11 Prevention and Control of Tuberculosis in Correctional Facilities

Farah M. Parvez

Introduction

Tuberculosis (TB) is a contagious infectious disease caused by *Mycobacterium tuberculosis* and is a leading source of preventable morbidity and mortality worldwide (Maher & Raviglione, 2005). In 1993, the World Health Organization declared TB a global health emergency. Nearly two decades later, despite TB control efforts, TB remains a global health concern. An estimated two billion people, or one-quarter of the world's population, are believed to be infected with *M. tuberculosis* and are at risk for developing active TB disease during their lifetime. Annually, worldwide, approximately ten million people develop active TB and 1.4 million die from the disease. The ongoing human immunodeficiency virus (HIV) epidemic and the emergence of multidrug-resistant and extensively drug-resistant TB contribute greatly to the global burden of TB disease (CDC, 2006b, 2007).

TB is a major public health concern in correctional facilities throughout the world. Incarcerated populations are at disproportionately high risk for developing TB infection and disease compared to general populations (MacNeil et al., 2005; Hammett et al., 2002). Numerous TB outbreaks have occurred in correctional facilities, and transmission of TB from inmates to persons within such facilities has been well documented (MacIntyre et al., 1999; Jones et al., 1999; Valway, et al., 1994b; CDC, 2004b). Each year, over ten million ex-offenders are released from US prisons and jails, presenting significant public health challenges to the communities into which they are released (Prison Policy Initiative, 2019; Jones et al., 2003; Bur et al., 2003; Re-Entry Policy Council, 2003). This chapter is intended to provide an overview of current strategies and recommendations for the prevention and control of TB in correctional facilities, with an emphasis on discharge planning for soon-to-be-released inmates. The strengthening of TB prevention and control efforts worldwide is imperative if transmission of TB is to be prevented and elimination of TB is to be achieved (CDC, 1999a).

F. M. Parvez (✉)
Division of Tuberculosis Elimination, Centers for Disease Control and Prevention, Atlanta, GA, USA

Bureau of Tuberculosis Control, New York City Department of Health and Mental Hygiene, New York, NY, USA
e-mail: fparvez@health.nyc.gov

R. B. Greifinger (ed.), *Public Health Behind Bars*, https://doi.org/10.1007/978-1-0716-1807-3_11

Background

Etiology of Tuberculosis

M. tuberculosis is a member of the *Mycobacterium tuberculosis* complex, which also includes *M. bovis, M. africanum, M. microti*, and *M. canettii.* Each member of the complex can cause TB disease; however, *M. tuberculosis* is the most prevalent human pathogen of this group. *M. tuberculosis* is a slow-growing, intracellular, acid-fast bacillus (AFB), identified by nucleic acid amplification testing and culture. Though considered an obligate aerobe, *M. tuberculosis* can exist in anaerobic environments within its host (Barclay & Wheeler, 1989).

Transmission of Tuberculosis

M. tuberculosis is spread via airborne transmission. It is passed from person to person via airborne particles called droplet nuclei. When an individual with pulmonary or laryngeal TB coughs, sneezes, shouts, speaks, or sings, *M. tuberculosis* (tubercle) bacilli, located within these droplet nuclei, are expelled into the air. The droplet nucleus forms after the droplet is expelled and most of its water evaporates. Larger, heavier droplets (>5 μm in diameter) quickly settle out of the air, usually within 3 ft of the source. However, smaller droplets (1–5 μm in diameter) are lighter and can remain suspended, and infectious, in the air for hours or days and may be dispersed by air currents or ventilation systems. In healthcare settings, these infectious droplet nuclei can also be generated during aerosolizing procedures such as sputum induction, bronchoscopy, suctioning, irrigation, and autopsy (CDC, 2005a).

Transmission of *M. tuberculosis* occurs when air contaminated with infectious droplet nuclei is inhaled. Infection may occur, in a susceptible host, if inhaled bacilli within the nuclei reach the alveoli of the lungs. Fewer than ten tubercle bacilli may initiate a pulmonary infection (Sherris & Plorde, 1990). A single cough, talking for 5 minutes, or singing for 1 minute can generate 3000 infectious droplets; one sneeze can generate tens of thousands of such droplets (Todar, 2005). Persons at risk of exposure to and infection with *M. tuberculosis* include: close contacts of persons with TB disease; persons living with HIV or other immunosuppressive conditions; non-US-born persons from areas with a high incidence or prevalence of TB disease (i.e., any country other than the United States, Canada, Australia, New Zealand, or a country in Western or Northern Europe) or those who reside or travel (≥1 month consecutively) in such areas; and residents and employees of high-risk congregate

Table 11.1 Factors associated with high risk for tuberculosis infection or progression to active tuberculosis disease

High risk for tuberculosis infection (LTBI)	High risk for progression to tuberculosis (TB) disease
Close contact to a person diagnosed with infectious TB disease	Close contact to a person diagnosed with infectious TB disease
Born in a country with a high TB incidence[a]	Conversion of test for TB infection result[c]
Traveled or resided in a high TB incidence area[a] for 1 month or more consecutively	Immunosuppression Human immunodeficiency virus infection Immunosuppressive therapy[d] Prolonged corticosteroid use (equivalent to prednisone ≥15 mg/day for ≥1 month) Use of other immunosuppressive medications (e.g., tumor necrosis factor-alpha inhibitors, Janus kinase inhibitors, interleukin receptor antagonists, chemotherapy, organ transplant medications)
Live or work in settings where TB exposure may be possible: Healthcare facilities[b] Correctional facilities Homeless shelters Mycobacteriology laboratories	Some cancers (e.g., leukemias, lymphomas, head, neck, or lung cancers)

Table 11.1 (continued)

High risk for tuberculosis infection (LTBI)	High risk for progression to tuberculosis (TB) disease
Infants, children, and adolescents at risk (as above)	Previous tuberculosis disease
	Evidence of old, healed tuberculosis lesions on chest radiograph
	History of untreated or inadequately treated tuberculosis disease
	Certain clinical conditions or procedures
	Silicosis
	Diabetes mellitus
	End-stage renal disease
	Low body weight (10% or more below ideal body weight) or body mass index less than 18.5 kg/m^2
	Organ transplantation
	Gastrectomy
	Chronic malabsorption syndromes
	Jejunoileal bypass
	Substance use (i.e., injecting illicit drugs or smoking tobacco products)
	Infants and children younger than 5 years of age with a positive test for TB infection

Source: Modified from Centers for Disease Control and Prevention (2005d)

[a]Any country other than the United States, Canada, Australia, New Zealand, or outside Western or Northern Europe, is considered a high TB incidence area

[b]Includes hospitals, long-term care facilities, and drug treatment centers

[c]Either by history or evidence of conversion of TB test result (change from negative to positive interferon gamma release assay (IGRA) result or an increase of 10 mm or more in size of tuberculin skin test (TST) reaction) within a 2-year period

[d]Persons with medical conditions which may require immunosuppressive therapy (e.g., rheumatoid arthritis, Crohn's disease, ulcerative colitis, ankylosing spondylitis, psoriasis) should receive a screening test for TB infection prior to initiation of the immunosuppressant agent(s)

settings including correctional facilities, long-term care facilities, and homeless shelters (CDC, 2005a) (Table 11.1).

The probability of TB transmission depends on three factors: the infectiousness of the person with TB, the environment in which exposure occurs, and the duration of exposure (Golub et al., 2001). Infectiousness of a person with TB is inferred from microscopic examination of sputum. Persons with TB disease who have large concentrations of tubercle bacilli in their sputum (i.e., if sputum is smear-positive) are more infectious than persons with smear-negative sputum. However, evidence of TB transmission from persons who are smear- or even culture-negative has been documented (CDC, 2005b). The environment in which exposure occurs plays an important role—crowded living or recreational spaces and inadequate ventilation can facilitate TB transmission. Likelihood of transmission after exposure to an infectious person is increased with greater frequency and duration of exposure; however, TB transmission after brief or casual encounters with infectious persons has also been documented, albeit rarely (Richeldi et al., 2004; Golub et al., 2001). In general, TB transmission is most likely to occur from persons with pulmonary or laryngeal TB who either are undiagnosed, are not on effective anti-TB therapy, or are not placed in respiratory isolation (CDC, 2005b).

Pathogenesis of Tuberculosis

There are three stages of TB: primary or initial infection with *M. tuberculosis,* latent or dormant *M. tuberculosis* infection, and reactivation or TB disease. The first stage, primary infection, occurs in a

susceptible person if inhaled tubercle bacilli reach the alveoli of the lungs and are engulfed by macrophages. Bacilli may survive initial attempts by the macrophages to destroy them and remain viable. These bacilli are transported by the macrophages to regional lymph nodes and, if not able to be contained, enter the bloodstream and widespread dissemination can occur. The most common site where the tubercle bacilli establish an infection is the upper portion of the lungs, but any organ system may also be involved.

The second stage, latent *M. tuberculosis* infection (LTBI), begins within 2–12 weeks of the primary infection. The tubercle bacilli multiply within the macrophages until they reach 10^3–10^4 in number, eliciting a cell-mediated immune response (American Thoracic Society, 2000). Macrophages and other immune cells are activated, creating granulomas and preventing further multiplication and spread of the bacilli. Though contained, the bacilli remain alive and dormant for long periods of time, maintaining the ability to reactivate at any time and cause TB disease (Wayne & Hayes, 1996). Persons with LTBI are asymptomatic and noncontagious; the only evidence of TB infection may be a positive interferon gamma release assay (IGRA) or tuberculin skin test (TST) (Table 11.2).

The third stage, TB disease, can occur at any time after infection. Primary infection can progress to TB disease without any intervening latent period, particularly in immunocompromised persons. Among persons with LTBI, disease occurs when latent bacilli reactivate and produce active symptomatic disease. The most common site of this reactivation is the upper portion of the lungs; however, any

Table 11.2 Differentiating between latent tuberculosis infection and active tuberculosis disease

Feature	Latent tuberculosis infection (LTBI)	Active tuberculosis (TB) disease
Infectious	No	Yes—persons with pulmonary or laryngeal TB
Symptoms/physical findings	None—does not feel sick	Usually has symptoms that may include:
		Cough that lasts 3 weeks or longer
		Chest pain
		Coughing up blood or sputum
		Weakness or fatigue
		Weight loss
		Decreased appetite
		Chills
		Fever
		Night sweats
IGRA or TST result	Usually positive[a]	Usually positive[a]
Chest radiography	Usually has a normal chest radiograph or evidence of previous healed infection	Usually has an abnormal chest radiograph with evidence of acute disease[b]
Respiratory specimens	Generally not obtained[c]	Usually positive; negative test does not rule out active TB[d]

Source: Centers for Disease Control and Prevention (2020a). https://www.cdc.gov/tb/topic/basics/tbinfectiondisease.htm

IGRA interferon gamma release assay, *LTBI* latent tuberculosis infection, *TB* tuberculosis, *TST* Mantoux tuberculin skin test

[a]May be nonreactive or negative in anyone, but especially persons with human immunodeficiency virus (HIV) or other immunosuppressive conditions and select conditions such as chronic renal failure

[b]Chest radiography may be normal in persons with advanced immunosuppression or extrapulmonary disease

[c]Respiratory specimens are obtained only if ruling out active TB based on clinical suspicion, symptoms, or abnormal chest X-ray. If respiratory specimens are obtained and they are smear- and culture-negative, then LTBI diagnosis is considered

[d]Sputum smear or culture may be negative in persons with extrapulmonary disease or minimal or early pulmonary disease

previously infected site in the body can become involved. Persons with pulmonary TB disease usually are symptomatic, contagious, and have positive radiographic (e.g., chest radiograph) or diagnostic test (e.g., sputum culture) findings. However, absence of such findings does not exclude the diagnosis of TB disease and, particularly for extrapulmonary TB, a high index of suspicion must be maintained.

TB disease develops in individuals whose immune system does not successfully contain their primary infection. Certain factors are associated with increased risk of LTBI progressing to TB disease (Table 11.1). In general, persons with LTBI have approximately a 10% likelihood of developing TB disease during their lifetime; the risk is highest during the first 2 years after primary infection (American Thoracic Society, 2000). The greatest risk for progression is being immunocompromised; persons who are coinfected with *M. tuberculosis* and HIV have an estimated 8–10% risk *per year* for developing TB disease (CDC, 1994, 1998, 2004a). Persons who use tobacco or inject illicit drugs may also have a higher risk for progression to TB disease (CDC, 2005a).

Progression from LTBI to TB disease can be reduced by up to 90% with completion of preventive antimicrobial therapy (Committee on Prophylaxis, International Union Against Tuberculosis, 1982). Once TB disease has developed, prolonged consistent multidrug therapy is required to achieve a cure. In the absence of effective treatment for TB disease, death can occur in up to two-thirds of cases (Dye & Floyd, 2006).

TB in Correctional Facilities

Worldwide, on any given day, an estimated 11 million persons are incarcerated in correctional facilities (Coninx et al., 2000; Walmsley, 2018). In the United States alone, the number of incarcerated persons has quadrupled over the past two decades to a census of over two million (Bureau of Justice Statistics, 2005; U.S. Department of Justice, 2004). Incarcerated populations are at disproportionately high risk for LTBI and TB disease compared to general populations (MacNeil et al., 2005). LTBI is present in 12–60% of inmate populations surveyed worldwide (Abrahao et al., 2006; Saunders et al., 2001; Adib et al., 1999). TB disease (case) rates in correctional facilities can be up to 50 times the reported national rate (Laniado-Laborin, 2001); prison TB case rates in excess of 2000 cases per 100,000 persons have been reported throughout the world in countries such as Moldova, Malawi, Azerbaijan, Georgia, and Ivory Coast (Coninx et al., 2000). In the United States, the prevalence of TB disease is estimated to be at least 4–17 times greater in correctional populations than in general populations (Hammett et al., 2002). While TB case rates in the general US population have remained at <10 cases per 100,000 persons since 1993, rates as high as 184 cases per 100,000 persons have been reported in jails and prisons (CDC, 2006a). In some large US cities, 20–46% of persons with TB disease are ex-inmates of a jail (Jones & Schaffner, 2001; Hammett et al., 2002). In addition to high TB rates, there is considerable evidence of TB transmission within correctional facilities. Numerous outbreaks of TB, including multidrug resistant (MDR) TB, have been documented in jails and prisons worldwide (Coninx et al., 1998; Valway et al., 1994b; CDC, 1992b, 2003a). Limited surveillance for TB disease, delayed diagnosis and isolation, and high turnover of those with unrecognized TB have led to inmates transmitting TB to other inmates and correctional staff, as well as to persons in the community postrelease (MacIntyre et al., 1999; Jones et al., 1999, 2003; Valway, et al., 1994b; Bur et al., 2003; CDC, 2004b).

Several factors contribute to the high rate and transmission of TB among correctional populations. The physical environment of correctional facilities, such as crowded shared living and recreational spaces with inadequate ventilation, can facilitate TB transmission (Jones et al., 1999; Koo et al., 1997; MacIntyre et al., 1997; White et al., 2001). Duration of incarceration also plays a role; longer lengths of incarceration increase the risk of inmates acquiring TB infection (Bellin et al., 1993; Carbonara

et al., 2005; CDC, 2003a). Frequent inter- or intra-facility movement of inmates, common in most correctional facilities, may hinder completion of TB treatment and contribute to treatment failure, drug resistance, and transmission of TB (Cummings et al., 1998; Laniado-Laborin, 2001). Many incarcerated persons are at high risk for TB secondary to factors such as impaired immune status from HIV infection or therapy with immunosuppressive agents, malnourishment, tobacco use, or substance abuse (CDC, 1999b, 2000a; Laniado-Laborin, 2001). Persons with these factors may be more likely to acquire TB infection if exposed to someone with TB disease. In addition, incarcerated persons with TB who are undiagnosed prior to incarceration can transmit TB to other inmates, correctional employees, or members of the community if not diagnosed and properly treated within the correctional setting (CDC, 2006a).

