

# Contact Investigation

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# 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 do the following:

- Identify persons who were exposed to an infectious case of TB.
- Ensure that contacts receive these evaluation services:
  - Testing for *M. tuberculosis* infection
  - Screening for TB disease
  - Medical evaluation, if indicated
  - Prompt initiation of treatment for tuberculosis infection (TBI) if at high risk for developing TB disease (younger than five years of age or immunocompromised)
  - A complete, standard course of treatment, unless medically contraindicated<sup>1</sup>

In addition, the following are secondary goals of a contact investigation:

- Stop transmission of *M. tuberculosis* by identifying persons with previously undetected infectious TB.
- Determine whether a TB outbreak has occurred (in which case, an expanded outbreak investigation should ensue).<sup>2</sup>

Use this section to understand and follow national and Ohio Department of Health TB Program guidelines to address 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 circumstances, 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) has 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, healthcare resources and efforts in Ohio 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 for achieving the goal of reduction of TB morbidity and mortality is prompt identification of contacts to patients with infectious TB and timely treatment of those at risk with an effective drug regimen.<sup>3</sup> National recommendations for contact investigations are provided in the CDC publication, *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]:1–49)*.

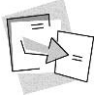
Challenges to successful control of TB include protecting contacts of persons with infectious TB and preventing and responding to TB outbreaks.<sup>4</sup> Reducing the risk of TB among contacts through the development of better methods of identification, evaluation, and management would lead to substantial personal and public health benefits and facilitate progress toward eliminating TB in the United States.<sup>5</sup>

The evaluation of contacts of cases of infectious TB is one of the most productive methods of identifying adults and children with TBI at high risk for progression to TB disease and persons in the early stages of TB disease. Therefore, contact investigations serve as an important means of detecting TB cases and at the same time identify persons in the early stage of TBI, when the risk for progression to TB disease is high and the benefit of treatment is greatest.<sup>6</sup> A study demonstrated that improvements in TB contact investigations might have prevented 17 (10%) of 165 pediatric TB cases in California in 1994.<sup>7</sup>

## Policy

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, or respiratory specimens that have acid-fast bacilli (AFB) on microscopy, or (especially) both.<sup>8</sup>
- 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.

## Ohio State Laws and Regulations

### **3701-15-03 Tuberculosis standards for the purposes of section 3701.14 of the Ohio Revised Code.**

(E) Except as set out in paragraph (A) of this rule, the standard for methods of preventing individuals with tuberculosis from infecting other individuals shall be as follows:

(1) Local tuberculosis control units shall ensure that a complete and timely contact investigation is done for tuberculosis cases reported in the area served by the unit.

(2) Local tuberculosis control units shall ensure that the services needed to evaluate, treat, and monitor tuberculosis patients are made available in each community, without regard to the patients' ability to pay for such services as specified in section 339.73 of the Ohio Revised Code.

Reporting and recordkeeping requirements:

### **3701-15-02 Acceptable tuberculosis program**

An acceptable tuberculosis program, designated pursuant to division (A) of section 339.72 of the Ohio Revised Code, is a program that includes at least the components set forth in this rule.

(B) An outpatient program ensuring the following services:

(1) Maintenance of a tuberculosis case registry with up-to-date information on all current clinically active and suspected tuberculosis cases within the area served using the designated Ohio department of health reporting system. Maintenance of records on the examination and treatment status of the contacts to infectious tuberculosis patients and other groups of high-risk infected persons.

## 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. Pre-interview 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 of contacts
8. Decision about whether to expand testing
9. Evaluation of contact investigation activities<sup>9,10</sup>

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.<sup>11</sup>

## 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 it 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: **Time Frames for Investigating the Index Patient and the Sites of Transmission** and Table 3: **Time Frames for Contact Evaluation and Treatment** in this section's topic "Time Frames for Contact Investigation."

The plan is a 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.<sup>12</sup>

# 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 upon 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.<sup>13</sup>

Table 1. **INDEX PATIENT FACTORS INCREASING TRANSMISSION RISK**<sup>14</sup>

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

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 TB are most likely to transmit infection. For contact investigations, pleural disease is grouped with pulmonary disease because sputum cultures can yield *Mycobacterium tuberculosis* even when no lung abnormalities present on radiography. Rarely, extrapulmonary TB may be transmitted during medical procedures, such as autopsy and embalming, if the bacteria become aerosolized.

## 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.<sup>15</sup> 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 with lung cavities observed on 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 detectable with computerized tomography, 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 HIV-infected TB patients, 3 percent 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 ten 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 five 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 five years typically indicates that the infection is recent. Young children usually do not transmit TB to others, and their contacts are unlikely to be infected through exposure to them.

## **Human Immunodeficiency Virus Status**

Evaluation of HIV status should be performed 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.<sup>16</sup> 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 the risk of 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 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.<sup>17</sup> Regardless of known HIV status, HIV counseling should always be recommended for all patients as a part of the screening process.<sup>18</sup>

## **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 resistance to both INH and RIF constitutes multidrug-resistant TB (MDR-TB). If this is the case, all the potential regimens are poorly tolerated to some extent, and none of these regimens have been fully tested 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 suspected to be infected with multidrug-resistant *M. tuberculosis* for two years after exposure.

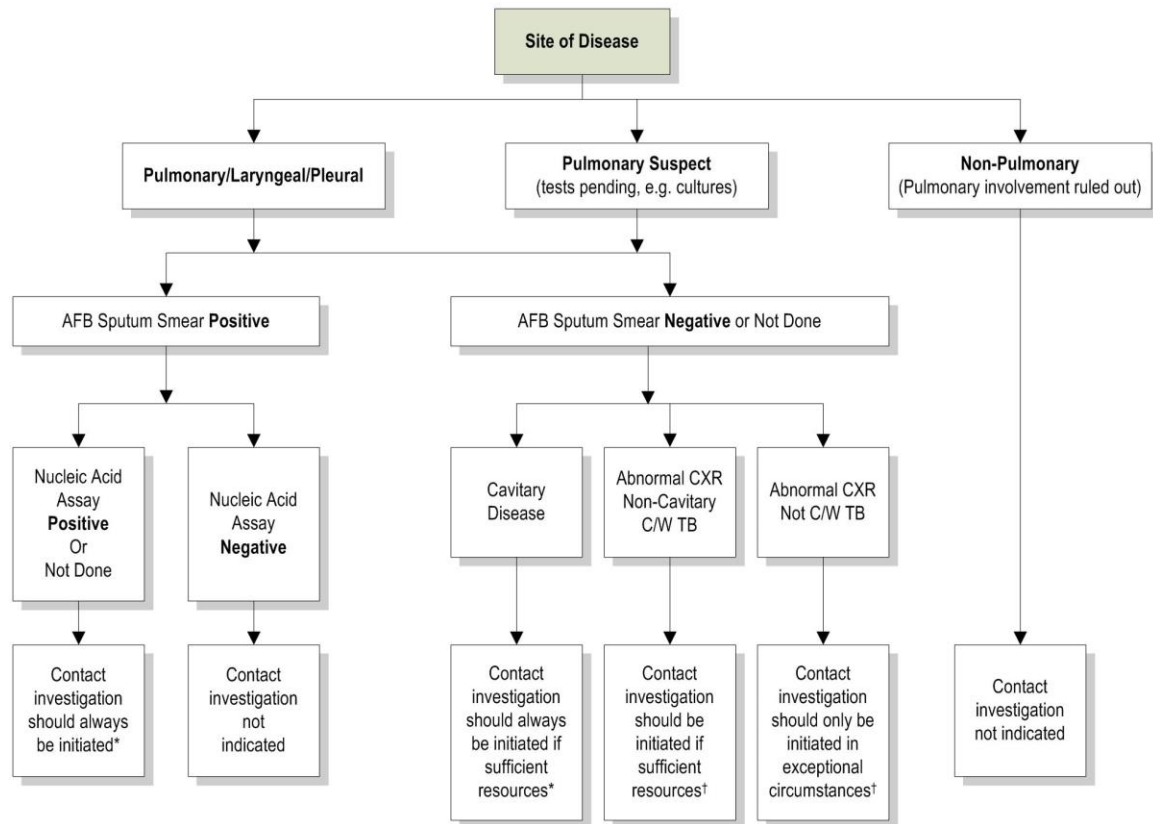
For TB consultation, please call the ODH TB Program at (614) 466-2381.



