary. Typically, an assigned start is 3 months before a TB diagnosis was made. However, in certain circumstances, an earlier or later start should be used. Information from the patient interview and other sources including approximate dates that TB symptoms were noticed, mycobacteriology results, and extent of disease (especially the presence of large cavities which imply prolonged illness and infectiousness) are all helpful. A recent, normal chest x-ray may suggest a later date for the start of the infectious period.

**Guidelines for Estimating the Beginning of the Infectious Period**

| Characteristic |                           | Recommended minimum beginning of likely period of infectiousness   |
|----------------|---------------------------|--|
| TB Symptoms    | AFB sputum smear positive |  |
| Yes            | No                        | 3 months before symptom onset or first positive finding (e.g., abnormal chest x-ray) consistent with TB disease, whichever is longer |
| Yes            | Yes                       | 3 months before symptom onset or first positive finding consistent with TB disease, whichever is longer                              |
| No             | No                        | 4 weeks before date of suspected diagnosis   |
| No             | Yes                       | 3 months before first positive finding consistent with TB  |

Adapted from: California Department of Health Services Tuberculosis Control Branch; California Tuberculosis Controllers Association. *Contact investigation guidelines*. Berkeley, CA: California Department of Health Services, 1998, and Centers for Disease Control. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC. *MMWR* 2005;54(No. RR-15).

For the purposes of contact investigation, the end of potential exposure to the infectious case determines the end of the infectious period. The potential for transmission is reduced by the initiation and duration of treatment, the source patient’s response to treatment, or the application of effective infection control measures such as isolation.

In general, for the purposes of contact investigation, the infectious period is closed when exposure to contacts has ended OR when all three of the following criteria are met:

1. The index case is receiving effective anti-TB drug treatment (as demonstrated by susceptibility results) for at least 2 weeks for sputum AFB smear-positive cases or as short as 5 days with negative smears; and
2. The index case has diminished symptoms; and
3. The index case exhibits mycobacteriologic response is sputum is AFB smear-positive (e.g., decrease in grade of sputum smear positivity on sputum smear microscopy).

Multi-drug resistant TB (MDRTB) may extend infectiousness if the treatment regimen is ineffective. Any patient with signs of extended infectiousness should be continually reassessed for recent contacts.

A patient returning to a congregate living setting or any setting in which susceptible persons might be exposed should have *at least three consecutive negative sputum AFB smear results from sputa collected at least 8 hours apart* (with one specimen collected during the early morning) before being considered noninfectious. Patients with cavitory disease and strongly positive sputa smears (3-4+) can be expected to be smear-positive for several weeks despite effective treatment. In this case, collect a single sputum specimen weekly until a smear is negative, and then collect 2 additional specimens to confirm.

The exposure period for individual contacts is determined by how much time they spent with the patient during the infectious period.

## 2. Source Case Interviews

### a. Pre-interview preparation

Background information regarding the patient and circumstances of the illness should be gathered prior to talking with the patient, if possible. Sources of information may include:

- current medical records and clinically relevant records from the past year
- information regarding the primary physician or physician who reported the case
- information about the hospital infection control practitioner (if the patient was hospitalized).

The information in the medical record can be disclosed to public health authorities under exemptions in the Privacy Rule of the Health Insurance Portability and Accountability Act (HIPAA) of 1996.

<http://www.hhs.gov/ocr/privacy/hipaa/understanding/summary/index.html>

The patient's name should be matched to prior TB registries and surveillance databases to determine if he or she has ever been listed.

Multiple factors are relevant to the contact investigation including:

- history, dates and locations of previous exposure to TB, or previous TB disease or previous TB treatment
- anatomical sites of disease
- symptoms of the illness and dates of onset for determining infectious period
- dates, results, and location of chest x-rays and other diagnostic imaging studies
- bacteriologic and pathology results, type of specimen, and dates collected
- TB treatment regimen with dates, medications, dosages, and treatment plan
- prior/current antibiotic treatment with drugs that have activity against TB such as fluoroquinolones, aminoglycosides, etc.
- most recent HIV results, date, and location
- the patient's concurrent medical conditions (e.g., renal failure implies that a renal dialysis center might be part of the patient's recent experience)
- other diagnoses that may directly affect the interviews (e.g., substance abuse, mental illness, dementia) or inhibit identification of other possible exposure settings

- identifying demographic information (e.g., residence, employment, language, aliases, date of birth, telephone numbers, addresses, next of kin and emergency contacts, immigration status, homelessness, incarceration in past year).

**b. Time frame for investigating the source case**

The timely initiation of contact investigation is a critical public health activity. However, this is a labor-intensive and expensive intervention that should be undertaken judiciously. The infectiousness of the source case determines the recommended time frames for pursuing the investigation. These time frames are recommendations of the CDC but may vary with each individual contact investigation.

| Activity   | Index Case TB Suspect Expected to Have Pulmonary, Laryngeal, or Pleural TB |  |
|--|--|--|
|  | Positive Sputum Smear  | Negative Sputum Smear                                |
| <b>First Index Case Interview</b><br>Number of days following notification within which the source case should be interviewed in person (i.e., not by telephone)   | ≤ 1 Business Day of Reporting*   | ≤ 3 Business Days of Reporting                       |
| <b>Residence Visit</b><br>Number of days following initiation of the contact investigation within which the place of residence of the source case should be visited  | ≤ 3 Business Days After First Interview                                    | 3 Business Days After First Interview                |
| <b>Field Investigation</b><br>Number of days following initiation of the contact investigation within which all potential settings for transmission should be visited  | 5 Business Days After the Start of the Investigation                       | 5 Business Days After the Start of the Investigation |
| <b>Index Case Re-interviews</b><br>Length of time after the first interview within which the source case should be re-interviewed 1 or more times for clarification and additional information   | 1 or 2 Weeks After First Interview   | 1 or 2 Weeks After First Interview                   |
| <b>Reassessment of Index Case</b><br>Information about the source case should be reassessed at least weekly until drug-susceptibility results are available for the <i>M.tuberculosis</i> isolate or for 2 months following notification, whichever is longer. |  |  |

\*Report received by the local health department.

Adapted from: Francis J. Curry National TB Center. Chapter 7: *Contact Investigation*. TB Program Manual Template (2007). Available at: [http://www.nationaltbcenter.edu/resources/tb\\_manual\\_template.cfm](http://www.nationaltbcenter.edu/resources/tb_manual_template.cfm) Accessed 10/18/2007; and Centers for Disease Control. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC. *MMWR* 2005;54 (No. RR-15):7–8.

