Tuberculosis Screening in the Federal Prison System: An Opportunity to Treat and Prevent Tuberculosis in Foreign-Born Populations

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SYNOPSIS

Objectives. Despite recent success in tuberculosis (TB) control efforts in the United States, marked declines in TB case rates have not been observed in foreign-born populations. Because foreign-born populations are becoming more important for targeted national TB control efforts, the Federal Bureau of Prisons (BOP) reviewed inmate medical data to evaluate risk factors associated with *Mycobacterium tuberculosis* infection and active TB disease. To improve screening strategies, BOP implemented chest radiograph screening for all inmates entering a federal detention center in San Diego, California.

Methods. Tuberculin skin test (TST) data from an approximated intake cohort of inmates entering the system from February 1 to June 30, 1999, were analyzed to assess risk factors for *M. tuberculosis* infection among inmates entering federal prisons. The most recent case reports of inmates diagnosed with TB disease were reviewed. All inmates entering a San Diego detention facility from July 1 to December 31, 1998, were screened for TB by symptom review, TST, and chest radiographs.

Results. System-wide, foreign-born inmates were 5.9 times more likely to have a positive TST than US-born inmates, and accounted for 60% of recently diagnosed TB cases. Chest radiograph screening of all inmates entering the San Diego facility reduced exposure time to active TB cases by 75%, but TB incidence remained unchanged.

Conclusions. The high prevalence of *M. tuberculosis* infection and TB disease among foreign-born inmates entering the federal prison system presents a strategic opportunity to provide preventive therapy to a high-risk population and to identify contagious cases that might elude traditional public health efforts. Universal chest radiograph screening was no more sensitive than TST for detecting active TB cases among newly incarcerated foreign-born inmates with a high prevalence of TB infection, but the screening reduced potential TB exposures through rapid identification of contagious cases.

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From 1992 to 1999, the incidence of tuberculosis (TB) in the United States decreased by 49%, largely as a result of declines in reported TB cases in US-born populations.[1] Comparable declines in TB case rates were not observed among foreign-born populations. If this trend continues, most TB cases diagnosed during the next decade in the United States will be foreign-born people.

Because foreign-born populations are becoming a more and more important group for targeted national TB control efforts, the Federal Bureau of Prisons (BOP) evaluated system-wide tuberculin skin test (TST) and TB case data to assess the prevalence of *Mycobacterium tuberculosis* infection and the incidence of active TB disease among foreign-born inmates. To improve the effectiveness of TB screening strategies among foreign-born inmates, BOP also implemented universal chest radiograph screening, together with TST and symptom screening, for all inmates entering a San Diego detention center with a high proportion of foreign-born inmates. Although a few large urban jails with a high incidence of TB disease have successfully employed chest radiograph screening for all new entrants, data comparing the sensitivity of universal chest radiograph screening with TST in the correctional setting are sparse.[2–4]

METHODS

The Bureau of Prisons operated 94 institutions throughout the United States at the end of fiscal year 1998, with an inmate population of 108,207. Eight of these institutions were designated federal detention centers, serving as a principal but not exclusive point of entry for inmates into the federal system, and with an estimated population of up to 10,000 inmates at any given time. An additional 14,109 inmates under BOP jurisdiction were housed in contract facilities. Of the total inmate population, 92.5% were male and 7.5% were female; the average age was 37 years. Nearly 58% of inmates were white, 40% were black, 30% were Hispanic, and 70% non-Hispanic. Approximately 28% of inmates came from foreign countries. The remaining 2% were Asian and Native American inmates. The racial and ethnic distribution varied considerably among institutions.

Human immunodeficiency virus (HIV) seroprevalence for the federal prison system is estimated at 1.0%, based on periodic randomized HIV testing of the BOP inmate population (unpublished data). The length of stay for inmates varies considerably between short-term federal detention centers or jails, where inmates are usually incarcerated for days to months, and long-term facilities or prisons, where inmates are usually incarcerated from months to years. Although many inmates enter BOP through its detention centers, initial incarceration and TB screening of inmates can occur at any BOP facility.