## 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 INVESTIGATION**<sup>19</sup>



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

\* 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 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(s). 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 may 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 program 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 be distinguished from other cases only 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.
- **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](https://www.cdc.gov/mmwr/pdf/rr/rr5415.pdf)" (*MMWR* 2005;54[No. RR-15]: 31) at this hyperlink <https://www.cdc.gov/mmwr/pdf/rr/rr5415.pdf>

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# Time Frames for Contact Investigation

Use this topic to understand the time frames for key contact investigation activities. A suspected or confirmed case of TB becomes designated as 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, cavitary disease, or an abnormal chest radiograph consistent with TB.

Refer to Table 2: **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 cavitary disease or abnormalities consistent with TB.
- Priority-ranking contacts for follow-up within an 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 progression from *Mycobacterium tuberculosis* infection to the development of TB disease.



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

Table 2: **TIME FRAMES FOR INVESTIGATING THE INDEX PATIENT AND THE SITES OF TRANSMISSION**<sup>20</sup>

Activity	Suspects Expected to Be Cases of Tuberculosis	
	Suspects with Indications of Infectiousness	Suspects without Indications of Infectiousness
<b>First Index Patient Interview</b> Number of days following notification within which the index patient should be interviewed in person (i.e., not by telephone)	≤1 Business Day of Reporting	≤3 Business Days of Reporting
<b>Residence Visit</b> Number of days following the first index patient interview within which the place of residence of the index patient should be visited	≤3 Business Days After the First Interview	3 Business Days After the First Interview
<b>Field Investigation</b> 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 Patient Reinterviews</b> Length of time after the first interview within which the index patient should be reinterviewed one or more times for clarification and additional information	1 or 2 Weeks After the First Interview	1 or 2 Weeks After the First Interview
<b>Reassessment of the Index Patient</b> 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.		

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: **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.<sup>21</sup> For information on how to determine which contacts are high-, medium-, or low-priority, see the “Contact Priorities” topic in this section.

Table 3: **TIME FRAMES FOR CONTACT EVALUATION AND TREATMENT**<sup>22</sup>

Type of Contact	Business Days from Listing of a Contact to Initial Encounter <sup>*</sup>	Business Days from Initial Encounter to Completion of Medical Evaluation <sup>†</sup>	Business Days from Completion of Medical Evaluation to Start of Treatment
<b>High-Priority Contact</b> Index patient with positive acid-fast bacilli (AFB) sputum smear results or cavitary disease on chest radiograph	<b>3 Business Days After Being Listed in the Investigation</b> <sup>23</sup>	5 Business Days	10 Business Days
		<b>5 Business Days</b>  Children and high-risk contacts can develop complicated tuberculosis (TB) within a few weeks of infection.	
<b>High-Priority Contact</b> Index patient with negative AFB sputum smear results	<b>3 Business Days After Being Listed in the Investigation</b> <sup>24</sup>	10 Business Days	10 Business Days
<b>Medium-Priority Contact</b> Regardless of AFB sputum smear or culture result	<b>3 Business Days After Being Listed in the Investigation</b> <sup>25</sup>	10 Business Days	10 Business Days
<p>* “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.</p> <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 mycobacteriologic results, but this applies to relatively few contacts.</p>			

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 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 ONGOING MANAGEMENT ACTIVITIES AND MAXIMUM TIME FRAMES**<sup>26</sup>

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 tuberculosis infection (TBI)	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 TBI treatment (Window Period Treatment for a TB Class I Contact)	To determine if treatment for TBI 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 the time of each visit

Activity	Purpose	Maximum Time Interval
Ensure contacts are monitored for adverse reactions and toxicity of TBI treatment regimens	To prevent development of adverse effects and toxicity from drug regimens	At least monthly while on TBI treatment
Evaluate problems and concerns that arise and may delay or hamper the 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 <sup>27</sup>	Ongoing
Collect data to complete the <i>Aggregate Reports for Tuberculosis Program Evaluation (ARPE)</i> form <sup>28</sup>	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 mycobacteriologic 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 3/12/2007. The last date the index patient was infectious was 3/5/2007. The household member should have a third TST 8 to 10 weeks from 3/5/2007. For consultation regarding the appropriateness of a third TST, call The Ohio Department of Health TB Program at (614) 387-2132.</p>		

Source: Adapted from: California Department of Public Health (CDPH)/California Tuberculosis Controllers Association (CTCA). Guidelines for Investigations of Contacts of Persons with Infectious Tuberculosis. *CDPH/CTCA Joint Guidelines* [CTCA Web site]. November 12, 1998:18 Revised 2005. Available at: [http://www.ctca.org/fileLibrary/file\\_363.pdf](http://www.ctca.org/fileLibrary/file_363.pdf). Accessed March 16, 2017.



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## 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 TB.<sup>29</sup> The exact start of the infectious period cannot be determined with any current methods, so a practical estimation is necessary. Based on a consensus of expert opinion, TB programs use the standard time frame of three months prior to TB diagnosis for the highly infectious patients. However, if the case-patient or the case-patient's associates were aware of protracted illness, the infectious period should encompass a time frame to include three prior to onset of symptoms (i.e., Coughing).

