

Protecting Health Care Workers From Tuberculosis, 2013

*ACOEM Medical Center Occupational Health Section Task Force on
Tuberculosis and Health Care Workers*

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EXECUTIVE SUMMARY

Although the rate of tuberculosis (TB) cases has fallen in the United States over the past two decades,¹ continuing importation and transmission combined with the global emergence of drug-resistant strains present an ongoing occupational risk for health care workers (HCWs). To reduce this risk, health care facilities need to implement multiple steps. These steps should include offering updated periodic training of HCWs to maintain awareness about potential TB risks; optimizing the design, ventilation, and patient flow in clinical spaces; providing baseline, periodic, and postexposure TB testing of HCWs; using appropriate and effective respiratory protection; implementing active infection control procedures; and periodically updating the facilities-written TB control plans.^{2,3} Evolving diagnostic methodologies and treatment options highlight the need for occupational and environmental medicine physicians to stay current to provide quality medical care to HCWs.

ACOEM POSITION

The American College of Occupational and Environmental Medicine (ACOEM) fully supports implementation of the Centers for Disease Control and Prevention's (CDC's) *Guidelines for Preventing the Transmission of Mycobacterium tuberculosis in Health-Care Facilities, 2005*,³ and *Updated Guidelines for Using Interferon Gamma Release Assays to Detect Mycobacterium Tuberculosis—United States, 2010*.⁴ In particular, the College endorses the use of individual risk assessments for each clinical facility and its specific components, with review of the institution's TB control program at appropriate intervals in accordance with its case experience. Available testing methods, including tuberculosis skin testing (TST) and interferon gamma release assays (IGRAs) in combination with appropriate se-

lective use of imaging and microbiology diagnostics to evaluate for active infection, provide the occupational and environmental medicine physician with multiple strategy options to identify persons who would benefit from treatment and thus reduce the risk of TB transmission (although it should be noted that preferred options are likely to change as ongoing research and test development evolve). Individual facility factors, local HCW and patient demographics, and cost issues will determine the best choice of TB surveillance methodologies.

ACOEM also supports the use of powered air-purifying respirators (PAPRs) or particulate filter respirators (N-95) approved by the National Institute for Occupational Safety and Health to enhance protection for HCWs engaged in high-risk procedures such as bronchoscopy and other airway instrumentation, endoscopy, dental procedures, and/or sputum induction.³ At least one comparative quantitative study has demonstrated that PAPRs, when appropriately worn, can increase the safety factor over an appropriate N-95 respirator by a factor of 10.⁵ Other studies have demonstrated that the quality of the N-95 respirator may be more important relative to a good fit than the fitting technique of the user, prompting ACOEM's ongoing recommendation for a national standard on N-95 mask quality.^{6,7}

In addition, ACOEM recommends that health care facilities implement suitable medical certification procedures and respirator fit testing consistent with the Occupational Safety and Health Administration's Respiratory Protection Standard (1910.134).⁸ Health care workers who are significantly immune-compromised by HIV, immunosuppressive medication, or other medical conditions are at increased risk of active TB infection and should be afforded the highest level of protection. This may include exclusion from activities at high risk of exposure to TB, and employers should make every attempt to honor requests for voluntary reassignment.

All HCWs who could potentially have airborne exposure from patients with active TB should undergo periodic surveillance testing, depending on the facility's risk as-

essment and previous test results.^{3,4} Health care workers with unprotected exposure to a patient with active TB should be retested as soon as possible (new baseline) and, if the results are negative, be retested again 8 to 10 weeks later to determine whether an infection (conversion) has occurred because of that exposure.

BACKGROUND

Tuberculosis is a highly communicable disease that, throughout human history, has claimed numerous lives.⁹ Transmission occurs by means of inhalation of droplet nuclei that may remain airborne and infectious for hours. Patients with acid-fast stainable mycobacteria in their saliva or sputum are the most infectious.