Prevention and Control of TB in Correctional Facilities

The continued transmission of TB in jails and prisons throughout the world signifies a need for improvement in TB control efforts focused on correctional populations, both during incarceration and postrelease (Laniado-Laborin, 2001). For many incarcerated persons, the correctional setting may be the primary source of health information, intervention, and promotion. As such, correctional facilities have a unique opportunity and responsibility to address TB.

The prevention and control of TB in correctional facilities requires the implementation of a TB control program that ensures prompt disease detection, isolation, management, and release planning for infectious inmates. Effective programs include assigned personnel responsible for the program, a written TB control plan, periodic facility-specific TB risk assessments, continuing staff education, and collaborations with public health and community partners (Table 11.3). In addition, fundamental TB

Table 11.3 Characteristics of an effective tuberculosis (TB) control program

I. Assignment of responsibility
A. Assign responsibility for the TB infection-control program to qualified person(s)
B. Ensure that persons with expertise in infection control, occupational health, and engineering are identified and included
II. Risk assessment, TB infection-control plan, and periodic reassessment
A. Initial risk assessments
1. Obtain information concerning TB in the community
2. Evaluate data concerning TB patients in the facility
3. Evaluate data concerning interferon gamma release assay (IGRA) or tuberculin skin test (TST) conversions among staff in the facility
4. Evaluate data for evidence of person-to-person transmission
B. Written TB infection-control program
1. Select initial risk protocol(s)
2. Develop written TB infection control protocols
C. Repeat risk assessment at appropriate intervals
1. Review current community and facility surveillance data and IGRA or TST results
2. Review records of TB patients
3. Observe staff infection control practices
4. Evaluate maintenance of engineering controls
III. Identification, evaluation, and treatment of patients who have TB
A. Screen patients for signs and symptoms of active TB
1. On initial encounter in new admission/intake area
2. Before or at the time of admission

Table 11.3 (continued)

B. Perform radiologic and bacteriologic evaluation of patients who have signs and symptoms suggestive of TB
C. Promptly initiate treatment
IV. Managing persons who have possible infectious TB
A. Promptly initiate TB precautions
B. Place patients in separate waiting areas or TB isolation rooms
C. Give patients a surgical mask, a box of tissues, and instructions regarding the use of these items
V. Managing inpatients who have possible infectious TB
A. Promptly isolate patients who have suspected or known infectious TB
B. Monitor the response to treatment
C. Follow appropriate criteria for discontinuing isolation
VI. Engineering recommendations
A. Design local exhaust and general ventilation in collaboration with persons who have expertise in ventilation engineering
B. Use a single-pass air system or air recirculation after high-efficiency particulate air (HEPA) filtration in areas where infectious TB patients receive care
C. Use additional measures, if needed, in areas where TB patients may receive care
D. Design TB isolation rooms in facilities to achieve greater than or equal to 6 air changes per hour (ACH) for existing facilities and greater than or equal to 12 ACH for new or renovated facilities
E. Regularly monitor and maintain engineering controls
F. TB isolation rooms that are being used should be monitored daily to ensure they maintain negative pressure relative to the hallway and all surrounding areas
G. Exhaust TB isolation room air to outside or, if absolutely unavoidable, recirculate after HEPA filtration
VII. Respiratory protection
A. Respiratory protective devices should meet recommended performance criteria
B. Respiratory protection should be used by persons entering rooms in which patients with known or suspected infectious TB are being isolated, by staff when performing cough-inducing or aerosol-generating procedures on such patients, and by persons in other settings where administrative and engineering controls are not likely to protect them from inhaling infectious airborne droplet nuclei
C. A respiratory protection program is required at all facilities in which respiratory protection is used
VIII. Cough-inducing procedures
A. Do not perform such procedures on TB patients unless necessary
B. Perform such procedures in areas that have local exhaust ventilation devices (e.g., booths or special enclosures) or, if this is not feasible, in a room that meets the ventilation requirements for TB isolation
C. After completion of procedures, TB patients should remain in the booth or special enclosure until their coughing subsides
IX. Staff TB training and education
A. All staff should receive periodic TB education appropriate for their work responsibilities and duties
B. Training should include the epidemiology of TB in the facility
C. TB education should emphasize concepts of the pathogenesis of and occupational risk for TB
D. Training should describe work practices that reduce the likelihood of transmitting *M. tuberculosis*
X. Staff counseling and screening
A. Counsel all staff regarding TB infection and disease
B. Counsel all staff about the increased risk to immunocompromised persons for developing active TB
C. Perform IGRAs or TSTs on staff at the beginning of their employment, and repeat at periodic intervals
D. Evaluate symptomatic staff for active TB
XI. Evaluate staff IGRA or TST conversions and possible transmission of *M. tuberculosis*
XII. Coordinate efforts with public health department(s) and community partners

Modified from: Centers for Disease Control and Prevention (1994)

prevention and control activities in correctional facilities can be categorized as: (1) prevention of TB transmission using administrative controls, environmental controls, and a respiratory protection program; (2) screening for TB disease and LTBI; (3) treatment of persons with TB disease and LTBI; (4) collaboration between correction, public health, and community partners; (5) release planning; and (6) program evaluation (CDC, 2006a).

Preventing TB Transmission

Prevention of TB transmission in correctional facilities requires a strong infection control program that includes administrative controls, environmental controls, and a respiratory protection program (CDC, 2006a).

Administrative Controls

Administrative controls are measures designed to reduce the risk of exposure to persons with infectious TB disease and include the following: (1) assigning responsibilities for TB infection control to qualified persons; (2) conducting facility TB risk assessments; (3) developing and updating a written TB infection control plan for each facility; (4) implementing and evaluating effective work practices for managing persons with suspected or confirmed infectious TB; and (5) providing ongoing staff education and training (CDC, 2006a) (Table 11.3). Detailed guidance has been previously published (CDC, 2003b, 2005a, 2006a).

Environmental Controls

Exposure to *M. tuberculosis* within correctional facilities can be reduced through consistent and effective use of environmental controls, including: (1) general and local exhaust ventilation; (2) air cleaning methods; (3) airborne infection isolation (AII); and (4) environmental control maintenance (CDC, 2006a). These environmental controls are detailed in published guidelines for the prevention of TB in healthcare settings and for environmental infection control in healthcare facilities and can be used to educate staff and inform policies and procedures in correctional settings (CDC, 2003b, 2005a).

General and Local Exhaust Ventilation

General ventilation maintains air quality by two processes: (1) dilution and removal of airborne contaminants, and (2) control of the airflow direction and pattern within a facility (CDC, 2006a). Uncontaminated air is supplied into an area where the air is contaminated and the mixed air and contaminants are subsequently removed from the area by an exhaust system. The amount of ventilation in an area is expressed by the number of air changes per hour (ACH). Air within a correctional facility should flow to minimize exposure of others within the building to airborne contaminants and should comply with minimum outdoor air supply, ACH, and ventilation design guidance for correctional facilities (American Society of Heating, Refrigerating, and Air-Conditioning Engineers, 2003; CDC, 2006a) (Table 11.4). General ventilation that exhausts air directly to the outside is the most protective ventilation design and should preferentially be used in areas likely to contain infectious aerosols (CDC, 2006a).

Table 11.4 Ventilation recommendations for selected areas in correctional settings

Correctional area	Minimum total air changes per hour	Air movement relative to adjacent areas	All air exhausted directly outdoors[a]
Cell or dormitory housing unit	6	In	No
Airborne infection isolation (AII) cells	12	In	Yes
Anteroom to AII cell	10	Out/In[b]	Yes
Day rooms	6	Out[c]	No
Intake, holding, or processing area	12	In	Yes
Kitchen or food preparation area	6–10	In	Yes[d]
Laundry	10–12	In	Yes[d]
Visitation area	6	Out[c]	No
Courtrooms	6	Out[c]	No

Source: Modified from Centers for Disease Control and Prevention (2006a)

[a]Single-pass ventilation that directly exhausts air to the outside is the most protective ventilation design approach and should be used for areas likely to contain infectious aerosols

[b]Anteroom pressurization should be designed to minimize cross-contamination between patient areas and adjacent areas and should comply with local fire smoke management regulations

[c]This determination should be made on the basis of the risk assessment conducted at each facility and whether a single-pass ventilation design can be used

[d]Exhausting all air from kitchens and laundry rooms to the outdoors is recommended for contaminant (not TB) and odor control

Although general ventilation dilutes the concentration of airborne particles, it does not contain them. Local exhaust ventilation (e.g., hoods, tents, booths) is a preferred source-control technique and is used to contain and remove airborne contaminants at their source and prevent their dispersion into the air. Local exhaust ventilation is often used during aerosol-generating procedures such as sputum induction and bronchoscopy. Such ventilation devices typically use hoods, which are of either exterior or enclosing types. Exterior devices are those in which the infectious source is near, but outside, the hood. Enclosing devices, the preferred type, are those in which the hood either partially or fully encloses the infectious source. Enclosing devices such as tents or booths should have sufficient airflow to remove 99% of airborne particles during the interval between the departure of one patient and the arrival of the next (CDC, 2006a). The time interval required to achieve proper level of airborne contaminant removal from enclosing devices varies, in part, according to the ACH. The higher the number of ACH, the shorter the amount of time that is required for removal of contaminated air (Table 11.5). Air from hoods, booths, or tents may either be exhausted directly to the outside or released back into the room where the device is located. If air is not released directly to the outside, a high-efficiency particulate air (HEPA) filter should be used at the discharge duct or vent of the exhaust device to remove airborne particulates before the air is recirculated into the room (CDC, 1994).

Air Cleaning Methods

Air cleaning technologies are useful adjuncts to general and local exhaust ventilation and include mechanical air filtration (e.g., HEPA filters) to reduce the concentration of airborne contaminants and ultraviolet germicidal irradiation (UVGI) to kill or inactivate microorganisms so that they no longer pose a risk for infection (CDC, 2006a). Air removed from areas likely to contain infectious aerosols should be preferentially exhausted directly to the outdoors. If direct exhaust is not feasible, HEPA

Table 11.5 Air changes per hour (ACH) and time required for removal of airborne contaminants, by efficiency percentage

	Minutes required for removal[a]	
Air changes per hour	99.0% efficiency	99.9% efficiency
2	138	207
4	69	104
6	46	69
12	23	35
15	18	28
20	14	21
50	6	8

Source: Modified from Centers for Disease Control and Prevention (2006a)
Values apply to a room or enclosure in which: (1) the generation of aerosols has ceased (e.g., the infectious inmate is no longer present in the room), or (2) the aerosol procedure has been completed and the room or booth is no longer occupied. The times provided assume perfect mixing of the air in the space; removal times will be longer in areas with imperfect mixing or air stagnation. Caution should be exercised in applying the table to such situations, and expertise from a qualified engineer or industrial hygienist should be obtained
[a]Minutes required for removal of airborne contaminants from the time that generation of infectious aerosols has ceased

filters should be used to clean the air before returning it to the general ventilation system. Whenever possible, such air should be recirculated into the same general area from which it originated. UVGI may also be used as a supplement to direct exhaust or HEPA filtration. UVGI can be used inside the ductwork of existing heating, ventilating, and air-conditioning systems or in the upper area of the room to be treated to ensure that organisms are inactivated. The effectiveness of UVGI depends on the UVGI lamp placement and intensity, air flow patterns and mixing, and relative humidity. Appropriate installation, maintenance, and monitoring of HEPA filters and UVGI equipment are essential. Additionally, staff and inmates should be educated about potential adverse effects of UVGI exposure such as skin erythema and photokeratoconjunctivitis (inflammation of the eye) (CDC, 2005a).

Airborne Infection Isolation

Inmates known or suspected of having TB disease should be placed in an AII room or cell that meets the design and specifications of an isolation room. AII rooms should have all three of the following characteristics: (1) negative pressure, such that the direction of the air flow is from the outside adjacent space (e.g., the corridor) into the room; (2) numerous ACH (12 ACH for new construction as of 2001; 6 ACH for construction before 2001); and (3) air that is directly exhausted to the outside, or recirculated through a HEPA filter (CDC, 1994). The use of personal respiratory protection is indicated for persons entering these rooms when caring for TB patients. Facilities without an AII room should refer inmates with suspected or confirmed TB to a facility that is able to provide such isolation and evaluate TB patients. If transfer to an alternative facility with an AII room is not available, the inmate should be temporarily housed in a room that has been modified to prevent the escape of infectious aerosols. Inmates may be discontinued from AII when infectious TB disease is considered unlikely and either: (1) another diagnosis is made that explains the clinical syndrome, or (2) the patient has three negative AFB sputum-smear results. Sputum samples should be collected 8–24 h apart with at least one being an early morning specimen. Inmates for whom suspicion of TB remains despite three negative AFB sputum-smear results should not be removed from AII room until they are on standard anti-TB treatment and are clinically improving. Inmates with confirmed TB disease should remain in AII until they have had three consecutive negative AFB sputum-smear results; have

received standard multidrug TB treatment for 2 weeks; and have demonstrated clinical improvement. Because transmission of drug-resistant TB can have dire consequences, facilities may choose to keep suspected or confirmed multidrug-resistant (MDR) TB cases in AII rooms until both negative smear and culture results are received (CDC, 2006a).

Environmental Control Maintenance

Environmental controls will fail if they are not appropriately operated and maintained. Improperly maintained AII rooms have been associated with transmission of TB within healthcare facilities (Ikeda et al., 1995; Kenyon et al., 1997). Correctional facilities should work with ventilation engineers and infection control personnel to ensure the proper design and ongoing maintenance of environmental controls. In addition, correctional facilities should schedule routine preventive maintenance that covers all components of the ventilation system, including air cleaning devices, to verify that environmental controls are operating as designed. Records of preventive maintenance and repairs should be carefully maintained (CDC, 2006a).

Respiratory Protection

All correctional facilities should develop, implement, and maintain a respiratory protection program. The program should include respiratory protection fit testing and training of all correctional employees who may potentially have contact with infectious or potentially infectious inmates. All staff working with infectious patients should be given respiratory protection to wear and be instructed on proper use. For most circumstances in correctional facilities, National Institute for Occupational Health and Safety-approved respirators (e.g., N95 or higher) should provide adequate staff protection (CDC, 2005a). Detailed guidance on respiratory protection has been published (CDC, 1999c; Garner, 1996). Personal respiratory protection is indicated for all persons who: (1) enter AII rooms, (2) transport infectious inmates, or (3) participate in aerosol-generating procedures (e.g., suctioning, sputum induction). Drivers or other persons who are transporting patients with suspected or confirmed TB disease in an enclosed vehicle should also wear N95 respirators. If the inmate has signs or symptoms of TB, consideration should be given to having the inmate wear a surgical mask during transport, in waiting areas, or when others are present (CDC, 2006a).