Assemble information from the index patient interview and other sources to estimate the infectious period. Helpful details include the approximate dates that TB symptoms were noticed, bacteriologic 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 INFECTIOUSNESS**<sup>30</sup>

Index Patient Characteristics						Recommended Beginning of Likely Period of Infectiousness
Tuberculosis Symptoms		Positive Acid-Fast Bacilli Sputum Smear Results		Cavitary Chest Radiograph		
Yes	No	Yes	No	Yes	No	
✓			✓		✓	3 months prior to symptom onset or first positive finding consistent with tuberculosis (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, 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 exposure to contacts has ended **OR** 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).<sup>31,32</sup>

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 have at least three consecutive negative AFB sputum smear results from sputum collected more than eight hours apart (with one specimen collected during the early morning) before being considered noninfectious.<sup>33</sup>

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## 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 care specific to that 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 occurs in the home, to obtain further information and answer additional questions.<sup>34</sup>



TB Interviewing for Contact Investigation: A Practical Resource for the Healthcare Worker (New Jersey Medical School Global Tuberculosis Institute Web site; 2004) at this hyperlink:

<http://globaltb.njms.rutgers.edu/downloads/products/tbinterviewing.pdf> offers specific suggestions on how to prepare for and conduct the interviews.<sup>35</sup>

## Pre-interview 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
- Laboratory, clinic, or other reporting source
- 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.<sup>36</sup>

## 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 determine 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.<sup>37</sup>
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 Directly Observed Therapy Training Curriculum for TB Control Programs (Francis J. Curry National Tuberculosis Center Web site; 2003) at this hyperlink:

[http://www.currytbcenter.ucsf.edu/sites/default/files/dot\\_session4\\_participant\\_book.pdf](http://www.currytbcenter.ucsf.edu/sites/default/files/dot_session4_participant_book.pdf) .



For assistance with language issues, see the Language Services Resource Guide for Health Care Providers (The National Health Law Program Web site; 2006) at this hyperlink:

<http://newenglandtb.pbworks.com/f/ResourceGuideFinal.pdf> .

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## Field Investigation

A field investigation includes visiting the patient's home (or shelter), workplace, or school (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 places in which exposure occurred. The field investigation may provide additional information for use in the risk assessment and for identifying additional contacts.<sup>38</sup>

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.<sup>39</sup>
- **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 tuberculin skin test (TST) 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 radiography and sputum collection.<sup>40</sup>

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.<sup>41</sup>



For more information on infection control, see the Infection Control section.

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 problems<sup>42</sup>

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## 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.<sup>43</sup> Priority-ranking contacts for investigation is based upon 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.<sup>44</sup>

Use the assigned priorities to allocate resources to complete all investigative steps for the high- and medium-priority contacts.<sup>45</sup> Dividing contacts into these three levels provides a system for public health staff to reach high-priority contacts first, and 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).<sup>46</sup>



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.

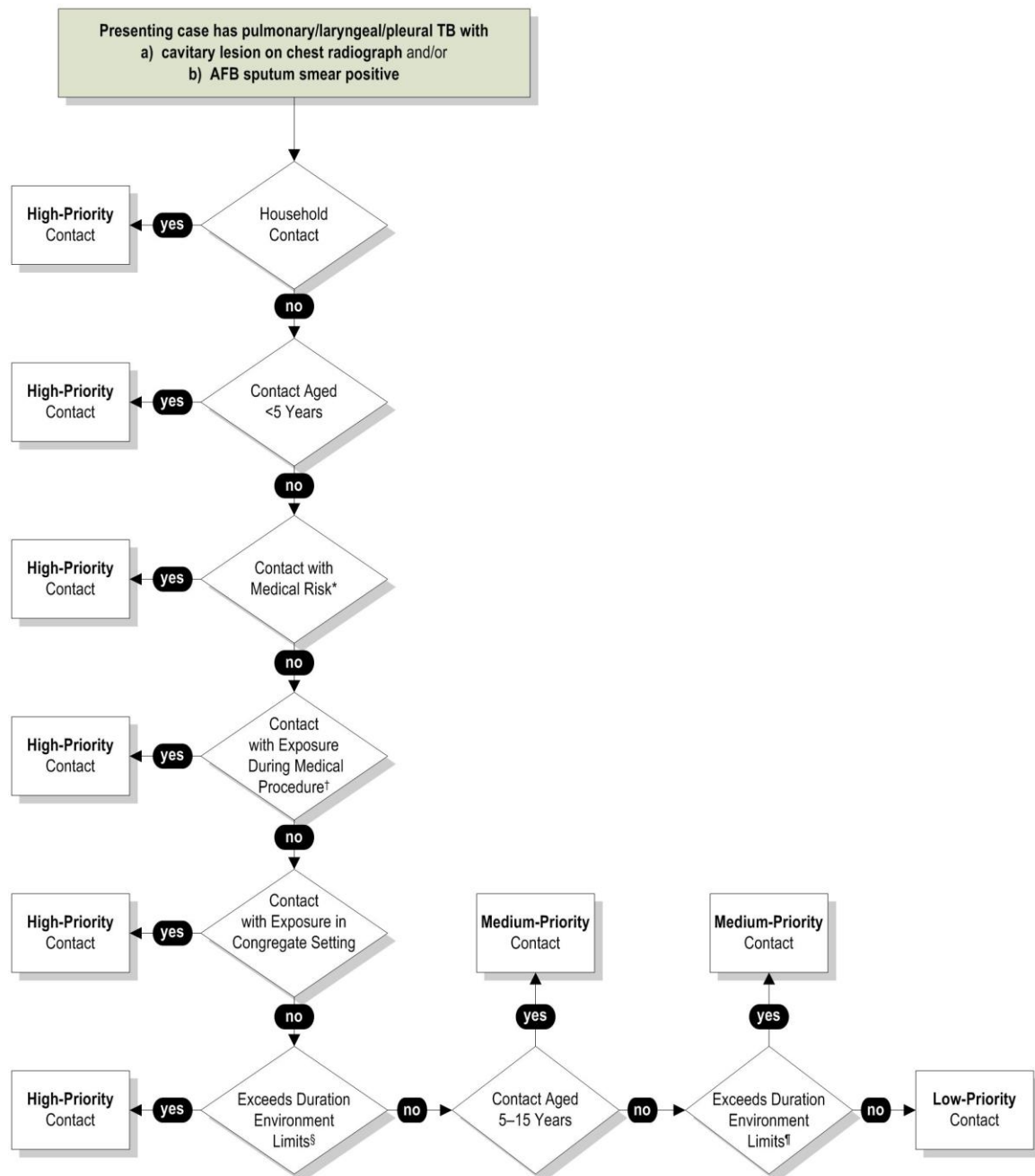


Use the figures or tables on the following pages to assign priorities to contacts to the following:

- **Figure 2 or table 6: Prioritization of Contacts to Smear-Positive or Cavitory Cases**
- **Figure 3 or Table 7: Prioritization of Contacts to Smear-Negative Cases**
- **Table 8: Prioritization of Contacts to Cases with Negative Bacteriologic Results and Abnormal Chest Radiographs not Consistent with Tuberculosis**

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

Figure 2: **PRIORITIZATION OF CONTACTS TO SMEAR-POSITIVE OR CAVITARY CASES**<sup>47</sup>



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. 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.