After inhalation, organisms that survive initial host defenses may cause granuloma formation in regional lymph nodes. The granulomas may progress to central caseating necrosis and calcification, identifiable on chest radiographs as characteristic Ghon complexes. If the granuloma does not contain the primary infection, it may spread throughout the body or locally by hematogenous, lymphatic, or direct routes. Infective nuclei are usually spread by cough but may also be disseminated by sneezing or vocalization. Laryngeal TB is highly infectious, may be difficult to diagnose, and may present without coughing. On the contrary, active extrapulmonary TB infections from other anatomic sites are frequently not contagious. Tuberculosis organisms tend to remain airborne, often creating clusters of secondary infection.

The risk of spreading TB from a given source case is related to the organism load in expectorated sputum or exhaled air and to how well those organisms are cleared from the air that is contaminated. This baseline risk level can be modified in health care settings by implementing the following measures:

- prompt masking of persons suspected of having active TB and their isolation in an approved negative-pressure room (eg, airborne isolation);
- appropriate and approved use of respiratory protection by potentially exposed HCWs; and

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- prompt diagnosis and treatment of patients with active TB with regimens appropriate to community patterns of microbial resistance.

Progression of early active infection is most likely in immune-compromised patients. In immune-competent hosts, initial TB infection usually becomes latent. Latent TB infection (LTBI) is manifested by a positive TST or IGRA in the absence of active radiologic findings or clinical disease. Left untreated, LTBI will progress to active disease in 5% of cases within 2 years of primary infection; an additional 5% may reactivate over their lifetimes. (These reactivation rates are based on TST, and given that IGRA is more specific, reducing the denominator of the ratio by as many as 80%, future calculations of reactivation rate may be much higher.¹⁰) Reactivation rates are higher in children, the elderly, the immune-compromised (particularly individuals with HIV infection), and those with chronic diseases such as diabetes, silicosis, or renal failure.

A high index of suspicion for TB can limit spread to HCWs and other patients. Thus, all HCWs with patient contact should be periodically trained to recognize the symptoms and signs of TB and to initiate protection protocols.

EPIDEMIOLOGY OF TB/EMERGENCE OF DRUG-RESISTANT TB STRAINS

By the early 1980s, it was thought that TB would be eradicated in the United States by 2010.³ Multidrug short-course treatment regimens for active TB achieved tremendous success in the United States during the 20th century and there was progress even in endemic areas of the globe. Nevertheless, there was a sharp rise in TB case rates beginning in the mid-1980s, fueled by the human immunodeficiency virus epidemic, rising rates of incarceration, and immigration from countries with high TB rates, combined with some lapsed resources for public health and infection control measures.^{3,11–13} This was followed by multiple reports of nosocomial TB transmission to HCWs and patients.^{3,14–16}

Many new TB isolates have been found to be resistant to isoniazid (INH) and/or other TB drugs, increasing the threat to HCWs. Additional strains that have proven resistant to multiple combinations of such drugs have developed and spread, hence the term multidrug resistant TB (MDR-TB). During the period of rising TB incidence, nosocomial MDR-TB transmission to HCWs was reported^{17,18} with related deaths. Of even greater concern are the extensively drug-resistant strains of TB (XDR-TB), which are resistant to INH, rifampin, fluoroquinolones, and at least one of the three second-line injectable drugs.

Since 1993, control programs targeting high-risk groups have successfully reduced TB case rates in the United States, with the current level of active TB disease at a record low.¹ Active TB case rates remain highest among foreign-born US residents who are from high-prevalence countries; this population also accounts for the majority of MDR-TB cases.¹⁹ Other populations with increased TB prevalence include immune-compromised patients (particularly those with HIV infection), the elderly and nursing home residents, alcoholics and illicit drug users, and residents and staff in prisons and homeless shelters. Although MDR-TB case rates have not declined, the US rates have remained less than 2%. Patients with unrecognized TB continue to present for evaluation and care; this makes diagnosis, treatment, and infection control challenging and presents an active risk for HCWs.