Screening for TB Disease and LTBI

Early identification, isolation, and treatment of persons with TB disease remain the most effective means of preventing TB disease transmission. Inmates with undiagnosed TB disease can expose other inmates and correctional staff, and, when released, can infect persons living in surrounding communities (Bur et al., 2003; Frieden et al., 1995; Jones et al., 1999, 2003; Mohle-Boetani et al., 2002; Stead, 1978). The primary goal of screening in a correctional facility is to detect TB disease and prevent transmission. The secondary benefit of TB screening is to find inmates with LTBI who are at higher risk of progressing to TB disease and could benefit from treatment (CDC, 2006a).

The type of screening recommended for a facility is determined by an assessment of the TB transmission risk within that facility. CDC guidelines define a facility's risk as being minimal or nonminimal (CDC, 2006a). A facility has minimal TB risk if: (1) no cases of TB disease occurred in the facility in the previous year; (2) it does not house substantial numbers of inmates with TB risk factors

(e.g., HIV infection); (3) it does not have significant numbers of inmates from areas of the world with high TB rates; and (4) employees of the facility are not otherwise at risk for TB. Any facility that does not meet these criteria should be categorized as a nonminimal TB risk facility. TB risk should be assessed at least annually, with assistance from the local or state health department (CDC, 2006a). A multipronged approach to TB screening is needed and, based on the context and inmate characteristics, includes TB history, symptom review, diagnostic testing (e.g., IGRA, TST, sputum smear and culture), chest radiograph, and a high index of suspicion.

TB History and Symptom Screening

All correctional facilities, regardless of TB risk level, should obtain a TB history from and conduct a symptom screening of all newly incarcerated inmates on intake. Inmates should be asked about history of and treatment for LTBI or TB disease (CDC, 2006a). In addition, all inmates should be asked about the presence of TB symptoms. Inmate issues such as acute drug withdrawal, mental illness, and fatigue at time of intake, as well as language or cultural barriers, may hinder obtaining a thorough history and symptom screening and should be addressed (Saunders et al., 2001).

Early symptoms of TB resemble other infectious respiratory illnesses such as influenza, acute bronchitis, or pneumonia. Symptoms include low-grade fever, chills, night sweats, fatigue, loss of appetite, weakness, or unintentional weight loss. In pulmonary TB, the most common form of disease, symptoms often include a prolonged cough (i.e., one lasting 3 weeks or more), production of sputum, hemoptysis (i.e., coughing up blood or blood-tinged sputum), or chest pain. Physical exam may include rales or signs of lung consolidation. In laryngeal TB, hoarseness or sore throat may be present. TB disease in the respiratory tract is associated with a high degree of infectiousness. Extrapulmonary TB, usually noncontagious, can involve virtually any organ system in the body.

Newly incarcerated inmates should not be housed with other inmates in general population until they have been adequately screened for TB disease. Inmates with symptoms suggestive of TB disease or with history of inadequate treatment for TB disease should be placed in an AII room until they receive a thorough medical evaluation (CDC, 2006a). AII rooms, formerly known as negative pressure isolation rooms, are single-occupancy rooms used for the isolation of persons infected with organisms spread via airborne droplet nuclei <5 μm in diameter. If the facility does not have an AII room, the inmate should be transferred to a location that has one. The absence of physical findings does not exclude active TB disease and a high index of suspicion should be maintained. Evaluation for TB disease among those in whom it is suspected should include a test for infection (e.g., IGRA or Mantoux TST), a chest radiograph, and sputum examination for microscopy and culture for mycobacteria.

Interferon Gamma Release Assays

For nearly 100 years, the TST has been the only diagnostic tool available for the detection of TB infection in persons who have no symptoms or findings of TB (Pai 2005; Pai et al., 2005; Pai et al., 2006). Recently, IGRAs have been developed as an alternative and are now the preferred test for TB infection for all persons of ages 2 years and older, particularly in settings where the return rates for TST reading are suboptimal (Mazurek et al., 2010; American Academy of Pediatrics, 2018). IGRAs are a new class of diagnostic assays that measure interferon gamma released by T-cells after stimulation by selected antigens. For *M. tuberculosis*, these antigens include early secreted antigenic target (ESAT)-6 and

culture filtrate protein (CFP)-10, which are present in *M. tuberculosis* but absent from all bacille Calmette-Guérin (BCG) strains and most other non-TB mycobacteria (with the exception of *M. kansasii, M. marinum, M. szulgai,* and *M. gordonae*) (Pai et al., 2004; Pai et al., 2006). Available data suggest that IGRAs have a higher specificity than TST and are at least as sensitive as TST for detection of TB disease (Pai et al., 2006). Laboratory-based test results are reported as: (1) positive (*M. tuberculosis* infection likely); (2) negative (*M. tuberculosis* infection unlikely but cannot be excluded); or (3) indeterminate, invalid, or borderline (depending on the specific IGRA). Advantages of IGRAs include: (1) only a single visit is required to obtain results; (2) result is unaffected by prior BCG vaccination; and (3) there is no boosting effect on future IGRA testing.

In correctional settings, IGRAs have a major advantage over the TST since IGRA results are laboratory-based and thus available even if inmates are released before receiving the results; inmates can request their IGRA results from the correctional facility at any time postincarceration. Additionally, in the event of recidivism, an inmate's IGRA result will be available at the correctional facility, precluding the need for redundant testing. Limitations of IGRAs include: (1) the need for phlebotomy; and (2) relatively high direct cost per test compared to the TST. However, correctional settings may find IGRAs to have operational benefits over the TST (Katyal et al., 2018). Comparisons of TST versus IGRAs have been extensively reviewed (Pai et al., 2005).

Two IGRAs are now commercially available worldwide: (1) QuantiFERON®-TB Gold Plus Test (QFT-Plus) (Cellestis Ltd, Carnegie, Australia) and (2) the T-SPOT™.*TB* (Oxford Immunotech Ltd, Oxford, UK). The QFT-Plus and T-SPOT™.*TB* can be used in all circumstances in which TST is currently being used (CDC, 2005c, 2010). A positive IGRA result suggests that infection with *M. tuberculosis* is likely; further evaluation is needed to rule out TB disease (e.g., chest radiography and other diagnostic tests as clinically indicated). Once TB disease is ruled out, a diagnosis of LTBI can be made and treatment options considered. As with a negative TST result, a negative QFT-Plus or T-SPOT™.*TB* result alone should not exclude the possibility of TB infection or disease and should be supplemented with medical history and other diagnostic tests as clinically indicated. An IGRA conversion is defined as a change from a negative to positive IGRA result within a 2 year period.

QFT-Plus

QFT-Plus results are reported as either "positive," "negative," or "indeterminate." Quantitative data are reported for TB Antigen Tube 1 antigens (TB1; ESAT-6, CFP-10), TB Antigen Tube 2 antigens (TB2; ESAT-6, CFP-10, additional peptides), positive (Mitogen) control, and negative (Nil) control values. Both TB1 and TB2 antigen tubes contain the *M. tuberculosis* antigens ESAT-6 and CFP-10. The TB1 tube

contains peptides from ESAT-6 and CFP-10 that are designed to elicit cell-mediated immune responses from CD4+ T-helper lymphocytes. The TB2 tube contains additional peptides targeted toward cell-mediated immune responses from CD8+ cytotoxic T-cells, which have been shown to be more frequently detected in persons with active TB disease versus LTBI and may be associated with recent *M. tuberculosis* exposure.

A QFT-Plus result is positive if the Nil value is ≤8.0 IU/ml and either TB antigen tube minus Nil is ≥0.35 IU/ml and ≥25% of the Nil value. A negative QFT-Plus result requires both antigen tubes minus Nil to be <0.35 IU/ml, or ≥0.35 and <25% of Nil value, and the mitogen minus Nil to be ≥0.5 IU/ml. Some QFT-Plus results may be indeterminate due to processing errors or the patient's inability to respond to either control. If the results of the QFT-Plus are indeterminate, repeat the QFT-Plus. If two different QFT-Plus specimens yield indeterminate results, clinical judgment is used to determine if the patient has likely TB infection (Table 11.6).

Table 11.6 Interpretation of QuantiFERON-TB Gold Plus (QFT-Plus)

Nil (IU/ml)	TB1 minus Nil (IU/ml)	TB2 minus Nil (IU/ml)	Mitogen minus Nil (IU/ml)[a]	QFT-Plus result	Report/interpretation
≤8.0	≥0.35 and ≥25% of Nil value	Any	Any	Positive[b]	*M. tuberculosis* infection likely
	Any	≥0.35 and ≥25% of Nil value			
	<0.35 or ≥0.35 and <25% of Nil value	<0.35 or ≥0.35 and <25% of Nil value	≥0.5	Negative	*M. tuberculosis* infection NOT likely
	<0.35 or ≥0.35 and <25% of Nil value	<0.35 or ≥0.35 and < 25% of Nil value	<0.5	Indeterminate[c]	Likelihood of *M. tuberculosis* infection cannot be determined
>8.0[d]	Any				

Source: Modified from Food and Drug Administration (2019)
Abbreviations used: *IU* international units, *ml* milliliters, *M. tuberculosis Mycobacterium tuberculosis*, *TB* tuberculosis
[a]Responses to the mitogen positive control (and occasionally TB Antigens) can be outside the range of the microplate reader. This has no impact on test results. Values >10 IU/ml are reported by the QFT-Plus software as >10 IU/ml
[b]Where *M. tuberculosis* infection is not suspected, initially positive results can be confirmed by retesting the original plasma samples in duplicate in the QFT-Plus ELISA. If repeat testing of one or both replicates is positive, the test result is considered positive
[c]Refer to package insert for possible causes (QuantiFERON-TB Gold Plus (QFT-Plus) Elisa [package insert]. Germantown, MD: Qiagen; 2017)
[d]In clinical studies, less than 0.25% of subjects had interferon gamma levels of >8.0 IU/ml for the Nil value

T-SPOT™.*TB*

T-Spot results are reported as "positive," "negative," "borderline," or "invalid." Quantitative data are reported for the Panel A (ESAT-6) and Panel B (CFP-10) TB antigens, positive (Mitogen) control, and negative (Nil) control spot counts. Results are interpreted by subtracting the spot count in the Nil control from the spot count in Panel A and Panel B. For a valid test, the Nil control has ≤10 spots; if Panel A or B minus Nil has ≤4 spots, then the mitogen must also have ≥20 spots for a valid result. T-Spot is the only IGRA test that gives a borderline result. T-Spot results may be invalid due to inappropriate blood storage conditions, delay in sample transport, patient specific conditions, or laboratory error. In the case of borderline or invalid results, repeat the T-Spot test. If two different T-Spot specimens yield borderline or invalid results, clinical judgment is used to determine if the patient has likely TB infection (Table 11.7).

Mantoux TST Screening

Historically, the TST has been the most common method for detection of TB infection. The Mantoux TST involves the intradermal injection of 0.1 ml of 5 tuberculin units (TU) of purified protein derivative (PPD) on the volar surface of the forearm. Multiple puncture tests (e.g., the tine test) and PPD strengths of 1 TU and 250 TU are not sufficiently accurate and should not be used (CDC, 2000b). In addition, anergy testing, in conjunction with TST, is no longer recommended in the United States (CDC, 1996a, 1996b). The TST is read within 48–72 h after administration, and the transverse diameter of induration, not redness, is recorded in millimeters (mm). Based on the sensitivity and specific-

Table 11.7 Interpretation of T-SPOT.*TB* test results

Nil (spots)	Panel A minus Nil (spots)	Panel B minus Nil	Mitogen (spots)	T-SPOT.*TB* result	Comment
≤10	≥8	≥8	Any	Positive	8 spots or more in either Panel A-Nil or Panel B-Nil (Panel A-Nil or Panel B-Nil)
	5, 6, or 7	5, 6, or 7	Any	Borderline[a, b]	5, 6, or 7 spots (highest of Panel A-Nil or Panel B-Nil)
	≤4	≤4	≥20	Negative	Mitogen control has 20 spots or more and both Panel A-Nil and Panel B-Nil have 4 spots or fewer
			<20	Invalid[a, c]	Mitogen control has fewer than 20 spots and both Panel A-Nil and Panel B-Nil have 4 spots or fewer
>10	Any	Any	Any	Invalid[a, c]	Nil control has more than 10 spots

Source: Modified from Food and Drug Administration (2008)
[a]Refer to package insert for possible causes (T-Spot.TB [package insert]. Marlborough, MA: Oxford Immunotec; 2012)
[b]Results where the highest of the Panel A or Panel B spot count is such that the (Panel minus Nil) spot count is 5,6, or 7 spots should be considered borderline (equivocal) and retesting by collecting another patient specimen is recommended (T-Spot.TB [package insert]. Marlborough, MA: Oxford Immunotec; 2012)
[c]Invalid results should be reported as "invalid," and it is recommended to collect another sample and retest the individual

Table 11.8 Criteria for determination of a positive tuberculin skin test result

≥5 mm	Persons who: Have had recent contact to someone with infectious TB disease Have HIV infection or other immunosuppressive conditions Have fibrotic changes on chest radiograph consistent with old TB disease Are currently taking certain medications that can cause immunosuppression, such as: Anti-TNF-α inhibitor treatment (e.g., infliximab, etanercept), JAK inhibitors, Interleukin receptor antagonists Medications after organ transplantation Steroids (equivalent to ≥15 mg of prednisone per day for ≥1 month)
≥10 mm	Persons who: Were born in OR traveled/resided ≥1 month consecutively in a country with a high TB incidence rate[a] Live or work in institutional settings where exposure to TB may be possible[b] (e.g., healthcare facilities, correctional facilities, homeless shelters, mycobacteriology laboratories) Have medical conditions associated with increased risk of progression to active TB disease, including: Silicosis Diabetes mellitus End-stage renal disease Gastrectomy Jejunoileal bypass Certain hematologic disorders (e.g., leukemias or lymphomas) Specific malignancies (e.g., carcinoma of the head, neck, or lung) Are younger than 5 years of age Inject illicit drugs
≥15 mm	Persons: At low risk for TB disease and for whom testing is not generally indicated

Source: Centers for Disease Control and Prevention (2020b). https://www.cdc.gov/tb/publications/factsheets/testing/skintesting.pdf
Abbreviations used: *HIV* human immunodeficiency virus, *JAK* Janus kinase, *mm* millimeters, *M. tuberculosis Mycobacterium tuberculosis*, *TB* tuberculosis, *TNF* tumor necrosis factor
[a]Countries with high TB incidence rates include any country other than the United States, Canada, Australia, New Zealand, or a country in Western or Northern Europe
[b]As defined by local epidemiological risk and/or regulations. Healthcare facilities include hospitals, long-term care facilities, and drug treatment centers

ity of the TST and the prevalence of TB in different groups, three cut points have been recommended for determining a positive tuberculin reaction (Table 11.8). In the majority of cases, a TST result of 10 mm induration is considered a positive result for inmates and correctional facility staff (CDC,

2006a). However, an induration of 5 mm is a positive result for the following persons: persons living with HIV; recent contacts of a person with TB disease; chest radiograph consistent with prior TB disease; organ transplant recipients; persons receiving prolonged immunosuppressive therapy; and those with findings raising a high suspicion of TB disease. A positive TST result suggests that infection with *M. tuberculosis* is likely; further evaluation is needed to rule out TB disease (e.g., chest radiography and other diagnostic tests as clinically indicated). A negative TST result alone should not exclude the possibility of TB infection or disease and should be supplemented with medical history and other diagnostic tests as clinically indicated. A TST conversion is defined as an increase of 10 mm or more within a 2-year period (CDC, 2000b).