Bureau of Prisons tuberculosis screening program

Inmates entering BOP correctional institutions are routinely screened by trained clinicians for symptoms of TB disease: productive cough (> 3 weeks), chest pain, hemoptysis, weight loss, night sweats, and fever. Within 48 hours of incarceration, trained medical personnel administer and read screening TSTs using the Mantoux method. The TST test is administered by the intradermal injection of 0.1 ml of 5 tuberculin units of purified protein derivative (PPD) solution (Tubersol) into the left volar forearm in accordance with established BOP guidelines.[5] The TST test results are read after 48 to 72 hours by palpation and measurement of induration. Prior bacille Calmette-Guérin (BCG) vaccination, pregnancy, or an undocumented history of a positive TST are not contraindications for a repeat TST. Inmates with TST reactions of at least 10 mm induration or who have HIV infection are further screened with a posterior-anterior view chest radiograph. The TSTs are also performed for the following indications: as a component of annual surveillance for all inmates with previously negative tests, as a diagnostic test when TB is clinically suspected, and during contact investigations of active TB cases to assess transmission of *M. tuberculosis*. Interpretation of the TSTs and indications for antibiotic prophylaxis are determined on the basis of Centers for Disease Control and Prevention (CDC) guidelines.[6–8] For all inmates who have had contact with someone known to have active TB and all immunocompromised inmates, a reading of at least 5 mm is considered a positive TST. For all other inmates, 10 mm is considered positive.

Beginning in July 1998, a BOP detention center in San Diego, California, initiated chest radiograph screening for all new inmates and continued TB screening by symptom review and tuberculin skin testing. Men and women received the same screening procedures, with the exception that chest radiography for women was delayed until pregnancy test results could be obtained, generally within 24 to 48 hours of incarceration. Trained clinicians at the institution prescreened all radiographs; when radiograph abnormalities were identified, inmates remained isolated in a negative pressure room until they could be transported to a community hospital for further diagnostic workup . Contract radiologists at community hospitals evaluated prescreened normal radiographs within 24 to 48

hours and prescreened abnormal radiographs suspicious for pulmonary TB within 24 hours.

Tuberculosis data collection

The BOP Health Services Division (HSD) estimated the prevalence of *M. tuberculosis* infection among recently incarcerated inmates by evaluating routinely collected TST data from inmates throughout the federal prison system. The TST data, which are documented on a mandatory inmate health care encounter form, were entered by medical records technicians into a restricted medical database in accordance with BOP policy. To approximate an intake cohort, data were selected from inmates who had their first TST reading recorded between February 1 and June 30, 1999. Data were selected from this period primarily for convenience, as TST data were not routinely recorded in an automated data system prior to that time.

The HSD also collected data pertaining to the diagnosis of active TB cases reported from federal prisons between January 1, 1997, and June 30, 1999, per a mandated reporting system. Case data were analyzed to ascertain TB incidence rates, screening strategy efficacy, and TB risk factors. Active TB was confirmed if induced sputum, bronchoscopy, or thoracotomy samples were culture-positive for *M. tuberculosis*, or if samples were culture-negative with radiographic findings consistent with pulmonary TB and a definitive clinical response to TB treatment.

To assess the effectiveness of screening strategies for TB and to determine risk factors for TST reactivity, the HSD analyzed routinely collected data from handwritten logs of all inmates admitted to the San Diego detention center from July 1 to December 31, 1998. Medical records of inmates treated for TB disease at the same facility during 1998 were analyzed to determine case rates of TB disease and the effectiveness of various diagnostic tests.

Statistical methods

To evaluate the San Diego detention center and the system-wide intake cohorts, the BOP Office of Research and Evaluation (ORE) modeled the effect of certain demographic characteristics on inmate TST positivity using logistic regression with SAS (version 6.8). Race, ethnicity, gender, and country of birth were recoded to numeric dummy variables with white, non-Hispanic, male, and US-born used as referent groups, while age was analyzed as a continuous variable. For the system-wide sample, an additional variable was created to differentiate general population inmates (referent group) from inmates confined in detention centers. In the system-wide cohort, 260 inmate records were excluded from the analysis because they lacked one or more variables, primarily country of birth (1%).