If the Figure 2 algorithm is not easy to use, use Table 6 to assign priorities. Note the exposure duration/limits for high-priority and medium priority contacts.

Table 6: **PRIORITIZATION OF CONTACTS TO SMEAR-POSITIVE OR CAVITARY CASES**<sup>48</sup>

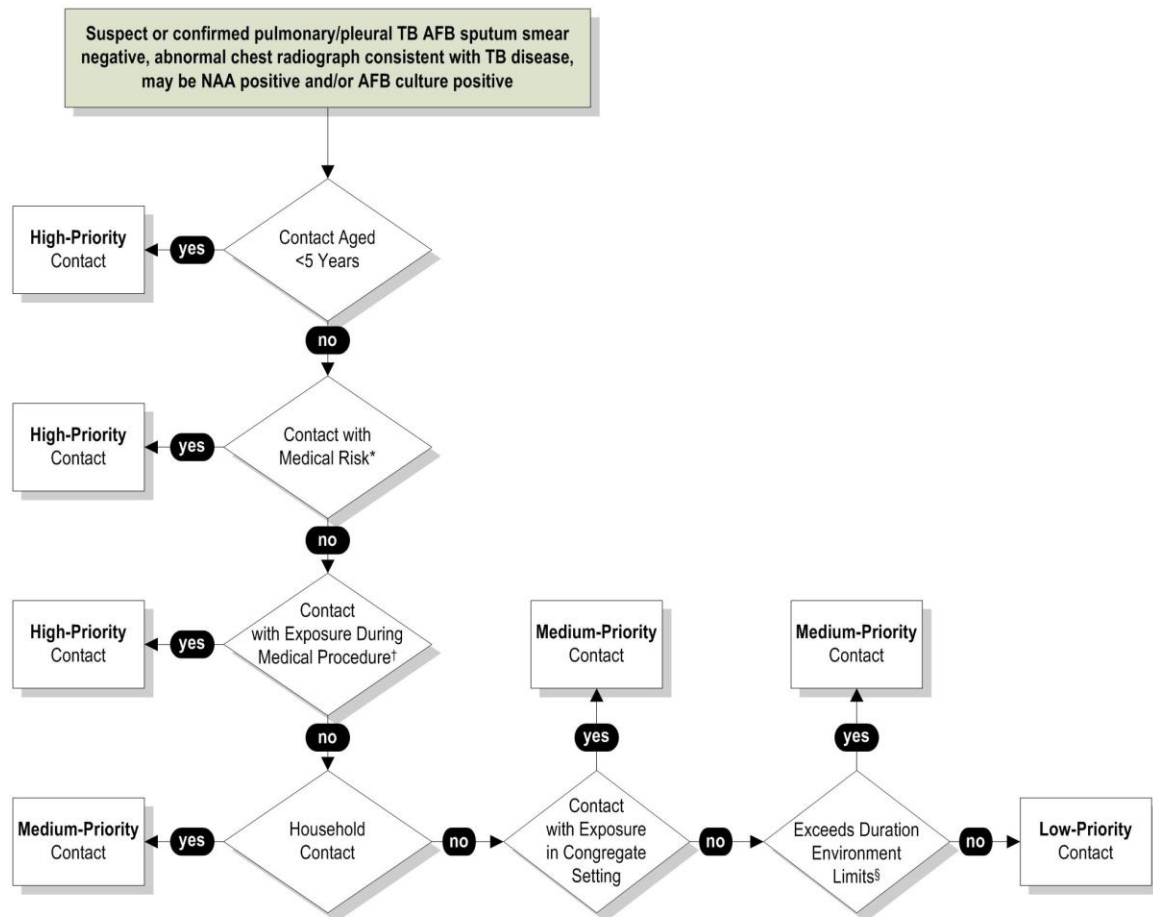
High-Priority Contacts	Medium-Priority Contacts	Low-Priority Contacts
<ul style="list-style-type: none"> <li>▪ Household contacts</li> <li>▪ Contacts &lt;5 years old</li> <li>▪ Contacts with human immunodeficiency virus (HIV) infection or other immunocompromising condition</li> <li>▪ Contacts with exposure during a medical procedure such as bronchoscopy, sputum induction, or autopsy</li> <li>▪ Contacts with exposure in a congregate setting</li> <li>▪ Contacts whose exposure exceeds duration/environment limits per unit time established by the health department for high-priority contacts:</li> <li>▪ <math>\geq 8</math> cumulative hours of exposure</li> </ul>	<ul style="list-style-type: none"> <li>▪ Contacts not in high-priority groups</li> <li>▪ Contacts 5–15 years old</li> <li>▪ Contacts whose exposure exceeds duration/environment limits per unit time established by the health department for medium-priority contacts:</li> <li>▪ <math>\leq 8</math> hours of exposure</li> </ul>	<ul style="list-style-type: none"> <li>▪ Contacts not in high-priority groups</li> <li>▪ Contacts not in medium-priority groups</li> </ul>

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):12.

## Index Patient with Negative Acid-Fast Bacilli Sputum Smear Results

Use Figure 3 or Table 7 to prioritize contacts to smear-negative index patients.

Figure 3: **PRIORITIZATION OF CONTACTS TO SMEAR-NEGATIVE CASES**<sup>49</sup>



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.

Use Table 7 to prioritize contacts to smear-negative index patients.

Table 7: **PRIORITIZATION OF CONTACTS TO SMEAR-NEGATIVE CASES**<sup>50</sup>

High-Priority Contacts	Medium-Priority Contacts	Low-Priority Contacts
<ul style="list-style-type: none"><li>▪ Contacts &lt;5 years old</li><li>▪ Contacts with human immunodeficiency virus (HIV) infection or other immunocompromising conditions</li><li>▪ Contacts exposed during a medical procedure such as bronchoscopy, sputum induction, or autopsy</li></ul>	<ul style="list-style-type: none"><li>▪ Contacts not in high-priority groups</li><li>▪ Household contacts</li><li>▪ Contacts exposed in a congregate setting</li><li>▪ Contacts whose exposure exceeds duration/environment limits per unit time established by the local TB control program for medium-priority contacts</li><li>▪ ≥ 8 hours of cumulative exposure</li></ul>	<ul style="list-style-type: none"><li>▪ Contacts not in high-priority groups</li><li>▪ Contacts not in medium-priority groups</li></ul>

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

Use Table 8 to prioritize contacts to a suspected case of pulmonary TB who is acid-fast bacilli (AFB) sputum smear negative, who is nucleic acid amplification (NAA) negative and culture negative, and who has abnormal chest radiographs not consistent with TB.

Table 8: **PRIORITIZATION OF CONTACTS TO CASES WITH NEGATIVE BACTERIOLOGIC RESULTS AND ABNORMAL CHEST RADIOGRAPHS NOT CONSISTENT WITH TUBERCULOSIS**<sup>51</sup>


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

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.

