Chapter 10: Contact Investigation

Contents

Introduction

Purpose

A contact investigation is the process of identifying, examining, evaluating, and treating all people who are at risk for infection with *Mycobacterium tuberculosis* due to recent exposure to a newly diagnosed or suspected case of respiratory tract tuberculosis (TB). The primary goal of a contact investigation is to identify people who were exposed to infectious TB and ensure that contacts receive these evaluation services:

- Testing for *M. tuberculosis* infection
- Screening for TB disease
- Medical evaluation and CXR, if indicated
- Prompt initiation of latent tuberculosis infection (LTBI) treatment, as appropriate
- Identification of eligible individuals and initiation of window prophylaxis, if applicable
- Resources to complete LTBI treatment, when applicable

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

- Stop transmission of *M. tuberculosis* by identifying people with previously undetected infectious TB.
- Determine whether a TB outbreak has occurred (in which case, an expanded outbreak investigation should ensue).[1]

Use this section to understand and follow national and Wisconsin 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 cases, every case of TB begins as a contact to a person with active, infectious TB disease. For this reason, the Centers for Disease Control and Prevention (CDC) has identified contact investigations (that is, seeking and evaluating contacts) as a fundamental strategy for the prevention and control of TB. To control and prevent TB, our health care resources and efforts in Wisconsin 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.[2] National recommendations for contact investigations are provided in the CDC's "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).

One of the major challenges to successful control of TB is in protecting contacts of people with infectious TB and in preventing and responding to TB outbreaks.[3] 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.[4]

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 people 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 people in the early stage of LTBI, when the risk for progression to TB disease is high and the benefit of treatment is greatest.[5] A study showed that improvements in contact investigations might have prevented 17 (10%) of 165 pediatric TB cases in California in 1994.[6]

Policy

The Wisconsin Tuberculosis Program recognizes that staff in local and Tribal health departments have many competing priorities, which can limit the resources that individual departments are able to allocate to contact investigations. However, contact investigations can be a powerful tool in the elimination of TB, and should be performed to the greatest extent possible. The state program recommends determining the priority status of contact investigation on a case-by-case basis, based on the following criteria that indicate a higher likelihood of increased transmission for pulmonary, laryngeal, or pleural TB:

Table 10.1 Environmental factors that enhance the probability that *M. tuberculosis* will be transmitted

Factor	Description
Concentration of infectious droplet nuclei	More droplet nuclei in the air increases the probability that *M. tuberculosis* will be transmitted
Space	Exposure in small, enclosed spaces
Ventilation	Inadequate local or general ventilation that results in insufficient dilution or removal of infectious droplet nuclei
Air circulation	Recirculation of air containing infectious droplet nuclei
Specimen handling	Improper specimen handling procedures that generate infectious droplet nuclei
Air pressure	Lack of negative air pressure in infectious patient's room that allows *M. tuberculosis* organisms to flow to other areas

Table 3.1 People at high risk for TB infection and progression to TB disease

For tuberculosis infection:	For progression to tuberculosis disease:

• High-priority contacts such as housemates or coworkers or contacts of people who have smear-positive pulmonary or laryngeal TB
• Infants, children, and adolescents exposed to adults in high-risk categories
• Recent immigrants (less than 5 years) from countries with high incidence of TB (Asian, African, Latin American, and Eastern European countries have TB rates 5–30 times higher than US rates, and an increasing percentage of TB cases here are occurring among immigrants from those countries)
• Recent immigrants from Mexico
• Migrant or seasonal workers
• People who have recently spent over three months in high-incidence countries
• Native Americans
• People with high rates of TB transmission:
  ○ People experiencing homelessness
  ○ People who use injection drugs
  ○ People living with HIV
• People living or working in institutions with individuals at risk for TB such as:
  ○ Hospitals, especially nursing staff, emergency department staff, and laboratory staff.
	• People living with HIV
	• Infants and children under age 5 years
	• People infected with *Mycobacterium tuberculosis* within the previous 2 years.
	• People with a history of untreated or inadequately treated TB disease
	• People with radiographic findings consistent with previous TB disease
	• People who use alcohol or illegal drugs
	• People with any of the following clinical conditions:
	  ○ Silicosis
	  ○ Diabetes mellitus
	  ○ End-stage renal disease, chronic renal failure
	  ○ People on hemodialysis
	  ○ Some hematologic disorders (for example, leukemias and lymphomas)
	  ○ Other malignancies (for example, carcinoma of head, neck or lung)
	  ○ Body weight or greater below ideal body weight.
	  ○ Prolonged corticosteroid use
	  ○ Use of other immunosuppressive treatments (for example, prednisone,

○ Long-term care facilities* ○ Homeless shelters* ○ Residences for people with acquired immunodeficiency syndrome (AIDS) ○ Correctional facilities*	tumor necrosis factor-alpha antagonists). ○ People with history of organ transplantation- especially if they take anti-rejection medications ○ Gastrectomy ○ Chronic malabsorption syndromes ○ Jejunoileal bypass
* In Wisconsin, there is typically not high incidence of TB in these institutions, however other states do have incidence rates in these institutions, and so individuals coming to these institutions from other states *may* be at higher risk.	

Documentation

For each investigation, complete CI entries in the WEDSS index case file.

Contact investigations and follow up activities must be documented in the Wisconsin Electronic Disease Surveillance System (WEDSS). A recorded training is available on WEDSS documentation for TB contact investigations on the TB program website. Watch here: DHS TB/LTBI Training for New Staff

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:

- Pre-interview preparation
- Index patient interviews
- Field investigation
- Risk assessment for *Mycobacterium tuberculosis* transmission
- Decision about priority of contacts
- Evaluation of contacts
- Treatment and follow-up of contacts
- Decision about whether to expand testing
- Evaluation of contact investigation activities[7,8]

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.[9]

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 10.2: **Time Frames for Investigating the Index Patient and the Sites of Transmission** and Table 10.3: **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.[10] As part of the CDC TB grant awarded to jurisdictions, evaluation of programs includes data on contact investigations. This includes whether or not contacts were able to be elicited from index cases, how many contacts were fully evaluated, and the treatment cascade for those contacts with LTBI. This information should be housed in WEDSS and is only accessible to the state program if entered into WEDSS. The state TB program evaluation focal point is available for consultation or questions about collected data, how to access this information, and how to use this data. Please contact the state program for questions regarding program evaluation metrics.

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 10.1: **Environmental factors that enhance the probability that M. tuberculosis will be transmitted** and **Table 3.1 People at high risk for TB infection and progression to TB disease.** In addition, other information about the index

patient, such as social habits or workplace environments, can influence the investigative strategy.[11]

Record your decision and rationale for initiating a contact investigation in the Contact Investigation record in WEDSS.

Anatomical site of disease

Ordinarily, patients with pulmonary or laryngeal 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 irrigation of areas containing TB bacteria or aggressive manipulation of TB infected tissues, that release aerosols.

Sputum bacteriology

The relative infectiousness increases when the sputum culture results are positive and increases even more when the acid-fast bacilli (AFB) sputum smear results are also positive.[12] 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. However, sputum collection should always still be attempted, especially post bronchoscopy, as this is a time of high yield.

Radiographic findings

Patients who have lung cavities observed on a chest radiograph are likely 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 housing instability, employment, work setting, non-work-related activities, recent arrival from a foreign country, and substance 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 is recent. Young children usually do not transmit TB to others, and their contacts are unlikely to be infected because of exposure to them. However, other household members may have LTBI from exposure to the same index case and it may be the index case is a primary caregiver with undiagnosed TB disease.

