

Contact Investigation

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Quick Start Check List: Contact Investigation

The tasks listed below should be performed by licensed nursing, medical, and laboratory staff according to Idaho statute.

| Steps for Contact Investigation | Instructions and Forms |
|--|--|
| <p>Follow the steps in this check list when a suspected or confirmed case of tuberculosis disease is reported to the local public health agency</p> | |
| <p>Gather the index patient's medical records for diagnosis of tuberculosis disease</p> <p>Decide whether to initiate a contact investigation</p> <p>Contact investigations are conducted for suspected or confirmed pulmonary, laryngeal, or pleuropulmonary disease with</p> <ul style="list-style-type: none"> ▪ Pulmonary cavities and/or ▪ Respiratory specimens positive for acid-fast bacilli sputum smear | <p>Examples of forms can be found in chapter 17.</p> <p>Be sure to consult your local protocols and standing orders, too.</p> |
| <p>Interview the index patient for information on the following:</p> <ul style="list-style-type: none"> ▪ Additional medical history ▪ Residence(s) ▪ Transmission sites, with dates and times ▪ Contacts <p>Gather other data and provide patient education as outlined for the initial assessment phase of Case Management. The index patient interview occurs at the same visit for the initial assessment in Case Management.</p> | <p>Recommended Forms:</p> <ul style="list-style-type: none"> ▪ "Idaho TB Contact Tracing Form" <p>Be sure to consult your local protocols and standing orders, too.</p> |
| <p>Determine the index patient's infectious period</p> | |
| <p>Visit the index patient's residence, if not already done in the first interview</p> <p>The visit to the index patient's resident may occur at the same visit for the first index patient interview and the initial assessment in Case Management.</p> | <p>Examples of forms can be found in chapter 17.</p> |
| <p>Conduct the field investigation, visiting all potential settings for transmission</p> | <p>Recommended Form:</p> <ul style="list-style-type: none"> ▪ "Idaho TB Contact Tracing Form" |
| <p>Reinterview the index patient</p> | <p>Recommended Form:</p> <ul style="list-style-type: none"> ▪ "Idaho TB Contact Tracing Form" |
| <p>Reassessment of Index Patient</p> <p>Reassess information about the index patient at least weekly until drug-susceptibility results are available for</p> | <p>Recommended Form:</p> <ul style="list-style-type: none"> ▪ "Idaho TB Contact Tracing Form" |

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| the <i>Mycobacterium tuberculosis</i> isolate or for 2 months following notification, whichever is longer. | |
| List contacts and assign them priorities: high, medium, low | Recommended Form: ▪ "Idaho TB Contact Tracing Form" |
| Complete a face-to-face initial assessment of high- and medium-priority contacts including the following: ▪ An impression of each contact's general health ▪ Administration of a tuberculin skin test | Recommended Form: ▪ "Idaho TB Contact Tracing Form" |
| Medically evaluate each high- and medium-priority contact to determine whether tuberculosis (TB) disease and latent tuberculosis infection (LTBI) are present or absent The medical evaluation is complete when the contact's status relative to <i>Mycobacterium tuberculosis</i> 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. | Recommended Form: ▪ "Idaho TB Contact Tracing Form" |
| Review and assess the completeness of each contact's medical follow-up and treatment plan | |
| Initiate treatment for latent tuberculosis infection for the following (if evaluation rules out tuberculosis disease): ▪ High-priority contacts ▪ Contacts likely to progress to TB disease if they are infected ▪ Contacts who could suffer severe morbidity if they had TB disease | Recommended Forms: ▪ "Idaho TB Contact Tracing Form" Be sure to consult your local protocols and standing orders, too. |
| Initiate treatment for tuberculosis disease for contacts diagnosed with tuberculosis disease | Recommended Forms: ▪ "Idaho TB Contact Tracing Form" Be sure to consult your local protocols and standing orders, too. |
| Review and assess the timeliness of initiating the treatment plan | |
| Summarize and review data to ▪ Determine if transmission occurred ▪ Decide whether to expand the contact investigation | Recommended Forms: ▪ "Idaho TB Contact Tracing Form" |
| Report to the State TB Program | Required Form: ▪ "Idaho TB Contact Tracing Form" |
| Repeat TSTs on contacts who were initially TST-negative | Recommended Form: ▪ "Idaho TB Contact Tracing Form" |
| Summarize and review data to ▪ Determine if transmission occurred ▪ Decide whether to expand the contact investigation | Recommended Forms: ▪ "Idaho TB Contact Tracing Form" |
| Report to the State TB Program | Required Form: ▪ "Idaho TB Contact Tracing Form" |

| | |
|--|---|
| Reevaluate contacts who were initially TST-negative and started on LTBI treatment | |
| Assess contacts' adherence with medical follow-up and TB medication | |
| Report to the State TB Program | Required Form: <ul style="list-style-type: none"> ▪ "Idaho TB Contact Tracing Form" |
| Collect and analyze data to evaluate the contact investigation | |
| Conduct an outbreak investigation, if necessary. | |
| Collect data to complete the <i>Aggregate Reports for Tuberculosis Program Evaluation (ARPE)</i> form. | |

Introduction

Purpose

A contact investigation is the process of identifying, examining, evaluating, and treating all persons who are at risk for infection with *Mycobacterium tuberculosis* due to recent exposure to a newly diagnosed or suspected case of pulmonary, laryngeal, or pleural tuberculosis (TB).

The primary goal of a contact investigation is to

- Identify persons who were exposed to an infectious case of TB
- Ensure that contacts receive
 - testing for *M. tuberculosis* infection;
 - screening for TB disease;
 - medical evaluation, if indicated;
 - prompt initiation of treatment for latent tuberculosis infection (LTBI) if high-risk (younger than 5 years of age or immunocompromised);
 - complete, standard course of treatment, if indicated.¹

Secondary goals of a contact investigation are to

- stop transmission of *M. tuberculosis* by identifying undetected patients with infectious TB;
- determine whether a TB outbreak has occurred (In which case, an expanded outbreak investigation should ensue).²

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

- Decide when to initiate a contact investigation
- Understand the time frames for key contact investigation activities
- Estimate the infectious period
- Conduct index patient interviews
- Assign priorities to contacts
- Complete contact evaluation, treatment, and follow-up
- Determine when to expand a contact investigation
- Manage data and evaluate contact investigations
- Conduct an outbreak investigation

Except in rare cases, every case of TB begins as a contact to a person with active pulmonary, laryngeal, or pleural TB disease. For this reason, the Centers for Disease Control and Prevention (CDC) have identified contact investigations (i.e., seeking and evaluating contacts) as a fundamental strategy for the prevention and control of TB. To control and prevent TB, our healthcare resources and efforts in Idaho should be directed to meeting the priorities outlined in the 2005 “Controlling Tuberculosis in the United States: Recommendations from the American Thoracic Society, Centers for Disease Control and Prevention, and the Infectious Diseases Society of America.” One of the recommended strategies to achieve the goal of reduction of TB morbidity and mortality is prompt identification of contacts of patients with infectious TB and timely treatment of those at risk with an effective drug regimen.³ National recommendations for contact investigations are provided in the CDC’s “Guidelines for the Investigation of Contacts of Persons with Infectious Tuberculosis.

One of the major challenges to successful control of TB is in protecting contacts of persons with infectious TB and in preventing and responding to TB outbreaks.⁴ Reducing the risk of TB among contacts through the development of better methods of identification, evaluation, and management would lead to substantial personal and public health benefits and facilitate progress toward eliminating TB in the U.S.⁵

The evaluation of contacts of cases of infectious TB 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. Contact investigations, therefore, serve as an important means of detecting TB cases and at the same time identify persons in the early stage of LTBI, when the risk for progression to TB disease is high and the benefit of treatment is greatest.⁶ A study showed that improvements in contact investigations might have prevented 17 (10%) of 165 pediatric TB cases in California in 1994.⁷

Guidance

A contact investigation is recommended for the following forms of suspected or confirmed TB because they are likely to be infectious:

Pulmonary, laryngeal, or pleuropulmonary disease with either

- pulmonary cavities;
- respiratory specimens that have acid-fast bacilli (AFB) on microscopy;
- especially both.⁸

Persons with AFB sputum smear negative results are less likely to be infectious, but are still capable of infecting others.



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



For each investigation, complete the “Idaho TB Contact Tracing Form” or the equivalent available.

Structure of a Contact Investigation

Basic Steps of 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. Preinterview preparation
2. Index patient interviews
3. Field investigation
4. Risk assessment for *Mycobacterium 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^{9,10}

Although these steps are presented in sequence above, it is important to remember that contact investigations do not always follow a predetermined sequence of events.¹¹

Contact Investigation Plan

The investigation plan starts with information gathered during interviews and site visits. It should include a registry of the contacts, their assigned priorities, and a written timeline. The timeline sets expectations for monitoring the progress of the investigation and informs public health officials whether additional resources are needed for finding, evaluating, and treating the high- and medium-priority contacts.



For more information on timelines, see Table 2: **CDC Recommended Time Frames for Investigating the Index Patient and the Sites of Transmission** and Table 3: **CDC Recommended Time Frames for Contact Evaluation and Treatment** in this section's topic, "Time Frames for Contact Investigation."

The plan is a pragmatic work in progress and should be revised if additional information indicates a need to expand a contact investigation. It is part of the permanent record of the overall investigation for later review and program evaluation.¹²

Decision to Initiate a Contact Investigation

Factors Predicting Transmission of Tuberculosis

Decide when to initiate a contact investigation using the criteria provided in this topic. Competing demands restrict the resources that can be allocated to contact investigations. Therefore, public health officials must decide which contact investigations are more significant and which contacts to evaluate first.

The index patient is the first patient that comes to the investigator's attention as an indicator of a potential public health problem. Whether or not to investigate an index patient depends on factors predicting transmission. See Table 1: **Index Patient Factors Increasing Transmission Risk**. In addition, other information about the index patient, such as social habits or workplace environments, can influence the investigative strategy.¹³

TABLE 1. INDEX PATIENT FACTORS INCREASING TRANSMISSION RISK¹⁴

| Characteristics of the Index Patient | Behaviors of the Index Patient |
|--|---|
| <ul style="list-style-type: none">▪ Pulmonary, laryngeal, or pleuropulmonary tuberculosis (TB)▪ Positive acid-fast bacilli sputum smear results▪ Cavitation on chest radiograph▪ Adolescent or adult patient▪ Lack of treatment or ineffective treatment of TB disease | <ul style="list-style-type: none">▪ Frequent coughing▪ Sneezing▪ Singing▪ Close social network |

Source: CDC. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and Guidelines for using the QuantiFERON[®]-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):4.

Anatomical Site of Disease

Ordinarily, patients with pulmonary or laryngeal tuberculosis (TB) are the only ones who can transmit their infection. For contact investigations, pleural disease is grouped with pulmonary disease because sputum cultures can yield *Mycobacterium tuberculosis* even when no lung abnormalities show on radiography. Rarely, extrapulmonary TB causes transmission during medical procedures, such as autopsy and embalming, that release aerosols.