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## Contact Evaluation, Treatment, and Follow-up

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

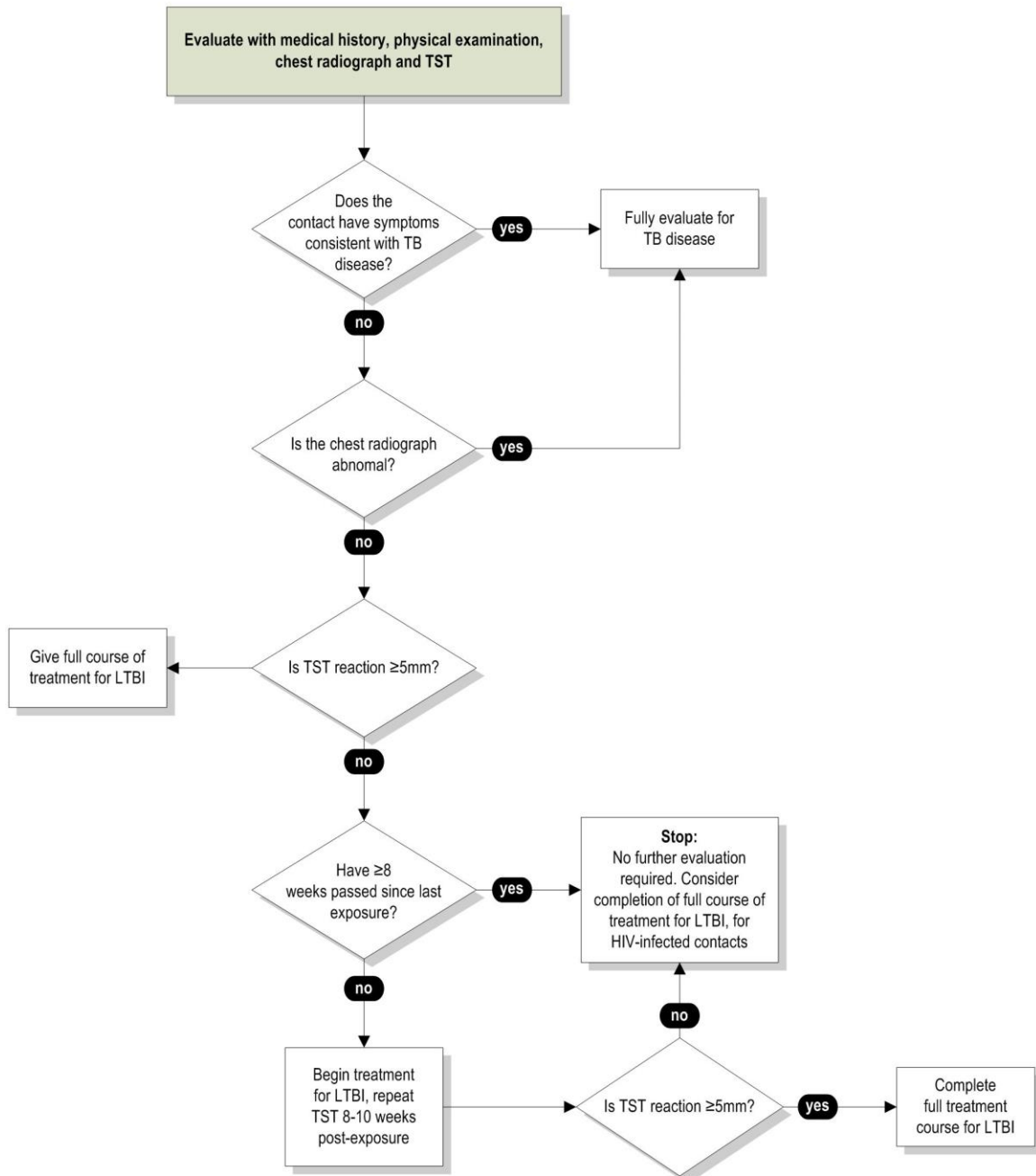
- 
- Provide each high- and medium-priority contact an initial assessment that includes a face-to-face encounter in which an impression of each contact's general health is formed and a tuberculin skin test (TST) is usually administered.
  - Medically evaluate each high- and medium-priority contact to determine whether tuberculosis (TB) disease or tuberculosis infection (TBI) is 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 TBI.<sup>52</sup>

Use the Figures 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 Five Years Old**
- **Figure 5: Evaluation, Treatment, and Follow-Up of Immunocompetent Adults and Children Five and Older (High- and Medium-Priority Contacts)**
- **Figure 6: Evaluation, Treatment, and Follow-Up of Contacts with Prior Positive Tuberculin Skin Tests**

## Immunocompromised Contacts and Children under Five

FIGURE 4: Evaluation, Treatment, and Follow-up of Immunocompromised Contacts and Children under Five years old<sup>53</sup>



Definition of abbreviations: HIV = human immunodeficiency virus; IGRA = interferon gamma release assay; TBI = 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.

If figure 4 is not easy to understand, then use Table 9 to Evaluate contacts who are immunocompromised or under five years of age with medical history, physical examination, chest radiograph, and tuberculin skin test (TST) or interferon gamma release assay (IGRA). Based on the results of these evaluations, take the actions in Table 9.