Human immunodeficiency virus (HIV) status

Evaluation of HIV status needs to be done promptly since progression to active TB may occur within weeks of exposure among individuals with acquired immunodeficiency syndrome (AIDS). People coinfected with TB and HIV with low CD4 T-cell counts frequently have chest radiographic findings that are not typical of pulmonary TB.[13] 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, people coinfected with HIV and TB, who have pulmonary or laryngeal TB on average are only as contagious as similar patients who are not living with HIV. Contacts to people coinfected with HIV and TB are also more likely to be living with HIV. Therefore, for all people who were exposed to people coinfected with HIV and TB (or those with risk factors for HIV) and whose infection status is unknown, HIV counseling and testing is recommended.[14] Regardless of known HIV status, HIV counseling should always be recommended for all patients as a part of the screening process.[15]

After starting chemotherapy

Infectiousness rapidly declines once people with TB are started on an appropriate TB regimen. 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. Much of the exposure of TB to others is likely to have occurred prior to diagnosis and treatment having been initiated. This is another reason contact investigations are so important.

Treatment after exposure to drug-resistant tuberculosis

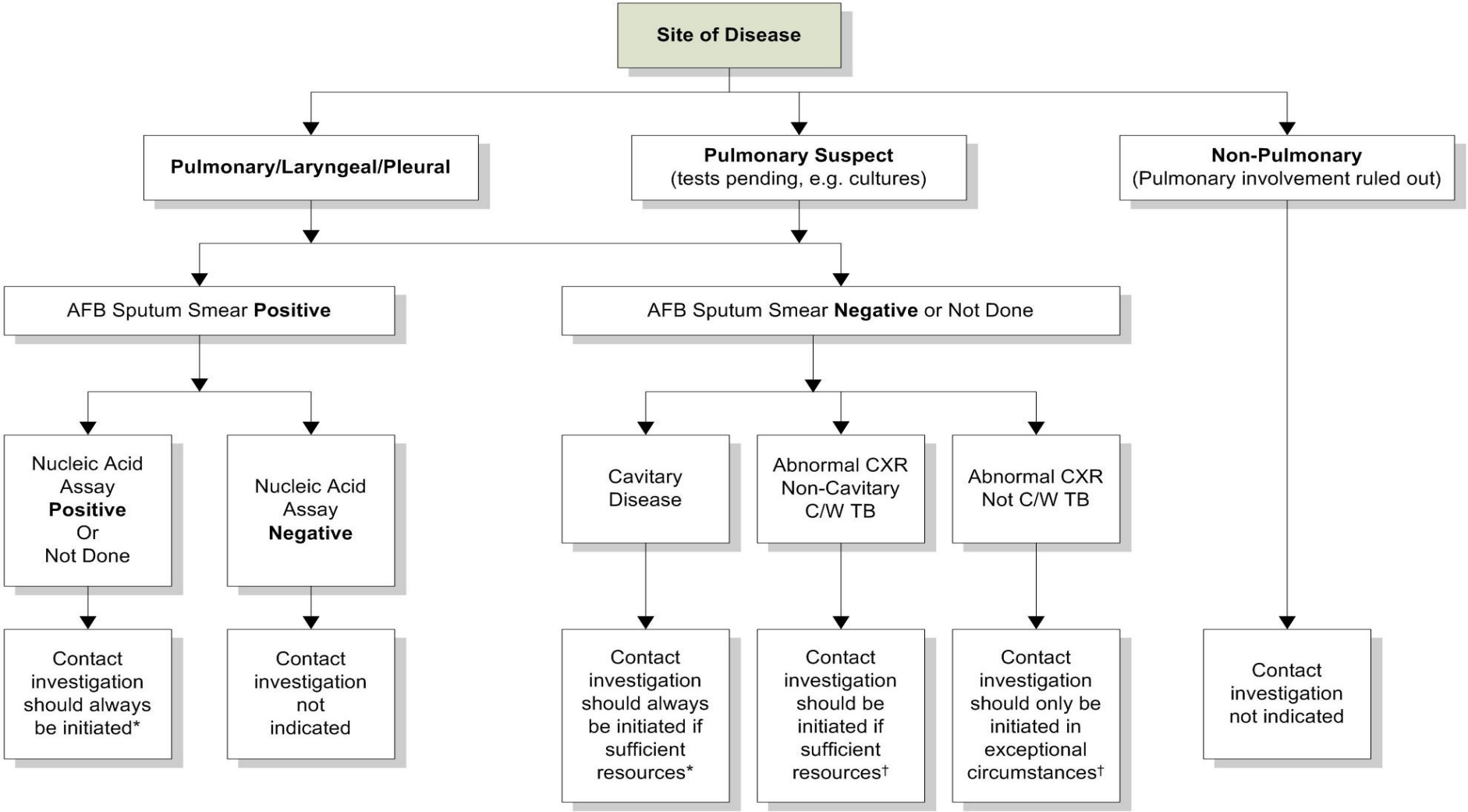
Drug susceptibility results for the *M. tuberculosis* isolate from the index patient (that is, the presumed source of infection) are absolutely necessary for selecting the treatment regimen.

Resistance to only isoniazid (INH) leaves the option of four months of daily rifampin (RIF), and resistance to only rifampin can be treated with six to eight months of daily isoniazid, but the 4R and 3HP regimens should be avoided. Clients with resistance to both INH and RIF meet the criteria for 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. Please contact the state TB program for medical consultation regarding the treatment of those likely infected with MDR-TB. 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 10.1 to help determine whether to start a contact investigation.

Figure 10.1: Decision to initiate a contact investigation[16]



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 (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. Specimens sent to WSLH for AFB smear and culture will automatically be reflexed to TB and MAC PCR testing, *if smear positive*. This can supply prompt identification of one of the most commonly identified NTM in Wisconsin, *Mycobacterium avium complex* (MAC).

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, and clinical suspicion for TB remains. Small parenchymal cavities that can be detected only by computerized imaging techniques (for example, 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 (for example, 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 attempted 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 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 until the diagnosis is confirmed**.** 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 (for example, 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 (for example, 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).

Time frames for contact investigation

Use this topic to understand the time frames for key contact investigation activities. A person with suspected or confirmed TB becomes referred to in TB texts and guidelines as an "index patient" when that person is the first person in group known or thought to have infectious TB disease. 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 test (NAAT), cavitary disease, or an abnormal chest radiograph consistent with TB.

Refer to Table 10.2: **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 10.2: Time frames for investigating the index patient and the sites of transmission[17]

Index patients expected to have infectious TB		
	With indications of infectiousness	**Without indications of infectiousness**
First index patient interview Number of days following notification within which the index patient should be interviewed in person (that is, not by telephone)	**1 business day or less of reporting**	**3 business days or less of reporting**
Residence visit 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 or less after the first interview**	**3 business days after the first interview**
Field investigation 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**
Index patient reinterviews 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**
Reassessment of the index patient Information about the index patient should be reassessed at least weekly until drug-susceptibility results are available for the *Mycobacterium tuberculosis* 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 10.2: **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.[18] For information on how to determine which contacts are high-, medium-, or low-priority, see the "Contact Priorities" topic in this section.

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 10.3: **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 10.3: Overview of ongoing management activities and maximum time frames[19]

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 LTBI	1 to 2 months after the index patient's initial sputum collection date

Activity	Purpose	Maximum time interval
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 the time of each visit
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 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[20]	Ongoing

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

† 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 Wisconsin Tuberculosis Program at 608-261-6319.