The first interview should be conducted in person (face-to-face) at the hospital, TB clinic, patient home, or any convenient location that accommodates the patient’s right to privacy. The first interview provides opportunities for the patient to acquire

information about TB and its control and for the public health nurse or outreach worker to learn how to best provide treatment and specific care to the patient.

A minimum of two interviews is recommended, with at least one interview occurring in the patient's home. At the first interview, the patient will likely be overwhelmed by the amount of information and the social stresses related to the illness (e.g., fear of disability, death, rejection by friends/family, financial issues related to isolation).

The second interview should take place 1-2 weeks later after the patient has had sufficient time to adjust to the disruptions caused by the illness and has become accustomed to the interviewer. The number of additional interviews required depends on the amount of information needed and the time required to develop a rapport.

### **c. Patient interviews and field investigation**

The following issues should be considered when interviewing TB patients:

- **Language.** Conduct the interview in the patient's language, using a medical interpreter if needed.
- **Establish rapport.** Allocate sufficient time to conduct the interview, possibly an hour or more. Ensure privacy during the interview. Display official identification and explain the reason for the interview. Keep in mind cultural differences and conduct the interviews in a culturally-competent manner.
- **Confidentiality.** Discuss confidentiality and privacy in frank terms that help the patient decide how to share information. These topics should be discussed several times to stress their importance. Inform the patient that relevant information will be shared confidentially with other health department staff or other persons who may assist in congregate settings to most efficiently ascertain which contacts need to be evaluated. Inform the patient that a health care worker will have to visit sites such as home, workplace, school, or leisure establishments to assess the shared air environment to accurately structure the contact investigation.
- **Information exchange.** Confirm information from the pre-interview phase, obtain missing information, and resolve disparities. Obtain information on how to locate the patient throughout treatment. The beginning of the infectious period should be set from the information derived from this interview.
- **Sites of transmission.** Information regarding possible transmission sites attended during the infectious period is needed for identifying the contacts and assigning priorities. Topics to include are where the patient spent nights, met with friends, worked, ate, visited, and sought health care. The

interviewer should give particular attention to ascertaining the length of time spent with each contact; this is often referred to as the duration of exposure. The interviewer should ask specifically about congregate settings (e.g., schools, shelters, correctional facilities, nursing homes). Ask about routine and non-routine travel (e.g., carpool, bus, airline flights). Contacts not previously identified might have been exposed during the patient's infectious period while the patient was traveling. The interview should be as comprehensive as possible. All possible sites of transmission should be listed, regardless of how long the patient spent at the sites.

Initial priorities should be set on the basis of the amount of time spent in specific places or with specific individuals. Further decisions regarding the investigation of sites and contacts should be made after all the information has been collected.

- **List of contacts.** For each transmission setting, the interviewer should ask for the names of contacts and the approximate types, frequencies, and durations of exposure. Ideal information regarding each contact includes full name, aliases or street names, physical description, location and communication information (e.g., addresses and telephone numbers), and current general health.
- **Closure.** Thank the patient. Provide an overview of the processes in the contact investigation, and remind the patient regarding confidentiality and its limits. The patient should be told how site visits are conducted and how confidentiality will be protected. Make an appointment for the next interview.
- **Follow-up interviews.** The best setting for the second and subsequent interviews is the patient's home. If the original interviewer senses an insufficient rapport with the patient, another outreach worker can be assigned to the case. The follow-up interviews are extensions of the initial interview.
- **Proxy interview.** Proxy interviews can build on the information provided from medical records and are essential when the patient cannot be interviewed (e.g., death, inability to communicate). Proxy informants are those that most likely know the patient's practices, habits, and behaviors and may be needed from each sphere of the person's life (home, work, and leisure). Care must be taken to maintain confidentiality.
- **Site visits.** Site visits are complementary to interviews. They can help add contacts to the list and are the most reliable source of information regarding transmission settings. Visiting the residence is particularly helpful for finding children who are contacts. The visit should be made within 3 days of the initial interview. Physical conditions at each setting contribute to the

likelihood of transmission. Pertinent details include room sizes, ventilation systems, and airflow patterns. These factors should be considered in the context of how often and how long the patient was in each setting.

- **Follow-up steps.** Frequent reassessment of results (e.g., secondary TB cases, estimated infection rates for groups of contacts) should continue throughout the contact investigation. Notification and follow-up with public health officials in other jurisdictions should be arranged for out-of-area contacts.

 See the *TB Interview Checklist* at the end of this chapter.

 For more information, see the section on “Referrals and Transfer” in *Chapter 12: Miscellaneous Protocols*.

### 3. Specific Investigation Plan

The investigation plan starts with information gathered in the interviews and site visits and includes:

- list of locations and time periods where the index case may have exposed individuals during the infectious period
- list of potentially exposed persons by location
- potential areas for expansion of the contact investigation if necessary and a timeline for these activities.

A timeline sets expectations for monitoring the progress of the investigation, and helps to give staff an idea if additional resources are needed for locating, evaluating, and treating the high- and medium-priority contacts. The plan is a work-in-progress and is revised if additional information is needed. If expansion is needed, other issues may come into play. For example, if a larger group in a school might need testing, it would be necessary to consider school holidays which may make it easier to test only once at 8-10 weeks after exposure.

The plan is also part of the permanent record of the overall investigation for later review and program evaluation. Data from the investigation should be recorded on standardized forms.

 See the TB Program Contact Investigation record at the end of this chapter.

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## D. Classifying and Assigning Priorities to Contacts

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The ideal goal is to distinguish all recently-infected contacts from those who are not infected while preventing TB disease by treating those with infection. In practice, existing technology and methods cannot achieve this goal. For example, although a relatively brief exposure can lead to *M. tuberculosis* infection and disease, certain contacts are not infected even after long

periods of intensive exposure. Not all contacts with substantial exposure are identified during the contact investigation. And lastly, available tests for *M. tuberculosis* infection do not differentiate between persons recently or remotely infected.

The increasing intensity and duration of exposure usually increases the likelihood of recent *M. tuberculosis* infection in contacts. The skin test cannot discriminate between recent and old infections, and including contacts that have had minimal exposure increases the workload while it decreases the public health value of finding positive skin test results. A positive result in contacts with minimal exposure is more likely to be the result of an old infection or nonspecific tuberculin sensitivity. Whenever the contact's exposure to the TB patient has occurred less than the 8-10 weeks necessary for detection of positive skin tests, repeat testing 8-10 weeks after the most recent exposure will help identify recent skin test conversions, which are likely indicative of recent infection. The CDC defines three levels of contact priorities:

- High-priority contacts
- Medium-priority contacts
- Low-priority contacts.