RESULTS

System-wide analysis of TB infection and disease

To assess the prevalence of TST positivity and associated risk factors in the inmate intake population, the BOP ORE identified all federal inmates recorded in the BOP health care database system as receiving their first TST between February 1 and June 30, 1999. Table 1a lists rates of TST positivity by various inmate demographic characteristics for this approximated intake cohort (N = 25,707). Overall, 13% of federal inmates had positive TST results, with foreign-born inmates accounting for 75% of the 3,302 positive skin tests. Only 5% of US-born inmates had a positive TST result, compared with 31% of foreign-born inmates. Among Hispanic inmates, 25% had positive TST results, accounting for 61% of all positive results. The highest rates of TST positivity were observed among foreign-born inmates in detention centers (35%), accounting for more than one-half of all positive TST readings but only 18% of the cohort population. Additionally, Asian inmates throughout the federal system (35% TST positive) accounted for less than 2% of the cohort but represented 5% of inmates with positive TSTs.

Foreign-born inmates were 5.9 times more likely to have positive TST results than US-born inmates; Asian inmates were 2.2 times more likely and Hispanic inmates were 1.6 times more likely to be TST-positive ($p < 0.001$; see Table 1b). Inmates housed in detention centers and other temporary holding facilities following sentencing were 1.7 times more likely to be TST-positive than inmates housed in the general population ($p < 0.001$). Black inmates were 20% more likely to be TST-positive than white inmates ($p = 0.002$), while female and Native American inmates were not statistically different from the referent groups (males and whites) in the model in terms of risk. The risk of TST positivity increased 2% for each year of inmate age ($p < 0.001$).

Data from the approximated intake cohort of federal inmates was retabulated further to describe the prevalence of *M. tuberculosis* infection by country of origin and region (Table 2). Country of birth data were missing for 260 inmates (1%). Inmates from 13 countries accounted for 87% of all positive TST results among foreign-born inmates, and 61% of positive TST reactions for the entire cohort. The countries with the greatest number of inmates with positive TSTs were Mexico (1,345), the Dominican Republic (207),

Table 1a. Results of tuberculin skin test (TST) screening among a Federal Bureau of Prisons screening cohort, February 1 to June 30, 1999

Variable	*Category*	*Screened (%)*	*TST ≥10mm (%)*	*Percent TST-positive*
Gender	Male	23,246 (90)	3,007 (91)	13
	Female	2,461 (10)	295 (9)	12
Age	Age < 35 years	13,508 (53)	1,596 (48)	12
	Age ≥ 35 years	12,200 (47)	1,707 (52)	14
Ethnicity	Hispanic	7,973 (31)	2,008 (61)	25
	Non-Hispanic	17,734 (69)	1,294 (39)	7
Race / ethnicity	White - Non-Hispanic	8,149 (32)	494 (15)	6
	White - Hispanic	7,340 (29)	1,857 (56)	25
	Black - Non-Hispanic	8,715 (34)	619 (19)	7
	Black - Hispanic	629 (2)	150 (5)	24
	Asian	464 (2)	160 (5)	35
	Native American	410 (1)	22 (0.7)	5
Facility / country of birth	Detention center – US born	3,165 (12)	268 (8)	9
	General population – US born	14,514 (57)	553 (17)	4
	Total – US-born	**17,679 (69)**	**821 (25)**	**5**
	Detention center - foreign born	4,679 (18)	1,644 (51)	35
	General population - foreign born	3,089 (12)	792 (24)	26
	Total – foreign-born	**7,768 (31)**	**2,436 (75)**	**31**
Total		25,707 (100)	3,302 (100)	13

and Colombia (148). The prevalence of *M. tuberculosis* infection varied by region but was greater than 25% for inmates from many parts of the world: Eastern Europe (45%), Asia (36%), Africa (35%), Latin America (33%), and the Caribbean (27%).