Source: Adapted from: California Department of Health Services (CDHS)/California Tuberculosis Controllers Association (CTCA). Contact investigation guidelines. *CDHS/CTCA Joint Guidelines* [CTCA Web site]. November 12, 1998:18. Available at CDPH-CTCA Joint Guidelines - CTCA.

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.[21] The exact 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 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 10.4: **Guide for Estimating the Beginning of the Period of Infectiousness** to determine the start of the infectious period.

Table 10.4: Guide for estimating the beginning of the period of infectiousness[22]

Guidelines for determining infectious period for TB			
TB symptoms	AFB sputum smear positive	Cavitary chest radiograph	Recommended minimum beginning of likely period of infectiousness
Yes	No	No	3 months before symptom onset or first positive finding consistent with TB disease, whichever is **longer**
Yes	Yes	Yes	3 months before symptom onset or first positive finding consistent with TB disease, whichever is **longer**
No	No	No	4 weeks before date of suspected diagnosis
No	Yes	Yes	3 months before first positive finding consistent with TB

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 exposure to contacts has ended **or** when **all** three of the following criteria are met:

- The index patient is receiving effective treatment (as demonstrated by Mycobacterium tuberculosis susceptibility results) for **at least two weeks**.

The index patient has diminished symptoms.

The index patient exhibits mycobacteriologic response (for example, decrease in grade of sputum smear positivity detected on sputum-smear microscopy).[23,24]

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 people 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.[25]

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 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.[26]

TB Interviewing for Contact Investigation: A Practical Resource for the Health care Worker (New Jersey Medical School Global Tuberculosis Institute Web site; 2004) offers specific suggestions on how to prepare for and conduct the interviews.[27]

Record information regarding the index patient and contacts in the case patient's WEDSS record and create Contact Investigation incidents for contacts that require

follow- up.

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
- Provider
- Laboratory, clinic, or other reporting source
- Infection control practitioner (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.[28]

General guidelines for interviewing an index patient

- 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 people 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.[29]

Conduct the interviews in the patient's language, using a medical interpreter if the patient does not speak English.

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)

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

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.[30]

During field visits, the health care worker should do the following:

Observe environmental characteristics, such as room size, crowding, and ventilation, to estimate the risk of 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 (for example, “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.[31]

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 the placement and reading of the tuberculin skin test (TST) results. Consider offering TST placement and reading in the client’s home to decrease barriers for screening.

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 or healthcare provider for a medical evaluation, including radiography and sputum collection.[32]

For larger field investigations, contact the Wisconsin Tuberculosis Program at 608-261-6319 for an excel line list template.

Health care workers should remember to follow infection control precautions while visiting a potentially infectious TB patient at home or in any other location. These precautions may include wearing a personal respirator.[33]

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

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

General safety precautions that are recommended for the health care worker include 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[34]

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 people 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.[35] 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.[36]

Use the assigned priorities to allocate resources to complete all investigative steps for the high- and medium-priority contacts.[37] 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:

- Find contacts who are secondary active TB cases.

Find contacts who have recent *M. tuberculosis* infection—the most likely to benefit from treatment.

Select contacts who are most likely to progress to TB disease if they are infected (that is, susceptible contacts) or who could suffer severe morbidity if they had TB disease (that is, vulnerable contacts).[38]

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 algorithms on the following pages to assign priorities to contacts to the following:

Figure 10.2: **Prioritization of contacts to smear-positive or cavitary cases**

Figure 10.3: **Prioritization of contacts to smear-negative case**

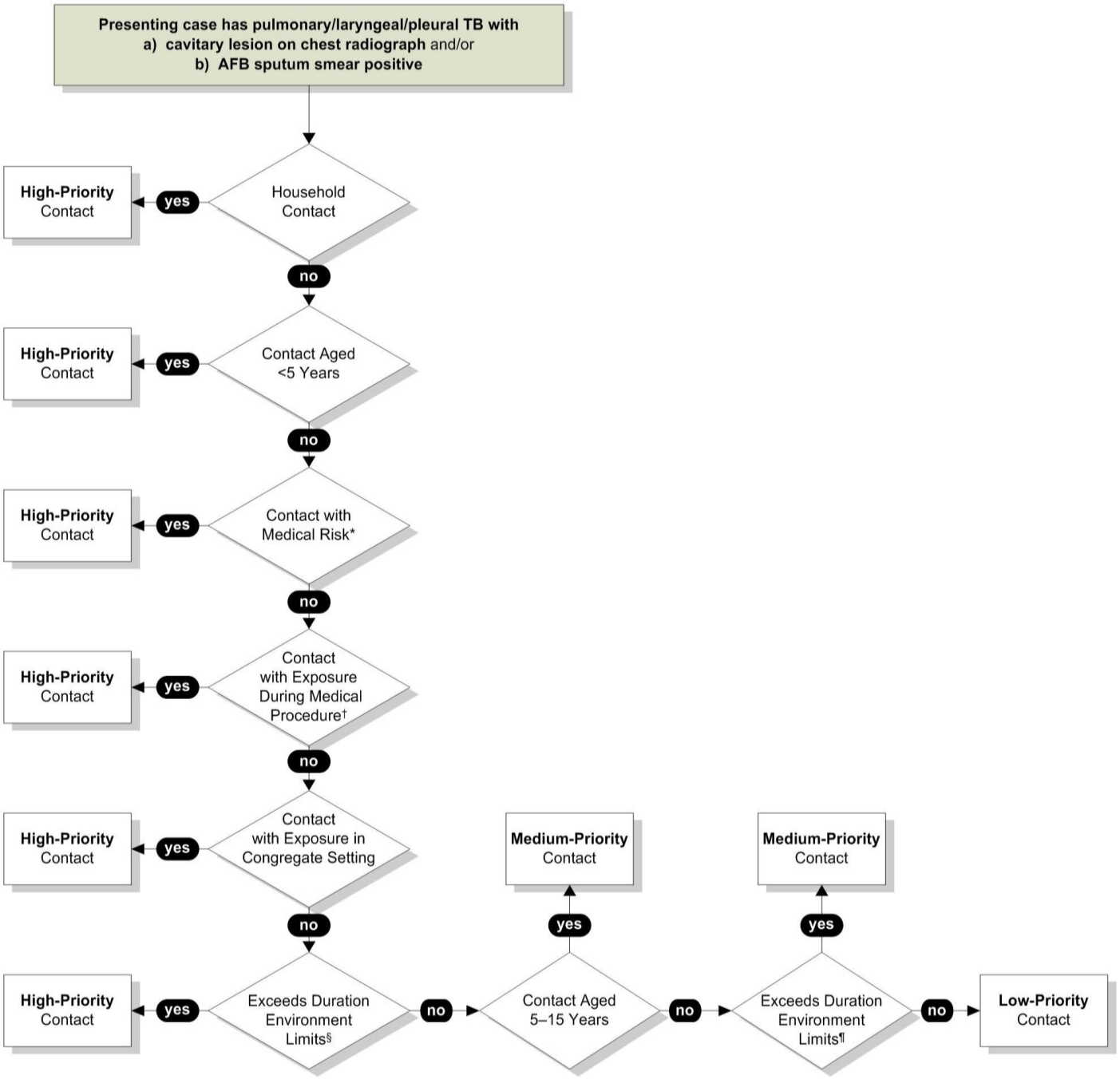
Table 10.5: **Prioritization of contacts to smear-positive or cavitary cases**

Table 10.6: **Prioritization of contacts to smear-negative cases**

Table 10.7: **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 10.2: Prioritization of contacts to smear-positive or cavitary cases[41]



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.