Sputum Bacteriology

The relative infectiousness increases when the sputum culture results are positive, and increases further when the acid-fast bacilli (AFB) sputum smear results are also

positive.¹⁵ The significance of results from respiratory specimens other than expectorated sputum, such as bronchial washings or bronchoalveolar lavage fluid, is undetermined. Expert opinion recommends that these specimens be regarded as equivalent to sputum.

Radiographic Findings

Patients who have lung cavities observed on a chest radiograph are more infectious than patients with noncavitary disease. This is an independent predictor after bacteriologic findings are taken into account. The significance of small lung cavities that are detectable with computerized tomography (CT), but not with plain radiography, is undetermined.

Isolated instances of highly contagious endobroncheal TB in severely immunocompromised patients who temporarily had normal chest radiographs have contributed to outbreaks. The number and relative significance of such instances is unknown, but in one case series with human immunodeficiency virus (HIV)-infected TB patients, 3% who had positive AFB sputum smears had normal chest radiographs at the time of diagnosis.

Social Characteristics

Social issues can influence transmission. To assess the risk of transmission, it is important to consider the index patient's social factors, such as a close social network, residential setting or homelessness, employment, work setting, non work-related activities, recent arrival from a foreign country, substance abuse, and intravenous drug use.

Age

Transmission from children younger than 10 years of age is unusual, although it has been reported in association with those pulmonary forms of disease typically seen in adults. Contact investigations to evaluate transmission from pediatric cases should not be undertaken except for those unusual cases. However, children younger than 5 years with TB, regardless of the site of disease, should have a contact investigation to identify the source case. A source-case investigation seeks the source of recent *M. tuberculosis* infection, perhaps newly diagnosed TB disease. TB disease in children younger than 5 years 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 them.

Human Immunodeficiency Virus Status

This evaluation needs to be done promptly since progression to active TB may occur within weeks of exposure among individuals with acquired immunodeficiency syndrome (AIDS). HIV-infected TB patients with low CD4 T-cell counts frequently have chest

radiographic findings that are not typical of pulmonary TB.¹⁶ In particular, they are more likely to have mediastinal adenopathy and less likely to have upper-lobe infiltrates and cavities. The atypical radiographic findings increase the potential for delayed diagnosis, which increases transmission. However, HIV-infected patients who have pulmonary or laryngeal TB on average are only as contagious as similar patients who are not HIV-infected. Contacts to HIV-infected index TB cases are also more likely to be HIV-infected. Therefore, for all persons who were exposed to HIV-infected TB cases (or those with risk factors for HIV) and whose infection status is unknown, HIV counseling and testing is recommended.¹⁷ Regardless of known HIV status, HIV counseling should always be recommended for all patients as a part of the screening process.¹⁸

After Starting Chemotherapy

TB patients rapidly become less contagious while under treatment. This has been corroborated by measuring the number of viable *M. tuberculosis* organisms in sputa and by observing infection rates in household contacts. However, the exact rate of decrease cannot be predicted for individual patients, and an arbitrary determination is required for each.



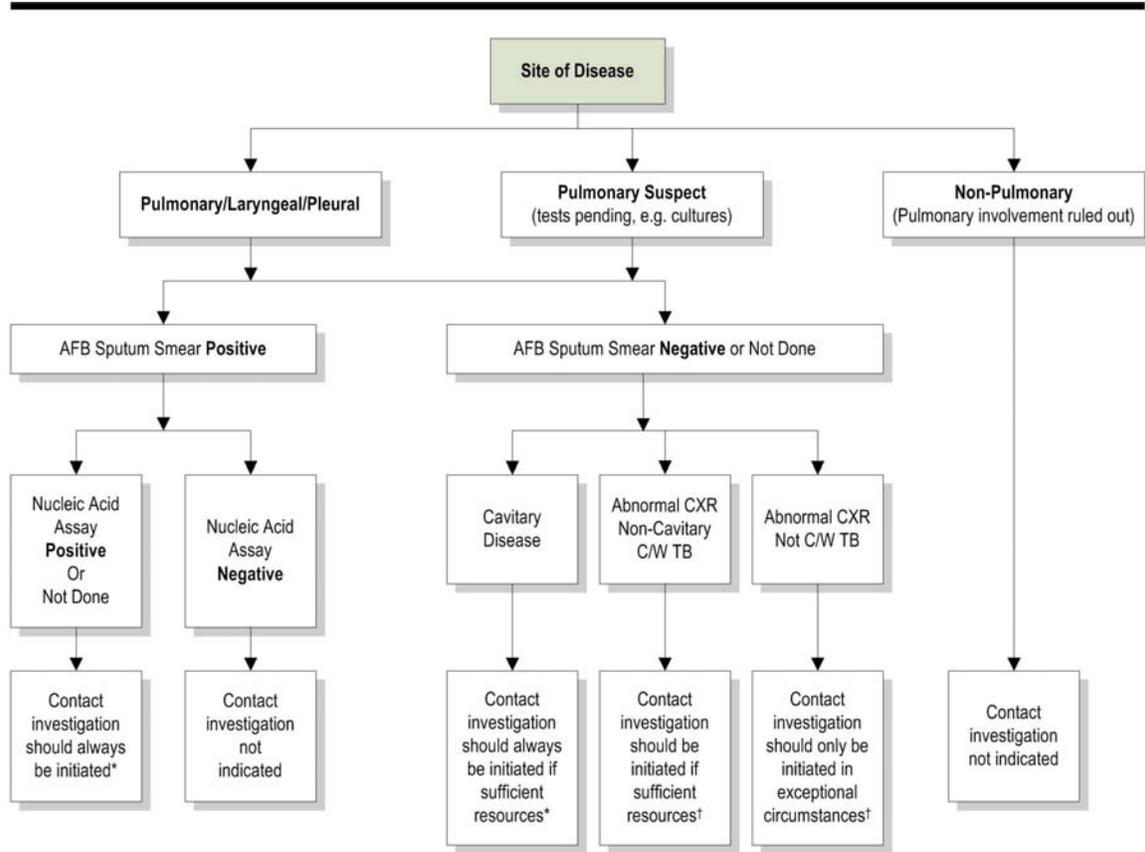
Treatment After Exposure to Drug-Resistant Tuberculosis

Drug susceptibility results for the *M. tuberculosis* isolate from the index patient (i.e., the presumed source of infection) are absolutely necessary for selecting the treatment regimen. Resistance to only isoniazid (INH) leaves the option of four months of daily rifampin (RIF), but additional resistance to RIF constitutes multidrug-resistant TB (MDR-TB). If this is the case, all the potential regimens are poorly tolerated to some extent, while none of these regimens have been tested fully for efficacy. Therefore, a consultation with a physician having expertise in this area is strongly recommended for selecting a regimen and managing the care of contacts. Monitor contacts who are suspected to be infected with multidrug-resistant *M. tuberculosis* for two years after exposure.

Deciding to Initiate a Contact Investigation

Consider a contact investigation for any patient with confirmed or suspected pulmonary, laryngeal, or pleuropulmonary TB. Refer to Figure 1 to help determine whether to start a contact investigation.

FIGURE 1. DECISION TO INITIATE A CONTACT INVESTIGATION¹⁹



Definitions of abbreviations: AFB = acid-fast bacilli; C/W = consistent with; CXR = chest radiograph.

* Use time frames from the middle column of Table 2 in the “Time Frames for Contact Investigation” topic.

† Use time frames from the right-hand column of Table 2 in the “Time Frames for Contact Investigation” topic.

Source: CDC. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantIFERON[®]-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):5.

In general, a contact investigation should be promptly initiated for an AFB sputum smear-positive pulmonary TB suspect. However, many AFB sputum smear-positive suspects may turn out to have nontuberculous mycobacteria (NTM) instead of *M. tuberculosis*. An approved nucleic acid amplification (NAA) test for *M. tuberculosis* can be used to avoid unnecessary contact investigations for suspects with NTM, particularly in patients who are at low risk for TB.

If AFB are not detected by microscopy of three sputum smears, an investigation is still recommended if the chest radiograph shows cavities in the lung. Small parenchymal cavities that can be detected only by computerized imaging techniques (e.g., computed tomography [CT], computerized axial tomography [CAT] scan, or magnetic resonance imaging [MRI] of the chest) are not included in these guidelines.

When sputum samples have not been collected, either because of an oversight or the patient's inability to expectorate, results from other types of respiratory specimens (e.g., gastric aspirates or bronchoalveolar lavage) may be interpreted in the same way as in the above recommendations. However, whenever feasible, sputum samples for each case should be collected before or while initiating chemotherapy.

A contact investigation can still be considered for high-risk contacts of suspects with non-cavitary disease and negative AFB sputum smears. The decision depends on the amount of resources that can be allocated and on whether goals are being met for higher priority contact investigations.

Contact investigations generally should not be initiated around index patients who have suspected TB disease and minimal diagnostic findings in support of pulmonary TB. Possible exceptions can be found during outbreak investigations, especially when vulnerable or susceptible contacts are found, or during a source-case investigation. Outbreak investigations and source-case investigations are explained briefly below.

- **Outbreak Investigation:** Definitions for TB outbreaks are relative to the local context. Outbreak cases can only be distinguished from other cases when some association in time, location, patient characteristics, or *M. tuberculosis* attributes (e.g., drug resistance or genotype) becomes apparent. In low-incidence jurisdictions, any temporal cluster will cause suspicion regarding an outbreak. In places where cases are more common, clusters can be obscured by the baseline incidence rate until suspicion is triggered by a noticeable increase, a sentinel event (e.g., pediatric cases), or related *M. tuberculosis* isolates.



For more information on outbreak investigations, see the “Outbreak Investigation” topic in this section.

- **Source-Case Investigation:** A source-case investigation seeks the source of recent *M. tuberculosis* infection, perhaps newly diagnosed TB disease. A source case or patient is the original source of infection for secondary cases or contacts. The source case can be, but is not necessarily, the index patient. For more information on

source-case investigations, see the CDC's "Guidelines for the Investigation of Contacts of Persons with Infectious Tuberculosis Cases" (*MMWR* 2005;54[No. RR-15]: 31) at <http://www.cdc.gov/mmwr/pdf/rr/rr5415.pdf> .

Time Frames for Contact Investigation

Use this topic to understand the time frames for key contact investigation activities. A suspected or confirmed case of tuberculosis (TB) becomes designated an “index patient” when that person is the first patient to appear as an indicator of a potential public health problem. An investigation is launched because of an index patient, and the investigation often starts with an interview of the index patient.

Information about the Index Patient and Transmission Sites

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

The infectiousness of the index patient determines the recommended time frames for pursuing the investigation. Indications of infectiousness include symptoms (such as cough, fever, weight loss, and night sweats), a positive acid-fast bacilli (AFB) sputum smear, a positive nucleic acid amplification (NAA) test, cavitory disease, or an abnormal chest radiograph consistent with TB.

Refer to Table 2: **CDC Recommended Time Frames for Investigating the Index Patient and the Sites of Transmission** for the recommended time frames for index patient interviews and visits to the residence transmission sites.