Persons who have a documented history of a positive TST or IGRA result or TB disease, or a reported history of severe necrotic reaction to tuberculin, should be exempt from a routine TST (CDC, 2006a). Pregnancy, lactation, or prior BCG vaccination is not a contraindication to receiving the TST. The same criteria for interpretation of TST results are used for BCG-vaccinated persons.

The TST is not particularly sensitive for TB disease and is highly nonspecific; its sensitivity ranges from 75% to 90% (CDC, 2006a) and may be lower in some populations. Asymptomatic persons who have a positive TST reaction should have a chest radiograph performed within 72 h after skin test is read (CDC, 2006a). Persons with either TB symptoms or history of TB exposure and a positive TST reaction should be promptly placed in an AII room for a diagnostic work-up and evaluated immediately.

Two-step testing can reduce the number of positive TSTs that would otherwise be misclassified as recent conversions and should be considered in persons who are likely to undergo future periodic screenings. Certain persons who were infected with *M. tuberculosis* years earlier exhibit waning delayed-type hypersensitivity to tuberculin. When they receive a TST years later, they may have a false negative result, though they are truly infected; however, this test stimulates the body's ability to react to future TSTs and result in a "boosted" reaction. When a TST is repeated and is positive, the results may be misinterpreted as a new infection (e.g., recent conversion). In two-step testing, persons whose baseline TST yields a negative result are retested 1–3 weeks after the initial test. If the second test is negative, they are considered not infected. If the second test result is positive, they are classified as having previous TB infection. Two-step testing may not be practical in jails, given the high turnover rates, but may be useful in prisons or as part of a correctional employee health program if IGRAs are not available.

Chest Radiograph Screening

Chest radiographs are essential in the evaluation of TB. Persons with LTBI may have chest radiograph findings that are normal or that suggest healed infection, such as granulomas or calcification. Persons with TB disease will commonly have lesions in the apical or posterior segments of the upper lobes, or in the superior segment of the lower lobes, of the lungs. Pulmonary cavities, atelectasis, or fibrotic scarring may also be evident. Rarely, chest radiographs may be normal in the presence of pulmonary TB, particularly in patients living with HIV and those with isolated laryngeal TB. Miliary TB will appear as diffuse, finely nodular lesions (~2 mm in size) on chest radiograph. Unilateral, or rarely bilateral, pleural effusion may be the only abnormality evident for pleural TB. Imaging techniques such as computed tomography or magnetic resonance imaging may assist in defining nodules, cavities, cysts, calcifications, or other lesions that are observed on chest radiograph.

Chest radiographs should be obtained for persons with TB symptoms or positive IGRA or TST results. Persons living with HIV, or those who are at risk for HIV but whose status is unknown, should receive a chest radiograph, regardless of IGRA or TST results, as these might be falsely negative. In facilities with on-site radiographic screening, the chest radiograph should be performed as part of intake and preferably be read by a physician within 24 h (CDC, 2006a). Inmates with chest radiographs consistent with TB disease should be promptly placed in an AII room and evaluated, regardless of IGRA or TST results.

Screening with chest radiographs can be an effective means of detecting new cases of TB disease at admission to a correctional facility, particularly in facilities with short lengths of stay or high-risk populations (e.g., HIV, intravenous drug use). Screening inmates with chest radiographs has been shown to increase the TB case-finding rate and enable quicker isolation of suspected TB cases when compared with TST or symptom screening (Jones & Schaffner, 2001; Layton et al., 1997; Puisis et al., 1996). However, universal chest radiography at one detention center was no more sensitive in the detection of active TB cases than routine symptom screen and TST; in addition, it led to an eight-fold increase in TB-related work-ups without detecting additional cases of TB (Saunders et al., 2001). Moreover, chest radiography screening does not assist in the detection of LTBI. The decision to implement universal chest radiography for TB screening is facility specific and should consider the following factors: local and facility TB epidemiology, suspected frequency of cutaneous anergy to skin testing among incarcerated population, lengths of stay, and cost-effectiveness (Saunders et al., 2001).

Initial TB Screening of Inmates

The following procedures are recommended for initial TB screening of inmates in all correctional facilities (CDC, 2006a). All inmates admitted to correctional facilities (minimal or nonminimal TB risk) should be evaluated on entry for symptoms of TB, preferably by healthcare staff. In facilities where custody staff conduct intake health screenings, trainings should be periodically provided on obtaining medical histories, identifying and referring inmates with TB signs and symptoms, and maintaining patient confidentiality. Any inmate with symptoms suggestive of TB should be promptly placed in an AII room and evaluated for TB disease. If the facility does not have an AII room, the inmate should be transferred to a facility that has one. All inmates admitted to a minimal TB risk facility should be evaluated for clinical conditions that increase the risk for TB infection or the risk for progressing to TB disease if infected (Table 11.2); persons with any of these conditions should undergo further screening with an IGRA, TST, or chest radiograph within 7 days of admission (CDC, 2006a). All inmates admitted to nonminimal TB risk facilities require screening with IGRA, TST, or chest radiograph within 7 days of admission (CDC, 2006a). Inmates with HIV or risk factors for HIV but whose status is unknown, regardless of IGRA or TST result, should receive a chest radiograph at admission to the facility.

If an inmate tests positive for TB infection by IGRA or TST, the provider must conduct further clinical and radiologic evaluation and rule out active TB disease before an LTBI diagnosis can be established or LTBI treatment can be initiated (Table 11.9). All persons who have a positive test for TB infection should be examined by a clinical provider and receive a medical history and physical examination, chest radiograph, and relevant laboratory testing if clinically indicated. In some instances, persons with a negative IGRA or TST should also receive a medical evaluation if TB disease is suspected.

Table 11.9 Recommended clinical evaluation based on test for tuberculosis infection results

Negative IGRA or TST	No further evaluation is needed unless indicated by clinical judgment (e.g., clinical suspicion of active TB, immunosuppression, new TB risk factor, live or work in high-risk setting)
Positive IGRA or TST	Rule out active TB disease with clinical evaluation, chest radiograph, and other diagnostics as clinically indicated
Indeterminate[a] or invalid[b] IGRA	Result could be due to error in specimen collection or laboratory processing or to the patient's reduced immune response to the TB antigens (i.e., anergy) Repeat the IGRA. If 2 separate specimens from a patient yield indeterminate or invalid results, do not repeat IGRA; consider medical evaluation and chest radiograph to rule out active TB
Borderline IGRA[b]	Indicates an uncertain likelihood of *M. tuberculosis* infection Repeat IGRA. If 2 separate specimens from a patient yield borderline results, do not repeat IGRA; consider medical evaluation and chest radiograph to rule out active TB

Abbreviations used: *IGRA* interferon gamma release assay, *M. tuberculosis Mycobacterium tuberculosis*, *TB* tuberculosis, *TST* tuberculin skin test
[a]QFT-TB Gold Plus only
[b]T-SPOT.TB only

Initial TB Screening of Correctional Employees

Correctional employees, such as officers or medical personnel, are at risk for occupational exposure to TB (Steenland et al., 1997). Correctional facilities should have an employee health program, or component of the overall TB control program, dedicated to prevention of TB among its staff. All new employees should have: (1) a medical history and physical exam; (2) IGRA or TST; (3) a chest radiograph if indicated; and (4) consideration for LTBI or TB disease treatment if indicated. Additionally, all regular visitors of nonminimal TB risk facilities, including volunteers or service providers, should be considered for TB screening (CDC, 2006a).

Periodic TB Screening

Two-step TST or single-step IGRA should be considered for the initial testing of all inmates and employees who will receive repeated testing as part of a periodic TB screening program (CDC, 2006a). Correctional facilities should strongly consider using two-step TST for long-term inmates, if TST is used. Routine screening of long-term inmates and correctional facility staff (e.g., custody and medical) should be incorporated into the TB control program (National Commission on Correctional Health Care, 2003a, b). Long-term inmates and all employees who have a negative baseline IGRA or TST result should have a follow-up evaluation at least annually, per facility, local, or state regulations. Inmates or employees with a history of positive IGRA or TST result should be screened for symptoms of TB disease; annual chest radiographs are not necessary for routine follow-up evaluations of infected persons (CDC, 2006a).

Treatment of LTBI and TB Disease

Treatment of TB and LTBI is a critical component of TB containment, both in correctional facilities and in the larger community. An untreated person with TB disease is estimated to infect 10–15 persons per year. Treatment of persons with TB and LTBI, particularly those with LTBI who are at high risk for progression to disease, can prevent secondary transmission to other inmates, correctional staff, or members of the community upon the inmates' release from the correctional facility.

Effective anti-TB treatment markedly reduces infectivity. Completion of an effective treatment regimen for TB disease is nearly always curative; without proper treatment, TB is often fatal. A completed regimen of treatment for LTBI can reduce the risk of progression from LTBI to TB disease by 90% (Committee on Prophylaxis, International Union Against Tuberculosis, 1982; Institute of Medicine, 2000).

The effectiveness of TB treatment is primarily determined by adherence to and completion of the treatment regimen (American Thoracic Society, 2003). Interrupted or incomplete treatment increases the risk of treatment failure, relapse of disease, and emergence of drug-resistant TB. Patients who often move residences or are residing in correctional facilities have a higher likelihood of defaulting on treatment (Cummings et al., 1998; MacNeil et al., 2005). The most effective method of monitoring treatment compliance is to use directly observed therapy (DOT). DOT involves watching as the patient swallows the medication. DOT can help diminish infectiousness, reduce risk for relapse, and help prevent the development of drug resistance (American Thoracic Society, 2003). DOT is the preferred treatment strategy for all persons with: (1) TB disease; (2) LTBI who are on intermittent therapy or are at high risk for progression to disease; and (3) recent contact of infectious persons with pulmonary TB.

All persons receiving treatment for TB disease or LTBI should: (1) undergo clinical monitoring at least monthly to screen for nausea, vomiting, abdominal pain, jaundice, or discolored urine; and (2) be educated about potential adverse effects of the drug(s) and the need to promptly discontinue treatment and seek medical evaluation if adverse effects occur. Certain populations, including individuals living with HIV infection, pregnant or postpartum females, persons with history of liver disease (or at risk for chronic liver disease), and regular users of alcohol (CDC, 2000b), initiating TB or LTBI treatment, should also receive baseline and subsequent periodic laboratory testing (e.g., measurement of serum transaminases).

Treatment of LTBI

Once TB disease is ruled out, LTBI can be diagnosed and treatment options can be considered. Updated treatment guidelines for LTBI have been recently published (Sterling et al., 2020). Short-course (3 or 4 month) rifamycin-based regimens are preferred over the longer (6 or 9 month) isoniazid monotherapy for treatment of LTBI due to higher treatment completion rates and lower risk of hepatotoxicity. Preferred LTBI treatment regimens include weekly isoniazid and rifapentine for 12 weeks, daily rifampin for 4 months, or daily isoniazid and rifampin for 3 months (Sterling et al., 2020) (Table 11.10). Two alternative treatment regimens for LTBI include 6 or 9 months of daily isoniazid monotherapy if rifamycin-based regimens cannot be used; isoniazid therapy, while efficacious, has higher toxicity and lower treatment completion rates than shorter rifamycin-based regimens (CDC, 2000b; Sterling et al., 2020) (Table 11.10). In HIV-positive individuals, the 6-month course of isoniazid should be offered only if the other regimens cannot be given. In addition, substitution of rifabutin for rifampin may be indicated in HIV-positive persons taking certain antiviral medications due to less frequent drug–drug interactions when rifabutin is used. LTBI treatment regimens must be modified if there is concern that the source of TB infection has drug-resistant TB disease. The appropriate treatment regimen should then be based on drug susceptibility results of the presumed source case (if known), coexisting medical conditions (e.g., HIV), and potential for drug–drug interactions. Consultation with a TB expert is advised if the known source of TB infection has drug-resistant TB. Combination therapy with rifampin and pyrazinamide had previously been recommended for treatment of LTBI; however, this regimen is no longer recommended due to subsequent reports of severe hepatotoxicity and death (CDC, 2003c).

Table 11.10 Common drug regimens for treatment of latent tuberculosis infection

	Adult dosage	Pediatric dosage	Interval, duration, administration, and completion criteria	Indications
Rifampin (RIF)	10 mg/kg (600 mg maximum)	15–20 mg/kg (600 mg maximum)	Daily for 4 months Self-administration *Completion:* 120 doses within 6 months	Preferred for persons of all ages May be used in persons living with HIV who are not taking antiretroviral therapy (ART) or who are taking ART with acceptable drug–drug interactions with RIF
Isoniazid (INH) and rifapentine (RPT)	*INH* Age 12 years and older: 15 mg/kg rounded up to nearest 50 or 100 mg (900 mg maximum)	*INH* Age 2–11 years: 25 mg/kg rounded up to nearest 50 or 100 mg (900 mg maximum)	Weekly for 12 weeks Directly observed therapy (DOT) preferred, but self-administration is acceptable *Completion:* 12 scheduled doses within a 16-week period	Can be used for persons aged 2 years and older May be used in persons living with HIV who are not taking ART or are taking ART with acceptable drug–drug interactions with RPT
	RPT (based on person's weight) 10.0–14.0 kg: 300 mg 14.1–25.0 kg: 450 mg 25.1–32.0 kg: 600 mg 32.1–49.9 kg: 750 mg ≥50.0 kg: 900 mg max			
Isoniazid (INH)	5 mg/kg (300 mg maximum)	10–20 mg/kg (300 mg maximum)	Daily for 6 months Self-administration *Completion:* 180 doses within 9 months	May be used for persons of all ages, but no longer a preferred regimen May be used if RIF or INH/RPT are contraindicated
			Daily for 9 months Self-administration *Completion:* 270 doses within 12 months	
	15 mg/kg (900 mg maximum)	20–40 mg/kg (900 mg maximum)	Twice weekly for 6 months Directly observed therapy (DOT) is required *Completion:* 52 doses within 9 months	
			Twice weekly for 9 months Directly observed therapy (DOT) is required *Completion:* 76 doses within 12 months	

Source: Modified from Sterling et al. (2020)
Visit aidsinfo.nih.gov for the latest guidelines and complete list of contraindicated medications

Treatment for TB Disease

Treatment regimens for TB disease must consider all clinical, radiographic, and laboratory results, including drug susceptibility testing. Treatment should be implemented in collaboration with local TB experts to select the appropriate regimen based on diagnostic results (American Thoracic Society, 2003). For most persons with TB disease, the preferred treatment regimen is an initial 2-month phase of rifampin, isoniazid, pyrazinamide, and ethambutol, followed by a continuation phase of isoniazid and rifampin for 4 or more months after drug resistance is excluded (Table 11.11). Persons living with HIV infection may require use of rifabutin rather than rifampin and may need more frequent dosing than HIV-negative persons.

Treatment for TB disease should use DOT until completion. Decision to stop treatment should be made in collaboration with TB experts from local or state public health departments and be based on clinical, bacteriological, and radiographic improvement and total number of anti-TB medication doses taken within a maximum period (American Thoracic Society, 2003).

Case Reporting

In the United States, all states require designated healthcare professionals, including those from correctional facilities, to report suspected or confirmed TB cases to their local or state health department. Suspected or confirmed cases among both inmates and correctional staff should be reported. This reporting is mandatory and should be conducted regardless of treatment status, even if an inmate has already been released or transferred from the facility (CDC, 2006a).