Table 10.5: Prioritization of contacts to smear-positive or cavitary cases[39]

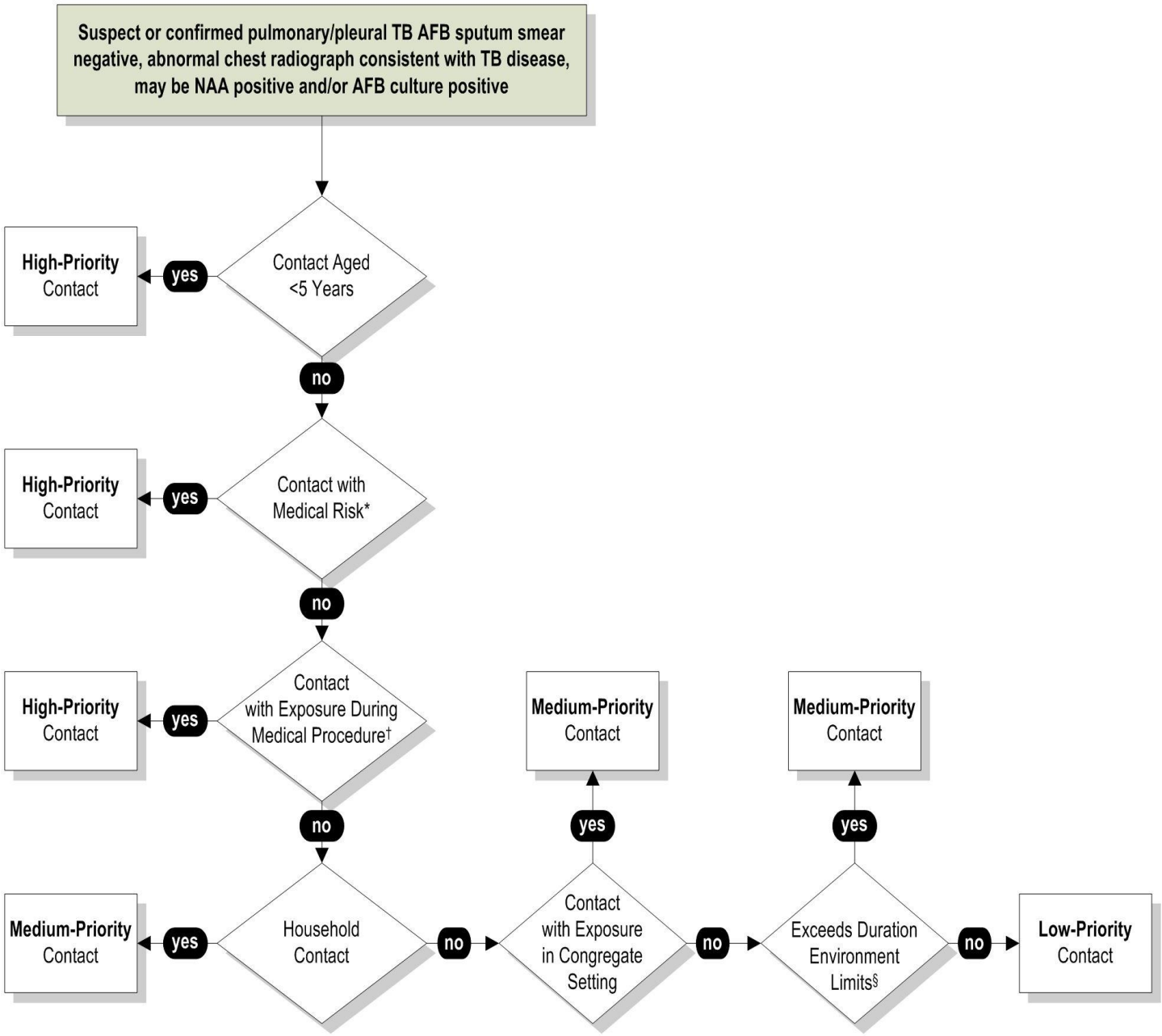
High-priority contacts	Medium-priority contacts	Low-priority contacts
• Household contacts • Contacts less than5 years old • Contacts with human immunodeficiency virus (HIV) infection or other immunocompromising condition • Contacts with exposure during an aerosolizing medical procedure such as bronchoscopy, sputum induction, without appropriate PPE • Contacts with exposure in a congregate setting (jail, prison, or other shared accommodation) • Contacts whose exposure exceeds duration/environment limits per unit time established by the health department for high-priority contacts	• Contacts not in high-priority groups • Contacts 5–15 years old • Contacts whose exposure exceeds duration/environment limits per unit time established by the health department for medium-priority contacts	• Contacts not in high-priority groups • 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):12.

Index patient with negative acid-fast bacilli sputum smear results

Use Figure 10.3 to prioritize contacts to smear-negative index patients.

Figure 10.3: Prioritization of contacts to smear-negative cases[40]



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 10.6 to prioritize contacts to smear-negative index patients.

Table 10.6: Prioritization of contacts to smear-negative cases[41]

High-priority contacts	Medium-priority contacts	Low-priority contacts
• Contacts less than 5 years old • Contacts with human immunodeficiency virus (HIV) infection or other immunocompromising conditions • Contacts with exposure during an aerosolizing medical procedure such as bronchoscopy, sputum induction, without appropriate PPE	• Contacts not in high-priority groups • Household contacts • Contacts exposed in a congregate setting • Contacts whose exposure exceeds duration/environment limits per unit time established by the local TB control program for medium-priority contacts	• Contacts not in high-priority groups • 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):13.

Index patient with negative bacteriologic results and abnormal chest radiographs not consistent with tuberculosis

Use Table 10.7 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 disease.

Table 10.7: Prioritization of contacts to cases with negative bacteriologic results and abnormal chest radiographs not consistent with tuberculosis[42]

High-priority contacts	Medium-priority contacts	Low-priority contacts
All	• 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	• 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, 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) or IGRA is usually administered.

Medically evaluate each high- and medium-priority contact to determine whether TB disease or LTBI 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 (that is, susceptible contacts) or contacts who could suffer severe morbidity if they had TB disease (that is, vulnerable contacts).

For recommended time frames, refer to Table 10.3: **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 for someone with a possible history of BCG-vaccine as evidence of recent *Mycobacterium tuberculosis* infection in contacts of people with infectious cases. Note that it is recommended that individuals who have received BCG vaccine be offered IGRA testing, as they may receive a false positive TST result. Evaluate these contacts for TB disease and offer them a course of treatment for LTBI.[43]

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

Figure 10.4: **Evaluation, Treatment, and Follow-Up of Immunocompromised Contacts and Children Under Five Years Old**

Figure 10.5: **Evaluation, Treatment, and Follow-Up of Immunocompetent Adults and Children Five and Older (High- and Medium-Priority Contacts)**

Figure 10.6: **Evaluation, Treatment, and Follow-Up of Contacts with Prior Positive Tuberculin Skin Tests**