Some readers confuse prioritizing an investigation with prioritizing follow-up of individual contacts within an investigation. The following explains the difference between the two:

- The time priority for investigating the index patient and transmission sites is determined by the infectiousness of the index patient. Indications of infectiousness include positive AFB sputum smear results as well as symptoms, positive NAA test results, and chest radiographs showing cavitory disease or abnormalities consistent with TB.
- Priority-ranking contacts for follow-up within an investigation is based on the characteristics of the index patient as well as the duration and circumstances of the exposure, and the vulnerability/susceptibility of the contacts to disease from *Mycobacterium tuberculosis* infection.



For information on how to determine which contacts are high, medium, and low priority, see the “Contact Priorities” topic in this section.

TABLE 2: CDC RECOMMENDED TIME FRAMES FOR INVESTIGATING THE INDEX PATIENT AND THE SITES OF TRANSMISSION²⁰

| Activity | Suspects Expected to Be Cases of Tuberculosis (TB) | |
|---|--|--|
| | Suspects with Indications of Infectiousness | Suspects Without Indications of Infectiousness |
| <p>First Index Patient Interview Number of days following notification within which the index patient should be interviewed in person (i.e., not by telephone)</p> | ≤1 Business Day of Reporting | ≤3 Business Days of Reporting |
| <p>Residence Visit Number of days following the first index patient interview within which the place of residence of the index patient should be visited</p> | ≤3 Business Days After First Interview | 3 Business Days After First Interview |
| <p>Field Investigation Number of days following initiation of the contact investigation within which all potential settings for transmission should be visited</p> | 5 Business Days After the Start of the Investigation | 5 Business Days After the Start of the Investigation |
| <p>Index Patient Reinterviews Length of time after the first interview within which the index patient should be reinterviewed 1 or more times for clarification and additional information</p> | 1 or 2 Weeks After First Interview | 1 or 2 Weeks After First Interview |
| <p>Reassessment of Index Patient Information about the index patient should be reassessed at least weekly until drug-susceptibility results are available for the <i>Mycobacterium tuberculosis</i> isolate or for 2 months following notification, whichever is longer.</p> | | |

Source: CDC. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON®-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):7–8.

Contact Evaluation and Treatment

In addition to the investigation of the index patient and transmission sites, a contact investigation also involves contact follow-up. Refer to Table 3: **CDC Recommended Time Frames for Contact Evaluation and Treatment** to monitor the progress of the investigation and determine whether additional resources are needed for finding, evaluating, and treating the high- and medium-priority contacts.



Priority-ranking contacts for investigation is based on the likelihood of infection and the potential hazard to the individual contact if infected.²¹ For information on how to determine which contacts are high-, medium-, or low-priority, see the “Contact Priorities” topic in this section.

TABLE 3: CDC RECOMMENDED TIME FRAMES FOR CONTACT EVALUATION AND TREATMENT²²

| Type of Contact | Business Days from Listing of 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 |
|--|--|---|---|
| High-Priority Contact Index patient with positive acid-fast bacilli (AFB) sputum smear results or cavitory disease on chest radiograph | 3 Business Days After Being Listed in the Investigation ²³ | 5 Business Days | 10 Business Days |
| | |  5 Business Days Children and high-risk contacts can develop complicated tuberculosis (TB) within a few weeks of infection. | |
| High-Priority Contact Index patient with negative AFB sputum smear results | 3 Business Days After Being Listed in the Investigation ²⁴ | 10 Business Days | 10 Business Days |
| Medium-Priority Contact Regardless of AFB sputum smear or culture result | 3 Business Days After Being Listed in the Investigation ²⁵ | 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) and to schedule further evaluation. † The medical evaluation is complete when the contact's status relative to <i>Mycobacterium tuberculosis</i> 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. | | | |

Source: Adapted from CDC. 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.

Ongoing Management Activities

Ongoing contact follow-up includes testing, medical evaluation, and treatment. Information from contact follow-up guides decisions about whether to expand a contact investigation. Refer to Table 4: **Overview of Recommended Ongoing Management Activities and Maximum Time Frames** to monitor the progress of ongoing contact follow-up and to determine when to decide whether to expand the investigation.

TABLE 4: OVERVIEW OF RECOMMENDED ONGOING MANAGEMENT ACTIVITIES AND MAXIMUM TIME FRAMES²⁶

| Activity | Purpose | Maximum Time Interval |
|--|---|--|
| Review all documentation | To ensure that contact list is complete | Ongoing |
| Review and assess completeness of each contact's medical follow-up and treatment plan | To ensure appropriate and complete medical follow-up | 5 business days after each contact's medical evaluation is completed* |
| Review and assess the timeliness of initiating the treatment plan | To avoid delays in treatment initiation, particularly in high-risk contacts | 10 business days after each contact's medical evaluation is completed* |
| Determine if transmission occurred | To decide whether to expand investigation | At completion of follow-up testing, or if secondary cases are identified |
| Obtain and review drug-susceptibility results | To determine if contacts are receiving appropriate treatment for latent tuberculosis infection (LTBI) | 1 to 2 months after the index patient's initial sputum collection date |
| Repeat tuberculin skin test (TST) if contact is initially TST-negative | To determine if contact has converted (TB Class I to TB Class II) | 8 to 10 weeks after each contact's initial TST or last exposure to the index patient † |
| Reevaluate contacts who were initially TST-negative and started on LTBI treatment (Window Period Treatment for a TB Class I Contact) | To determine if treatment for LTBI should be continued | 8 to 10 weeks after each contact's initial TST or last exposure to the index patient before the end of the infectious period † |
| Assess contacts' adherence with medical follow-up and TB medication | To remove barriers and ensure timely and complete evaluation and follow-up | Monthly, at time of each visit |

| Activity | Purpose | Maximum Time Interval |
|--|---|--|
| Ensure contacts are monitored for adverse reactions and toxicity of LTBI treatment regimens | To prevent development of adverse effects and toxicity from drug regimens | At least monthly while on LTBI treatment |
| Evaluate problems and concerns that arise and may delay or hamper contact investigation | To remove barriers and ensure timely and complete evaluation and follow-up | Whenever problems are identified |
| Collect and analyze data to evaluate the contact investigation | To provide epidemiologic analysis of investigations and to measure performance using indicators that reflect performance objectives ²⁷ | Ongoing |
| Collect data to complete the <i>Aggregate Reports for Tuberculosis Program Evaluation (ARPE)</i> form ²⁸ | To report on investigation to the Centers for Disease Control and Prevention | Ongoing |
| <p>* The medical evaluation is complete when the contact's status relative to <i>Mycobacterium tuberculosis</i> 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.</p> <p>† Third TST: In rare circumstances, an infectious index patient with advanced disease can stay infectious for several months. In these circumstances, the second TST for negative contacts should be performed in the usual time frame (8 to 10 weeks). This will identify any contacts who have already converted so they can be evaluated for treatment. However, any household members who remain TST negative and have continued exposure to the infectious index patient should have a third TST 8 to 10 weeks after the index patient becomes noninfectious. This is especially true for contacts who are infants in a household where a resident is culture positive after 3 months or has multidrug-resistant TB. For example, a household member with continued exposure to an infectious index patient had a negative second TST on 3/12/2005. The last date the index patient was infectious was 3/5/2005. The household member should have a third TST 8 to 10 weeks from 3/5/2005. For consultation regarding the appropriateness of a third TST, call the State TB Program Manager at 406-444-0275.</p> | | |

Source: Adapted from: California Department of Health Services (CDHS)/California Tuberculosis Controllers Association (CTCA). Contact investigation guidelines. *CDHS/CTCA Joint Guidelines*. November 12, 1998:18. Available at: <http://www.ctca.org/guidelines/IID1contactinvestigation.pdf>. Accessed July 6, 2006.

Infectious Period

Determine the infectious period to focus the investigation on those contacts most likely to be at risk for infection and to set the time frame for testing contacts.

The infectious period is the time frame in which potential exposure to others may have occurred while the patient was infectious or able to transmit tuberculosis (TB).²⁹ The start of the infectious period cannot be determined with any current methods, so a practical estimation is necessary. From expert opinion, an assigned start three months prior to TB diagnosis is recommended for the more infectious patients. Some circumstances may indicate an even earlier start, which should be used instead. The clearest example is when the patient or the patient's associates were aware of protracted illness, which can exceed one year in extreme examples.

Assemble information from the index patient interview and other sources to estimate the infectious period. Helpful details are the approximate dates that TB symptoms were noticed, bacteriology results, and the extent of disease—especially the presence of large lung cavities, which imply prolonged illness as well as infectiousness.

Use Table 5: **Guide for Estimating the Beginning of the Period of Infectiousness** to determine the start of the infectious period.

TABLE 5: GUIDE FOR ESTIMATING THE BEGINNING OF THE PERIOD OF INFECTIOUSNESS³⁰

| Index Patient Characteristics | | | | | | Beginning of Likely Period of Infectiousness |
|-------------------------------|----|---|----|---------------------------|----|--|
| Tuberculosis (TB) Symptoms | | Positive Acid-Fast Bacilli (AFB) Sputum Smear Results | | Cavitary Chest Radiograph | | |
| Yes | No | Yes | No | Yes | No | |
| ✓ | | | ✓ | | ✓ | 3 months prior to symptom onset or first positive finding consistent with TB disease (whichever is longer) |
| ✓ | | ✓ | | ✓ | | 3 months prior to symptom onset or first positive finding consistent with TB disease (whichever is longer) |
| | ✓ | | ✓ | | ✓ | 4 weeks prior to date of suspected diagnosis |
| | ✓ | ✓ | | ✓ | | 3 months prior to first positive finding consistent with TB |

Source: California Department of Health Services Tuberculosis Control Branch; California Tuberculosis Controllers Association. Contact investigation guidelines. Berkeley, CA: California Department of Health Services; 1998; in CDC. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON®-TB Gold test for detecting Mycobacterium tuberculosis infection, United States. *MMWR* 2005;54(No. RR-15):7.

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 index patient's response to treatment, and/or the application of effective infection control measures.

In general, for the purposes of contact investigation, the infectious period is closed when **all** three of the following criteria are met:

1. The index patient is receiving effective treatment (as demonstrated by *Mycobacterium tuberculosis* susceptibility results) for at least two weeks.
2. The index patient has diminished symptoms.
3. The index patient exhibits mycobacteriologic response (e.g., decrease in grade of sputum smear positivity detected on sputum-smear microscopy).³¹

or

- Exposure to contacts has ended.³²

Take careful note of the following exceptions:

- **Multidrug-resistant TB (MDR-TB):** MDR-TB can extend infectiousness if the treatment regimen is ineffective.
- **Signs of Infectiousness:** Any index patient with signs of extended infectiousness should be continually reassessed for recent contacts.
- **Susceptible Contacts:** Apply more stringent criteria for setting the end of the infectious period if particularly susceptible contacts are involved.



A patient returning to a congregate living setting or to any setting in which susceptible persons might be exposed should meet the criteria for noninfectiousness that are listed in the topic “Determining Noninfectiousness” in the Infection Control section of this manual..

Index Patient Interviews

Conduct index patient interviews to set the direction for the contact investigation, identify contacts, provide opportunities for the patient to learn about tuberculosis (TB) and its control, and help the public health worker learn how to provide treatment and specific care for the patient.