Table 11.11 Intensive and continuation phase drug regimens for culture-positive pulmonary tuberculosis (TB) caused by drug-susceptible organisms

Intensive phase		Continuation phase[1,2,3]		
Drugs	Interval and duration	Drugs	Interval and duration	Comment
Isoniazid Rifampin Pyrazinamide Ethambutol	7 days/week for 56 doses (8 weeks)	Isoniazid Rifampin	7 days/week for 126 doses (18 weeks) --- or --- 3 days/week for 54 doses (18 weeks with DOT)[4]	Standard regimen for drug-susceptible TB disease
Isoniazid Rifampin[b] Ethambutol[c]	7 days/week for 56 doses (8 weeks)	Isoniazid Rifampin	7 days/week for 217 doses (31 weeks)[3] --- or --- 3 days/week for 93 doses (31 weeks with DOT)[3,4]	The continuation phase is extended to 7 months when PZA is excluded from the intensive phase for a total of 9 months of treatment This is the appropriate regimen for pregnant patients unless multidrug-resistant TB is suspected

Source: Adapted from Nahid et al. (2016), by permission of Oxford University Press on behalf of the Infectious Diseases Society of America. Please visit: https://www.idsociety.org/practice-guideline/treatment-of-drug-susceptible-tb/

[1]Biweekly treatment regimens during the continuation phase are not recommended due to high rates of relapse

[2]For missed doses, extend treatment to make up the doses

[3]Patients with a positive culture at 2 months of treatment should receive a 7-month continuation phase regimen (31 weeks; either 217 doses daily or 93 doses 3 times per week)

[4]Not recommended for patients with HIV infection

Contact Investigations

The identification of a potentially infectious case of TB in a correctional facility should trigger a prompt public health response because of the potential for widespread TB transmission. TB contact investigations are initiated on a case-by-case basis with the goal of interrupting the transmission of *M. tuberculosis.* TB transmission is prevented by: (1) promptly isolating and treating persons with TB disease; and (2) identifying infected contacts of such persons and providing them with treatment for LTBI. Decisions involved in initiating, planning, and prioritizing contact investigations are complex; a multidisciplinary team of trained professionals, including infection control, medical, nursing, custody, and local or state public health staff, should be convened to plan and conduct the investigations (CDC, 2006a).

Contact investigations should be initiated for the following conditions: (1) suspected or confirmed pulmonary, laryngeal, or pleural TB with cavitary disease on chest radiograph or positive AFB smears (on sputum or other respiratory specimens); and (2) suspected or confirmed pulmonary or pleural TB with negative AFB smears and a decision has been made to initiate TB treatment. Contact investigations generally are not indicated for extrapulmonary TB (excluding laryngeal and pleural TB) unless pulmonary involvement is also diagnosed.

The following steps should be used for contact investigations. Once an inmate with suspected or confirmed TB disease (source patient) is identified, local public health authorities and correctional management officials should be notified. The source patient should be interviewed and medical records should be reviewed to collect information on: (1) TB exposure history and symptoms; (2) date of illness onset; (3) results of diagnostic testing for TB; (4) dates and location of housing, employment, and education within the facilities; and (5) names of contacts (both in the correctional facilities and community). The infectious period for the source patient should be determined. The infectious period is typically defined as 12 weeks before the TB diagnosis was made or the onset of TB symptoms (whichever is longer). The presumptive infectious period can be reduced to 4 weeks preceding the date of diagnosis if the source patient is asymptomatic, is AFB smear negative, and has a noncavitary chest radiograph (CDC, 2006a). All living, working, and recreation areas of the source patient within the facilities should be toured to characterize the ventilation system and airflow direction. Contact lists should be developed, grouped according to location (e.g., incarcerated, released, transferred), and prioritized according to duration and intensity of exposure to the source patient (e.g., high, medium, low priority); local public health staff can assist in the prioritization of contacts (CDC, 2005b).

Contact investigations should focus on identifying the contacts at highest risk for TB transmission, screening them completely, and providing them with a complete course of LTBI treatment if they are infected. Persons with the most exposure to the source patient and HIV-positive or immunocompromised persons (regardless of duration of exposure) are of the highest priority. Medical charts should be reviewed for all high-priority contacts to determine TB-exposure history and symptoms. Baseline IGRA or TST should be performed on all eligible contacts (e.g., excluding those with prior positive tests or those who were tested after 1–3 months of exposure). All HIV-positive contacts should be evaluated for TB disease and LTBI regardless of IGRA or TST result; LTBI therapy should be initiated once TB disease has been excluded (CDC, 2005b). Public health authorities should be notified about contacts who have been transferred to another correctional facility or released to the community so that they can be screened. Follow-up IGRA tests or TSTs should be performed 8–10 weeks after exposure to the source patient has ended. Decision to expand the contact investigation beyond the high- and medium-priority contacts should be based on calculated infection rates (e.g., total number of inmates whose IGRA or TST has converted from negative baseline to positive should be divided by the total number of inmates with an IGRA performed and TST placed and read) and should be com-

pared with infection rates among nonexposed inmates. The contact investigation team should analyze infection rates both at baseline and follow-up to determine the need for expanding the investigation. Once the contact investigation is completed, the investigation team should prepare a summary report of the methods, results, and follow-up plans of the investigation. Reports should be shared with correctional and public health authorities. Detailed guidelines for conducting contact investigations have been published (CDC, 2005b).

Drug Susceptibility Testing

Initial isolates from persons with positive smears or cultures for *M. tuberculosis* should be tested for susceptibility to anti-TB drugs (CDC, 1992c). Drug susceptibility testing is imperative for choosing effective TB treatment regimens. Delays in susceptibility testing result in a longer duration of ineffective treatment and prolonged infectiousness. Susceptibility testing should be repeated if positive sputum smears or cultures persist despite 3 months of anti-TB drug therapy or develop after a period of negative sputum test results. Drug resistance should be reported to the TB control program at the local or state health department, and consultations with TB experts should be made to select a treatment regimen for drug-resistant TB.

MDR TB, defined as resistance to at least isoniazid and rifampin, emerged globally over the past three decades, creating a major challenge to TB management, including in correctional facilities (CDC, 1992a, 2006b; Valway et al., 1994a). MDR TB outbreaks in prisons have been documented worldwide and have resulted in the spread of MDR TB beyond the confines of correctional facilities into the community (Coninx et al., 1998; Valway et al., 1994a). Treatment of MDR TB requires the use of second-line drugs that are less effective, more toxic, and costlier than first-line isoniazid- and rifampin-based regimens (American Thoracic Society, 2003).

Ineffective treatment of persons with TB disease (e.g., insufficient quality, quantity, or duration of medications) may lead to the progressive development of drug resistance, including extensively drug-resistant (XDR) TB. XDR TB has recently emerged as a worldwide threat to TB control and is characterized by a predilection for immunocompromised persons, high mortality, and limited treatment options (World Health Organization, 2006). XDR TB is defined as resistance to isoniazid and rifampin (MDR TB), plus resistance to any fluoroquinolone and at least one of three injectable drugs (i.e., amikacin, kanamycin, or capreomycin). In the United States, approximately 4% of MDR TB is XDR TB (CDC, 2006b). In the industrialized nations of Australia, Belgium, Canada, France, Germany, Ireland, Japan, Portugal, Spain, Britain, and the United States, XDR TB increased from 3% of drug-resistant TB cases in 2000 to 11% in 2004 (CDC, 2006b). During 1993–2002, patients with XDR TB in the United States were 64% more likely to die during treatment than patients with MDR TB (CDC, 2006b). Ensuring appropriate, uninterrupted continuity of directly observed TB treatment both within and outside of correctional facilities is of utmost importance in the prevention of drug resistance.

Comprehensive Release Planning

Comprehensive release planning for soon-to-be-released inmates, or reentrants, with TB infection or disease is an essential component of TB control efforts, both within correctional facilities and in the communities to which inmates return (Hammett et al., 1998). Comprehensive release planning includes: (1) medical discharge planning; (2) transitional planning related to the social determinants of health; and (3) security-related release planning. Effective release planning facilitates improved postrelease utilization of medical services (Frieden et al., 1995) and reduced recidivism (Flanigan

et al., 1996). In addition, continuity of care postrelease is imperative for reducing secondary TB transmission and preventing the development of drug resistance (Glaser & Greifinger, 1993). Failure to complete a diagnostic evaluation for TB disease can result in undiagnosed reentrants exposing their families, friends, and community members to TB. Treatment interruptions or cessation before completion can also have serious consequences. Individuals with LTBI who do not complete their treatment are at risk for developing TB disease, particularly if they are coinfected with HIV or have other risk factors for progression. Inmates with TB disease who are unable to complete their treatment regimen are at risk for developing drug resistance and relapsing to symptomatic and infectious disease. Recidivists with incompletely diagnosed or untreated TB disease can reintroduce TB into a correctional facility upon admission and place other inmates and correctional staff at risk. Thus, case management and release planning efforts must be made to ensure timely completion of TB diagnostic evaluation and treatment both during and after incarceration, to prevent potential health risks to both reentrants and the larger community.

Correctional facilities should conduct prerelease case management and release planning for all inmates with suspected or confirmed TB disease and those with LTBI who are at high risk for progression to TB disease (CDC, 2006a). For inmates with LTBI who are at low risk for progression to TB disease, correctional facilities should collaborate with appropriate public health agencies to develop feasible release planning policies. Regardless of risk of progression, all inmates with LTBI who are started on TB preventive therapy during incarceration should receive discharge and transitional care planning to ensure uninterrupted treatment after release.

Correctional facilities should have designated staff assigned to conduct TB-related release planning and to notify the appropriate public health agency of inmates with suspected or confirmed TB disease and inmates receiving treatment for LTBI or TB disease (CDC, 2006a). Designated staff may be correction personnel, medical or administrative staff working in the facility, or public health department staff that work on-site. Such personnel should also be responsible for communication with other correctional facilities or community service providers if inmates are transferred or released mid-TB evaluation or treatment. Correction and medical staff within correctional facilities should work with the designated release planning staff to develop timely and thorough release plans. Planning should address TB diagnosis and treatment efforts begun in jails or prisons and provide for their continuation postrelease. Correctional facilities should ensure that their release planning process is comprehensive, is tailored to the needs of the individual, and is conducted in collaboration with public health and community partners.

Collaboration Between Correction, Public Health, and Community Partners

Both effective TB case management and release planning require and benefit from collaboration between correction, public health, and community partners (Lobato et al., 2004). Such collaboration and coordination maximize the effectiveness of TB control efforts begun in correctional facilities (Hammett et al., 2001). TB diagnostic evaluation or treatment-initiated during incarceration can be completed postrelease by public health or community partners, thus ensuring continuity of care and improved health for the inmate and reducing the likelihood of TB transmission in the community. In addition, collaboration with public health and community partners can assist correctional facilities in overcoming barriers such as brief inmate lengths of stay, unscheduled releases or transfers from the facility, and limited available resources for recommended TB prevention, screening, treatment, and release planning services (CDC, 2006a). Public health agencies and community-based organizations

may have financial, programmatic, or personnel resources that they can offer to correctional facilities. Public health staff can provide TB medical expertise and assistance with case management, contact investigations, administration of DOT, and accessing community TB-related resources (e.g., local TB clinics for follow-up appointments). In addition, public health departments often maintain TB registries containing diagnostic and treatment-related information on all persons with TB within their jurisdictions. Correctional facilities and public health departments can work together to use TB registry data to find inmates with TB infection or disease and obtain the TB history. Registry information including TB diagnostic test results, drug susceptibility patterns, and treatment history can be helpful to correctional facilities in case management and release planning. Use of TB registry data in correctional settings may also enable health departments to locate persons with TB who have been lost to follow up in the community. Correctional facilities can assist public health departments by promptly reporting all inmates with suspected or confirmed TB disease, so that the public health staff can ensure timely performance of case management, contact investigations, and entry of information into the TB registry. Correctional facilities should contact their local or state health departments to identify their designated TB control staff. Likewise, public health departments should make efforts to contact the infection or TB control staff of local correctional facilities. To facilitate effective collaboration, correctional facilities and public health departments should designate liaisons and have regularly scheduled meetings to discuss correctional TB control issues (Lobato et al., 2004).

Community-based partners, including clinical and social service providers and community correction staff (e.g., probation and parole officers), are vital to the success of release planning efforts. Recently released inmates have a multitude of health- and non-health-related needs, and it is imperative to link them with organizations that are interested and experienced in working with these populations; correctional facilities and public health agencies should make efforts to identify and partner with such organizations. Soon-to-be-released inmates often express a need for help in accessing healthcare services after release and have high expectations of the role that community correction staff will play in helping them gain lawful employment, find substance use treatment programs, stay crime free, or otherwise transition into the community (La Vigne et al., 2004). Parolees meet with their assigned parole officer on a monthly or bimonthly basis; as such, including community correction staff in prerelease TB-related planning, with inmate consent, may facilitate continuity of care (Nelson & Trone, 2000). By participating in release planning for soon-to-be-released inmates with LTBI or TB, community correction staff become more knowledgeable about TB and can assess TB management-related compliance issues with their parolees; as such, they are better able to protect themselves, their clients, and their communities (Hammett et al., 2001; Wilcock et al., 1995). Community correction can also assist public health departments in locating TB cases that are lost to follow-up in the community and are on probation or parole.

Successful TB release planning requires correctional facilities to provide timely and thorough TB diagnostic and treatment information to public health agencies (via mandatory TB case reporting), as well as to community partners involved in postrelease provision of services. Likewise, feedback of postrelease TB follow-up data from public health departments and community partners back to correctional facilities is helpful in maintaining continuity of care, particularly for persons with TB who are reincarcerated. However, there are patient-confidentiality-related restrictions on sharing information across agencies, and local, state, and federal regulations should be followed. Correction, public health, and community partners should inform and reassure inmates of their confidentiality rights. In addition, inmates should be explained the importance and benefits of signing a limited release or consent so that their TB-related information can be shared among appropriate agencies (Hammett et al., 2001). Caution should be taken to share only the information necessary to provide continuity of care.

Components of Comprehensive Release Planning

Incarcerated populations have a complexity of release planning needs. Following release from correctional facilities, reentrants face urgent housing, employment, financial, and other subsistence needs that often take priority over their health care (Hammett et al., 2001). While incarcerated, inmates may lose their employment, housing, eligibility for food stamps, or Medicaid and Social Security benefits. As such, postrelease, reentrants with TB may not have the ability or resources to make or keep follow-up appointments or obtain necessary medications. They may have language, literacy, or cultural barriers, which further complicate their ability to seek care. In addition, reentrants often have mental health or substance use issues that can hinder their ability to access healthcare services. Thus, to be effective, TB release planning efforts must be holistic and tailored to the needs of the reentrant. As such, correctional facility release planning programs should: (1) initiate release planning early; (2) provide case management; (3) obtain detailed postrelease contact information; (4) assess and plan for substance abuse, mental health, and social service needs; (5) make arrangements for postrelease follow-up; (6) make provisions for unplanned release and transfers; and (7) provide education and counseling (CDC, 2006a).

Initiate Release Planning Early

Release planning efforts for inmates diagnosed with TB infection or disease should begin as early as possible during incarceration and continue postrelease to facilitate continuity of care and avoid delays in initiating or resuming TB treatment. Designated release planning staff in the correctional facilities should promptly notify the public health department of all inmates with suspected or confirmed TB disease or inmates receiving TB treatment, even if the inmates have been transferred or released from the facility. Inmates diagnosed with TB disease are of the highest priority for ensuring continuity of care and should be interviewed by public health (preferred) or correctional release planning staff as soon as possible after diagnosis so that the medical discharge and transitional care plans can be developed (CDC, 2006a). Whenever possible, correctional facilities should provide the release planning staff with advance notice about the inmates' projected release dates; this will enable development of a more individualized and thorough plan. Even in short-term detention facilities, where a significant number of inmates may be released within 1–3 days of admission, many critical community TB linkages can be made if the release planners are promptly notified about an inmate with TB.