For optimal efficiency, priorities should be assigned to contacts, and resources should be allocated to complete all investigative steps for high- and medium-priority contacts. Priorities are based on the likelihood of infection and the potential hazards to the specific contact if infected. The priority scheme directs resources to selecting contacts who:

- have secondary cases of TB disease,
- have recent *M. tuberculosis* infection and are most likely to benefit from treatment, and
- are most likely to become ill with TB disease if they are infected (i.e., susceptible contacts) or who could suffer severe morbidity if they have TB disease (i.e., immunosuppressed contacts).

Priorities should be assigned to contacts based on a) characteristics of the index case, b) characteristics of the contact and c) circumstances surrounding the exposure. Priorities are constantly reevaluated as new information is obtained and as TST/IGRA results are collected on all of the contacts.

### **1. Characteristics of the Index Case**

Many factors contribute to the transmission of infectious particles (droplet nuclei) from the index case to the contact. Infection rates tend to stay fairly stable at 20-30% for contacts to infectious tuberculosis. Patients with only extra-pulmonary TB are rarely infectious; however transmission can occur through aerosolization during autopsy or tissue irrigation. Those with multi-drug resistant (MDR) tuberculosis are not more infectious than patients with drug-susceptible TB. However, the infectious period may be delayed for those with MDR tuberculosis. This delay may lead to the infection of

more contacts. The infectiousness of the index case is increased with the presence of any of the following factors:

- a positive AFB smear which represents a higher concentration of bacteria in sputum
- signs of cavitation on chest x-ray
- a cough or forceful exhalations (e.g., singing or shouting)
- a high volume of watery sputum
- the prolonged duration of respiratory symptoms
- tuberculosis laryngitis.

Effective TB treatment rapidly decreases infectiousness. The duration of infectiousness after treatment initiation will vary with the extent of the disease and response to therapy. The following can be used as guidelines for defining the end of community isolation:

- patients with minimal disease and negative sputa smears - 5 daily DOT doses weekly
- smear-positive patients responding clinically to treatment -10 to 15 daily DOT doses
- patients with extensive disease, delayed response or risk for MDR disease – individualized, but may be as long as 1 to 2 months of interrupted DOT
- patients who work or live in high-risk environments (e.g., congregate living settings, hospitals, childcare) – determined by response to treatment, drug susceptibility information, and 3 negative smears.

 For more information on isolation and infection control, see *Chapter XI: Infection Control*.

Anti-tuberculosis drugs reduce cough and sputum production within days and decrease markedly the excretion of viable tubercle bacilli within a few weeks after initiation of adequate drug therapy.

Contacts to patients with extra-pulmonary TB disease should be evaluated only if the patient has concurrent pulmonary or laryngeal TB disease. Contact evaluation is not necessary for patients with extra-pulmonary TB disease alone.

## 2. Characteristics of Contacts

A variety of medical conditions and treatments might affect the likelihood of a contact progressing from latent infection to active TB disease. An age of less than 5 years and the status of a contact's immune system are the most important factors.

 For more information, see *Chapter II: Testing for TB Infection*.

Risk to the contact is decreased by:

- consistently taking anti-TB therapy at the time of exposure (prophylaxis)

- prior infection (positive TST before exposure to the source case).

**Age.** After infection, TB disease is more likely to develop in younger children-- the incubation or latency period is shorter and more serious, invasive forms of the disease are more common. Children less than 5 years old who are contacts to active cases are assigned high priority for investigation. Infants and adolescents are at increased risk for progression to TB disease if infected, and children less than 4 years of age are at increased risk for disseminated (miliary) TB disease.

**Immune status.** HIV infection results in the progression of *M. tuberculosis* infection to TB disease more frequently and more rapidly than any other known factor and there is a greater likelihood of progression to disseminated and extrapulmonary disease. HIV-infected contacts are assigned high priority and, extra vigilance around diagnosing TB disease is recommended.

Contacts receiving more than 15 mg of prednisone or its equivalent for more than 4 weeks also should be assigned high priority. Other immunosuppressive agents, including multiple cancer chemotherapy agents, anti-rejection drugs for organ transplantation, and tumor necrosis factor alpha (TNF-a) antagonists increase the likelihood of TB disease developing after infection. These contacts are also assigned a high priority.

### 3. The circumstances of the exposure

**Amount of exposure.** The likelihood of infection depends on the intensity, frequency, and duration of exposure. CDPHE recommends prioritizing contacts based on the amount and type of contact while the patient was considered infectious.

| Contact Priority | Weekly Hours        | Continuous hour      | Total Hours        |
|------------------|---------------------|----------------------|--------------------|
| High Priority    | >15 hours per week  | 10 continuous hours  | >180 total hours   |
| Medium Priority  | 5-14 hours per week | 8-9 continuous hours | 90-179 total hours |
| Low Priority     | 1-4 hours per week  | 4-7 continuous hours | 10-89 total hours  |

**Environment where the exposure occurred.** Tiny particles (1-5 microns in size) containing tubercle bacilli can stay suspended in the air for several hours. Both air filtration (in which droplet nuclei are entrapped and removed from recirculated air) and ultraviolet irradiation (sunlight or artificial light which kills the tubercle bacilli inside the droplet nuclei) can decrease the number of infectious particles and therefore decrease the risk to contacts.

Air volume, exhaust rate, and circulation predict the likelihood of transmission in an enclosed space. In large indoor settings, because of diffusion and local circulation patterns, the degree of proximity between contacts and the index patient can influence the likelihood of transmission. Other subtle environmental factors (e.g., humidity and light) are impractical to incorporate into decision-making. The volume of air shared

between an infectious TB patient and their contacts will dilute the infectious particles. Local circulation and overall room ventilation also dilute infectious particles, but both factors can redirect exposure into spaces that were not visited by the index patient and these factors have to be considered.