In index patient interviews, gather information about the index patient's medical history, treatment needs, residence, transmission sites, dates and times at specific transmission sites, and contacts at specific sites. Use the information from these interviews to decide whether to start a contact investigation, establish its priority relative to other investigations, and determine the scope of the investigation.

There should be an initial interview and one or two reinterviews before discharge from the hospital, or within one to two weeks if the initial interview is at home, to obtain further information and answer additional questions.³³



TB Interviewing for Contact Investigation: A Practical Resource for the Healthcare Worker from the New Jersey Medical School Global Tuberculosis Institute at

<http://www.umdnj.edu/globaltb/products/tbinterviewing.htm> offers specific suggestions on how to prepare for and conduct the interviews.³⁴



Record information on the index patient and contacts on the “Idaho TB Contact Tracing Form” available from chapter 17 “Forms” or an equivalent form.

Preinterview Preparation

Gather information on the patient and the circumstances of the illness to prepare for the first interview.

Consult these sources:

- Current medical record
- Physician who reported the case
- Infection control nurse (if the patient is hospitalized)

The Privacy Rule in the Health Insurance Portability and Accountability Act (HIPAA) permits disclosure of medical record information to public health authorities.³⁵

General Guidelines for Interviewing an Index Patient

1. Discuss confidentiality and privacy in frank terms to help the patient decide how to share information, and revisit these topics several times during the interview to stress their importance. Emphasize confidentiality, but inform the patient that relevant information may need to be shared 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 it will be necessary for visits to be made at sites such as the home, workplace/school, or leisure establishments to assess the shared air environment to accurately structure the contact investigation.³⁶
2. Conduct the interviews in the patient's language, using a medical interpreter if the patient does not speak English.
3. Conduct the interviews in a culturally competent manner.



For more information on cultural sensitivity, refer to the *Participant's Workbook* for Session 4: "Working with Culturally Diverse Populations," in the Francis J. Curry National Tuberculosis Center's *DOT Essentials: The DOT Trainer's Curriculum*, at

<http://www.nationaltbcenter.edu/catalogue/epub/index.cfm?uniqueID=2&tableName=DOTE> .

For assistance with language issues, see the *Language Services Resource Guide for Health Care Providers* (The National Health Law Program and The National Council on Interpreting Health Care) at <http://www.healthlaw.org/library.cfm?fa=download&resourceID=89928&ppView=folder&print> or follow local protocols.

Medical interpretation options are suggested in the Supplies, Materials, and Services section of this manual in addition to local resources.

Field Investigation

A field investigation includes 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.³⁷

During field visits, the healthcare worker should do the following:

- **Observe environmental characteristics** such as room size, crowding, and ventilation, to estimate the risk of tuberculosis (TB) transmission: air volume, exhaust rate, and circulation predict the likelihood of transmission in an enclosed space. In large indoor settings, the degree of proximity between contacts and the index patient can influence the likelihood of transmission. The most practical system for grading exposure settings is to categorize them by size (e.g., “1” being the size of a vehicle or car, “2” the size of a bedroom, “3” the size of a house, and “4” a size larger than a house). The volume of air shared between an infectious TB patient and contacts dilutes the infectious particles. Local circulation and overall room ventilation also dilute infectious particles, but both factors have to be considered because they can redirect exposure into spaces that were not visited by the index patient.³⁸
- **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 high- and medium-priority 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 *Mycobacterium 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 collection³⁹



For field investigation, use the “Idaho TB Contact Tracing Form” available from the “Idaho Tuberculosis Forms” Web page at .

Healthcare 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.⁴⁰



For more information on infection control, see the Infection Control section. This section will be available in the Spring of 2007. Check the *Idaho Tuberculosis Program Manual Updates* page at .

Another critical consideration during field investigations is safety. Healthcare 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 healthcare worker include the following:

- 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 problems⁴¹

Contact Priorities

Assign priorities to contacts, using the registry of contacts compiled from the index patient interviews, site visits, interviews with contacts, and information from other persons involved in the investigation. The Centers for Disease Control and Prevention (CDC) defines the three levels of contact priorities as follows:

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

Contact priorities are determined by the likelihood of infection and the potential hazards to the individual contact if infected.⁴² Priority-ranking contacts for investigation is based on the characteristics of the index patient, the duration and circumstances of the exposure, and the vulnerability/susceptibility of the contacts to disease from *Mycobacterium tuberculosis* infection.⁴³

Use the assigned priorities to allocate resources to complete all investigative steps for the high- and medium-priority contacts.⁴⁴ Dividing contacts into these three levels provides a system for public health staff to reach high-priority contacts first, then medium-priority contacts, and then low-priority contacts. The priority scheme directs resources to the following essential actions:

1. Find contacts who are secondary active tuberculosis (TB) cases
2. Find contacts who have recent *M. tuberculosis* infection—the most likely to benefit from treatment
3. Select contacts who are most likely to progress to TB disease if they are infected (i.e., susceptible contacts) or who could suffer severe morbidity if they had TB disease (i.e., vulnerable contacts)⁴⁵



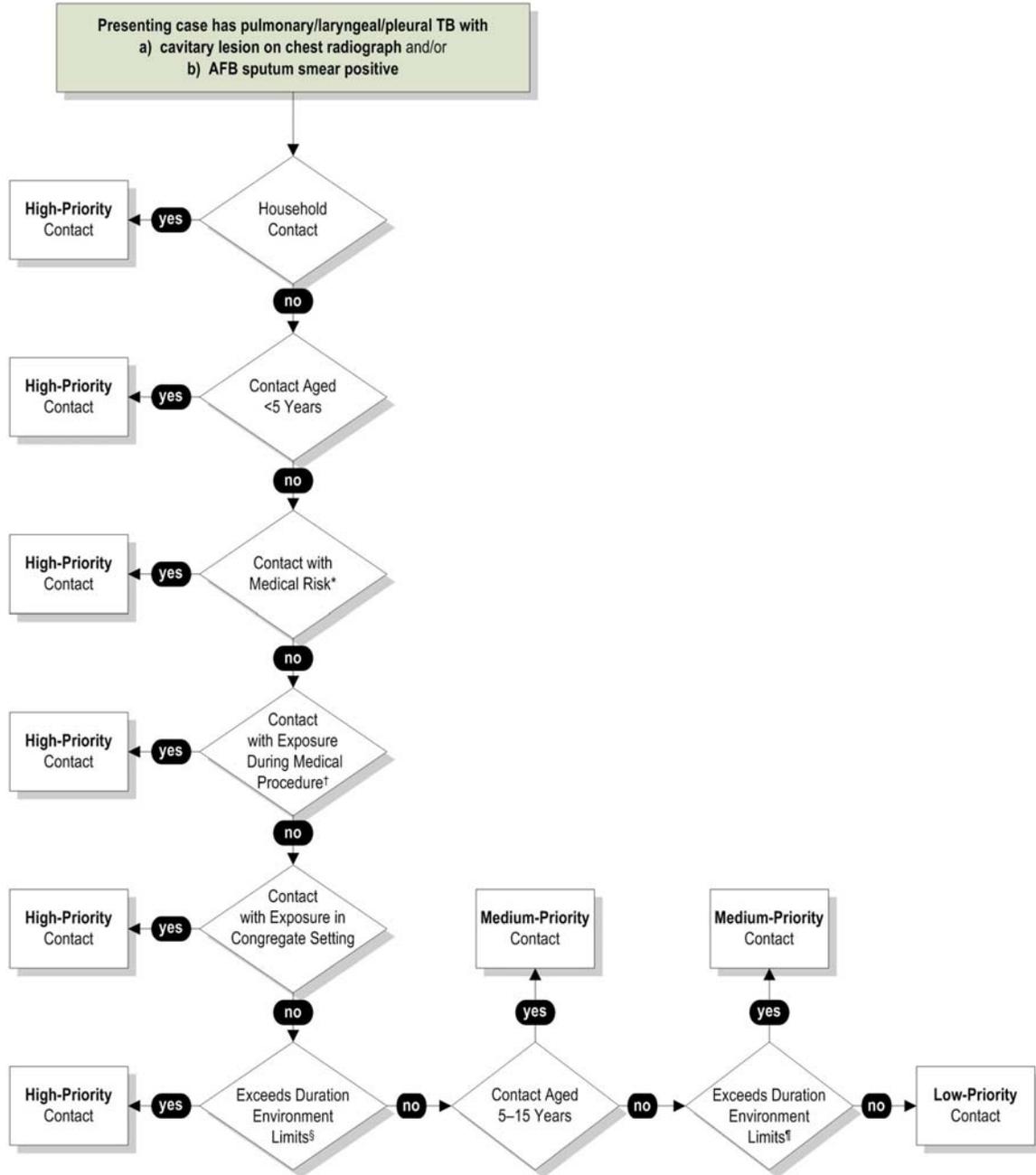
Timely initiation of treatment is especially important for susceptible and vulnerable contacts. Refer to Table 3: **Time Frames for Contact Evaluation and Treatment** in the “Time Frames for Contact Investigation” topic.

Use the figures and table on the following pages to assign priorities to contacts to the following:

- Figure 2: **Prioritization of Contacts to Smear-Positive or Cavitory Cases**
- Figure 3: **Prioritization of Contacts to Smear-Negative Cases**
- Table 6: **Prioritization of Contacts to Cases with Abnormal Chest Radiographs not Consistent with Tuberculosis:** to prioritize contacts to a suspected case of pulmonary TB who is acid-fast bacilli (AFB) sputum smear negative, nucleic acid amplification (NAA) negative, and culture negative and who has abnormal chest radiographs not consistent with TB disease.

Index Patient with Positive Acid-Fast Bacilli Sputum Smear Results or Cavitary Tuberculosis

FIGURE 2: PRIORITIZATION OF CONTACTS TO SMEAR-POSITIVE OR CAVITARY CASES



Definition of abbreviations: AFB = acid-fast bacilli; HIV = human immunodeficiency virus.