Latent TB infection continues to affect almost one third of the global population, with US rates highest among foreign-born residents. The majority of active TB cases are due to reactivation of LTBI.²⁰

ACTION STEPS TO REDUCE THE RISK OF TB TRANSMISSION

Recognition of the ongoing risk and potential resurgence of TB, particularly the threat of MDR-TB and XDR-TB, along with recent advances in TB diagnostic and therapeutic options, have led the CDC to issue periodic updates to guidance on limiting TB transmission, especially in health care facilities.^{3,4} The Occupational Safety and Health Administration considers TB a health care-wide hazard and enforcement is based on the General Duty Clause, in addition to certain specific standards—for example, related to respiratory protection, record keeping, and signage.⁸ Guidelines call for a TB infection-control program in each such facility, with the program to include a written control plan. The written plan is based on careful risk assessment for the institution as a whole, as well as analyses for specific components such as those in which high-risk activities occur.

Risk assessment will support implementation of many of the following action steps:

- Periodic training of HCWs to enhance awareness and maintain an appropriate index of suspicion for new TB cases.
- Appropriate management of patients likely to have undiagnosed TB in emergency, ambulatory, and inpatient settings. ACOEM supports a syndromic approach to the initial management of these patients, which is likely to reduce the risk of nosocomial transmission of other cough illnesses to HCWs.

- Use of engineering controls, including the use of negative-pressure rooms, adequate air exchanges in rooms of patients with suspected TB, careful handling of contaminated air, stand-alone high-efficiency particulate air filter units, and adjunctive use of ultraviolet germicidal irradiation.
- Masking of patients with suspected TB when those patients are in uncontrolled areas of health care facilities, until they are known not to be contagious. There should be a high index of suspicion of possible active TB in populations at high risk for the disease, such as homeless or incarcerated/institutionalized people, as well as persons from endemic areas of the world who present with fever or cough illnesses. In those situations where a patient with known or suspected active pulmonary TB refuses to wear a mask, questions as to available options should be directed to the institution's legal counsel or to the state public health department.
- Mandatory respiratory protection of HCWs in contact with TB patients, particularly when engaged in high-risk procedures such as bronchoscopy, intubation, sputum induction, surgery, and/or autopsy. Those HCWs who need to wear respirators must be medically evaluated prior to fit-testing or PAPR-training,⁸ and they must be reevaluated if they encounter health changes that might affect safe respirator use. Periodic training must include respirator fit testing and the proper care and use of respirators.
- Routine periodic testing of HCWs and testing after known or likely TB exposures, including travel rotations.
- Tuberculosis surveillance testing using baseline and periodic tests, either TST and/or IGRA. Individual facility factors, local population demographics, and cost issues will determine the best approach regarding TB surveillance testing and the use of TST, IGRA, or both.^{3,4,21–23} (Table 1 summarizes the current CDC recommendations regarding TB surveillance test use.^{3,4})

Tuberculosis control program effectiveness is measurable by ongoing monitoring of TST or IGRA conversions among HCWs, scrutiny of conversion clusters, investigation of possible person-to-person transmission, and similar analyses. Local public health authorities may be able to assist with investigating HCW conversion clusters, particularly when there is suspicion that the shared exposure site may be outside the workplace.

The use of the Bacille Calmette-Guérin (BCG) vaccine in childhood may cause 8- to 10-mm TST reactions during two-step testing of new hires but does not obviate the need to rule out active TB and evaluate for

TABLE 1. Recommended Preferences and Special Considerations for TB Surveillance Testing in Certain Populations and Situations*

IGRA Preferred	TST Preferred	TST or IGRA, No Preference	Both TST or IGRA May Be Considered (Not Generally Recommended)
Groups that historically have poor rates of return for TST reading	Children older than 5 years	Recent contacts of persons with infectious TB	When initial test (IGRA or TST) is negative and: <ul style="list-style-type: none"> • HIV infection or less than 5 years old • Clinical suspicion of active TB disease
Persons who have received Bacille Calmette-Guérin (as a vaccine or for cancer therapy)		Periodic screening that addresses occupational exposure to TB, eg, surveillance programs for health care workers	When initial test (IGRA or TST) is positive and: <ul style="list-style-type: none"> • Additional evidence required to encourage treatment adherence • Healthy person with low risk for infection and progression • Initial IGRA result is indeterminate, borderline, invalid, or unusual

*Derived from Centers for Disease Control and Prevention.⁴
 IGRA, interferon gamma release assay; TB, tuberculosis; TST, tuberculosis skin testing.