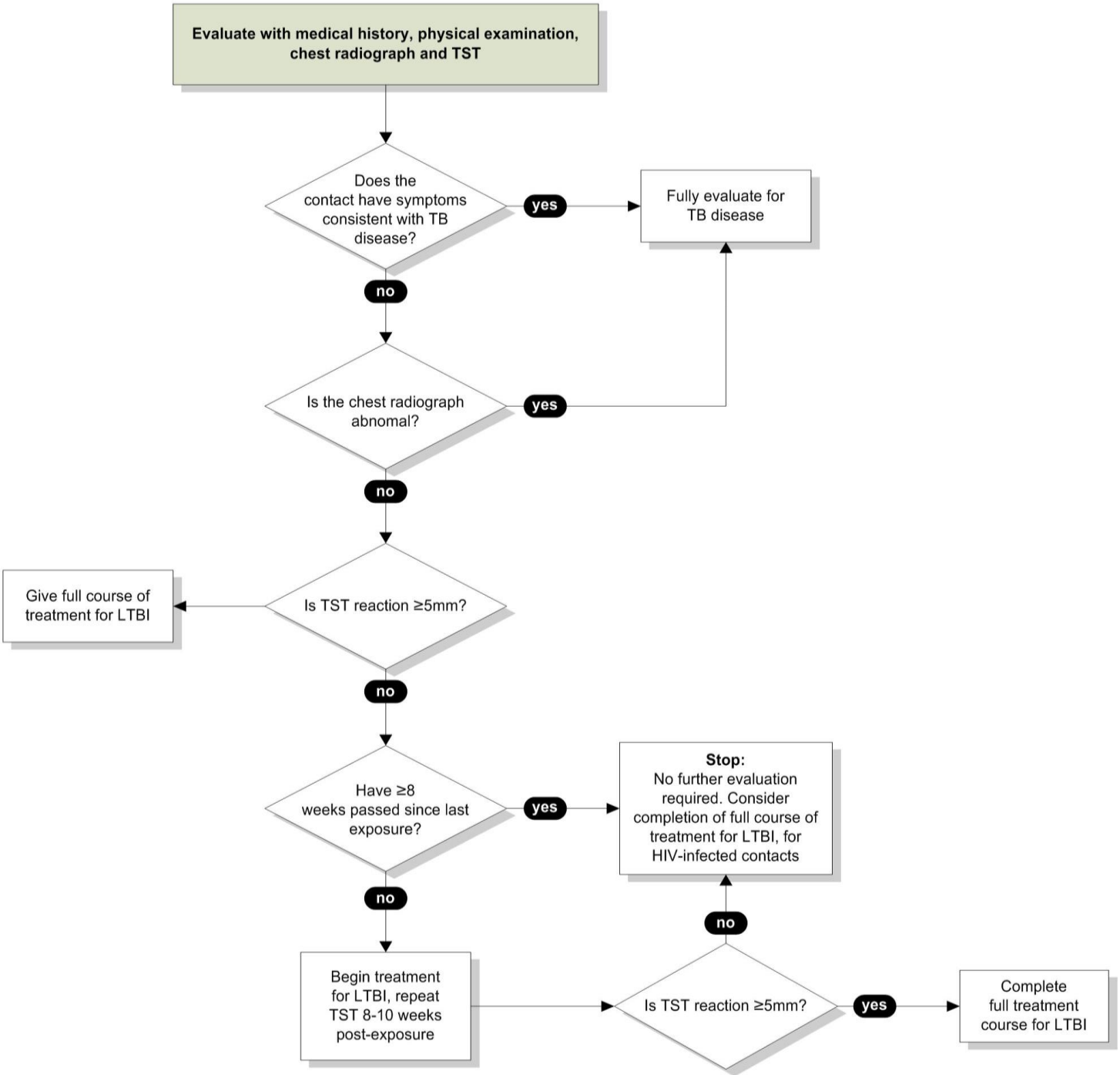
For time frames, see the "Time Frames for Contact Investigation" topic in this section. To arrange follow-up with public health officials in other jurisdictions for out-of-area contacts, see the Transfer Notifications section.[44]

The concentric circle model in TB control. The highest risk individuals are in the center, and the outer circles indicate either less time in contact, greater distance, or both between the contact person and the case patient. Begin by evaluating the highest risk exposures (in the center circle). If a greater than expected number of those individuals test positive by TST or IGRA, it indicates that the case patient may have been more infectious, and you should expand your contact investigation efforts to include contacts in the next ring (dark blue)- those who spent less time with the case patient or were not physically as close, but are at higher than the next ring and so forth.

Immunocompromised contacts and children under 5

Use Figure 10.4 to select evaluation, treatment, and follow-up activities for contacts who are immunocompromised or under 5 years old.

Figure 10.4: Evaluation, treatment, and follow-up of immunocompromised contacts and children under 5 years old[45]



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.

Evaluate contacts who are immunocompromised or under 5 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 10.8.

Young children who are close contacts to someone with infectious TB should receive treatment for LTBI even if the TST result is negative and once TB disease is excluded by chest radiograph and symptom review. This is called “window“ prophylaxis.

A second TST should be administered eight to 10 weeks after the last exposure to infectious TB. Window prophylaxis can be discontinued if **all** the following conditions are met:

- The infant is at least 6 months of age
- The second TST result is also negative and
- The second TST was performed at least eight weeks after the child was last exposed to an adult with infectious TB disease

Timely initiation of treatment is especially important for these contacts. Refer to Table 10.3: **Time Frames for Contact Evaluation and Treatment** in the “Time Frames for Contact Investigation” topic.

Table 10.8: Evaluation, treatment, and follow-up of immunocompromised contacts and children under five years old[46]

If evaluation or test results show a contact has the following:		Then take this action or these actions:
Symptoms consistent with TB disease or Abnormal chest radiograph		Fully evaluate for TB disease
No symptoms consistent with TB disease and normal chest radiographs	1st TST* ≥5 mm Or A positive IGRA (note that IGRAs are acceptable in children one year old and older).	Complete a full course of treatment for LTBI
	1st TST <5 mm Or A positive IGRA and ≥8 weeks since last exposure	If not HIV-infected, no further evaluation required If HIV-infected, no further evaluation required; consider a full course of treatment for LTBI

If evaluation or test results show a contact has the following:		Then take this action or these actions:
	1st TST <5 mm Or A positive IGRA and <8 weeks since last exposure	Begin treatment for LTBI and retest 8–10 weeks post exposure
	2nd TST ≥5 mm Or A positive IGRA	Complete a full course of treatment for LTBI
	2nd TST <5 mm Or A positive IGRA	If not HIV-infected, no further evaluation required If HIV-infected, no further evaluation required; consider a full course of treatment for LTBI