Early involvement of the inmate in the planning process is integral to the success of the release plan. Inmates may perceive the plan and community linkages as an extension of their punishment in jail or prison and be reluctant or fearful to participate. Release planning staff should work to build a rapport and trusting relationship and to educate the inmates on the benefits of such planning to their health and well-being. Staff should assess the inmates' perceptions of their postrelease needs and priorities and tailor the plan accordingly; inmates may have received release planning before and know what worked or did not work for them in the past. In addition, staff should assess the inmates' expectations of postrelease support from their families, particularly as it relates to their health care. Often soon-to-be-released inmates expect that their families will assist them with accessing health care, finding housing or employment, and finances in the community; however, postrelease, inmates may find that the expected support is not always available (La Vigne, 1994; Vishner et al., 2004). Whenever possible, staff should attempt to include inmate families early in the release planning process and link inmates with additional and varied sources of support (e.g., peer counselors, support groups) (Nelson & Trone, 2000).

Provide Case Management

Comprehensive case management is an essential component of release planning and involves identifying, planning, and facilitating the postrelease services required to meet reentrants' health and social service needs. Case management has been demonstrated to support reentrants in utilizing community healthcare services (Rich et al., 2001), modifying risk behaviors (Rhodes & Gross, 1997), and reducing recidivism (Flanigan et al., 1996). In addition, case management for persons with TB has been shown to improve adherence to TB treatment regimens (Marco et al., 1998) and reduce loss to follow-up in the community (Salomon et al., 1997).

Designated correctional staff should provide case management for inmates with TB infection or disease and work with public health and community partners to ensure continuity of care postrelease (Klopf, 1998). Prerelease case management should include a thorough assessment of the inmate's TB exposure, diagnosis, and therapy history by interviewing the inmate directly and reviewing pertinent medical records. Case managers should review the TB exposure history to identify potential TB contacts either in the correctional facility or community and should inform facility infection control and local public health partners so that contact investigations can be initiated as needed. Case managers should also review the results of all TB diagnostic testing conducted during incarceration, such as IGRA or TST, chest radiograph, sputum smears and cultures, and drug susceptibilities. In addition, TB treatment and medication compliance history during incarceration should be reviewed. Case managers should request the local or state public health department to review their TB registry data for additional information that might be useful in release planning. Comorbid conditions, such as HIV or viral hepatitis, can complicate the treatment regimen and should be addressed in the overall plan by ensuring linkages with appropriate community clinical providers.

Case managers should work with public health and community partners to determine where soon-to-be-released inmates will receive TB follow-up care and obtain necessary medications. Newly released inmates sometimes choose not to return to the neighborhood they lived in before incarceration either to avoid previous influences which led to their incarceration or because their family moved to another location (La Vigne et al., 2004). Additionally, released inmates may wish not to receive medical care in the same neighborhood where they live due to a perceived stigma. Case managers should determine where soon-to-be-released inmates would be able and willing to continue their TB follow-up appointments. Case managers should discuss the importance of the follow-up, and identify and address any potential barriers to inmates being able to keep the appointments.

Obtain Detailed Contact Information

Case managers should emphasize the importance of continuity of care in TB treatment and encourage inmates with LTBI or TB disease to provide accurate postrelease contact information. Case managers should request detailed information from soon-to-be-released inmates, such as: (1) their expected residence, including shelters; (2) names and contact information for friends or relatives; and (3) community locations usually frequented, in order to enable location of the released inmate in the community (White et al., 2002). In addition, case managers should obtain a signed consent from inmates authorizing the case manager and public health department to contact and share TB-related information with worksites, community clinical or social service providers, or community correction staff if necessary (CDC, 2006a).

Inmates may provide contact information based on their expectations of where they will reside postrelease; however, for many reasons, they may need to change their residence after they return to

the community. Alternatively, inmates may intentionally give correctional staff aliases or incorrect contact information because of mistrust or fear of incrimination or deportation (CDC, 2006a). The inability to locate and provide continuity of care for released inmates with LTBI or TB disease can result in incomplete treatment regimens (Nolan et al., 1997) and the risk of transmission or drug resistance (Glaser & Greifinger, 1993). In addition, the use of an alias by an inmate with LTBI or TB disease can hinder continuity of care upon reincarceration and potentially place other inmates and correctional staff at risk. Case managers should confirm contact information, including true identity and any aliases, with inmates on a periodic basis throughout incarceration and immediately before release if possible. Correctional facilities should also develop strategies to confirm an inmate's true identity as quickly as possible after admission to the facility (e.g., using fingerprint-based unique identification number).

Assessment and Plan for Substance Abuse, Mental Health, and Social Service Needs

TB case management efforts must include an assessment of substance abuse, mental health, or social service needs that may adversely influence the inmate's ability to adhere to the TB release plan. Substance abuse and mental health issues are significant barriers to continuity of care postrelease and should be addressed by release planning staff in correctional facilities (Hammett et al., 2001). After release from jail or prison, many reentrants return to their old neighborhoods and are challenged to avoid the same influences or circumstances that led to their recent incarceration, which places them at risk for defaulting on their TB care. Relapse to substance abuse postincarceration often occurs and can impact all aspects of a reentrant's life including their health, housing, relationships, employment, parole conditions, and likelihood of reincarceration (Rich et al., 2001). Inmates with mental illness have similar postrelease conditions as those with substance abuse issues. Without sufficient postrelease support in the community, reentrants with mental illness may have difficulty in coping or with treatment adherence and may experience acute decompensation of their mental status, thus greatly increasing the chances of nonadherence to TB follow-up or treatment. Reentrants with prior drug offenses or mental illness often have difficulty in obtaining permanent housing and risk becoming homeless (Lindblom, 1991), which is a major barrier to completion of TB therapy (LoBue et al., 1999). For inmates with a substance abuse history, case managers should provide referrals to or information about convenient substance abuse treatment programs and peer support group meetings (e.g., Alcoholics or Narcotics Anonymous). In addition, inmates with substance abuse histories are at risk for HIV and viral hepatitis, both of which can affect TB management, and would benefit from referrals to community clinical providers experienced in working with these issues. Inmates with TB who have mental illness require community linkages to mental health treatment programs that are integrated with primary care, substance abuse, and social service providers to best facilitate continuity of care.

Incarceration creates several other barriers for released inmates, which can hinder continuity of TB care. During incarceration, inmates may lose their employment or other sources of income. In addition, inmates often lose health insurance or other government benefits, such as Medicaid, Temporary Assistance for Needy Families, Food Stamps, Supplemental Security Income, or Social Security Disability Insurance, while incarcerated and may have to wait several months postrelease to become eligible again (Bazelon Center for Mental Health Law, 2000). This loss of income and services can adversely impact the inmate's ability to adhere to TB follow-up and treatment in the community. Although federal laws require the suspension of certain benefits during the period of incarceration, many states will terminate the benefits and require inmates to reapply for benefits upon release

(Human Rights Watch, 2003). The requirement to reapply for benefits postrelease can present difficulties for inmates as they must provide documentation that may have been lost or destroyed (e.g., birth certificates, social security card, passport, driver's license, or other photo identification). Many states will allow inmates to apply for reinstatement of benefits in anticipation of release from jail or prison; case managers should assist inmates in obtaining the necessary documentation and completing the required application forms.

Correctional facilities should assist this process by making the inmates' driver's licenses, Medicaid cards, or other forms of photo identification available to the case managers during incarceration, as needed, and to the inmates with their personal property postrelease. In addition, correctional facilities should create agreements with agency partners to facilitate prompt reactivation of these benefits (e.g., with state Department of Motor Vehicles to provide nondriver's license photo identification cards, with local Social Security Administration offices to expedite processing of applications) (Hammett et al., 2001). Case managers should ensure that inmates requiring TB care in the community have access to free TB follow-up appointments and medications immediately postrelease and for as long as they are needed.

Make Arrangements for Postrelease Follow-Up

One of the most critical components of release planning for inmates with LTBI or TB disease is the arrangement of postincarceration follow-up appointments and access to medications. Inmates on LTBI therapy who are released from jail or prison before treatment is completed have low community clinical follow-up and treatment completion rates (Nolan et al., 1997; Tulsky et al., 1998). Inmates with TB are at high risk for not completing their TB treatment regimen (MacNeil et al., 2005). Factors such as homelessness, substance abuse, lack of social support or stability, unemployment, and lower education levels contribute to nonadherence postrelease (Cummings et al., 1998; White et al., 2002). Whenever possible, efforts should be made to have inmates complete their LTBI or TB therapy during incarceration. If this is not feasible, case managers, in collaboration with public health staff, should arrange for postrelease follow-up of inmates with appropriate community-based clinical providers so that treatment can be completed.

Case managers should first create an individualized plan based on interviews with inmates about their perceived postrelease health- and non-health-related needs, review of the medical records, and discussions with appropriate correction, public health, and community correction staff. When deciding where to refer inmates for TB care and substance abuse, mental health, or other social services needs, case managers should attempt to find community providers that can best integrate and coordinate all of these areas. To maximize the likelihood of continuity of care, case managers should ensure that the community-based providers are interested and experienced in meeting ex-inmates' needs and provide services in locations convenient to where inmates anticipate living or working postrelease. Case managers should establish relationships and agreements with community partners to facilitate inmates' utilization of services (e.g., enabling "walk-in services," providing phone or mail appointment reminders, utilizing telehealth services when appropriate, or providing transportation for referred inmates).

A variety of models exist in correctional facilities for linking prerelease inmates to community clinical providers (Hammett et al., 2001). Some involve community providers coming into the jail or prison to provide direct clinical services, establish a therapeutic alliance with the inmates and follow them clinically in the community postrelease (Flanigan et al., 1996). Less intensive models include: (1) community providers working with inmates for only a few months prerelease; (2) inmates not meeting the provider during incarceration, but receiving a set appointment postrelease; and (3) inmates

receiving a prerelease list of clinical providers to contact (Hammett et al.). Correctional facilities that enable community providers to establish a direct therapeutic relationship with inmates during incarceration optimize the likelihood of continuity of care postrelease. Correctional staff should encourage public health and community partners to establish a prerelease relationship with inmates either by providing direct services to inmates during incarceration, or by working closely with the release planning staff to assist in development of the release plan. For some correctional facilities, however, the distance between them and likely community providers presents difficulties to meeting with the inmates prerelease (Hammett et al.). Even in such cases, providing the inmate with a set appointment date can improve compliance with community follow-up (Rich et al., 2001). Additionally, prerelease telehealth visits may facilitate the establishment of a therapeutic relationship and encourage community follow-up postrelease. At minimum, soon-to-be-released inmates should be given a list of community clinical and social service providers and resources.

As part of the release plan, case managers should ensure that all inmates who have been diagnosed with LTBI or TB disease receive community referrals for initiation or continuation of TB treatment. In particular, inmates started on DOT for TB disease or LTBI while incarcerated should continue to be closely monitored by local public health staff who will arrange for the continuation of DOT postrelease until the treatment regimen is completed. Inmates with LTBI who do not require DOT should have uninterrupted access to TB medications postrelease for the duration of their treatment regimen. At minimum, they should be given a sufficient supply of their TB medications until their next TB follow-up appointment in the community (CDC, 2006a). If the anticipated inmate release date and community follow-up appointment date are known, then the case manager can determine the exact amount of medication to provide. If either of these dates is unknown, case managers should work with correction or public health staff to arrange for at least a 2-week to 1-month supply of the TB medications to be available at discharge (Hammett et al., 2001). Providing soon-to-be-released inmates with the actual medication is preferable to giving them a prescription; suspension of health insurance or benefit programs due to incarceration may prevent inmates from being able to fill the prescription soon enough to avoid missing doses. However, if legal, policy, or financial reasons prohibit correctional facilities from providing sufficient amounts of medication for discharge, inmates should be given a prescription to cover the time period from release to the first TB appointment in the community (Hammett et al., 2001). Case managers should also inform inmates about public hospitals and clinics affiliated with state or local health departments that may provide free or low-cost TB care and medications. Regardless of whether medications or prescriptions are given, case managers should ensure that the inmates understand the proper dosing and administration of the TB medications and provide written instructions in the inmates' preferred languages.

Make Provisions for Unplanned Release and Transfers

Correctional facilities should have policies and procedures in place to address unplanned transfers or releases of inmates with LTBI or TB disease (CDC, 2006a). Correctional clinical or release planning staff should create and routinely update a summary health record for all inmates (Re-Entry Policy Council, 2003), particularly those with LTBI or TB disease. The summary health record can be initiated based on the initial health screening and added to as needed. The summary should contain all pertinent medical history; physical examination, radiology, and laboratory results; prescribed medications; scheduled consults or clinical appointments; and postrelease management plans. For inmates with LTBI or TB, the summary health record should contain detailed information on TB exposure

history, diagnostic testing results including IGRA or TST, chest radiograph, sputum smear and cultures, TB therapy, drug susceptibility patterns, and planned postrelease follow-up.

The summary record should be updated throughout the case management and release planning process, based on collaboration with public health and community partners. It should be part of the inmate's medical record and be easily accessible. In addition, staff should ensure that the summary is as complete and up-to-date as possible prior to inmate transfer or release. All inmates being released or transferred from jail or prison should receive a copy of their summary health record, so that they have documentation of the tests or services provided and can share this information with clinical providers upon release (CDC, 2006a).

Correctional release planning staff should promptly notify the public health department of all reentrants into the community with TB disease or those on treatment for LTBI, to ensure continuity of care postrelease. Inmates with LTBI or TB disease, who are being released into the community and do not yet have a comprehensive release plan, should, at minimum, be given their summary health record and a list of community TB providers where they can follow-up postrelease. If the summary record cannot be provided before release, inmates should be informed on how to obtain a copy postrelease. Inmates with LTBI or TB disease who are being transferred to another correctional facility should have all of their TB diagnosis and management information sent to the receiving facility, to avoid duplication of tests or delays in treatment initiation or continuation. Inmates with TB disease who are infectious but are eligible for release or transfer to another medical or correctional facility should remain in AII precautions until they become noninfectious (CDC, 2006a). If AII precautions cannot be maintained during and after the transfer process, facility administrators can consider using a brief "medical hold," so that a follow-up plan can be initiated.

Provide Education and Counseling

Ongoing education and counseling about TB is an important component of release planning and TB control efforts in correctional facilities. Inmates, as well as correctional facility staff, may not fully understand TB transmission, the difference between LTBI and TB disease, and methods of TB prevention and treatment (Woods et al., 1997). In addition, some inmates and staff may still perceive a stigma associated with TB, which may be a barrier to seeking or providing proper TB care (Woods et al., 1997).

TB education, to increase knowledge, and counseling, to change attitudes, have been shown to increase perception of self-efficacy (Morisky et al., 2001) and improve adherence to community TB follow-up visits and completion of treatment regimens postrelease (White et al., 2002). Frequent education sessions were shown to be more effective than a single education session at diagnosis or even financial incentives in facilitating improved adherence to clinic visits and completion of treatment postrelease (White et al., 2002). Inmates on TB treatment should receive ongoing supportive education and counseling about the importance of adhering to the treatment plan after release into the community. Education should be provided in the inmate's preferred language and be culturally sensitive with regard to ethnicity, gender, and age (Goldberg et al., 2004; Hovell et al., 2003; White et al., 2003). Individual TB counseling should be conducted in a private setting if possible (White et al., 2003), so that inmates feel comfortable discussing their questions or concerns. Case managers should ensure that inmates are active participants in the development of the TB release plan and provide feedback into their motivations or challenges regarding treatment and adherence.