## E. Evaluation of Contacts

On average, 10 contacts are listed for each case of infectious TB in the United States. Approximately 20%-30% of all contacts have LTBI and 1-2% of that cohort is found to have TB disease during the investigation. Of those contacts that ultimately will develop TB disease, approximately half acquire the disease in the first year after exposure. For this reason, contact investigations are a crucial prevention strategy. Identifying TB disease and TB infection efficiently during an investigation requires identifying, locating, and evaluating high- and medium-priority contacts that are most at-risk. **Communicable disease laws that protect the health of the community should be considered for contacts that decline examinations, especially those for whom a missed TB diagnosis would pose an exceptional public health risk (e.g., member of a household with small children).**



### 1. Time Frame for Evaluation and Treatment of Contacts

| Type of Contact   | Business Days from Identifying a Contact to Initial Encounter* | Business Days from Initial Encounter to Completion of Medical Evaluation†  | Business Days from Completion of Medical Evaluation to Start of Treatment |
|---|--|--|---|
| <b>Children &lt; 5 years of age and high-risk contacts (e.g. HIV +)</b><br>Children and high-risk contacts can develop complicated tuberculosis (TB) within a few weeks of infection. | 1-3 business Days after being identified in the investigation  | 5 Business Days - chest x-rays, clinical evaluation, and treatment initiation are indicated regardless of TST result |   |
| <b>High-Priority Contact</b><br>Source case with positive acid-fast bacilli (AFB) sputum smear results and/or cavitary disease on chest radiograph                                    | 3 business days after being identified in the investigation    | 5 Business Days  | 10 Business Days  |
| <b>High-Priority Contact</b><br>Source case with negative AFB sputum smear results  | 3 business days after being identified in the investigation    | 10 Business Days   | 10 Business Days  |
| <b>Medium-Priority Contact</b><br>Regardless of AFB sputum smear or culture result  | 3 business days after being identified in the investigation    | 10 Business Days   | 10 Business Days  |

\* "Encounter" means a face-to-face meeting, which gives the public health worker a chance to determine whether the contact is generally healthy or ill. The initial encounter also provides opportunities to administer a tuberculin skin test (TST/IGRA) and to schedule further evaluation.

† The medical evaluation is complete when the contact's status relative to *Mycobacterium tuberculosis* infection or TB disease has been determined. A normal exception to this schedule is the delay in waiting for final mycobacteriology results, but this applies to relatively few contacts.

Adapted from: Francis J. Curry National TB Center. *TB Program Manual Template (2007)*, Chapter 7: Contact Investigation. Available at [http://www.nationaltbcenter.edu/resources/tb\\_manual\\_template.cfm](http://www.nationaltbcenter.edu/resources/tb_manual_template.cfm). Accessed 10/16/2007, and Centers for Disease Control. Guidelines for the investigation of contacts of persons with infectious tuberculosis: recommendations from the National Tuberculosis Controllers Association and CDC. *MMWR*. 2005; 54(No. RR-15):9.

## 2. Initial Assessment of Contacts

The initial encounter should occur within 3 working days after the identification of the individual as a contact. Information collected should include the following:

- documentation of previous *M. tuberculosis* infection or disease and subsequent treatment
- documentation of previous TST/IGRA results
- contact's verbal report of BCG vaccine, or observation of scar (important if this is a child who received the vaccine within the past few years)
- current symptoms of TB disease (e.g., cough, hemoptysis, chest pain, fever, night sweats, weight loss, malaise)
- medical conditions or risk factors making TB disease more likely and therefore a high-priority contact (e.g., children under 5 yrs, HIV/AIDS, end-stage renal disease or other immunosuppressive conditions or treatments,)
- type, duration, and intensity of TB exposure
- sociodemographic factors (e.g., age, race or ethnicity, residence, country of birth).

Once initial information has been collected, priority assignments should be reassessed for each contact and a medical plan for diagnostic tests and possible treatment can be formulated for high- and medium-priority contacts.

## 3. Contacts to Drug-Susceptible Tuberculosis

### a. Contacts with a positive TST/IGRA

Persons who are contacts to patients with drug-susceptible TB and who have positive tuberculin skin-test reactions ( $\geq 5$  mm) should be treated with one of the recommended regimens, regardless of age.

**b. Contacts with a negative TST**

Some contacts with negative TST/IGRAs should be considered for LTBI treatment after active TB disease has been ruled out. These contacts include children (see below), people who are immuno-suppressed (e.g., HIV positive, immunosuppressive medications, chronic renal failure), and others who may develop TB disease quickly after infection. Close contacts that have a negative reaction to an initial TST should be retested 8 to 12 weeks after their last exposure to TB. Treatment of latent TB infection may be discontinued if the second TST result is again negative and if the person is no longer exposed to TB. However, persons known or suspected of having HIV infection and other immuno-compromised persons should be considered for a full course of LTBI treatment regardless of their TST/IGRA status.

**4. Contacts to Drug-Resistant TB**

Note: Please consult with CDPHE's TB Program prior to deciding on a regimen.

**a. Contacts to isoniazid-resistant TB**

No definitive data exist concerning treatment of contacts exposed to patients with probable or confirmed isoniazid-resistant TB. A 4-month regimen of rifampin is the current recommended treatment. In situations in which rifampin cannot be used due to drug interactions, rifabutin can be substituted.

**b. Contacts to multidrug-resistant (MDR) TB**

Outbreaks of multidrug-resistant (MDR) TB caused by strains of *M. tuberculosis* resistant to at least isoniazid and rifampin, and the rise in resistance rates worldwide have focused attention on options for treatment of persons exposed to, and presumed to be infected by, such organisms. Persons infected with isoniazid- and rifampin-resistant organisms are unlikely to benefit from treatment with regimens containing these agents. Therefore, a regimen containing those drugs active against *M. tuberculosis* should be considered. When possible, selection of drugs should be guided by susceptibility test results from the isolate to which the patient was exposed and with which the patient is presumed infected.

When determining treatment for contacts to MDR TB, it is important to look at how likely it is that the individual is infected with a strain of MDR TB rather than drug-susceptible TB. Factors to consider:

Infectiousness of the source patient. A source patient who is sputum-smear-positive, has cavitory disease, and is coughing is much more infectious than one who is smear-negative and not coughing. A source patient whose contacts had TST conversions is more infectious than a source patient whose contacts did not have TST conversions.

Closeness and intensity of the MDR TB exposure. Contacts are at higher risk for infection if they have spent a prolonged period of time sharing air with a person who has MDR TB, for example, if they were exposed in a small, poorly ventilated area, or if exposure was during cough-inducing procedures (bronchoscopy, sputum induction, endotracheal intubation, etc.).

Contact's risk of exposure to drug-susceptible TB. Individuals who have been exposed to several sources of TB (e.g., some health care workers) may be less likely to be infected with a MDR strain than individuals whose only known exposure to TB was with an infectious MDR TB patient (e.g., a TST-positive infant of a mother with MDR TB).