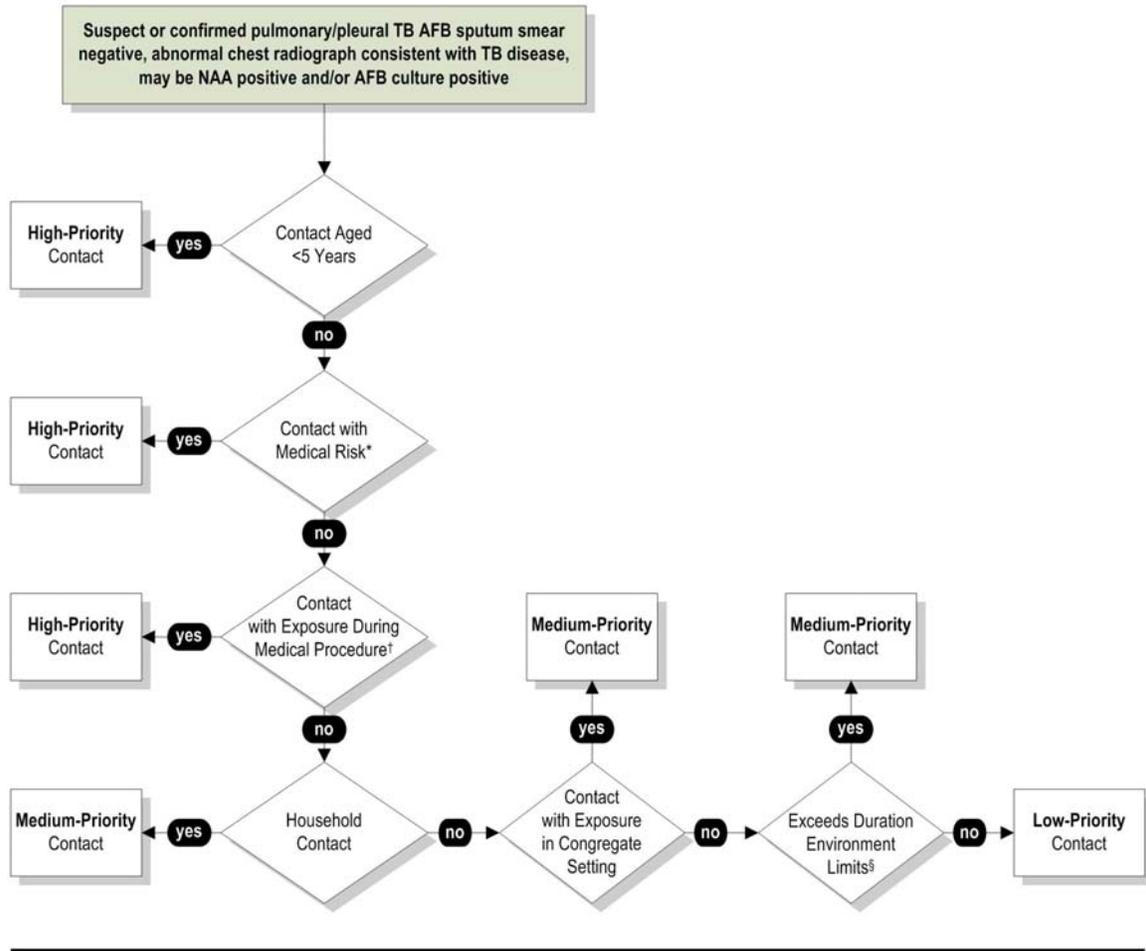
* HIV or other medical risk factor. † Bronchoscopy, sputum induction, or autopsy. § Exposure exceeds duration/environment limits per unit time established by the health department for high-priority contacts. ¶ Exposure exceeds duration/environment limits per unit time established by the health department for medium-priority contacts.

Source: CDC, NTCA. 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):12.

Index Patient with Negative Acid-Fast Bacilli Sputum Smear Results

FIGURE 3: PRIORITIZATION OF CONTACTS TO SMEAR-NEGATIVE CASES



Definition of abbreviations: AFB = acid-fast bacilli; HIV = human immunodeficiency virus; NAA = nucleic acid assay.

* HIV or other medical risk factor.

† Bronchoscopy, sputum induction, or autopsy.

§ Exposure exceeds duration/environment limits per unit time established by the local TB control program for medium-priority contacts.

Source: CDC. 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):13.

Index Patient with Negative Bacteriologic Results and Abnormal Chest Radiographs Not Consistent with Tuberculosis

TABLE 6: PRIORITIZATION OF CONTACTS TO CASES WITH NEGATIVE BACTERIOLOGIC RESULTS AND ABNORMAL CHEST RADIOGRAPHS NOT CONSISTENT WITH TUBERCULOSIS⁴⁶

| High-Priority Contacts | Medium-Priority Contacts | Low-Priority Contacts |
|------------------------|---|--|
| | <ul style="list-style-type: none"> ▪ Household contacts ▪ Contacts <5 years old ▪ Contacts with human immunodeficiency virus (HIV) infection or other medical risk factor ▪ Contacts exposed during a medical procedure such as bronchoscopy, sputum induction, or autopsy | <ul style="list-style-type: none"> ▪ Contacts not in medium-priority groups |

Source: CDC. 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):14.

Contact Evaluation, Treatment, and Follow-up

Complete evaluation, treatment, and follow-up for high- and medium-priority contacts, and as specified in your contact investigation plan. The Centers for Disease Control and Prevention (CDC) recommends the following:

- Provide each high- and medium-priority contact an initial assessment that includes a face-to-face encounter in which an impression of each contact's general health is formed and a tuberculin skin test (TST) is usually administered.
- Medically evaluate each high- and medium-priority contact to determine whether tuberculosis (TB) disease and latent tuberculosis infection (LTBI) are present or absent.
- Timely initiation of treatment is especially important for high-priority contacts and for contacts likely to progress to TB disease if they are infected (i.e., susceptible contacts) or contacts who could suffer severe morbidity if they had TB disease (i.e., vulnerable contacts). For recommended time frames, refer to Table 3: **Time Frames for Contact Evaluation and Treatment** in the "Time Frames for Contact Investigation" topic.
- Use the same diagnostic methods for all contacts, except when they have medical or constitutional conditions making TB more likely or more difficult to diagnose. A contact's country of origin and Bacille Calmette-Guérin (BCG) vaccination are not included in algorithms for diagnosis or treatment. Interpret a positive TST in a foreign-born or BCG-vaccinated person as evidence of recent *Mycobacterium tuberculosis* infection in contacts of persons with infectious cases. Evaluate these contacts for TB disease and offer them a course of treatment for LTBI.⁴⁷



Record the testing results for contacts on the "Idaho TB Contact Tracing Form" (or equivalent) available from chapter 17 "Forms".

Use the tables on the following pages to determine the evaluation activities for contacts in these different risk groups and priority rankings:

Figure 4: Evaluation, Treatment, and Follow-up of Immunocompromised Contacts and Children Under 5 Years Old



Timely initiation of treatment is especially important for these contacts. Refer to Table 3: **Time Frames for Contact Evaluation and Treatment** in the “Time Frames for Contact Investigation” topic.

Figure 5: Evaluation, Treatment, and Follow-up of Immunocompetent Adults and Children 5 Years and Older (High- and Medium-Priority Contacts)

Figure 6: Evaluation, Treatment, and Follow-up of Contacts with Prior Positive Tuberculin Skin Tests



For the evaluation of low-priority contacts, see the “When to Expand a Contact Investigation” topic.



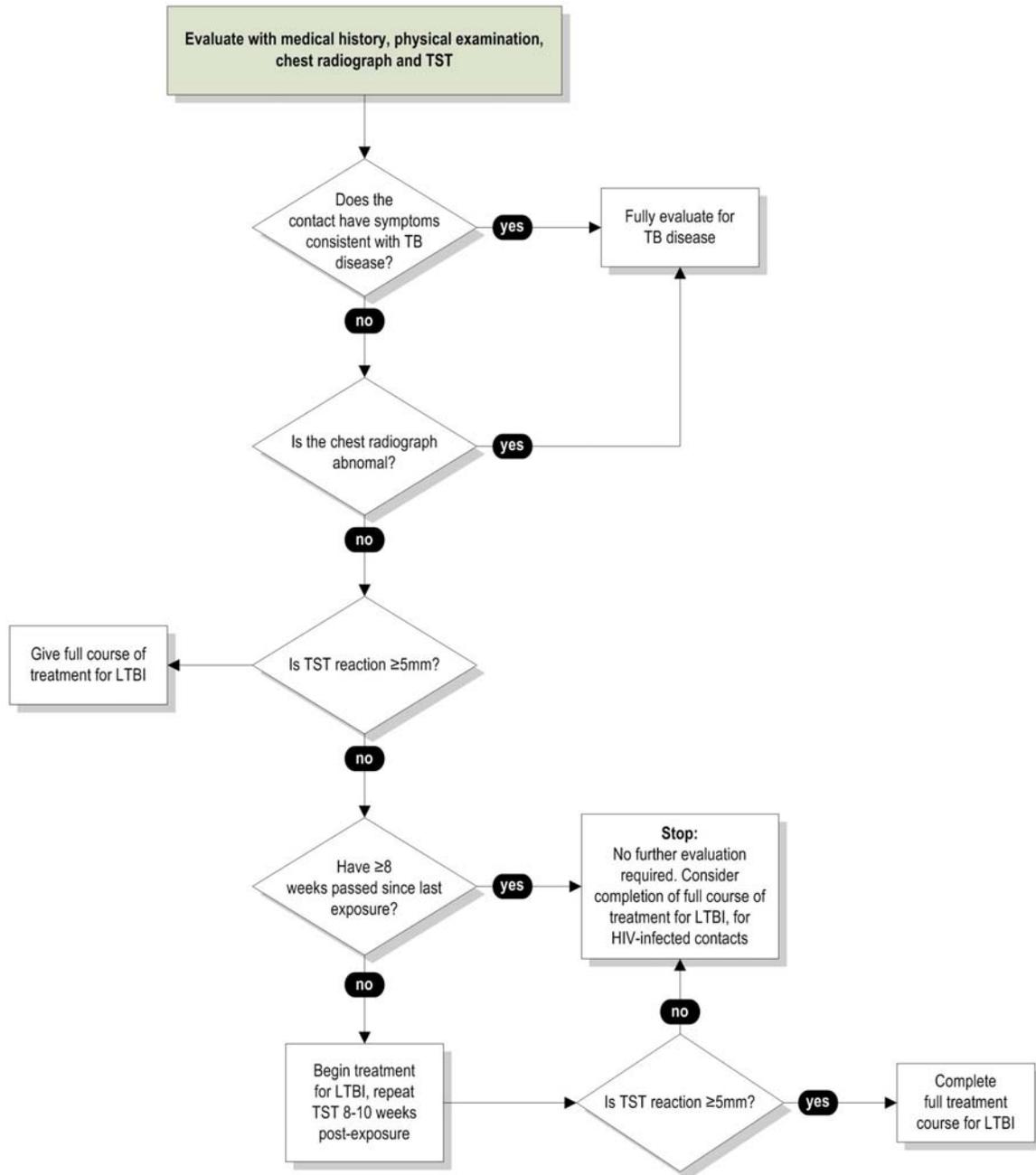
During contact evaluation, treatment, and follow-up, use the “Idaho TB Contact Tracing Form” (or equivalent) available in chapter 17 “Forms”.