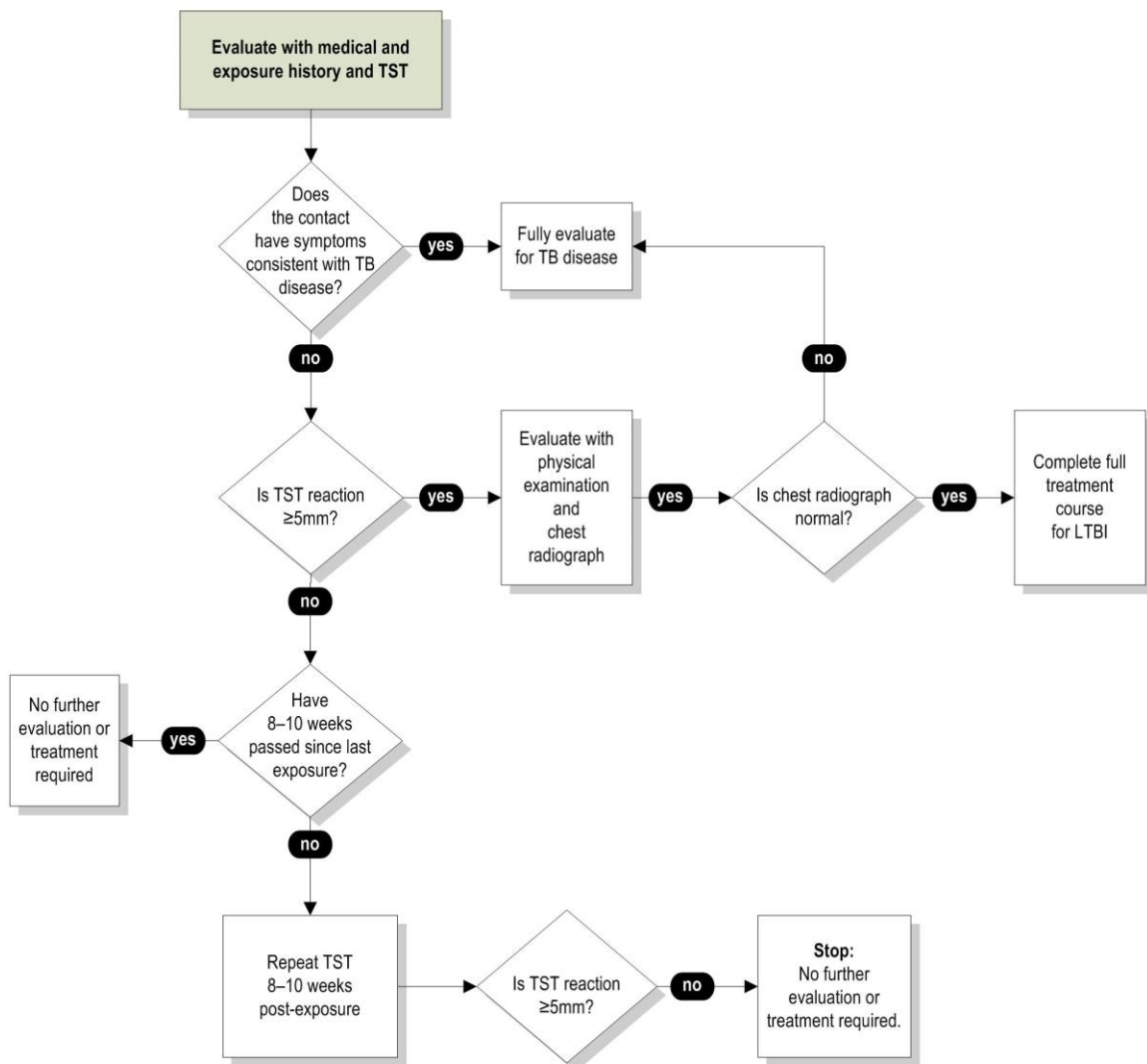
Table 9: **EVALUATION, TREATMENT, AND FOLLOW-UP OF IMMUNOCOMPROMISED CONTACTS AND CHILDREN UNDER FIVE YEARS OLD**<sup>54</sup>

If evaluation or test results show that a contact has the following:		Then take this action or these actions:
Symptoms consistent with TB disease and/or Abnormal chest radiograph		Fully evaluate for TB disease
No symptoms consistent with TB disease and normal chest radiographs	1st TST* $\geq 5$ mm	Consider a full course of treatment for TBI
	1st TST $< 5$ mm and $\geq 8$ weeks since last exposure	<ul style="list-style-type: none"> <li>▪ If not HIV-infected, no further evaluation required</li> <li>▪ If HIV-infected, no further evaluation required; consider a full course of treatment for TBI</li> </ul>
	1st TST $< 5$ mm and $< 8$ weeks since last exposure	Begin treatment for TBI and retest 8–10 weeks post exposure
	2nd TST $\geq 5$ mm	Consider a full course of treatment for TBI
	2nd TST $< 5$ mm	<ul style="list-style-type: none"> <li>▪ If not HIV-infected, no further evaluation required</li> <li>▪ If HIV-infected, no further evaluation required; consider a full course of treatment for TBI</li> </ul>
Definitions of abbreviations: HIV = human immunodeficiency virus; IGRA = interferon gamma release assay; TBI = latent tuberculosis infection; TB = tuberculosis; 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):15–16.

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

FIGURE 5: Evaluation, Treatment, and Follow-up of Immunocompetent Adults and Children five years or older (High- and Medium-Priority Contacts)<sup>55</sup>



Definition of abbreviations: IGRA = interferon gamma release assay; TBI = 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.

If Figure 5 is not easy to use, then use Table 10:

Evaluate high- and medium-priority contacts who are immunocompetent and/or five years of age or older, with medical history, exposure history, and tuberculin skin test (TST) or interferon gamma release assay (IGRA). Based on the results of these evaluations, take the actions in Table 10.

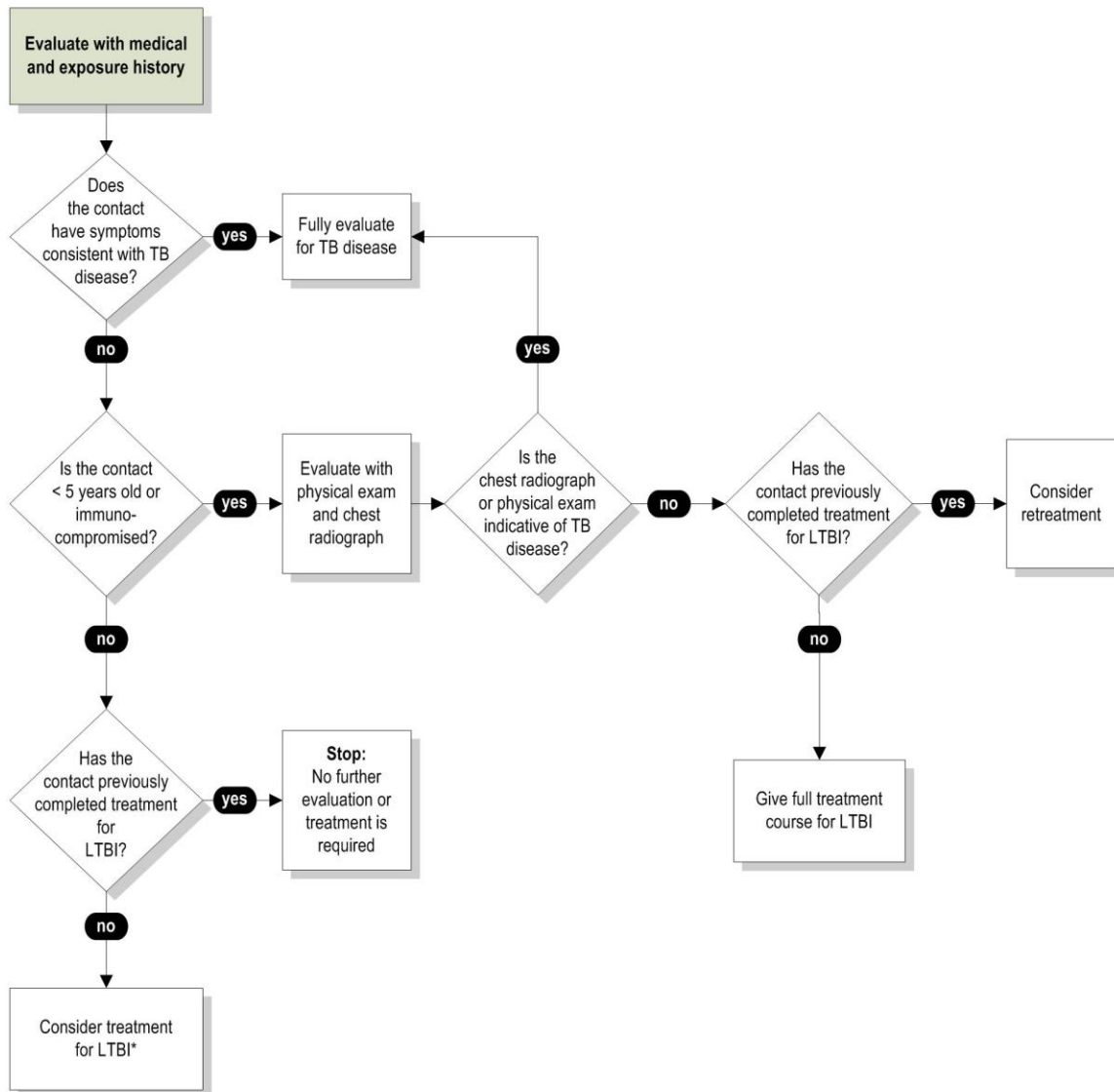
Table 10: **EVALUATION, TREATMENT, AND FOLLOW-UP OF IMMUNOCOMPETENT ADULTS AND CHILDREN FIVE YEARS AND OLDER (HIGH- AND MEDIUM-PRIORITY CONTACTS)**<sup>56</sup>