For persons likely to be infected with MDR TB and at high risk of developing active TB, PZA and ethambutol or PZA and a fluoroquinolone (i.e., levofloxacin or ofloxacin) for 6 to 12 months are recommended, if the organisms from the source case-patient are known to be susceptible to these agents. Immuno-competent contacts thought to be at risk for developing MDR TB should be treated for at least 6 months. Immuno-compromised contacts (e.g., HIV-infected) should be treated for 12 months. Side effects of PZA and fluoroquinolones include gastrointestinal symptoms and hepatic transaminase elevations. All contacts to suspected MDR TB cases should be followed for at least 2 years, irrespective of treatment.

There are no published studies regarding treatment of LTBI in children after exposure to MDR TB. Ethambutol, PZA, and fluoroquinolones have all been used safely in children. The combination of PZA and ethambutol for 9 to 12 months is recommended if the isolate is susceptible to both drugs. When PZA and ethambutol cannot be used, many experts recommend using a combination of two other drugs to which the infecting organism is likely susceptible. A fluoroquinolone has been used as a single drug in patients for whom this was the only active or tolerated drug, but, as with any of the regimens above, there is no data on effectiveness. This drug regimen should be done in consultation with a pediatric infectious disease expert.

## **5. Tuberculin Skin Testing**

All high- and medium-priority contacts who do not have a documented positive TST result or previous TB disease should have a TST placed or IGRA given at the initial encounter. If that is not possible, then the test should be administered within 5 business days after identifying them as a high-priority contact and within 10 business days for medium priority contacts. When interpreting the TST reaction, an induration transverse diameter of  $\geq 5$  mm is positive for any contact.

If the reaction to the initial TST is negative (less than 5 mm), the contact should be classified as TB Class I, and a repeat TST should be placed 8-10 weeks after the contact's last exposure to the index case while the index case was infectious.

Two-step testing is not usually used for contacts. A contact whose second test is positive after an initial negative result should be classified as recently infected.

In some instances, an individual may state he or she has had a positive TST/IGRA in the past. If it is not possible to verify this information, two options are available:

- Get a chest x-ray if the person reports a positive TST/IGRA reaction as well as contact with a person who has TB disease.
- Repeat the TST (unless the person describes a “very large” reaction, e.g., size of a quarter or bigger, to a previous TST) or residual evidence such as a scar or pigmentation is seen. In general, the safest option is to perform a symptom evaluation, and then get a chest x-ray if a possible contact reports a prior positive TST reaction, even when the history cannot be verified.

Among persons who have been recently infected, the demonstration of cell-mediated immunity by a positive TST or IGRA takes several weeks to develop. The outer limit of the estimated interval between infection and a detectable TST (window period) is 8 weeks. A negative TST result obtained prior to 8 weeks is considered unreliable for excluding infection.

## 6. Medical Evaluation

All high- and medium-priority contacts should be evaluated for symptoms of TB.

**Contacts with TB symptoms take priority over all other contacts.** Individuals who have symptoms consistent with TB (e.g., weight loss, a cough of at least 3 weeks duration, fever, night sweats, etc.) and who have been in close contact with a person who has a positive *M. tuberculosis* culture or an AFB-positive sputum smear should be classified as TB Class V (regardless of the chest x-ray findings and TST reaction) and should be evaluated promptly for TB disease. If appropriate, there should be a search for extra-pulmonary sites of tuberculosis.

All contacts whose TST induration is 5 mm or larger or who have a positive IGRA should undergo further examination starting with a PA chest x-ray (PA and lateral CXR for children 13 and under).

- If the chest x-ray is normal, the contact should be classified as TB Class II and evaluated for LTBI treatment.
- If the chest x-ray is abnormal, the contact should be classified as TB Class V and evaluated for TB disease. Any contact with an abnormal chest x-ray consistent with TB should submit 3 sputa for AFB smear and culture.

Sputum specimen collection is decided on a case-by-case basis and is not recommended for healthy contacts with a normal chest x-ray.

All contacts who are high-priority because of special susceptibility or vulnerability to TB disease (e.g., HIV, end-stage renal disease, children under 5) should have a PA and lateral chest x-ray, regardless of their TST/IGRA result.

## 7. HIV Testing

Contacts who do not know their HIV status should be offered HIV testing. This is particularly important for contacts of HIV-infected patients with TB as their contacts are more likely to have HIV infection. Approximately 7% of TB patients in the United States have HIV infection at the time of TB diagnosis, and 12% of TB patients aged 25-44 years have HIV infection. In addition, an estimated 275,000 persons in the United States are unaware they have HIV. HIV-positive TB patients will require closer case management. Their HIV status will also necessitate a different anti-TB drug regimen and schedule (due to HAART) than if they were HIV negative, which is why it is imperative to know a patient's HIV status prior to beginning an anti-TB drug regimen. Failure to do so can lead to treatment failure and increased morbidity and/or mortality.

## 8. Contacts Who Refuse Evaluation

For a variety of reasons, some contacts will not comply with requests for TSTs, chest x-ray, or medical evaluation. Because of the risk of developing secondary TB cases, contacts to infectious TB are considered contagious themselves until proven otherwise. Public health law may be used to require that these types of contacts report for medical evaluation or risk incarceration until that evaluation is completed. Parents who refuse to bring their children for evaluation risk being reported to Social Services for child abuse or neglect.

## F. Treatment for Contacts with LTBI

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Contacts identified as having positive TST results are regarded as recently infected with *M. tuberculosis*, which puts them at higher risk for TB disease. Decisions to treat contacts that have documentation of a previous positive TST result must be individualized because their risk for TB disease is unknown. Considerations for the decision include previous LTBI treatment, medical conditions putting them at risk for TB disease, and the duration and intensity of exposure. Treatment of presumed LTBI is recommended for all HIV-infected contacts in this situation (once TB disease has been excluded) whether they previously received LTBI treatment or not.

 For information regarding the time frames in which to begin LTBI treatment of contacts, see section E-1 above.

### 1. Window-Period Prophylaxis

During the window period between the first and second TST/IGRA, preventative treatment is recommended for susceptible and vulnerable contacts to prevent rapidly emerging TB disease, even if the TST/IGRA is negative. The following contacts should undergo a chest x-ray to rule out TB disease before starting preventive treatment:

- contacts <5 years of age- start treatment within 1 week of identification as a contact
- contacts between 5 and 15 years old, at the physician's discretion
- contacts who are HIV positive or otherwise immuno-suppressed
- contacts who decline HIV testing but have risk factors for HIV.