For time frames, see the “Time Frames for Contact Investigation Activities” topic in this section. To arrange follow-up with public health officials in other jurisdictions for out-of-area contacts, see the Transfer Notifications section.⁴⁸

Immunocompromised Contacts and Children Under 5

FIGURE 4: EVALUATION, TREATMENT, AND FOLLOW-UP OF IMMUNOCOMPROMISED CONTACTS AND CHILDREN UNDER 5 YEARS OLD



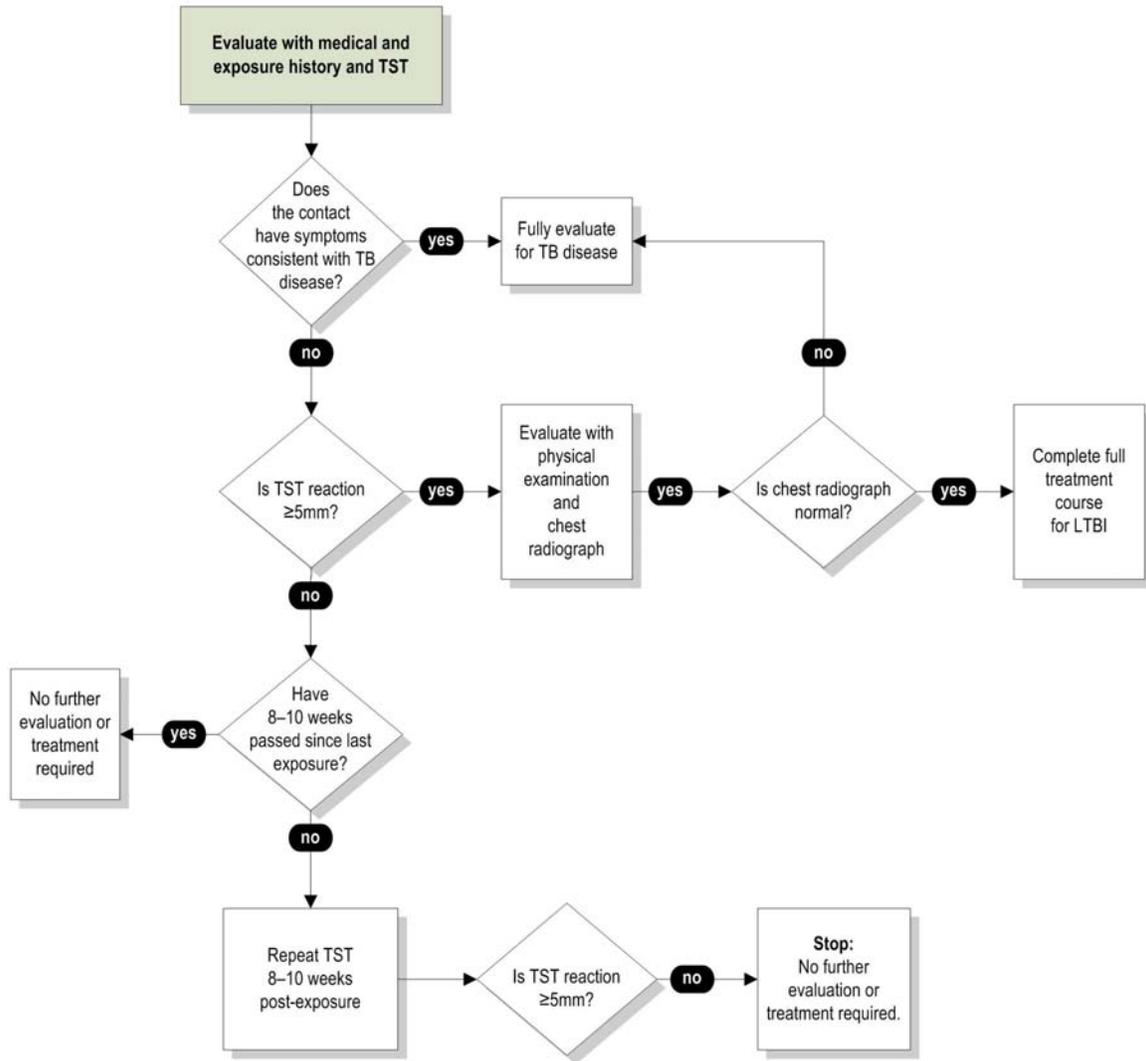
Definition of abbreviations: HIV = human immunodeficiency virus; IGRA = interferon gamma release assay; LTBI = latent tuberculosis infection; TST = tuberculin skin test.

Note: An IGRA may be used in place of a TST.

Source: CDC. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON[®]-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):15.

Immunocompetent Adults and Children 5 and Older (High- and Medium-Priority Contacts)

FIGURE 5: EVALUATION, TREATMENT, AND FOLLOW-UP OF IMMUNOCOMPETENT ADULTS AND CHILDREN 5 YEARS OR OLDER (HIGH- AND MEDIUM-PRIORITY CONTACTS)



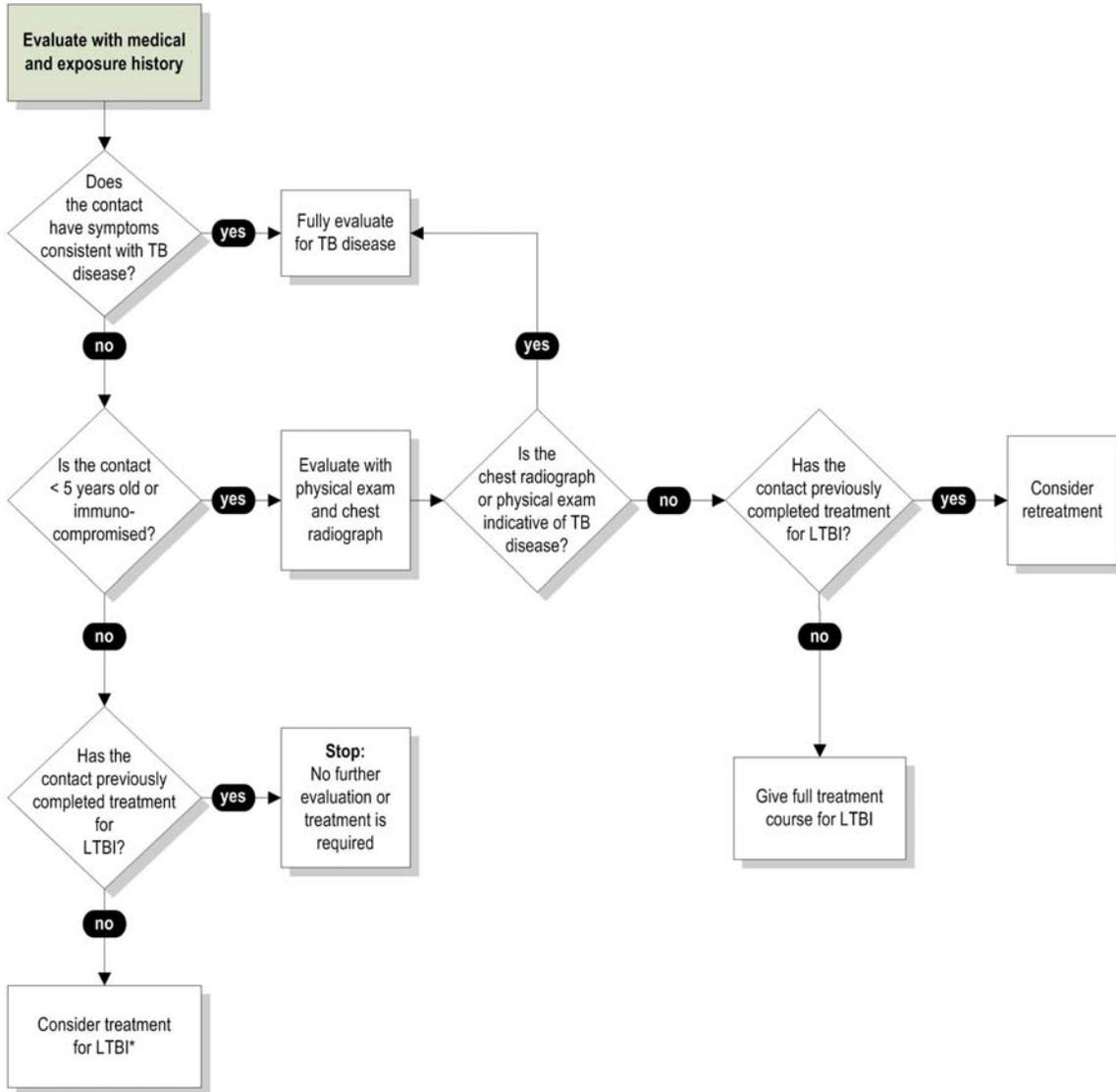
Definition of abbreviations: IGRA = interferon gamma release assay; LTBI = latent tuberculosis infection; TST = tuberculin skin test.

Note: An IGRA may be used in place of a TST.

Source: CDC. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON®-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):17.

Contacts with Prior Positive Tuberculin Skin Tests

FIGURE 6: EVALUATION, TREATMENT, AND FOLLOW-UP OF CONTACTS WITH PRIOR POSITIVE TUBERCULIN SKIN TESTS



Definition of abbreviations: HIV = human immunodeficiency virus; LTBI = latent tuberculosis infection.

* Before initiation of treatment, contacts should be evaluated fully for TB disease. A full course treatment is recommended for HIV-infected contacts in this category.

Source: CDC. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON®-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):19.

When to Expand a Contact Investigation

Determine when to expand a contact investigation using the following guidelines:

1. Do not include lower-priority contacts unless objectives for high- and medium-priority contacts are being met.
2. Consider the extent of recent transmission.
3. Consider expanding the scope (e.g., number of contacts) of an investigation if any one or more of the following criteria are met:
 - a. Unexpectedly large rate of tuberculosis (TB) infection or disease in high-priority contacts: 10% or at least twice the rate of a similar population without recent exposure, whichever is greater

Since the background prevalence of tuberculosis infection in adult foreign-born populations from high-incidence countries often exceeds 30%, it is important to stratify the infection rates by country of birth and/or length of residence and by age. For example, household contacts with a positive tuberculin skin test (TST) results are more likely to be infected recently (or as a result of exposure to the index patient) if the contacts are U.S.-born children rather than adults born in high-incidence countries.

- b. Evidence of second-generation transmission (i.e., from TB patients who were infected after exposure to the source patient)
 - c. TB disease in any contacts who had been assigned low priority
 - d. Infection in any contacts younger than 5 years old
 - e. Contacts with change in TST status from negative to positive
4. When results from an investigation indicate that it should be expanded, but resources are insufficient, seek assistance from the next higher public health administrative level.

In general, without evidence of recent transmission, do not expand an investigation to lower-priority contacts. When program evaluation objectives have not been met, expand a contact investigation only in exceptional circumstances, generally involving highly infectious cases with high rates of infection among contacts or evidence for secondary cases and secondary transmission. Derive the strategy for expanding an investigation from the data obtained from the investigation to that point in time. Without data from the initial contact investigation to support evidence of transmission, there is little support to expand to lower-priority contacts. As in the initial investigation, review the incoming results of the expanded investigation at least weekly to reassess the strategy.