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

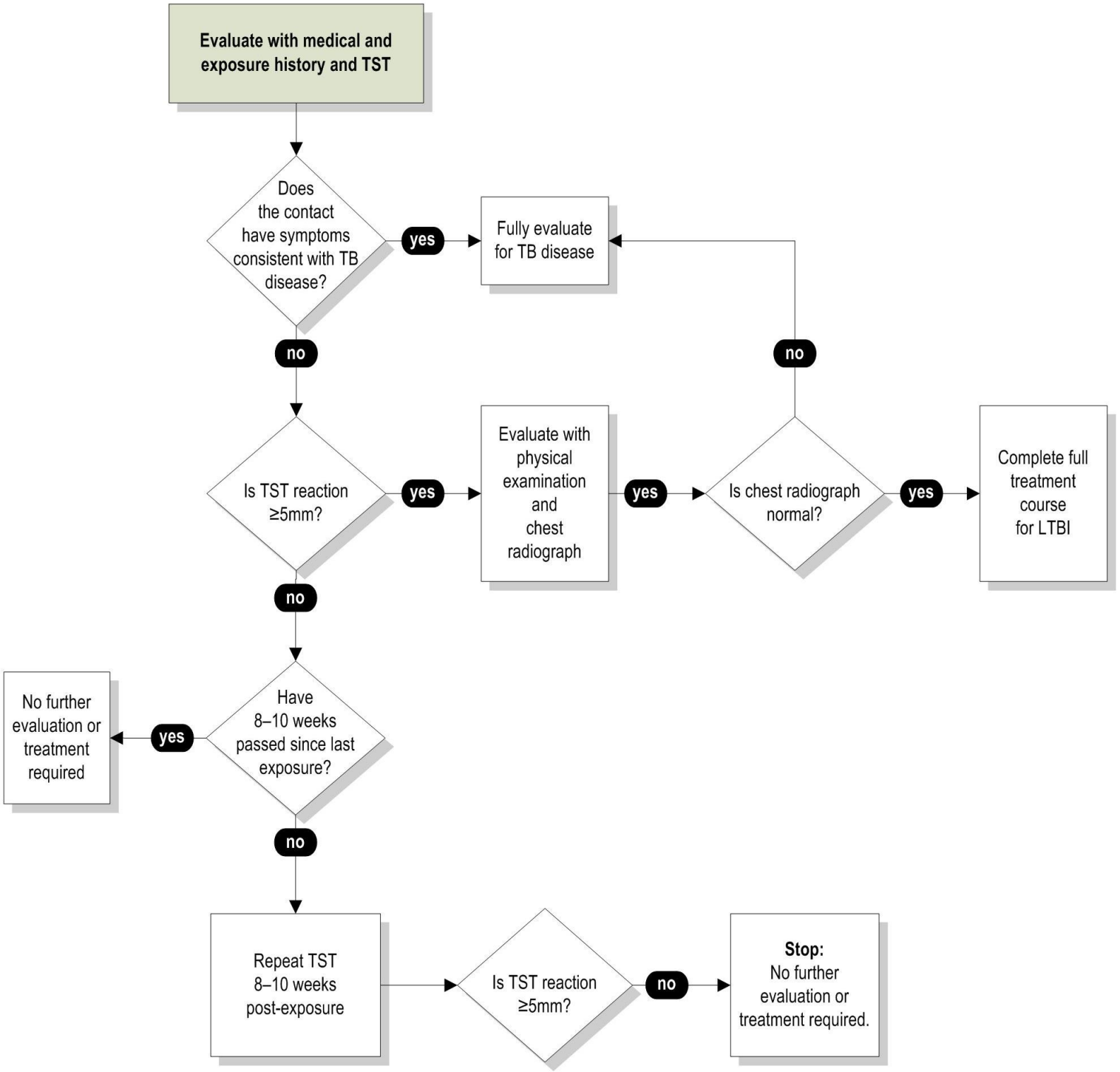
* **Note:** An IGRA may be used in place of a TST.

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 5 years and older (high- and medium-priority contacts)

Use Figure 10.5 to select evaluation, treatment, and follow-up activities for high- and medium-priority contacts who are immunocompetent and/or five years of age or older.

Figure 10.5: Evaluation, treatment, and follow-up of immunocompetent adults and children five years or older (high- and medium-priority contacts)[47]



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.

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 10.9.

Table 10.9: Evaluation, treatment, and follow-up of immunocompetent adults and children five years and older (high- and medium-priority contacts)[48]

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* ≥5 mm Or A positive IGRA (note that IGRAs are acceptable in children one year old and older).	Evaluate with a physical examination and CXR: If CXR abnormal, fully evaluate for TB disease If CXR normal, complete a full course of treatment for LTBI
No symptoms consistent with TB disease	1st TST <5 mm Or A positive IGRA And 8–10 weeks since last exposure	No further evaluation or treatment required
No symptoms consistent with TB disease	1st TST <5 mm Or A positive IGRA and <8 weeks since last exposure	Retest 8–10 weeks post exposure
No symptoms consistent with TB disease	2nd TST ≥5 mm Or A positive IGRA	Evaluate with a physical examination and CXR: If CXR abnormal, fully evaluate for TB disease If CXR normal, complete a full course of treatment for LTBI
No symptoms consistent with TB disease	2nd TST <5 mm Or A positive IGRA	No further evaluation or treatment required

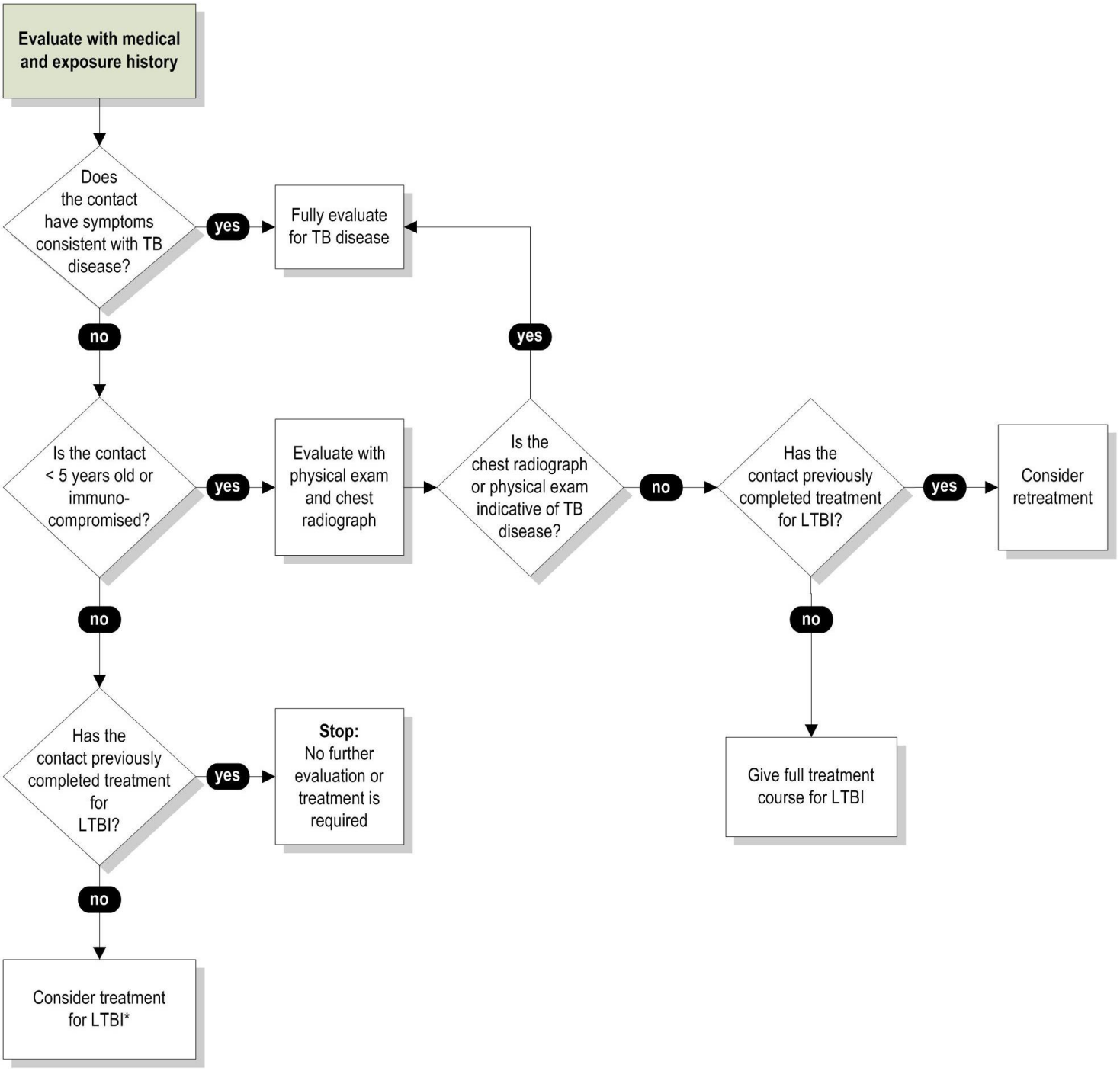
Definitions of abbreviations: CXR = chest radiograph; IGRA = interferon gamma release assay; LTBI = latent tuberculosis infection; TB = tuberculosis; TST = tuberculin skin test.
*__Note:__ An IGRA may be used in place of a TST.