A system-wide review of federal inmates diagnosed and treated for TB disease from January 1, 1997, to June 30, 1999 (Table 3, $n = 75$), indicated that 65% of TB cases were diagnosed at the time of incarceration. More than 70% of those diagnosed at the time of incarceration were diagnosed in detention centers, with nearly one-third diagnosed at the federal detention center in San Diego. More than 60% of TB disease cases diagnosed were foreign-born inmates. The TB case rate for general population inmates (inmates diagnosed months to years after initial incarceration) during 1997 was comparable to the rate observed in the US general population in 1997 (7.4 / 100,000).

Table 1b. Logistic regression of positive tuberculin skin test by demographic characteristics for all federal inmates newly screened between February 1 and June 30, 1999 (*N* = 25,447)

Variable	*Parameter estimate*	*Standard error*	p-value[a]	*Odds ratio*
Detention center	0.50	0.05	< 0.001	1.66
Asian	0.80	0.12	< 0.001	2.23
Black	0.17	0.06	< 0.01	1.19
Native American	0.32	0.23	NS	—
Hispanic	0.49	0.06	< 0.001	1.63
Foreign-born	1.78	0.06	< 0.001	5.92
Female	−0.14	0.07	NS	—
Age (years)	0.02	0.002	< 0.001	1.02
Intercept	−4.19	0.10	< 0.001	—

Notes: Maximum re-scaled *R* square = 0.2280, concordance = 79.4%, Hosmer and Lemeshow goodness-of-fit statistic = 116.11 with 8 DF ($p = 0.0001$)

[a]Wald chi-square statistic

Table 2. Tuberculin skin test (TST) positivity by country and region of birth in a screening cohort, Federal Bureau of Prisons, February to June 1999

Country or region of birth	*Number screened*	*TST ≥ 10 mm (%)*	*Percent TST-positive*
Mexico	3,951	1,345 (55)	34
Dominican Republic	678	207 (9)	31
Colombia	541	148 (6)	27
Cuba	541	107 (4)	20
Jamaica	278	75 (3)	27
Haiti	125	63 (3)	50
China	125	50 (2)	40
El Salvador	78	33 (1)	42
Vietnam	75	32 (1)	43
Canada	66	5 (0.2)	8
Nigeria	64	25 (1)	39
Philippines	59	17 (0.7)	29
Germany	56	3 (0.1)	5
Country subtotal	**6,637**	**2,110 (87)**	**32**
All other foreign-born	1,131	326 (13)	29
By region			
Latin America	4,930	1,640 (67)	33
Caribbean	1,740	468 (19)	27
Asia	613	219 (9)	36
Africa	133	47 (2)	35
Eastern Europe	74	33 (2)	45
Western Europe & Canada	267	27 (1)	10
Pacific	11	2 (<1)	18
Foreign-born	**7,768**	**2,436 (100)**	**31**
US-born	**17,679**	**821**	**5**
Total	25,477	3,302 (100)	13

One in four inmates with TB had confirmed HIV co-infection, although only 59 of 75 inmates agreed to HIV testing or had test results documented. Among inmates with pulmonary TB, only 52% were reported to be symptomatic at the time of diagnosis, 79% were TST-positive, and 91% had abnormal chest radiographs. One inmate was diagnosed with multidrug-resistant TB.

Tuberculosis infection and disease at the San Diego detention center during the implementation of universal chest radiography screening

Of the 1,830 inmates screened with chest radiographs at the federal detention center in San Diego between July and December, 1998, 171 (9.5%) did not have a TST reading for administrative reasons. Administrative reasons included release from custody before the test could be read (3.2%), returning to the jail facility with a recently documented TST reading (2.4%), documented history of a positive TST reading from a transferring institution (1.6%), an unrecorded TST reading measured in a community hospital (1.3%), or unknown reasons (1.0%). In comparing the risk factor data of those who were screened and those who were not, a higher percentage of those not screened was US-born (16%) rather than foreign-born (8%). This may be due to slower turnover rates among foreign-born inmates, as they often have more legal and immigration issues to resolve before release.