Community-Based Case Management After Release

The first 24 h after release from a correctional facility are critical to an ex-inmate's success with reentry into the community (Mitty et al., 1998). Reentrants returning to the same neighborhood where they lived prior to incarceration may be exposed to the same circumstances and influences that led to their arrest. Additionally, at the time of release from jail or prison, reentrants may not have adequate food, clothing, shelter, or financial resources; thus, health care becomes less of a priority than these other urgent needs. Therefore, it is imperative that the case management process begun in the correctional facility be continued after release, particularly for ex-inmates with suspected or confirmed TB disease, LTBI who are at high risk for progression to disease, or those who are on TB treatment (CDC, 2006a). Former inmates may experience a lack of social stability and support after reentry into the community; often they find that their community case manager is a much-needed source of support and encouragement (Rhodes & Gross, 1997). As such, public health and community partners should attempt to make contact with reentrants within the first week of release to assist with general transition issues and ensure continuity of TB care as prescribed in the release plan created in the correctional facility. Case management that is culturally sensitive and serves reentrant-defined needs, along with TB control needs, has been shown to improve completion rates for therapy (Goldberg et al., 2004). Public health and community partners should also work with community correction staff to ensure that ex-inmates adhere to their follow-up TB clinic visits and medication regimens.

DOT for active TB or LTBI, both in the correctional setting and postrelease, is a strategy for facilitating adherence to TB treatment regimens. DOT initiated in the correctional facility provides an opportunity for education and counseling and establishes the medication as routine (CDC, 2006a). The continuation of DOT postrelease may enhance compliance and reduce relapse rates and acquired drug resistance (Nolan et al., 1997). Implementation of DOT in conjunction with housing programs has been effective in improving TB therapy outcomes in homeless populations (LoBue et al., 1999).

Incentives and enablers are another strategy that case managers can use to promote adherence to TB treatment. Incentives are items or services that encourage individuals to complete TB treatment by motivating them with something they want or need (e.g., food, money, and clothing). Enablers help clients overcome barriers to completing their TB treatment (e.g., transportation, stable housing, service programs). Incentives and enablers, combined with education and counseling, have been shown to improve adherence to TB follow-up appointments and treatment completion in incarcerated populations (Frieden et al., 1995; Tulsky et al., 1998; White et al., 1998, 2002). Financial incentives are believed to be most effective for promoting adherence (Giuffrida & Torgerson, 1997). Recent data suggest that financial incentives may be helpful in adherence to initial follow-up clinic visits, but that ongoing education and counseling may be more effective in facilitating completion of TB treatment regimen (Pilote et al., 1996; White et al., 2002).

Comprehensive release planning and community linkages have been shown to reduce recidivism rates (Flanigan et al., 1996). Despite these successes, approximately two-thirds of all parolees are rearrested within 3 years; most are rearrested within the first 6 months after release. Thus, case management after release is critical for continuity of care in the event of reincarceration, particularly for inmates who are still taking TB treatment when rearrested.

TB Control Program Evaluation

Correctional facilities should conduct a program evaluation of their TB control program to determine if stated and desired TB prevention and control goals are being met. The program evaluation should include a systematic assessment of TB program goals, activities, and outcomes. In addition, local TB

epidemiology data (e.g., TB case rates, demographics of TB cases, local drug susceptibility data) should be used to inform the evaluation. Data from the program evaluation should be used to guide program planning and policy. Guidelines on conducting a TB program evaluation in correctional facilities have been published (CDC, 2006a).

Conclusion

TB in any segment of the population endangers every member of society (Laniado-Laborin, 2001). Correctional facilities are part of our communities, not separate from them (Hammett et al., 2001). If the goal of TB elimination is ever to be achieved, increased attention must be given to incarcerated populations in which the prevalence and transmission risk of TB are high. The early screening, diagnosis, isolation, and treatment of inmates with TB must be prioritized. In addition, continuity of care must be provided throughout incarceration and postrelease through effective TB transitional care planning and case management. Collaboration between correction, public health, and community partners is essential, and this ensures the greatest chance of success in the prevention, control, and ultimately, elimination of TB.

References

Abrahao, R. M., Nogueira, P. A., & Malucelli, M. I. (2006). Tuberculosis in county jail prisoners in the western sector of the city of Sao Paulo, Brazil. *The International Journal of Tuberculosis and Lung Disease, 10*(2), 203–208.

Adib, S. M., Al-Takash, H., & Al-Hajj, C. (1999). Tuberculosis in Lebanese jails: Prevalence and risk factors. *European Journal of Epidemiology, 15*(3), 253–260.

American Academy of Pediatrics. Committee on Infectious Diseases,, Kimberlin, D. W., Brady, M. T., Jackson, M. A., & Long, S. S. (2018). Red book: 2018–2021 report of the Committee on Infectious Diseases (31st edition.). Elk Grove Village, IL: American Academy of Pediatrics.

American Society of Heating, Refrigerating, and Air-Conditioning Engineers. (2003). Justice facilities. In *ASHRAE handbook: HVAC applications* (pp. 8.1–8.3). American Society of Heating, Refrigerating, and Air-Conditioning Engineers.

American Thoracic Society. (2000). Diagnostic standards and classification of tuberculosis in adults and children. *American Journal of Respiratory and Critical Care Medicine, 161*, 1376–1395.

American Thoracic Society, Centers for Disease Control and Prevention, and Infectious Diseases Society of America. (2003). Treatment of tuberculosis. *MMWR, 52*(RR-11), 1–77.

Barclay, R., & Wheeler, P. R. (1989). Metabolism of mycobacteria in tissues. In C. Ratledge, J. Stanford, & J. M. Grange (Eds.), *Clinical aspects of mycobacterial disease* (pp. 37–106). Academic Press.

Bazelon Center for Mental Health Law. (2000). *Finding the key to successful transition from jail to community*. Available from URL: http://www.ich.gov/innovations/1/index.html

Bellin, E. Y., Fletcher, D. D., & Safyer, S. M. (1993). Association of tuberculosis infection with increased time in or admission to the New York City jail system. *The Journal of American Medical Association, 269*, 2228–2231.

Bur, S., Golub, J. E., Armstrong, J. A., Myers, K., Johnson, B. H., Mazo, D., et al. (2003). Evaluation of an extensive tuberculosis contact investigation in an urban community and jail. *The International Journal of Tuberculosis and Lung Disease, 7*, S417–S423.

Bureau of Justice Statistics. (2005). *Adult correctional populations, 1980–2004*. U.S. Department of Justice, Office of Justice Programs. Available at http://www.ojp.usdoj.gov/bjs/glance/corr2.htm

Carbonara, S., Babudieri, S., Longo, B., Starnini, G., Monarca, R., Brunetti, B., et al. (2005). Correlates of *Mycobacterium tuberculosis* infection in a prison population. *The European Respiratory Journal, 25*, 1070–1076.

Centers for Disease Control and Prevention. (1992a). Transmission of multidrug-resistant tuberculosis among immunocompromised persons in a correctional system-New York, 1991. *MMWR, 41*(28), 507–509.

Centers for Disease Control and Prevention. (1992b). Tuberculosis transmission in a state correctional institution – California, 1990–1991. *MMWR, 41*(49), 927–929.

Centers for Disease Control and Prevention. (1992c). National action plan to combat multidrug-resistant tuberculosis. *MMWR, 41*(RR-11), 1–48.

Centers for Disease Control and Prevention. (1994). Guidelines for preventing the transmission of *Mycobacterium tuberculosis* in health-care facilities. *MMWR, 43*(RR-13), 1–132.
Centers for Disease Control and Prevention. (1996a). The role of BCG in the prevention and control of tuberculosis in the United States. *MMWR, 45*(RR-4), 1–18.
Centers for Disease Control and Prevention. (1996b). Anergy skin testing and tuberculosis preventive therapy for HIV-infected persons: Revised recommendations. *MMWR, 46*(RR-15), 1–10.
Centers for Disease Control and Prevention. (1998). Prevention and treatment of tuberculosis among patients infected with Human Immunodeficiency Virus: Principles of therapy and revised recommendations. *MMWR, 47*(RR-20), 1–78.
Centers for Disease Control and Prevention. (1999a). Tuberculosis elimination revisited: Obstacles, opportunities, and a renewed commitment – Advisory Council for the Elimination of Tuberculosis (ACET). *MMWR, 48*(RR-9), 1–13.
Centers for Disease Control and Prevention. (1999b). Tuberculosis outbreaks in prison housing units for HIV-infected inmates – California, 1995–1996. *MMWR, 48*(4), 79–82.
Centers for Disease Control and Prevention. (1999c). *TB respiratory protection program in health care facilities*. Available at http://www.cdc.gov/niosh/99–143.html
Centers for Disease Control and Prevention. (2000a). Drug-susceptible tuberculosis outbreak in a state correctional facility housing HIV-infected inmates – South Carolina, 1999–2000. *MMWR, 49*(46), 1041–1044.
Centers for Disease Control and Prevention. (2000b). Targeted tuberculosis testing and treatment of latent tuberculosis infection. *MMWR, 49*(RR-6), 1–54.
Centers for Disease Control and Prevention. (2001). *Helping inmates return to the community*. Available at http://www.cdc.gov/idu/facts/cj-transition.htm
Centers for Disease Control and Prevention. (2003a). Rapid assessment of tuberculosis in a large prison system – Botswana, 2002. *MMWR, 52*(12), 250–252.
Centers for Disease Control and Prevention. (2003b). Guidelines for environmental infection control in health-care facilities: Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). *MMWR, 52*(RR-10), 1–42.
Centers for Disease Control and Prevention. (2003c). Update: Adverse Event Data and Revised American Thoracic Society/CDC recommendations against the use of rifampin and pyrazinamide for treatment of latent tuberculosis infection – United States, 2003. *MMWR, 52*(31), 735–739.
Centers for Disease Control and Prevention. (2004a). Tuberculosis associated with blocking agents against tumor necrosis factor-alpha – California, 2002–2003. *MMWR, 53*(30), 683–686.
Centers for Disease Control and Prevention. (2004b). Tuberculosis transmission in multiple correctional facilities – Kansas, 2002–2003. *MMWR, 53*, 734–738.
Centers for Disease Control and Prevention. (2005a). Guidelines for preventing the transmission of Mycobacterium tuberculosis in health-care settings. *MMWR, 54*(RR-17), 1–141.
Centers for Disease Control and Prevention. (2005b). Guidelines for the investigation of contacts of persons with infectious tuberculosis: Recommendations from the National Tuberculosis Controllers Association and CDC. *MMWR, 54*(RR-15), 1–37.
Centers for Disease Control and Prevention. (2005c). Guidelines for using the QuantiFERON®-TB Gold test for detecting *Mycobacterium tuberculosis* infection, United States. *MMWR, 54*(RR-15), 49–55.
Centers for Disease Control and Prevention. (2005d). Guidelines for preventing the transmission of *Mycobacterium tuberculosis* in health-care settings, 2005. *Morbidity and Mortality Weekly Report, 54*(17), 4–5.
Centers for Disease Control and Prevention. (2006a). Prevention and control of tuberculosis in correctional and detention facilities: Recommendations from CDC. *MMWR, 55*(RR-9), 1–44.
Centers for Disease Control and Prevention. (2006b). Emergence of *Mycobacterium tuberculosis* with extensive resistance to second-line drugs – Worldwide, 2000–2004. *MMWR, 55*(11), 301–305.
Centers for Disease Control and Prevention. (2007). Extensively drug-resistant tuberculosis – United States, 1993–2006. *MMWR, 56*(11), 250–253.
Centers for Disease Control and Prevention. (2010). Updated guidelines for using interferon gamma release assays to detect Mycobacterium tuberculosis infection --- United States, 2010. *MMWR, 59*(RR05), 1–25.
Centers for Disease Control and Prevention. (2020a). *Latent TB infection and TB disease*. Available at https://www.cdc.gov/tb/topic/basics/tbinfectiondisease.htm
Centers for Disease Control and Prevention. (2020b). *Tuberculin skin testing*. Available at https://www.cdc.gov/tb/publications/factsheets/testing/skintesting.pdf
Committee on Prophylaxis, International Union Against Tuberculosis. (1982). Efficacy of various durations of isoniazid preventive therapy for tuberculosis: Five years of follow-up in the IUAT trial. *Bulletin of the World Health Organization, 60*, 555–564.
Coninx, R., Pfyffer, G. E., Mathieu, C., Savina, D., Debacker, M., Jafarov, F., et al. (1998). Drug resistant tuberculosis in prisons in Azerbaijan: Case study. *British Medical Journal, 316*, 1423–1425.
Coninx, R., Maher, D., Reyes, H., & Grzemska, M. (2000). Tuberculosis in prisons in countries with high prevalence. *British Medical Journal, 320*, 440–442.

Cummings, K. C., Mohle-Boetani, J., Royce, S. E., & Chin, D. P. (1998). Movement of tuberculosis patients and the failure to complete antituberculosis treatment. *American Journal of Respiratory and Critical Care Medicine, 157*(4), 1249–1252.

Dye, C., & Floyd, K. (2006). Tuberculosis. In D. T. Jamison, J. G. Breman, A. R. Measham, G. Alleyne, M. Claeson, D. B. Evans, P. Jha, A. Mills, & P. Musgrove (Eds.), *Disease control priorities in developing countries* (2nd ed., pp. 271–287). The World Bank Group.

Flanigan, T. P., Kim, J. Y., Zierler, S., Rich, J., Vigilante, K., & Bury-Maynard, D. (1996). A prison release program for HIV-positive women: Linking them to health services and community follow-up. *American Journal of Public Health, 86*(6), 886–887.

Food and Drug Administration. (2008). T-SPOT®.TB Test. PMA P070006: FDA Summary of Safety and Effectiveness Data, pp. 1–23.

Food and Drug Administration. (2019). LIAISON QuantiFERON-TB Gold Plus, LIAISON Control QuantiFERON-TB Gold Plus, LIAISON QuantiFERON Software. PMA P180047: FDA Summary of Safety and Effectiveness Data, pp. 1–45.

Frieden, T. R., Fujiwara, P. I., Washko, R. M., & Hamburg, M. A. (1995). Tuberculosis in New York City – Turning the tide. *The New England Journal of Medicine, 333*, 229–233.

Garner, J. S. (1996). Guideline for isolation precautions in hospitals. The Hospital Infection Control Practices Advisory Committee. *Infection Control and Hospital Epidemiology, 17*(1), 53–80.

Giuffrida, A., & Torgerson, D. J. (1997). Should we pay the patient? Review of financial incentives to enhance patient compliance. *British Medical Journal, 315*, 703–707.

Glaser, J. B., & Greifinger, R. B. (1993). Correctional health care: A public health opportunity. *Annals of Internal Medicine, 118*(2), 139–145.

Goldberg, S. V., Wallace, J., Jackson, J. C., Chaulk, C. P., & Nolan, C. M. (2004). Cultural case management of latent tuberculosis infection. *The International Journal of Tuberculosis and Lung Disease, 8*(1), 76–82.