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

Use Figure 10.6 to select evaluation, treatment, and follow-up activities for contacts who have prior positive TSTs or IGRAs.

Figure 10.6: Evaluation, treatment, and follow-up of contacts with prior positive tuberculin skin tests[49] or positive IGRA test results



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.

For contacts with prior positive TSTs or IGRAs, evaluate them with medical and exposure history. Based on these histories, take the actions in Table 10.10.

Table 10.10: Evaluation, treatment, and follow-up of contacts with prior positive tuberculin skin tests or positive IGRA results[50]

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: If CXR or physical examination is indicative of TB disease, fully evaluate for TB disease If results are **not** indicative of TB disease: • If contact previously completed treatment, consider retreatment • If treatment not completed previously, complete a full course of LTBI treatment
No symptoms consistent with TB disease	Immunocompetent and ≥5 years old	If contact previously completed treatment for LTBI, no further evaluation or treatment required If contact has **not** completed treatment for LTBI, consider treatment for LTBI

Definitions of abbreviations: CXR = chest radiograph; LTBI = 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.

When to expand a contact investigation

Guidelines for expanding an investigation

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

- Do not include lower-priority contacts unless objectives for high- and medium-priority contacts are being met.
- Consider the extent of recent transmission.
- Consider expanding the scope (for example, 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.

Since the background prevalence of tuberculosis infection in adult non-US born populations from high-incidence countries often exceeds 30%, it is important to stratify the infection rates by country of birth or length of residence and by age. For example, household contacts with positive TB test 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.

b. Evidence of second-generation transmission (that is, 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 TB test status from negative to positive.

When results from an investigation indicate that it should be expanded, but resources are insufficient, seek assistance from the state TB program. The state may have assistance in the form of a TB disease intervention specialist (DIS) who is available for questions, WEDSS documentation assistance, and contacting clients at the request of the local jurisdiction. Please inquire if this person is on staff and available to assist.

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 (for example, 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 Wisconsin Tuberculosis Program at 608-261-6319 to consult about expanding a contact investigation.

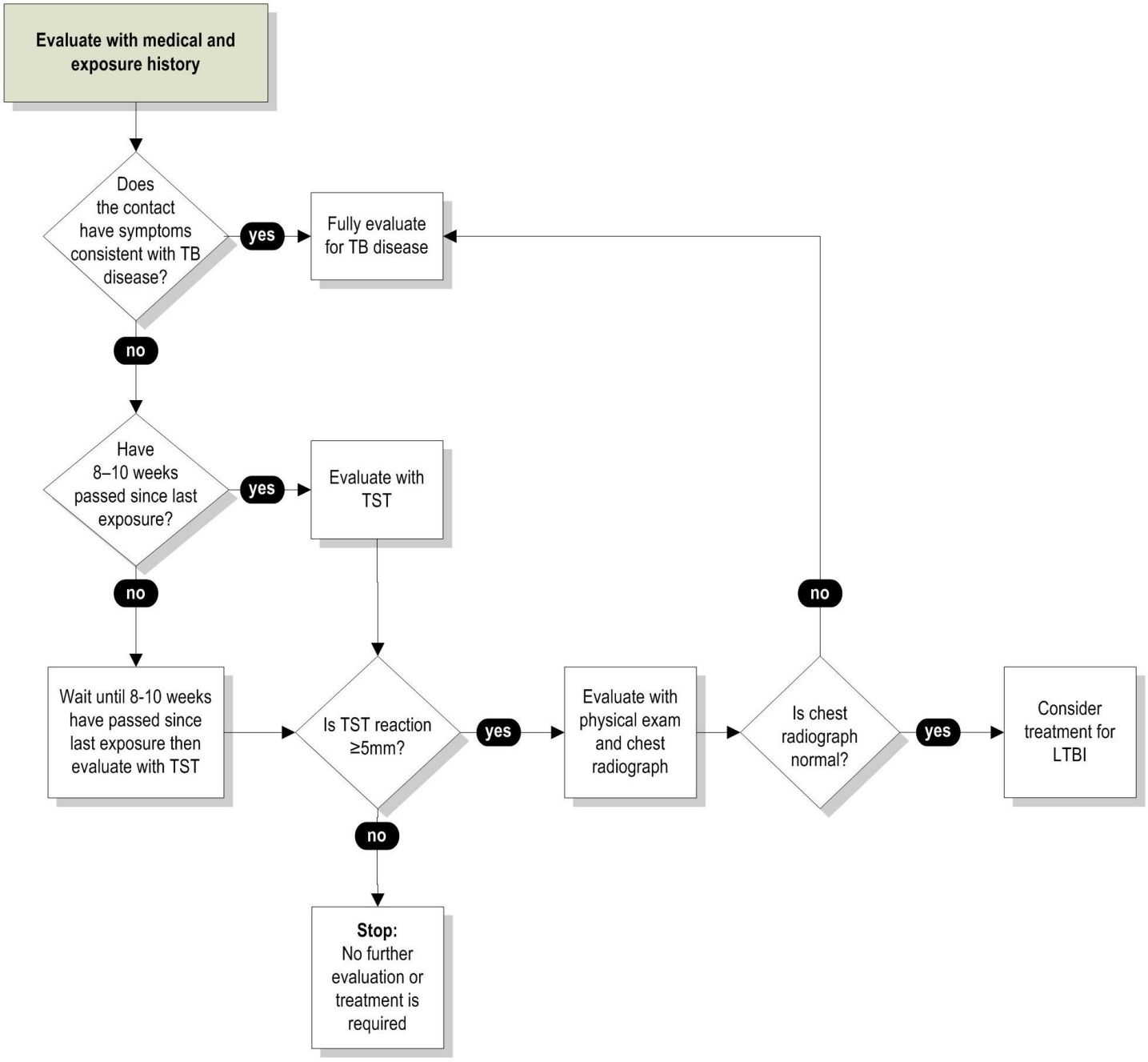
The state may have help in the form of a TB disease intervention specialist (DIS) who is available for questions, WEDSS documentation aid, and contacting clients for phone interviews/ initial notification at the request of the local jurisdiction. Please inquire if this person is on staff and available to help.

Record your decision and rationale for expanding a contact investigation in WEDSS.

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[51]



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.

Evaluate low-priority contacts with medical and exposure history. Based on these histories, take the actions in the Table 10.11.

Table 10.11: Evaluation, treatment, and follow-up of low-priority contacts[52]

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 or IGRA
No symptoms consistent with TB disease	Less than 8 weeks since last exposure	Wait 8–10 weeks after last exposure, and then evaluate with a TST or IGRA
No symptoms consistent with TB disease	1st TST* ≥5 mm	Evaluate with physical examination and CXR: If CXR is abnormal, fully evaluate for TB disease If CXR is normal, consider treatment for LTBI
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; LTBI = 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):22.