Table 3. Inmates treated for TB disease, Federal Bureau of Prisons, January 1, 1997 to June 30, 1999[a]

Tuberculosis cases	*n = 75 (%)*	*No data*
Diagnosed on intake	49 (65)	—
Diagnosed in the standing population	26 (35)	—
Diagnosed at San Diego detention center	22 (29)	—
HIV-positive	15 (20)	16 (21)
Foreign-born	46 (61)	—
PPD-positive	58 (77)	8 (11)
Pulmonary TB only	*n = 68 (or 91% of cases)*	
Symptomatic	35 (52)	10 (15)
PPD-positive	54 (79)	7 (10)
AFB-positive sputum smear(s)	30 (44)	—
Abnormal chest radiograph	64 (94)	—

[a]Includes all inmates treated for TB disease, regardless of culture results or response to therapy.

HIV = human immunodeficiency virus; PPD = purified protein derivative; AFB = acid-fast bacillus

Of the remaining 1,659 inmates who were skin tested, 40% had a TST reading greater than 10 mm of induration (Table 4a). The intake cohort was 74% foreign-born, with a TST positivity rate of 48%, compared to 18% TST positivity for both non-Hispanic and US-born jail entrants. Most of the foreign-born Hispanic inmates were detainees from Mexico. Inmates who were Asian, Hispanic, and foreign-born were 4.4, 3.5, and 2.4 times more likely to be TST-positive. When other variables were controlled (Table 4b; $p < 0.001$), the risk of TST positivity increased by 2% for each year of inmate age, similar to observations in the system-wide cohort ($p < 0\ .001$).

During 1998, 72 inmates isolated for suspected pulmonary tuberculosis at the San Diego detention center were sent for further work-up at nearby commu-

Table 4a. Results of tuberculin skin test screening at the San Diego detention center, June 29 to December 3, 1998 (1830 inmates eligible for screening)

Variable	*Category*	*Not screened (%)*	*Number screened (%)*	*TST ≥10mm (%)*	*Percent TST-positive*
Gender	Male	143 (84)	1,461 (88)	608 (92)	42
	Female	28 (16)	198 (12)	55 (8)	28
Age	< 35 years of age	92[a] (61)	1,046 (63)	397 (60)	38
	≥ 35 years of age	58[a] (39)	613 (37)	264 (40)	43
Ethnicity	Hispanic	113 (66)	1,339 (81)	605 (91)	45
	Non-Hispanic	58 (34)	320 (19)	58 (9)	18
Race	White	141[a] (94)	1,532 (92)	628 (95)	41
	Asian	3[a] (2)	58 (4)	30 (4)	52
	Black	6[a] (4)	69 (4)	(1)	7
Country of birth	Foreign-born	98 (57)	1,222 (74)	585 (88)	48
	US-born	73 (43)	437 (26)	78 (12)	18
Totals		171(100)	1,659 (100)	663 (100)	40

[a]In addition to missing PPD(purified protein derivative) test results, 21 of these inmates were missing data for age and race variables.

TST = tuberculin skin test

nity hospitals. Only eight of these inmates were isolated between January 1 and June 30, 1998, prior to the implementation of universal chest radiography. However, 64 were isolated during the trial period for universal screening between July 1 and December 31, 1998, (an eightfold increase in isolations). Time to isolation of suspected TB cases exceeded 96 hours prior to the implementation of universal chest radiograph screening, but was subsequently reduced with chest x-ray screening to 24 hours or less from the time of inmate entry to the facility. This change in isolation reflected the change in screening protocol that eliminated the waiting period for reading TST results.

All 16 inmates treated for pulmonary TB during 1998 at the San Diego detention center are classified in Table 5 by clinical diagnostic characteristics. During both the six months before and after the implementation of universal chest radiography, eight inmates were treated for pulmonary tuberculosis. During both periods, only seven of the 16 inmates ultimately met the case definition for TB disease. Inmate No. 8 was symptomatic with a chest radiograph suggestive of active TB but negative sputum cultures, and he refused more invasive tests. Although treatment was begun, the patient was released from detention prior to completion of the treatment protocol, and was lost to follow-up. Inmate No. 13 was asymptomatic but had an abnormal chest radiograph and a history of active disease. The inmate completed a course of treatment but showed no improvement radiographically or clinically.