If evaluation or test results show that a contact has the following:		Then take this action or these actions:
Symptoms consistent with TB disease		Fully evaluate for TB disease
No symptoms consistent with TB disease	1st TST* $\geq 5$ mm	Evaluate with a physical examination and CXR: <ul style="list-style-type: none"> <li>▪ If CXR abnormal, fully evaluate for TB disease</li> <li>▪ If CXR normal, complete a full course of treatment for TBI</li> </ul>
No symptoms consistent with TB disease	1st TST $< 5$ mm and 8–10 weeks since last exposure	No further evaluation or treatment required
No symptoms consistent with TB disease	1st TST $< 5$ mm and $< 8$ weeks since last exposure	Retest 8–10 weeks post exposure
No symptoms consistent with TB disease	2nd TST $\geq 5$ mm	Evaluate with a physical examination and CXR: <ul style="list-style-type: none"> <li>▪ If CXR abnormal, fully evaluate for TB disease</li> <li>▪ If CXR normal, complete a full course of treatment for TBI</li> </ul>
No symptoms consistent with TB disease	2nd TST $< 5$ mm	No further evaluation or treatment required
Definitions of abbreviations: CXR = chest radiograph; IGRA = interferon gamma release assay; TBI = latent tuberculosis infection; TB = tuberculosis; 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**<sup>57</sup>



Definition of abbreviations: HIV = human immunodeficiency virus; TBI = 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.

If Figure 6 is not easy to use, then use Table 11:

For contacts with prior positive TSTs, evaluate them with medical and exposure history. Based on these histories, take the actions in Table 11.

Table 11: **EVALUATION, TREATMENT, AND FOLLOW-UP OF CONTACTS WITH PRIOR POSITIVE TUBERCULIN SKIN TESTS**<sup>58</sup>

If evaluation or test results show that a contact has the following:		Then take this action or these actions:
Symptoms consistent with TB disease		Fully evaluate for TB disease
No symptoms consistent with TB disease	Immunocompromised or <5 years old	Evaluate with a physical examination and CXR: <ul style="list-style-type: none"> <li>▪ If CXR or physical examination is indicative of TB disease, fully evaluate for TB disease</li> <li>▪ If results are <b>not</b> indicative of TB disease:               <ul style="list-style-type: none"> <li>▪ If contact previously completed treatment, consider retreatment</li> <li>▪ If treatment not completed previously, complete a full course of TBI treatment</li> </ul> </li> </ul>
No symptoms consistent with TB disease	Immunocompetent and ≥5 years old	<ul style="list-style-type: none"> <li>▪ If contact previously completed treatment for TBI, no further evaluation or treatment required</li> <li>▪ If contact has <b>not</b> completed treatment for TBI, consider treatment for TBI</li> </ul>
Definitions of abbreviations: CXR = chest radiograph; TBI = latent tuberculosis infection; TB = tuberculosis.		

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.

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# When to Expand a Contact Investigation

## Guidelines for Expanding an 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:

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 US-born children rather than adults born in high-incidence countries.



Unexpectedly large rate of tuberculosis (TB) infection or disease in high-priority contacts: 10 percent or at least twice the rate of a similar population without recent exposure, whichever is greater

- a. Evidence of second-generation transmission (i.e., from TB patients who were infected after exposure to the source patient)
  - b. TB disease in any contacts who had been assigned low priority
  - c. Infection in any contacts younger than five years old
  - d. 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.