Golub, J. E., Cronin, W. A., Obasanjo, O. O., Coggin, W., Moore, K., Pope, D. S., et al. (2001). Transmission of *Mycobacterium tuberculosis* through casual contact with an infectious case. *Archives of Internal Medicine, 161*, 2254–2258.

Hammett, T. M., Gaiter, J. L., & Crawford, C. (1998). Reaching seriously at-risk populations: Health interventions in criminal justice settings. *Health Education & Behavior, 25*(1), 99–120.

Hammett, T. M., Roberts, C., & Kennedy, S. (2001). Health-related issues in prisoner reentry. *Crime & Delinquency, 47*(3), 390–409.

Hammett, T. M., Harmon, M. P., & Rhodes, W. (2002). The burden of infectious disease among inmates of and releasees from US correctional facilities, 1997. *American Journal of Public Health, 92*(11), 1789–1794.

Hovell, M. F., Sipan, C. L., Blumberg, E. J., Hofstetter, C. R., Slymen, D., Friedman, L., et al. (2003). Increasing Latino adolescents' adherence to treatment for latent tuberculosis infection: A controlled trial. *American Journal of Public Health, 93*(11), 1871–1877.

Human Rights Watch. (2003). *Ill-equipped: U.S. prisons and offenders with mental illness*. Available at http://www.hrw.org/reports/2003/usa1003/

Ikeda, R. M., Birkhead, G. S., DiFerdinando, G. T., Jr., Bornstein, D. L., Dooley, S. W., Kubica, G. P., et al. (1995). Nosocomial tuberculosis: An outbreak of a strain resistant to seven drugs. *Infection Control and Hospital Epidemiology, 16*, 152–159.

Institute of Medicine. 2000. Ending Neglect: The Elimination of Tuberculosis in the United States. Washington, DC: The National Academies Press. https://doi.org/10.17226/9837.

Jones, T. F., & Schaffner, W. (2001). Miniature chest radiograph screening for tuberculosis in jails: A cost-effective analysis. *American Journal of Respiratory and Critical Care Medicine, 164*, 77–81.

Jones, T. F., Craig, A. S., Valway, S. E., Woodley, C. L., & Schaffner, W. (1999). Transmission of tuberculosis in a jail. *Annals of Internal Medicine, 131*, 557–563.

Jones, T. F., Woodley, C. L., Fountain, F. F., & Schaffner, W. (2003). Increased incidence of the outbreak strain of *Mycobacterium tuberculosis* in the surrounding community after an outbreak in a jail. *The Southern Medical Journal, 96*, 155–157.

Katyal, M., Leibowitz, R., & Venters, H. (2018). IGRA-based screening for latent tuberculosis infection in persons newly incarcerated in New York City jails. *Journal of Correctional Health Care, 24*(2), 156–170. https://doi.org/10.1177/1078345818763868. Epub 2018 Apr 10.

Kenyon, T. A., Ridzon, R., Luskin-Hawk, R., Schultz, C., Paul, W. S., Valway, S. E., et al. (1997). A nosocomial outbreak of multidrug-resistant tuberculosis. *Annals of Internal Medicine, 127*, 32–36.

Klopf, L. C. (1998). Tuberculosis control in the New York State Department of Correctional Services: A case management approach. *American Journal of Infection Control, 26*(5), 534–537.

Koo, D. T., Baron, R. C., & Rutherford, G. W. (1997). Transmission of *Mycobacterium tuberculosis* in a California state prison, 1991. *American Journal of Public Health, 87*, 279–282.

La Vigne, N. G., Visher, C., & Castro, J. (2004). *Chicago prisoners' experiences returning home*. The Urban Institute. Available at http://www.urban.org/url.cfm?ID=311115

Laniado-Laborin, R. (2001). Tuberculosis in correctional facilities: A nightmare without end in sight. *Chest, 119*, 681–683.

Layton, M. C., Henning, K., Alexander, T., Gooding, A., Reid, C., Heyman, B., et al. (1997). Universal radiographic screening for tuberculosis among inmates upon admission to jails. *American Journal of Public Health, 87*, 1335–1337.

Lindblom, E. N. (1991). Toward a comprehensive homelessness-prevention strategy. *Housing Policy Debate, 2*(3), 957–1025.

Lobato, M., Roberts, C., Bazerman, L., & Hammett, T. (2004). Public health and correctional collaboration in tuberculosis control. *American Journal of Preventive Medicine, 27*(2), 112–117.

LoBue, P. A., Cass, R., Lobo, D., Moser, K., & Catanzaro, A. (1999). Development of housing programs to aid in the treatment of tuberculosis in homeless individuals: A pilot study. *Chest, 115*, 218–223.

MacIntyre, C. R., Kendig, N., Kummer, L., Birago, S., & Graham, N. M. (1997). Impact of tuberculosis control measures and crowding on the incidence of tuberculosis infection in Maryland prisons. *Clinical Infectious Disease, 24*, 1060–1067.

MacIntyre, C. R., Kendig, N., Kummer, L., Birago, S., Graham, N. M., & Plant, A. J. (1999). Unrecognised transmission of tuberculosis in prisons. *European Journal of Epidemiology, 15*, 705–709.

MacNeil, J., Lobato, M. N., & Moore, M. (2005). An unanswered health disparity: Tuberculosis among correctional inmates, 1993 through 2003. *American Journal of Public Health, 95*, 1800–1805.

Maher, D., & Raviglione, M. (2005). Global epidemiology of tuberculosis. *Clinics in Chest Medicine, 26*(2), 167–182.

Marco, A., Cayla, J. A., Serra, M., Pedro, R., Sanrama, C., Guerrero, R., et al. (1998). Predictors of adherence to tuberculosis treatment in a supervised therapy programme for prisoners before and after release. Study Group of Adherence to Tuberculosis Treatment of Prisoners. *The European Respiratory Journal, 12*, 967–971.

Mitty, J. A., Holmes, L., Spaulding, A., Flanigan, T., & Page, J. (1998). Transitioning HIV-infected women after release from incarceration: Two models for bridging the gap. *Journal of Correctional Health Care, 5*(2), 239–254.

Mohle-Boetani, J. C., Miguelino, V., Dewsnup, D. H., Desmond, E., Horowitz, E., Waterman, S. H., et al. (2002). Tuberculosis outbreak in a housing unit for human immunodeficiency virus-infected patients in a correctional facility: Transmission risk factors and effective outbreak control. *Clinical Infectious Disease, 34*, 668–676.

Morisky, D. E., Malotte, C. K., Ebin, V., Davidson, P., Cabrera, D., Trout, P. T., et al. (2001). Behavioral interventions for the control of tuberculosis among adolescents. *Public Health Reports, 116*(6), 568–574.

Mazurek GH, Jereb J, Vernon A, et al. (2010). Updated guidelines for using Interferon Gamma Release Assays to detect Mycobacterium tuberculosis infection - United States, 2010. *MMWR Recomm Rep. 59*(RR-5):1–25.

Nahid, P., Dorman, S. E., Alipanah, N., Barry, P. M., Brozek, J. L., Cattamanchi, A., Chaisson, L. H., Chaisson, R. E., Daley, C. L., Grzemska, M., Higashi, J. M., Ho, C. S., Hopewell, P. C., Keshavjee, S. A., Lienhardt, C., Menzies, R., Merrifield, C., Narita, M., O'Brien, R., Peloquin, C. A., … Vernon, A. (2016). Official American Thoracic Society/Centers for Disease Control and Prevention/Infectious Diseases Society of America clinical practice guidelines: Treatment of drug-susceptible tuberculosis. *Clinical Infectious Diseases: an official publication of the Infectious Diseases Society of America, 63*(7), e147–e195. https://doi.org/10.1093/cid/ciw376

National Commission on Correctional Health Care. (2003a). *Standards for health services in jails*. National Commission on Correctional Health Care.

National Commission on Correctional Health Care. (2003b). *Standards for health services in prisons*. National Commission on Correctional Health Care.

Nelson, M., & Trone, J. (2000). Why planning for release matters. *Vera Institute for Justice*. Available at http://www.vera.org/publication_pdf/planning_for_release.pdf

Nolan, C. M., Roll, L., Goldberg, S. V., & Elarth, A. M. (1997). Directly observed isoniazid preventive therapy for released jail inmates. *American Journal of Respiratory and Critical Care Medicine, 155*, 583–586.

Pai, M. (2005). Alternatives to the tuberculin skin test: Interferon-γ assays in the diagnosis of Mycobacterium tuberculosis infection. *Indian Journal of Medical Microbiology, 23*(3), 151–158.

Pai, M., Riley, L. W., & Colford, J. M. (2004). Interferon-γ assays in the immuno-diagnosis of tuberculosis: A systematic review. *The Lancet Infectious Disease, 4*, 761–776.

Pai, M., Gokhale, K., Joshi, R., Dogra, S., Kalantri, S., Mendiratta, D. K., et al. (2005). *Mycobacterium tuberculosis* infection in health care workers in rural India: Comparison of a whole-blood interferon g assay with tuberculin skin testing. *The Journal of American Medical Association, 293*, 2746–2755.

Pai, M., Kalantri, S., & Dheda, K. (2006). New tools and emerging technologies for the diagnosis of tuberculosis: Part I. Latent tuberculosis. *Expert Review of Molecular Diagnostics, 6*(3), 413–422.

Pilote, L., Tulsky, J. P., Zolopa, A. R., Hahn, J. A., Schecter, G. F., & Moss, A. R. (1996). Tuberculosis prophylaxis in the homeless. A trial to improve adherence to referral. *Archives of Internal Medicine, 156*(2), 161–165.

Prison Policy Initiative. (2019). *Annual releases from state prisons and local jails, by sex and state*. Available at https://www.prisonpolicy.org/data/releases_sex_state.xlsx

Puisis, M., Feinglass, J., Lidow, E., & Mansour, M. (1996). Radiographic screening for tuberculosis in a large urban county jail. *Public Health Reports, 111*, 330–334.

Re-Entry Policy Council. (2003). *Charting the safe and successful return of prisoners to the community*. Available at http://www.reentrypolicy.org/reentry/THE_REPORT.aspx

Rhodes, W., & Gross, M. (1997). Case management reduces drug use and criminality among drug-involved arrestees: An experimental study of an HIV prevention intervention. *NIJ Research Report*, 1–50.

Rich, J. D., Holmes, L., Salas, C., Macalino, G., Davis, D., Ryczek, J., et al. (2001). Successful linkage of medical care and community services for HIV-positive offenders being released from prison. *Journal of Urban Health, 78*(2), 279–289.

Richeldi, L., Ewer, K., Losi, M., Bergamini, B. M., Roversi, P., Deeks, J., et al. (2004). T cell-based tracking of multidrug resistant tuberculosis infection after brief exposure. *American Journal of Respiratory and Critical Care Medicine, 170*, 288–295.

Salomon, N., Perlman, D. C., Rubenstein, A., Mandelman, D., McKinley, F. W., & Yancovitz, S. R. (1997). Implementation of universal directly observed therapy at a New York City hospital and evaluation of an out-patient directly observed therapy program. *The International Journal of Tuberculosis and Lung Disease, 1*(5), 397–404.

Saunders, D. L., Olive, D. M., Wallace, S. B., Lacy, D., Leyba, R., & Kendig, N. E. (2001). Tuberculosis screening in the federal prison system: An opportunity to treat and prevent tuberculosis in foreign-born populations. *Public Health Reports, 116*(3), 210–218.

Sherris, J. C., & Plorde, J. J. (1990). Mycobacteria. In *Medical microbiology* (2nd ed., pp. 443–461).

Stead, W. W. (1978). Undetected tuberculosis in prison: Source of infection for community at large. *The Journal of American Medical Association, 240*, 2544–2547.

Steenland, K., Levine, A. J., Sieber, K., Schulte, P., & Aziz, D. (1997). Incidence of tuberculosis infection among New York State prison employees. *American Journal of Public Health, 87*(12), 2012–2014.

Sterling, T. R., Njie, G., Zenner, D., Cohn, D. L., Reves, R., Ahmed, A., et al. (2020). Guidelines for the treatment of latent tuberculosis infection: Recommendations from the National Tuberculosis Controllers Association and CDC, 2020. *MMWR Recommendations and Reports, 69*(RR-1), 1–11. https://doi.org/10.15585/mmwr.rr6901a1

Todar, K. (2005). *Todar's online textbook of bacteriology*. Available at http://text-bookofbacteriology.net/tuberculosis.html

Tulsky, J. P., White, M. C., Dawson, C., Hoynes, T. M., Goldenson, J., & Schecter, G. (1998). Screening for tuberculosis in jail and clinic follow-up after release. *American Journal of Public Health, 88*(2), 223–226.

U.S. Department of Justice. *Prison and jail inmates at midyear 2003*. Bureau of Justice Statistics Bulletin: 2004. NCJ 203947.

Valway, S. E., Greifinger, R. B., Papania, M., Kilburn, J. O., Woodley, C., DiFerdinando, G. T., et al. (1994a). Multidrug resistant tuberculosis in the New York state prison system, 1990–1991. *The Journal of Infectious Disease, 170*, 151–156.

Valway, S. E., Richards, S. B., Kovacovich, J., Greifinger, R. B., Crawford, J. T., & Dooley, S. W. (1994b). Outbreak of multi-drug-resistant tuberculosis in a New York state prison, 1991. *American Journal of Epidemiology, 140*(2), 113–122.

Vishner, C., Kachnowski, V., La Vigne, N., & Travis, J. (2004). *Baltimore prisoners' experiences returning home*. The Urban Institute. Available at http://www.urban.org/UploadedPDF/310946_BaltimorePrisoners.pdf

Walmsley, R. (2018). *World Prison Population List, 12th Edition*. Available at: https://www.prisonstudies.org/sites/default/files/resources/downloads/wppl_12.pdf

Wayne, L. G., & Hayes, L. G. (1996). An in vitro model for sequential study of shift-down of Mycobacterium tuberculosis through two stages of nonreplicating persistence. *Infection and Immunity, 64*(6), 2062–2069.

White, M. C., Tulsky, J. P., McIntosh, H. W., Hoynes, T. M., & Goldenson, J. (1998). A clinical trial of a financial incentive to go to the tuberculosis clinic for isoniazid after release from jail. *The International Journal of Tuberculosis and Lung Disease, 2*, 506–512.

White, M. C., Tulsky, J. P., Portillo, C. J., Menendez, E., Cruz, E., & Goldenson, J. (2001). Tuberculosis prevalence in an urban jail: 1994 and 1998. *The International Journal of Tuberculosis and Lung Disease, 5*, 400–404.

White, M. C., Tulsky, J. P., Goldenson, J., Portillo, C. J., Kawamura, M., & Menendez, E. (2002). Randomized controlled trial of interventions to improve follow-up for latent tuberculosis infection after release from jail. *Archives of Internal Medicine, 162*, 1044–1050.

White, M. C., Duong, T. M., Cruz, E. S., Rodas, A., McCall, C., Menendez, E., et al. (2003). Strategies for effective education in a jail setting: The tuberculosis prevention project. *Health Promotion Practice, 4*(4), 422–429.

Wilcock, K., Hammett, T. M., & Parent, D. G. (1995). *Controlling tuberculosis in community corrections* (pp. 1–11). National Institute of Justice: Research in Action.

Woods, G. L., Harris, S. L., & Solomon, D. (1997). Tuberculosis knowledge and beliefs among prison inmates and lay employees. *Journal of Correctional Health Care, 4*(1), 61–71.

World Health Organization. (2006). *Emergence of XDR-TB*. Available at http://www.who.int/mediacentre/news/notes/2006/np23/en/index.html