Groups of contacts who are likely to benefit from a full course of treatment (beyond the window-period) include those with HIV infection, those taking immunosuppressive therapy for organ transplantation, and those taking TNF- $\alpha$  antagonists. Once TB disease is ruled out, prophylactic treatment of presumed TB infection is recommended as an option for all of these groups. The decision to treat individual contacts that have negative skin test results should take into consideration two factors:

- the frequency, duration, and intensity of exposure (even brief exposure to a highly contagious TB patient in a confined space probably warrants the same concern as extended exposure to less contagious patients); and
- evidence of transmission from the index case (a substantial number of contacts with a positive TST/IGRA implies infectiousness).

### 2. Treatment after Exposure to Drug-Resistant TB

Drug susceptibility results for the *M. tuberculosis* isolate from the index patient are needed for selecting or modifying the treatment regimen for any associated contacts. Resistance to INH alone among the first-line agents leaves the option of 4 months of daily rifampin. Additional resistance to rifampin constitutes multi-drug resistant (MDR) TB. Regimens may be selected depending on the drug susceptibilities of the index case. None of the potential regimens for persons likely infected with MDR TB has been fully tested for efficacy and these regimens are often poorly tolerated. In lieu of treatment, periodic monitoring (at 6-month intervals) for TB symptoms or chest x-rays may be considered for contacts who have received a diagnosis of infection attributed to MDR TB.

### 3. Adherence to Treatment

One of the National TB Indicators Project (NTIP) objectives for 2015 is to complete LTBI treatment in 85% of contacts with LTBI. All contacts being treated for infection should be evaluated monthly by a nurse checking for adherence and adverse effects of treatment. Education regarding TB, its treatment, and the signs of adverse drug effects

should be part of each patient encounter. While DOPT (directly observed preventive therapy) improves completion rates, it is a resource-intensive intervention that might not be feasible for all infected contacts. The following groups should receive priority for DOPT (including window-period prophylaxis):

- contacts 5 years of age or younger
- Contacts who are HIV-infected or otherwise substantially immunocompromised
- Contacts with a change in their tuberculin status from negative to positive
- Contacts who might not complete treatment because of social or behavior impediments (e.g., alcohol addiction, chronic mental illness, injection drug users, unstable housing or employment).

## **G. When to Expand a Contact Investigation**

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When determining whether or not to expand the contact investigation, consider the extent of recent transmission, as evidenced by:

- Active TB diagnosed in contacts
- Unexpectedly high rate of infection in high-priority contacts. In general, national guidelines have arbitrarily defined an unexpected high rate as 10% or at least twice the rate of a similar population without recent exposure. The last national prevalence survey of 1999-2000 provides age-specific data for U.S.-born and foreign-born populations that can be used to compare with rates among contacts. Since the background prevalence of TB infection in adult foreign-born populations from high-burden countries often exceeds 30%, it is important to stratify the infection rates by US- and Foreign-born. For example, household contacts with a positive TST/IGRA result are more likely to have recent infection (or as a result of exposure to the infectious case) if the contacts are US-born children rather than adults born in a high-burden country.
- evidence of *secondary transmission* (i.e., from TB patients who were infected after exposure to the index patient)
- TB disease in any contacts who had been assigned a low priority
- infection of contacts less than 5 years of age
- contacts with a change of TST/IGRA status from negative to positive between their first and second TST/IGRA.

In the absence of evidence of recent transmission, an investigation should not be expanded to lower-priority contacts. As in the initial investigation, results should be reviewed at least weekly so the strategy can be reassessed.

## **H. Data Management and Evaluation**

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Data collection related to contact investigations has three broad purposes: 1) management of care and follow-up for individual index patients and their contacts, 2) epidemiological analysis of any investigation in progress and investigations overall, and 3) program evaluation using performance indicators that reflect performance objectives.

### **1. TB Contact Sheet / TB Contact Investigation Record Form**

The TB Contact Sheet/TB Contact Investigation Record Form is completed in the field as each contact is identified, interviewed, and evaluated. When the contacts' information is put into TBdb, the contact investigation sheet is automatically completed in TBdb and can be printed from the index case's file.

## **I. Confidentiality and Consent**

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Maintaining confidentiality is challenging during contact investigations because of social connections between TB cases and their contacts. Ongoing discussions with the case and contacts regarding confidentiality are helpful in finding solutions and learning individual preferences. Legal and ethical issues in sharing confidential information can often be resolved by obtaining consent from the patient to disclose information to specific persons and by documenting this consent using a signed form.

In congregate settings such as the workplace, maintaining confidentiality during a TB contact investigation can be especially difficult. Anticipatory discussions with the patient can lead to solutions for safeguarding confidentiality and a patient's preferences should be honored when consistent with laws and sound public health practices. Site administrators will know some confidential information regarding the active case and his or her contacts. The administrators should be asked to respect confidentiality even if they are not legally bound to do so. Employee and occupancy rosters should be provided to health department staff to facilitate identification of contacts that should be evaluated and confidentiality of these records should also be safeguarded. Communication back to the site administrator should relate only to completeness of the evaluation, not the individual medical results. Legal and ethical concerns for privacy and confidentiality extend beyond TB. All personal information regarding an active case and his or her contacts is afforded the same protection.

## **J. Contact Investigations in Special Circumstances**

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### **1. Outbreaks**

A TB outbreak indicates potentially extensive transmission characteristics. An outbreak suggests that a TB patient was infectious, contacts were exposed for a substantial period, and the interval since exposure has been sufficient for infection to progress to disease.

An outbreak investigation involves several overlapping contact investigations with an increased need for public health resources.

A working definition of "outbreak" is recommended for planning investigations. A recommended definition is a situation that is consistent with either of two sets of criteria:

- during a contact investigation, two or more contacts are identified as having active TB disease, regardless of their assigned priority; or
- any two or more cases occurring within 1 year of each other are discovered to be linked and the linkage is established outside of a contact investigation (e.g., two patients who received a diagnosis of TB outside of a contact investigation are found to work in the same office and only one (or neither) of the persons was listed as a contact to the other).