Sometimes the result from an investigation indicates a need for expansion, but resources do not permit this. In these situations, seek consultation and assistance from the next higher level in public health administration (e.g., the county health department consults with the state health department). Consultation offers an objective review of

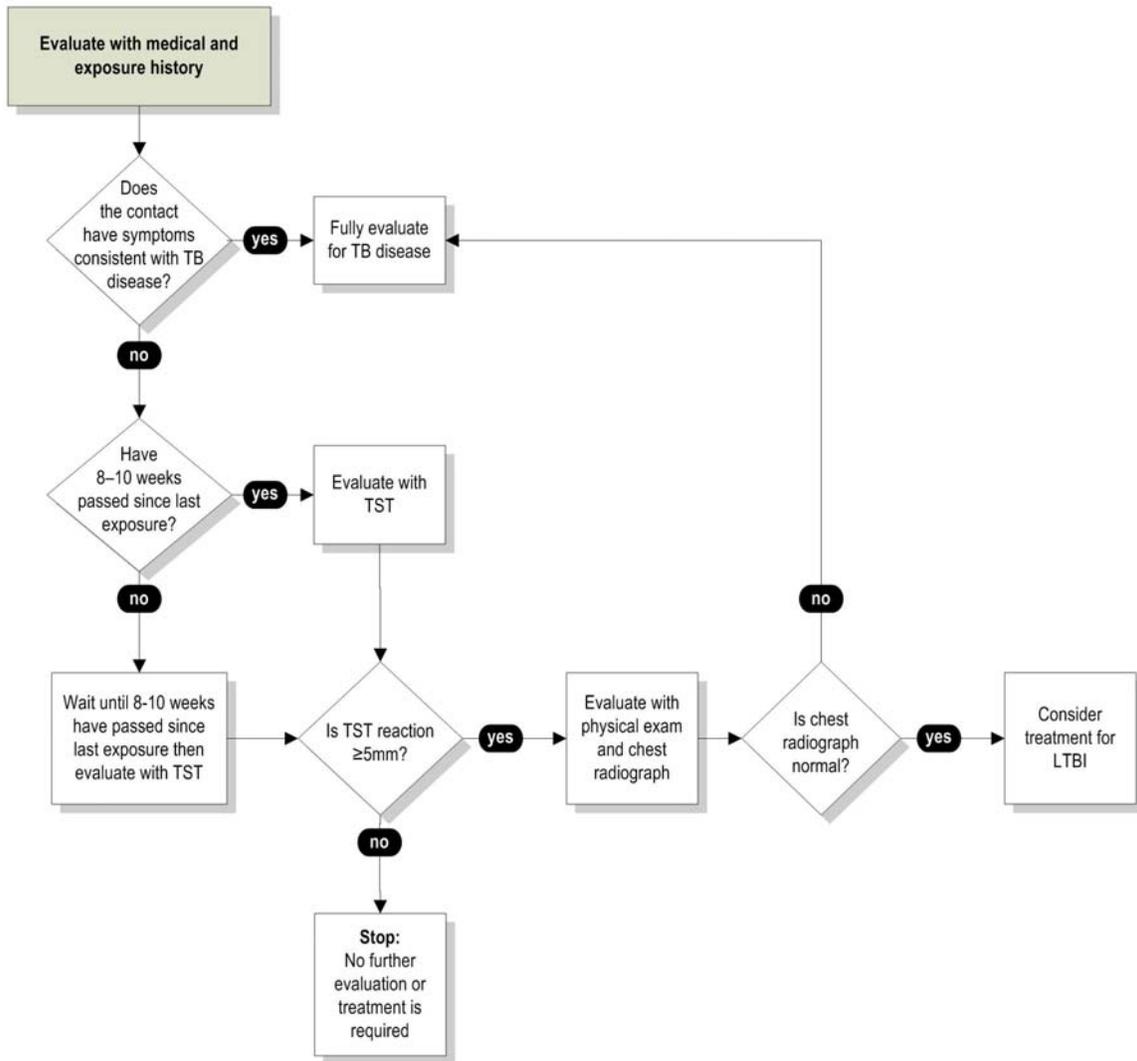
strategy and results, additional expertise, and the potential for personnel or funds for meeting unmet needs.



Contact the Idaho State TB Program at 208-334-5939 to consult about expanding a contact investigation.

Low-Priority Contacts

FIGURE 7: EVALUATION, TREATMENT, AND FOLLOW-UP OF LOW-PRIORITY CONTACTS



Definition of abbreviations: CXR = chest radiograph; IGRA = interferon gamma release assay; LTBI = latent tuberculosis infection; TST = tuberculin skin test.

* **Note:** An IGRA may be used in place of a TST.

Source: CDC. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON®-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):18.

Data Management and Evaluation of Contact Investigations

Data collection related to contact investigations has three broad purposes:

1. Management of care and follow-up of individual index patients and contacts
2. Epidemiological analysis of an investigation in progress and overall investigations
3. Program evaluation via performance indicators that reflect performance objectives

Reasons Contact Investigation Data is Needed

Comprehensive Care

For each index patient and the associated contacts, a broad amount of demographic, epidemiological, historical, and medical information are needed for providing comprehensive care. The care for these individuals can extend to longer than a year in some instances, so the information builds stepwise and has numerous longitudinal elements (e.g., clinic visits attended, treatment doses administered, and bacteriological response to treatment).

Timeline Objectives

Many of these data elements also contribute to the other reasons for collecting data. Data on some process steps is necessary for monitoring whether the contact investigation is keeping to the timeline objectives (e.g., how soon after listing is the tuberculin skin test administered to a contact).

Completion of Investigation

When aggregated, the data from an investigation informs public health officials whether the investigation is on time and complete. The analysis of data also contributes to reassessments of the strategy used in the investigation (e.g., was the infection rate greater for contacts believed to have more exposure?).

Reassessment of Strategy

The data from a completed investigation and all investigations in a fixed period (e.g., six months) show the achievements in meeting program objectives, such as observance of timelines and completion of therapy for infected contacts. These core measurements for program evaluation, however, cannot directly show why objectives were not met. If the data is structured and stored in formats allowing detailed retrospective review, then the reasons for problems can be studied.



CDC's "Framework of Program Evaluation in Public Health" (*MMWR* 1999;48[No. RR-11]), at <ftp://ftp.cdc.gov/pub/Publications/mmwr/rr/rr4811.pdf>, is recommended for assessing the overall activities of contact investigations.

Approach

Follow a systematic, consistent approach to data collection, organization, analysis, and dissemination.

1. Collect specific data elements on index patients and their contacts. The data elements should permit calculation of program performance indices.
2. Collect data on standardized (paper or electronic) forms.
3. Supply data definitions and formats for use by persons who collect, use, and interpret contact investigation data.
4. Whenever feasible, use data definitions and formats that are standard among jurisdictions.
5. Monitor data frequently.
6. Implement policies for data management that enable quick analysis of interim results.
7. Implement policies for data management and storage that specify the assignment of responsibilities.
8. Implement training and policies for data accuracy, completeness, and security.
9. Periodically summarize and review data during a particular contact investigation and for overall contact investigations.
10. Evaluate programs for contact investigation activities at least annually. Evaluation is an integral part of TB program responsibility.
11. Beyond standard data elements shown in these guidelines, specific additional elements can contribute to local program management.

Index Patient and Contact Data

For data required on each index patient and contact, see Table 13 and Table 14 on the following pages.

TABLE 7: DATA ABOUT THE INDEX PATIENT⁴⁹

| | |
|---|--|
| Identifiers/Demographic Information | <ul style="list-style-type: none"> ▪ Case manager ▪ Name and aliases ▪ For minors and dependents: guardian information ▪ Date of birth ▪ Social security number ▪ Current locating information and emergency contacts ▪ Residences during infectious period if unstably housed ▪ RVCT number and local case number ▪ Sex ▪ Race ▪ Ethnicity ▪ Country of birth ▪ Time in U.S., if foreign-born ▪ Primary language and preferred language ▪ Methods of translation or interpretation |
| Transmission Settings and Associated Time Frames | <ul style="list-style-type: none"> ▪ Living situation(s) ▪ Employment or school ▪ Social/recreational activities ▪ Congregate settings (e.g., jail, homeless shelter) ▪ Substance abuse with social implications (e.g., crack cocaine) |
| TB Information | <ul style="list-style-type: none"> ▪ Healthcare provider for TB (e.g., public health, private, both, other) ▪ Anatomic site of disease ▪ Symptoms and their dates ▪ CXR results, presence of cavity ▪ TB medications with start and stop dates ▪ Bacteriologic results (sputum smear, culture, drug susceptibility) with dates ▪ Previous history of TB disease and treatment ▪ Infectious period (updated as new information arrives) ▪ HIV infection status ▪ HIV/AIDS registry number |
| Contact Investigation | <ul style="list-style-type: none"> ▪ Date of initial interview with index patient ▪ Dates of follow-up interviews with the index patient |

Definition of abbreviations: AIDS = acquired immunodeficiency syndrome; CXR = chest radiograph; HIV = human immunodeficiency virus; LTBI = latent tuberculosis infection; RVCT = Reports of Verified Cases of Tuberculosis; TST = tuberculin skin test.

Source: CDC. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON[®]-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):21.

TABLE 8: DATA ABOUT EACH CONTACT

| | |
|---|---|
| Investigator and Dates | <ul style="list-style-type: none"> ▪ Contact manager or investigator ▪ Date listed ▪ How or why contact was listed (e.g., named by index patient) ▪ Dates of interviews ▪ Start and end dates for exposure (updated as new information arrives) |
| Identifiers | <ul style="list-style-type: none"> ▪ Name and aliases ▪ For minors and dependents: guardian information ▪ Social security number ▪ Date of birth ▪ Locating information and emergency contacts ▪ Sex ▪ Race ▪ Ethnicity ▪ Country of birth ▪ Time in U.S., if foreign-born ▪ Primary language and preferred language ▪ Methods of translation or interpretation |
| Exposure | <ul style="list-style-type: none"> ▪ Relationship/connection to index patient ▪ Social affiliations (e.g., work, school, church, clubs, activities) ▪ Environmental information about exposure settings (e.g., size, ventilation) ▪ Frequency, duration, and time frame of interactions |
| Medical History and Risk Factors | <ul style="list-style-type: none"> ▪ Prior history of TB disease or LTBI, and documentation ▪ BCG vaccination and date ▪ Medical risk factors for progression of infection to TB disease† ▪ Population risk factors for prevalent <i>M. tuberculosis</i> infection† |
| Evaluation for TB Disease and LTBI | <ul style="list-style-type: none"> ▪ Healthcare provider for TB (e.g., public health, private, both, other) ▪ Symptoms suggesting TB disease ▪ TSTs, with dates, reagents and lot numbers, reaction measurement ▪ IGRA results ▪ CXR results with dates ▪ Bacteriologic results with dates ▪ HIV infection status ▪ Final diagnostic classifications for LTBI or TB disease |
| Treatment Information for Contacts with LTBI | <ul style="list-style-type: none"> ▪ Dates of treatment ▪ Treatment regimen (medication, dosing schedule, any changes to these) ▪ Methods of supervising treatment (DOT, etc.) ▪ Adverse reactions (specify each) ▪ Interruptions in regimen and dates ▪ Outcome of treatment (completion, etc., consistent with ARPE†) ▪ If treatment not completed, reason† |

Definition of abbreviations: ARPE = Aggregate Report for Program Evaluation; CXR = chest radiograph; DOT = directly observed therapy; HIV = human immunodeficiency virus; IGRA = interferon gamma release assay; LTBI = latent tuberculosis infection; TST = tuberculin skin test.

† As defined by CDC ARPE for contact investigations.

Source: CDC. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON®-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):22.

Evaluation of a Contact Investigation

Summarize the results of a contact investigation to report by priority the total number of contacts identified, tested, read, U.S.-born, and foreign born.



Record your summary on the “Idaho TB Contact Tracing Form” available from the “Idaho Tuberculosis Forms” Web page at .