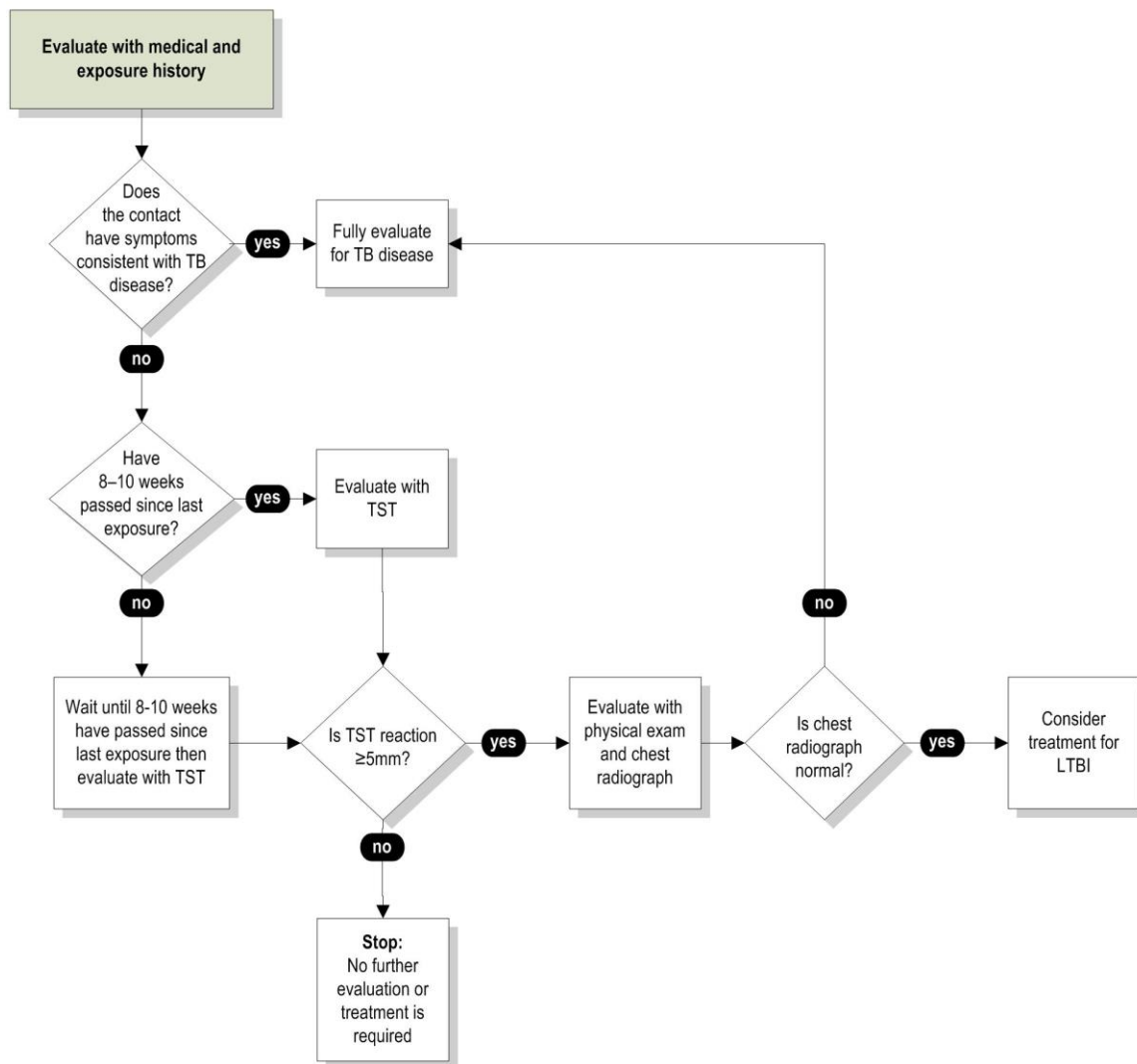


Contact the ODH TB Program at (614) 466-2381 to consult about expanding a contact investigation.

## Low-Priority Contacts

Use Figure 7 to select evaluation, treatment, and follow-up activities for low-priority contacts.

Figure 7: **EVALUATION, TREATMENT, AND FOLLOW-UP OF LOW-PRIORITY CONTACTS**<sup>59</sup>



Definition of abbreviations: CXR = chest radiograph; IGRA = interferon gamma release assay; TBI = 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.



If Figure 7 is not easy to use, then use Table 12:

Evaluate low-priority contacts with medical and exposure history. Based on these histories, take the actions in the Table 12.

Table 12: **EVALUATION, TREATMENT, AND FOLLOW-UP OF LOW-PRIORITY CONTACTS**<sup>60</sup>

If evaluation or test results show that a contact has the following:		Then take this action or these actions:
Symptoms consistent with TB disease		Fully evaluate for TB disease
No symptoms consistent with TB disease	8–10 weeks since last exposure	Evaluate with a TST
No symptoms consistent with TB disease	<8 weeks since last exposure	Wait 8–10 weeks after last exposure, and then evaluate with a TST
No symptoms consistent with TB disease	1st TST* ≥5 mm	Evaluate with physical examination and CXR: <ul style="list-style-type: none"> <li>▪ If CXR is abnormal, fully evaluate for TB disease</li> <li>▪ If CXR is normal, consider treatment for TBI</li> </ul>
No symptoms consistent with TB disease	1st TST <5 mm	No further evaluation or treatment required
Definitions of abbreviations: CXR = chest radiograph; IGRA = interferon gamma release assay; TBI = tuberculosis infection; TB = tuberculosis; TST = tuberculin skin test. * <b>Note:</b> 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):22.

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# **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. Epidemiologic analysis of an investigation in progress as well as overall results of previous investigations
3. Program evaluation via performance indicators that reflect performance objectives

## **Reasons Contact Investigation Data Are Needed**

### **Comprehensive Care**

For each index patient and the associated contacts, a broad amount of demographic, epidemiologic, historical, and medical information is 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 bacteriologic response to treatment).

### **Timeline Objectives**

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

### **Completion of Investigation**

When aggregated, the data from an investigation inform public health officials as to 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 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 are structured and stored in formats allowing detailed retrospective review, then the reasons for problems can be studied.



To assess the overall activities of contact investigations, see the CDC's "Framework of Program Evaluation in Public Health" (*MMWR* 1999;48[No. RR-11]) at this hyperlink:

<ftp://ftp.cdc.gov/pub/Publications/mmwr/rr/rr4811.pdf> .

## 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. Store data electronically for quick analysis of interim results.
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



Enter a new reportable condition of TB for the case-patient. The use of the contact module in ODRS is optional unless a known contact is diagnosed with active TB disease. In this instance, please enter the linking state case number in the case administration section of the index case.

## Evaluation of a Contact Investigation

Summarize the results of a contact investigation to report by priority the total number of contacts who were identified, were tested, started therapy, and completed therapy.



You may record your summary in ODRS using the contact section of the index cases record. This section of the TB Module will provide easy access to investigation data required for the Aggregate Report for Tuberculosis Program Evaluation due annually to CDC.

In addition, the CDC's Framework for Program Evaluation in Public Health is recommended for assessing the overall activities of contact investigations.<sup>61</sup>



For information about 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 this hyperlink:

[https://www.cdc.gov/tb/publications/PDF/ARPEs\\_manualsm1.pdf](https://www.cdc.gov/tb/publications/PDF/ARPEs_manualsm1.pdf) .

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# Outbreak Investigation

If data from a contact investigation or surveillance indicate 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:

1. An increase has occurred above the expected number of TB cases.
2. 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).
3. 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).
4. A genotype cluster leads to discovery of one or more verified transmission links that were missed during a contact investigation within the prior two years.

Criteria based on program resources:

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

## Deoxyribonucleic Acid Genotyping

Deoxyribonucleic acid (DNA) genotyping is a laboratory technique used by public health officials during a TB outbreak to distinguish between different strains of *M. tuberculosis* and to help assess the likelihood of TB transmission. Characterization of *M. tuberculosis* with DNA genotyping is a tool for the following:

1. Surveillance of potential outbreaks
2. Confirming TB cases linked by traditional epidemiologic methods
3. Identifying clusters of patients infected with genetically related or identical strains of *M. tuberculosis* and determining common sources of infections
4. In some situations, help guide contact investigations and the appropriate use of preventive therapy
5. Identifying laboratory cross-contamination as the cause of misdiagnosis

When used to track the transmission of a specific strain, DNA genotyping can help assess the effectiveness of TB control programs, a particularly useful methodology for areas with low TB incidence as the United States approaches TB elimination.

Confirm the linkage between cases by genotyping results if isolates have been obtained. An outbreak increases the urgency of investigations and will put greater demands on the health department. Therefore, corroborate a suspected linkage between cases by genotyping results before intensifying an investigation. An epidemiologic investigation is required for determining probable transmission linkages even if genotypes match.

Any secondary case that is unexpectedly linked to a known index patient represents a potential failure in the contact investigation; in such cases, reassess the original investigation to determine whether the strategy for finding contacts was optimal and whether the priorities were valid. If a secondary case occurred because treatment for a known contact with tuberculosis infection (TBI) was not started or completed, then review the strategies for treatment and completion.

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# Resources and References

## Resources

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