LTBI in all such individuals who meet criteria for a positive test. Similar reactions, sometimes larger in size, can occur because of prior exposure to atypical mycobacteria such as *Mycobacterium avium-intracellulare*, *M marinum*, or *M kansasii*, but these effects will not usually confound serial TST readings in adults.

For HCWs, conversion of a TB test should be considered work-related unless there was known exposure to an identified pulmonary TB case outside the work environment. For HCWs in facilities where TB patients receive care, TST reactions of 10-mm or more induration are considered positive, as is a new positive IGRA result. For HCWs with recent close unprotected exposure to a patient with infectious TB, and for HCWs with significant immune compromise, 5 mm or more (or an increase of 5 mm or more) is also considered positive. For positive IGRA results, there is accumulating evidence that the current Food and Drug Administration–approved threshold for a positive test may not be accurate. Newer studies suggest that raising the threshold and redefining IGRA positive results may be appropriate.^{24–26} Thanassi and colleagues²⁶ have determined through application of receiver operator characteristic analysis that employing an IGRA retesting zone between 0.35 and 1.11 IU/mL will reduce the number of false-positive tests by up to 76% ($P < 0.001$) without compromising sensitivity.

Neither IGRAs nor TSTs alone can be considered definitive proof of infection. Many physicians currently use both TST and IGRA in combination to manage LTBI surveillance and treatment.^{10,27} The Canadian Tuberculosis Committee²⁸ has published recommendations for interpreting results when both IGRA and TST are available, while Menzies and colleagues at McGill Uni-

versity have created an on-line tool to determine the positive predictive value of TB testing combined with reactivation and drug toxicity risks.²⁹ Physicians should weigh all available clinical evidence in the diagnosis and management of LTBI.

When a true conversion is determined to have occurred, the HCW is considered to have LTBI and should undergo a symptom review and chest radiograph as soon as possible to exclude active disease. In a majority of cases, radiographs do not show active disease and prophylactic treatment is recommended to prevent reactivation TB. Effective regimens include 9 months of INH, 4 months of rifampin, or 3 months of weekly INH and rifapentine done under direct observed therapy.^{20,30–34} Shorter regimens may improve compliance. All patients should be evaluated for potential drug interactions and counseled on the importance of completing therapy. Patients on all regimens should be monitored for hepatotoxicity. Daily pyridoxine should be given with INH to prevent neurotoxicity in patients at risk.

For HCWs with a previously positive TST, periodic education should continue. Some facilities choose to do yearly surveillance with questions directed at symptoms compatible with pulmonary TB (persistent cough, hemoptysis, night sweats, weight loss, and/or persistent fatigue). There is currently no evidence-based guideline for using IGRA or other laboratory diagnostic tests to monitor for reactivation, although this may evolve with future research. If there is clinical suspicion of TB, the HCW should be further evaluated by a physician. Annual chest radiographs are not recommended for asymptomatic HCWs with a previously positive TST.

Health care workers with active pulmonary (or laryngeal) TB require immedi-

ate therapy with INH, plus three other anti-TB medications, pending the results of sputum culture and sensitivity determination to guide definitive treatment.^{30,31} Health care workers who are found to have active disease may return to work, including patient care, after three consecutive daily sputum smears are negative for acid-fast organisms, provided they are responding clinically and radiographically to treatment. Close follow-up is critical to ensure completion of therapy and to monitor for drug toxicities.

Occupational and environmental medicine physicians should take leadership roles in promoting an active TB control program not only in health care institutions but in any settings where the workforce includes persons at special risk of acquiring and spreading this infection. These settings include homeless shelters, prisons, some nursing homes and residential care sites, and other locations that provide services to groups with increased risk of undiagnosed TB. Persons with occupational travel to endemic areas may also benefit from inclusion in TB control programs.

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ACOEM requires all substantive contributors to its documents to disclose any potential competing interests, which are carefully considered. ACOEM emphasizes that the judgments expressed herein represent the best available evidence at the time of publication and shall be considered the position of ACOEM and not the individual opinions of contributing authors.

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