The Centers for Disease Control and Prevention (CDC) collect contact investigation data using the Aggregate Reports for Tuberculosis Program Evaluation (ARPE) form.⁵⁰ In addition, the CDC’s Framework for Program Evaluation in Public Health is recommended for assessing the overall activities of contact investigations.⁵¹



For information on how to complete the ARPE form, see the CDC’s *Aggregate Reports for Tuberculosis Program Evaluation: Training Manual and User’s Guide*. (Atlanta, GA: US Department of Health and Human Services, CDC; 2005) at http://www.cdc.gov/tb/pubs/PDF/ARPEs_manual.pdf .



For more information on using this evaluation framework, see the CDC Program Evaluation Workgroup’s Website at <http://www.cdc.gov/eval/framework.htm> .

Outbreak Investigation

If data from a contact investigation or surveillance indicates a potential outbreak, conduct an outbreak investigation. A tuberculosis (TB) outbreak warns of potential extensive transmission. An outbreak implies that 1) a TB patient was contagious, 2) contacts were exposed significantly, and 3) the interval since exposure has been sufficient for infection to progress to disease. An outbreak investigation involves several overlapping contact investigations, with a surge in the need for public health resources. More emphasis on active case finding is recommended, which sometimes means that more contacts than usual should have chest radiographs and specimen collection for mycobacteriology.

Definition of a Tuberculosis Outbreak

Definitions for **TB outbreak** are relative to the local context. Outbreak cases can be distinguished from other cases only when certain associations in time, location, patient characteristics, or *Mycobacterium tuberculosis* attributes (e.g., drug resistance or genotype) become apparent. In low-incidence jurisdictions, any temporal cluster is suspicious for an outbreak. A working definition of a potential "TB outbreak" is helpful for planning and response and may include any of the following six criteria:

Criteria based on surveillance and epidemiology:

- An increase has occurred above the expected number of TB cases
- During and because of a contact investigation, two or more contacts are identified as having TB disease, regardless of their assigned priority (i.e., high, medium, or low priority)
- Any two or more cases occurring within one 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 disease 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)
- A genotype cluster leads to discovery of one or more verified transmission links which were missed during a contact investigation within the prior two years

Criteria based on program resources:

- Transmission is continuing despite adequate control efforts by the TB control program
- Contact investigation associated with increased cases requires additional outside help

Resources and References

Resources

(For easy access to references, hyperlinks are provided for online references in the list below.)

- California Department of Health Services (CDHS)/California Tuberculosis Controllers Association (CTCA). "Contact Investigation Guidelines" (*CDHS/CTCA Joint Guidelines* 1998) at <http://www.ctca.org/guidelines/IID1contactinvestigation.pdf>
- CDC. *Aggregate Reports for Tuberculosis Program Evaluation: Training Manual and User's Guide* (Atlanta, GA. 2005) at http://www.cdc.gov/tb/pubs/PDF/ARPEs_manual.pdf
- CDC. *Effective TB Interviewing for Contact Investigation: Self-Study Modules*. (Atlanta, GA. 2006) at <http://www.cdc.gov/tb/pubs/Interviewing/default.htm>
- CDC. "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]) at: <http://www.cdc.gov/mmwr/pdf/rr/rr5415.pdf>
- CDC. "The Plan: Goal II: Accelerate the decline" (CDC's Response to *Ending Neglect: The Elimination of Tuberculosis in the United States*) at <http://www.cdc.gov/tb/pubs/iom/iomresponse/goal2.htm>
- CDC. Program Evaluation Workgroup's Website at <http://www.cdc.gov/eval/framework.htm> DTBE
- New Jersey Medical School National Tuberculosis Center. *Performance Guidelines: A Supervisor's Guide for the Development and Assessment of TB Field Investigation Skills* at <http://www.umdnj.edu/globaltb/products/performanceguide.htm>
- New Jersey Medical School National Tuberculosis Center. Performance Guidelines for Contact Investigation: The TB Interview at: <http://www.umdnj.edu/globaltb/products/tbinterview.htm>

References

- ¹ ATS, CDC, IDSA. Controlling tuberculosis in the United States: Recommendations from the American Thoracic Society, CDC, and the Infectious Diseases Society of America, *MMWR*, 2005;54 (No. RR-12):35.
- ² ATS, CDC, IDSA. Controlling tuberculosis in the United States: Recommendations from the American Thoracic Society, CDC, and the Infectious Diseases Society of America, *MMWR*, 2005;54 (No. RR-12):35.
- ³ ATS, CDC, IDSA. Controlling tuberculosis in the United States: Recommendations from the American Thoracic Society, CDC, and the Infectious Diseases Society of America, *MMWR*, 2005;54 (No. RR-12):15.
- ⁴ ATS, CDC, IDSA. Controlling tuberculosis in the United States: Recommendations from the American Thoracic Society, CDC, and the Infectious Diseases Society of America, *MMWR*, 2005;54 (No. RR-12):3.

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- ⁵ ATS, CDC, IDSA. Controlling tuberculosis in the United States: Recommendations from the American Thoracic Society, CDC, and the Infectious Diseases Society of America, *MMWR*, 2005;54 (No. RR-12):4.
- ⁶ ATS, CDC, IDSA. Controlling tuberculosis in the United States: Recommendations from the American Thoracic Society, CDC, and the Infectious Diseases Society of America, *MMWR*, 2005;54 (No. RR-12):15.
- ⁷ ATS, CDC, IDSA. Controlling tuberculosis in the United States: Recommendations from the American Thoracic Society, CDC, and the Infectious Diseases Society of America, *MMWR*, 2005;54 (No. RR-12):17.
- ⁸ CDC, NTCA. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON[®]-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):4.
- ⁹ CDC, NTCA. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON[®]-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):5, 6.
- ¹⁰ CDC. Module 6: Contact investigations for tuberculosis. *Self-Study Modules on Tuberculosis*. 1999:10; CDC, NTCA. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON[®]-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15): 6.
- ¹¹ CDC. Module 6: Contact investigations for tuberculosis. *Self-Study Modules on Tuberculosis*. 1999:10.
- ¹² CDC, NTCA. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON[®]-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):9.
- ¹³ CDC, NTCA. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON[®]-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):4.
- ¹⁴ CDC, NTCA. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON[®]-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):4.
- ¹⁵ CDC, NTCA. 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):4.
- ¹⁶ CDC, NTCA. 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):4.
- ¹⁷ ATS, CDC, IDSA. Controlling tuberculosis in the United States: Recommendations from the American Thoracic Society, CDC, and the Infectious Diseases Society of America. *MMWR*, 2005;54(No. RR-12):51.
- ¹⁸ CDC. Racial/ethnic disparities in diagnoses of HIV/AIDS --- 33 States, 2001—2004. *MMWR* 2006;55(No. 5):121-125.
- ¹⁹ CDC, NTCA. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON[®]-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):5.
- ²⁰ CDC, NTCA. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON[®]-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):7–8, 43.
- ²¹ CDC, NTCA. 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.
- ²² CDC, NTCA. 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.
- ²³ CDC, NTCA. 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):11.
- ²⁴ CDC, NTCA. 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):11.
- ²⁵ CDC, NTCA. 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):11.
- ²⁶ California Department of Health Services (CDHS)/California Tuberculosis Controllers Association (CTCA). Contact investigation guidelines. *CDHS/CTCA Joint Guidelines*. November 12, 1998: 18. Available online at <http://www.ctca.org/guidelines/ILD1contactinvestigation.pdf>. Accessed July 6, 2006.
- ²⁷ CDC, NTCA. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON[®]-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):21.
- ²⁸ CDC. Aggregate reports for tuberculosis program evaluation: training manual and user's guide. Atlanta, GA: US Department of Health and Human Services, CDC; 2005. Available at http://www.cdc.gov/tb/pubs/PDF/ARPEs_manual.pdf.
- ²⁹ CDC. *Effective TB Interviewing for Contact Investigation: Self-Study Modules*. Atlanta, GA: Department of Health and Human Services Centers for Disease Control and Prevention Division of Tuberculosis Elimination; 2006:4.
- ³⁰ California Department of Health Services Tuberculosis Control Branch; California Tuberculosis Controllers Association. Contact investigation guidelines. Berkeley, CA: California Department of Health Services; 1998; in CDC. Guidelines for

-
- the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON[®]-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):7.
- ³¹ CDC, NTCA. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON[®]-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):7.
- ³² CDC. *Effective TB Interviewing for Contact Investigation: Self-Study Modules*. Atlanta, GA: Department of Health and Human Services Centers for Disease Control and Prevention Division of Tuberculosis Elimination; 2006:4.
- ³³ Adapted from New Jersey Medical School National Tuberculosis Center, *TB Interviewing for Contact Investigation: A Practical Resource for the Healthcare Worker* (Revised 2004):3–17.
- ³⁴ Adapted from New Jersey Medical School National Tuberculosis Center, *TB Interviewing for Contact Investigation: A Practical Resource for the Healthcare Worker* (Revised 2004):3–17.
- ³⁵ CDC, NTCA. 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):6.
- ³⁶ Adapted from New Jersey Medical School National Tuberculosis Center, *TB Interviewing for Contact Investigation: A Practical Resource for the Healthcare Worker* (Revised 2004):3–17.
- ³⁷ CDC. Module 6: Contact investigations for tuberculosis. *Self-Study Modules on Tuberculosis*. 1999:18.
- ³⁸ CDC, NTCA. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON[®]-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):10.
- ³⁹ CDC. Module 6: Contact investigations for tuberculosis. *Self-Study Modules on Tuberculosis*. 1999:18.
- ⁴⁰ CDC. Module 6: Contact investigations for tuberculosis. *Self-Study Modules on Tuberculosis*. 1999:18.
- ⁴¹ CDC. Module 6: Contact investigations for tuberculosis. *Self-Study Modules on Tuberculosis*. 1999:18.
- ⁴² CDC, NTCA. 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.
- ⁴³ CDC, NTCA. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON[®]-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):10–11.
- ⁴⁴ CDC, NTCA. 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.
- ⁴⁵ CDC, NTCA. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON[®]-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):9–10.
- ⁴⁶ CDC. 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):14.
- ⁴⁷ ATS, CDC, IDSA. Controlling tuberculosis in the United States: Recommendations from the American Thoracic Society, CDC, and the Infectious Diseases Society of America, *MMWR*, 2005;54 (No. RR-12):11.
- ⁴⁸ ATS, CDC, IDSA.. Controlling tuberculosis in the United States: Recommendations from the American Thoracic Society, CDC, and the Infectious Diseases Society of America, *MMWR*, 2005;54 (No. RR-12):9.
- ⁴⁹ CDC, NTCA. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON[®]-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):21.
- ⁵⁰ CDC. Aggregate reports for tuberculosis program evaluation: training manual and user's guide. Atlanta, GA: US Department of Health and Human Services, CDC; 2005. Available at http://www.cdc.gov/nchstp/tb/pubs/PDF/ARPEs_manual.pdf.
- ⁵¹ CDC, NTCA. Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from the National Tuberculosis Controllers Association and CDC, and guidelines for using the QuantiFERON[®]-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR* 2005;54(No. RR-15):22.