Data management and evaluation of contact investigations

Data collection related to contact investigations has three broad purposes:

- Management of care and follow-up of individual index patients and contacts.
- Epidemiologic analysis of an investigation in progress as well as overall results of previous investigations.
- 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 (for example, 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 (for example, 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 (for example, 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 (for example, 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: Framework for Program Evaluation - CDC

Approach

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

- Collect specific data elements on index patients and their contacts. The data elements should permit calculation of program performance indices.

- Collect data on standardized (paper or electronic) forms.
- Supply data definitions and formats for use by people who collect, use, and interpret contact investigation data.
- Whenever feasible, use data definitions and formats that are standard among jurisdictions.
- Store data electronically for quick analysis of interim results.
- Implement policies for data management that enable quick analysis of interim results.
- Implement policies for data management and storage that specify the assignment of responsibilities.
- Implement training and policies for data accuracy, completeness, and security.
- Periodically summarize and review data during a particular contact investigation and for overall contact investigations.
- Evaluate programs for contact investigation activities at least annually. Evaluation is an integral part of TB program responsibility.
- Beyond standard data elements shown in these guidelines, specific additional elements can contribute to local program management.

Index patient and contact data

Use the Contact Information Template at the end of this section to collect the data for each contact to the index patient.

Table 10.12: Data about the index patient[53]

Identifier or demographic information	• Case manager • Name and aliases • For minors and dependents: guardian information • Date of birth • Current locating information and emergency contacts • Residences during infectious period if unstably housed • Gender • Sex assigned at birth • Race • Ethnicity • Country of birth • Time in United States if non-US born • Primary language and preferred language

	• Methods of translation or interpretation
Transmission settings and associated time frames	• Living situation(s) • Employment or school • Social and recreational activities • Congregate settings (for example, jail, homeless shelter) • Substance use with social implications (for example, crack cocaine)
Tuberculosis information	• Health care provider for TB (for example, 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	• Date of initial interview with index patient • Dates of follow-up interviews with index patient

Definitions of abbreviations: AIDS = acquired immunodeficiency syndrome; CXR = chest radiograph; HIV = human immunodeficiency virus; *RVCT* = *Reports of Verified Cases of Tuberculosis*; 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):21.

Table 10.13: Data about each contact[54]

Investigator and dates	• Contact manager or investigator • Date listed • How or why the contact was listed (for example, named by index patient) • Dates of interviews • Start and end dates for exposure (updated as new information arrives)
Identifiers	• For minors and dependents: guardian information • Name and aliases

	• Date of birth • Locating information and emergency contacts • Gender • Sex assigned at birth • Race • Ethnicity • Country of birth • Time in the United States if non-US born • Primary language and preferred language • Methods of translation or interpretation
Exposure	• Relationship or connection to the index patient • Social affiliations (for example, work, school, place of worship, clubs, activities) • Environmental information about exposure settings (for example, size, ventilation) • Frequency, duration, and time frame of interactions
Medical history and risk factors	• 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 *M. tuberculosis* infection†
Evaluation for tuberculosis disease and latent tuberculosis infection	• Health care provider for TB (for example, 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 latent tuberculosis infection	• Dates of treatment • Treatment regimen (medications, dosing schedule, any changes to these) • Methods of supervising treatment (DOT) • Adverse reactions (specify each) • Interruptions in regimen and dates • Outcome of treatment (completion, consistent with *ARPE*†) • If treatment not completed, reason†

Definitions of abbreviations: *ARPE* = *Aggregate Report for Program Evaluation*; BCG = bacille Calmette-Guérin; CXR = chest radiograph; DOT = directly observed therapy; HIV = human immunodeficiency virus; IGRA = interferon gamma release assay; LTBI = latent tuberculosis infection; TB = tuberculosis; 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):21.

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.

Contact the Wisconsin Tuberculosis Program at 608-261-6319 to consult about any indications an outbreak may be occurring.

The state may have help in the form of a TB disease intervention specialist (DIS) who is available for questions, WEDSS documentation aid, and contacting clients for phone interviews and initial notification at the request of the local jurisdiction. Please inquire if this person is on staff and available to help.

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 (for example, 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 (that is, 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 (for example, 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 people was listed as a contact to the other).
- 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. If there are a significant number of people with unknown epi links across the state who have demonstrated genotypic links suggestive of recent transmission, the state TB program will reach out to the affected jurisdictions and coordinate or suggest next steps.

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.

Whole genome sequencing (WGS)

Whole genome sequencing (WGS) 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 powerful tool for the following:

- Surveillance of potential outbreaks
- Confirming TB cases linked by traditional epidemiologic methods
- Identifying clusters of patients infected with genetically related or identical strains of M. tuberculosis and determining common sources of infections
- Guiding contact investigations and the appropriate use of preventive therapy
- Identifying laboratory cross-contamination as the cause of misdiagnosis

When used to track the transmission of a specific strain, DNA whole genome sequencing 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 whole genome sequencing 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 whole genome sequencing 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 LTBI was not started or completed, then review the strategies for treatment and completion.

Whole-genome sequencing (WGS) is a significant scientific advancement. Conventional genotyping methods, used prior to 2018, examine less than 1% of the genome. WGS can examine more than 90% of the genome.

CDC began performing retrospective WGS for isolates in select genotype-matched clusters in 2012. In 2018, the National TB Molecular Surveillance Center was established to perform WGS prospectively on all new M. tuberculosis isolates. The National TB Molecular Surveillance Center is part of the Antimicrobial Resistance Network.

CDC uses this WGS data for various types of analyses that serve different purposes:

- Whole-genome multilocus sequence typing (wgMLST)
- Whole-genome single nucleotide polymorphism comparison
- Detection of possible drug resistance

In 2018, CDC began universal WGS. This means an M. tuberculosis isolate is sequenced for each U.S. case of culture-confirmed TB disease. Results can help state and local TB programs guide TB cluster and outbreak investigations.

All unique TB isolates that go through WSLH are automatically sent to CDC for WGS as part of the “universal genotyping” nationwide programmatic goal.

Find more information on CDC’s WGS program webpage.

Contact information template (make additional copies as needed)

Name:		Age:
Nickname/Alias:		Sex:
Race:	Relationship to Case:	
Address:	Physical Description:	
	Employer/School:	
Phone:	Other Locating Info:	
Beginning of exposure (date):		
End of exposure (date):		
Estimated Hours of Exposure:		
Contact Interview Completed?	Yes- Date:	No- reason:
Testing info:		
Other Notes:		

Name:		Age:
Nickname/Alias:		Sex:
Race:	Relationship to Case:	
Address:	Physical Description:	
	Employer/School:	
Phone:	Other Locating Info:	
Beginning of exposure (date):		
End of exposure (date):		
Estimated Hours of Exposure:		
Contact Interview Completed?	Yes- Date:	No- reason:
Testing info:		
Other Notes:		

Resources and references

Resources

"DHS TB and LTBI Training for New Staff" (April, 2023): A webinar by the Wisconsin TB Program introducing TB and LTBI concepts and reporting for new LTHD staff. View the recording of this webinar.

California Department of Health Services (CDHS)/California Tuberculosis Controllers Association (CTCA). "Contact Investigation Guidelines" (*CDHS/CTCA Joint Guidelines*; 1998). Available at: Guidelines for the Assessment of Tuberculosis Patient Infectiousness and Placement into High and Lower Risk Settings (ctca.org).

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