The linkage between cases should be confirmed by genotyping results. In an outbreak, contacts can be exposed to more than one case. Cases and contacts can be interrelated through multiple social connections which can complicate efforts to set priorities. The risk factors contributing to a specific outbreak should be determined, because these findings will affect how the investigation is conducted and what educational outreach efforts need to be made during and after the investigation is completed. Risk factors that may lead to an outbreak include:

- **Infectious TB undiagnosed or untreated for an extended period, or an extremely infectious case.** The challenges created by the extended infectious period include the patient's inability to remember persons and places and a greater number of contacts in a greater number of places. A highly infectious case, sometimes with several pulmonary cavities or laryngeal disease, suggests a greater number of high-priority contacts. Sometimes a delay in treating TB is caused by failure to suspect TB or to report it. Opportunities for educating patient's primary health care providers should be pursued immediately, especially if contacts are likely to seek health care from the same providers. Multi-drug resistance can also cause prolonged contagiousness if a standard treatment regimen for drug-susceptible TB is administered prior to drug-susceptibility results being available.
- **Index patient visiting multiple sites.** A TB patient who has an active, complex social life and who frequents multiple sites where transmission of *M. tuberculosis* could occur is also less likely to be able to name all contacts.
- **Patient and contacts in close or prolonged company.** When an outbreak has been discovered, high priority is recommended for contacts having close or prolonged exposure to the index case.
- **Environment promoting transmission.** A small interior space with poor ventilation can facilitate transmission of *M. tuberculosis*. High priority is recommended for all contacts who spent time with an outbreak index patient in such spaces, even if the periods of exposure were brief or unknown. Certain larger environments (e.g., a

warehouse worksite or a school bus) have been reported as sites of intensive transmission when patients were highly infectious or when patients and contacts were in prolonged company. If the evidence from the investigation indicates a link between the site and transmission in an outbreak, the contacts in such a site should be designated as high priority, regardless of the site's characteristics.

- **Contacts very susceptible to disease after *M. tuberculosis* infection.** Urgency is required when outbreak cases are diagnosed among contacts who are relatively more susceptible to progression from *M. tuberculosis* infection to TB disease. Other contacts with similar susceptibility should be sought. If such an outbreak includes children 5 years or younger, a source-case investigation should be undertaken if the infectious source is unknown initially. Intensified methods for active case finding among contacts are recommended.
- **Gaps in contact investigations and follow-up.** Omissions, errors, and system failures can result in secondary TB cases (i.e., an outbreak). Tracing back cases in an outbreak may identify missed opportunities for prevention during previous contact investigations or other prevention activities (e.g., targeted testing).

## 2. Congregate Settings

### a. Correctional facilities

Inmates move within correctional facilities on both daily and weekly schedules that can increase the number of TB exposures. They are also transferred within and between jails and prisons. Some facilities have convenient, comprehensive records for the locations of inmates that are essential for identifying contacts, estimating exposure time, and assigning priorities to contacts and others do not. Investigations in jails can be challenging because of rapid turnover of inmates and overcrowding. Although the number of contacts may be high and proximity may be close, the exposure time may be brief, which complicates assigning priorities. Unless tracking records for inmates who were in a confined space with an infectious TB patient show that total exposure time was less than 8 hours, these contacts should be given high priority. High priority contacts that were transferred, released, or paroled from a facility prior to medical evaluation should be traced.

Populations in correctional facilities have a higher prevalence of HIV infection than the general public. If inmates have not been offered voluntary HIV testing and if TB exposure is suspected, offering HIV testing is strongly recommended.

### b. Workplaces

Details regarding employment, hours, working conditions and workplace contacts should be obtained during the initial interview with the patient. The workplace should be toured after accounting for confidentiality and permission from workplace management. Occasional customers of a business (e.g., fast food restaurant) should

be designated low priority. Customers who visit a workplace repeatedly should be assigned priorities as in any other investigation, especially susceptible or vulnerable contacts. Administrators and managers often express concern regarding liability, worker's compensation issues, lost productivity, and media coverage. They are also likely to have limited understanding or commitment to the issues around patient confidentiality. All of these issues can be addressed during the planning stages of the investigation. Questions should be referred to the CDPHE TB Program.

**c. Hospitals and other health care settings**

Contact investigations should be conducted jointly between the health care setting and the local public health agency. Most health care settings have policies for testing employees at the time of hire and periodically thereafter. These test results are useful for baseline data. The availability of baseline results for clients of the facility varies. Many long-term-care facilities place a baseline TST on their patients. The health care facility usually conducts TST/IGRAs and chest x-rays on staff and patients and provides final results (raw data without identifiers) to CDHPE at the end of the contact investigation so these numbers can be reported to the CDC. CDPHE staff will assist with evaluation of contacts that have left the facility.

**d. Schools**

This category includes childcare centers, preschools, primary through secondary schools, vocational schools, colleges and universities. Contact investigations that involve juvenile detention centers or adult education centers should be conducted in the same way as correctional settings or workplaces respectively.

Early collaboration and good communication with school officials is imperative as there is potential for controversy and panic among school officials, parents, and the community. Consent, assent, and disclosure of information are more difficult for non-emancipated minors than for adults.

The strategy for contact investigation depends on whether the active case is a child, a teen, or an adult. The potential infectiousness of an adult in the school should be determined. Young children are seldom very contagious as they usually cannot cough hard enough to spread the bacteria very far. However, in settings where an active case is a child under 5 years old, a source case investigation should be conducted in the school or childcare setting as well as in the home. In some home-based childcare settings there may be adults in the home who do not provide direct child-care but who still share air space with the child. They should be evaluated as well. In secondary and higher levels of education students usually have adult-form TB and infectiousness can be estimated by the standard criteria. With older students academic schedules, extramural activities, and social schedules become more complex and information reported by the active patient is more important for a thorough investigation.

Some childcare settings, schools, and colleges require TB screening of employees or students at the time of hire or entrance. This information can be used as baseline data during a contact investigation.

School breaks, vacations, graduations, and transfers can disrupt the contact investigation. All of these should be taken into account and collaboration with the school will be needed to notify contacts that are no longer at the school. Contacts should be referred to the health department in their jurisdiction for follow-up and those seeking care from their own providers should receive written instructions to give to those providers.

In some situations when there transmission in close contacts is sufficient that there are plans to extend the contact investigation to larger populations such as in a school or worksite, it may be best to plan a single evaluation of students or co-workers at 8 weeks after the last exposure rather than attempting two rounds of testing, particularly if 4 to 6 weeks have already passed since the end of the period of exposure.

#### **e. Shelters and settings with services for the homeless**

The challenges that can be anticipated for a contact investigation involving a homeless TB patient include difficulty locating the patient and contacts due to mobility, episodic incarceration, and migration from one jurisdiction to another and psychiatric illnesses (including chemical dependency disorders) that hinder communication or participation. When names or locations of specific contacts are unknown, interviews with the patient and potential contacts should focus on social networks and settings, including correctional facilities. One criterion for degree of exposure at an overnight shelter is the bed or cot assignment. The proximity and duration of overlap should be estimated as closely as possible for selecting high-priority contacts. Certain shelters keep sign-in lists, but these might lack information regarding overlap of visits.

Homeless persons frequently seek health care from multiple volunteer providers, halfway houses, chemical dependency treatment programs, community clinics, urgent care centers, and hospital emergency departments. Consultation and assistance from health-care providers in these systems can be helpful. This also creates an opportunity for collaboration, contact ascertainment, and mutual education.

Site visits and interviews are crucial, because the social networks of homeless persons are likely to vary by situation. A contact investigation presents an opportunity to review screening and testing services and to offer assistance with these and other means of decreasing transmission of *M. tuberculosis* (e.g., environmental controls). Transmission can also occur at sites other than shelters (e.g., jails, taverns, abandoned buildings, and cars). Access to visitation and occupancy rosters (or logs)

and to other information vital to identifying contacts and determining priorities, may be restricted by law (e.g., at settings that provide treatment for substance-abuse disorders), and the terms of access should be negotiated.

Low treatment-completion rates have been reported for treatment of LTBI diagnosed at homeless shelters. TB control officials should work with such shelter administrators to offer onsite supervised intermittent treatment. Sites with more stable populations are likely to benefit most from this approach.

#### **f. Transportation modes**

Transmission of *M. tuberculosis* has been confirmed on military vessels at sea, commercial aircraft, passenger trains, and school buses. However, transmission is unlikely unless ventilation is restricted (windows are closed) or exposure is long (>8 hours) or repetitive (at least 2 separate trips were taken with the index case).

 Contact the Colorado Department of Public Health and Environment TB Program (303) 692-2638 for assistance in following up with possible contacts on commercial modes of transportation.

#### **g. Drug or alcohol usage sites**

Shared sites of drug or alcohol usage (e.g., taverns or crack houses) are possible sites of TB transmission due to close person-to-person contact, repetitive exposure, and poor ventilation. It may be difficult or impossible to generate a complete list of contacts if the patient was known to frequent these locations. Site visits may not be possible and outreach worker safety should be paramount in conducting an investigation that involves such locales.

HIV infection is associated with multiple forms of substance abuse and HIV counseling, testing, and referral services should be offered to all potential contacts in these settings.

### **3. Index Patient Unable to Participate**

In the past, approximately 8% of pulmonary TB patients with AFB detected on sputum microscopy had no contacts listed. TB patients who have few or no contacts listed are more likely to be homeless or to have died before an interview could be conducted. This makes gathering contact information more difficult and extra effort needs to be used to identify contacts to these patients. Information from social networks, family members, and other proxy methods are recommended. In addition, any person who is diagnosed after death indicates a probable delay in their TB diagnosis. Cases of death after diagnosis often lead to prolonged infectiousness and necessitate widening the scope of the contact investigation.

#### 4. MDR TB

MDR TB does not change recommendations for assigning contact priorities. Special consideration should be given to instances when resistance is acquired during treatment or when drug resistance was detected late during the treatment course, as these patients may have had a prolonged period of infectiousness.

#### 5. Interjurisdictional Contact Investigations

##### a. Multiple jurisdictions within the U.S.

An index case and his or her contacts may have a stable residence in the U.S. while traveling to different areas of the country during treatment. The health department that counts the case is responsible for leading the investigation and notifying the health departments in other areas of those individuals in their areas that need follow-up. The health department in charge of the contact investigation is also responsible for requesting follow-up information at the end of a contact's evaluation and treatment.

 See section on *Referrals and Transfers* in *Chapter XII: Miscellaneous Protocols* for more information on transfers between counties and states.

##### b. Infectious TB patient traveling within the U.S.

The health department that initially encounters the infectious patient should interview the patient to gather as much identifying and locating information as possible for contacts during the patient's travels. These data should be shared with the health departments in which the contacts are located. The health department that counts the index case is assigned responsibility for managing the overall contact investigation.

##### c. International contact investigations

Cure TB coordinates care for TB patients that move between Mexico and the United States. TBNet has a more extensive network that stretches beyond Mexico.

 See section on *Referrals and Transfers* in *Chapter XII: Miscellaneous Protocols* for more information on Cure TB and TBNet.

#### 6. Unusual Events Causing Exposure to *M. tuberculosis*

##### a. Animals with human-type or bovine TB

Many mammals are susceptible to human-type TB, presumably through exposure to persons with infectious TB. Many animals can also contract bovine TB from exposure to infected animals or from consuming infected dairy products or feed. Animal-to-human transmission of human TB in a household has not been confirmed. Animals suspected of having TB should be referred to a veterinarian.

Patients who acquire *M. bovis* from ingestion are more likely to have extrapulmonary TB, but pulmonary disease is possible. Treatment and contact investigation should be planned according to the guidelines for human-type TB.

**b. Surgical wounds, abscesses, embalming, and autopsies**

Diseased tissues are not typical sources of infection unless aerosol-producing procedures such as water-jet irrigation, dripping fluids, electrical cauterization, and cutting with power tools are used. If procedures were performed on infected tissues before infection control precautions were instituted, then persons in the room at the time should be designated as high-priority contacts.

## **K. Source Case Investigations**

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A source case investigation seeks the source of recent *M. tuberculosis* infection, usually newly diagnosed TB disease, in a young child. TB disease in children less than 5 years of age typically indicates that the infection must be recent. Young children usually do not transmit TB to others, and their contacts are unlikely to be infected because of exposure to the child. A source-case investigation moves in the opposite direction of a contact investigation, but the principles used in a contact investigation still apply.

A source case investigation should be performed when a child younger than 3 years of age is found to have active tuberculosis. The possible source patient is usually an adult in the home or an adult with whom the child spends significant periods of time (e.g., baby sitters, day care personnel, or relatives). In a child with suspected active TB, an investigation may be started before the diagnosis of TB is confirmed because waiting for confirmation can decrease the chances of finding associates. (See below).

Seeking a source case follows the same overall procedures as a standard contact investigation. Parents or guardians usually are the best sources of information. Such persons are termed associates. Attention focuses on ill associates who have symptoms of TB disease. A source-case investigation should begin with the closest associates (e.g., household members).

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