Table 4b. Logistic regression analysis of positive tuberculin skin test by demographic characteristics of inmates entering the San Diego detention center

Variable	*Parameter estimate*	*Standard error*	*p-value*[a]	*Odds ratio*
Asian	1.49	0.37	< 0.001	4.42
Black	−0.71	0.51	NS	—
Hispanic	1.25	0.26	< 0.001	3.47
Foreign-born	0.86	0.16	< 0.001	2.35
Female	−0.36	0.18	< 0.05	0.70
Age (years)	0.02	0.01	< 0.001	1.02
Intercept	−2.82	0.32	< 0.001	—

[a]Wald chi-square statistic

NOTES: Maximum re-scaled *R* square = 0.1436, concordance = 65.6%, Hosmer and Lemeshow goodness-of-fit statistic = 10.728 with 8 DF (p = 0.2176)

Table 5. Suspected cases of pulmonary tuberculosis treated with four drug therapy at a San Diego detention center, 1998, before (Cases 1–8) and after (Cases 9–16) the implementation of universal chest radiograph screening

	Case	*TST*	*Chest radiograph or CT scan reading*	*AFB smear*	*Culture*	*Biopsy*	*Signs/ symp-toms*	*History of TB/HIV/ drug resistance*	*Treatment complete?*	*Clinically im-proved?*
Inmates	1	+	Abnormal	+	+		–	Yes	Yes	Yes
treated	2	+	Abnormal	–	+		–	No	Yes	Yes
prior to	3	+	Normal	+	+		–	Yes; HIV+	Yes	Yes
universal	4	+	Abnormal: upper lobe cavitary lesion	–	+	+	–	No	Yes	Yes
chest X-ray	5	+	Abnormal: upper lobe infiltrate	–	–		+	Yes	No	Yes
(January 1–June 30)	6	+	Abnormal	–	+		–	No; INH-resistant	No	Unknown
	7	+	Abnormal: upper lobe cavity	–	–	+	–	No	Yes	Yes
	8[a]	+	Abnormal: granuloma/mass	–	–	refused	+	No	No	No
Inmates	9	+	Abnormal: cavitary lesion	–	–	+	–	Yes; partially treated	Yes	Yes
treated	10	+	Abnormal: bilateral infiltrate	+	+		–	No	Yes	Yes
during	11	+	Abnormal: right upper lobe cavity	+	+		–	No	Yes	Yes
universal chest radiograph	12	+	Abnormal: upper lobe nodule/cavity	+	+	+	–	No; PZA-resistant	No	Unknown
(July 1–December 31)	13[a]	+	Abnormal: cavity vs. old granuloma	–	–		–	Yes	Yes	No
	14	+	Abnormal: right lower lobe cavity	–	–	–	+	No	Yes	Yes
	15	2	Abnormal: right upper lobe infiltrate	–	–		–	No	Yes	Yes
	16	+	Abnormal: bilateral infiltrate	+	+		–	No	Yes	Yes

[a]Inmates did not ultimately meet the definition of pulmonary TB disease.

TST = tuberculin skin test; AFB = acid-fast bacillus; HIV = human immunodeficiency virus

The incidence of pulmonary tuberculosis during both periods was roughly 422 per 100,000 inmates screened. There was one case of extrapulmonary TB diagnosed during the period of universal screening. Overall, four of the 16 inmates from the San Diego Detention Center (25%) did not complete their course of treatment before release from the facility. These four inmates were referred for treatment at the time of release to other jurisdictions or their country of origin; treatment completion data are not available. Induced sputum cultures were relatively insensitive for diagosing TB disease; five of 12 culture-proven cases (42%) required invasive methods (percutaneous biopsy, bronchoscopy, or thoracotomy) to obtain an adequate specimen. Only three of the 16 treated patients (19%) had signs or reported symptoms of systemic disease. One inmate with culture-proven pulmonary TB had a normal chest radiograph and was known to be HIV positive (case No. 3).

DISCUSSION

M. tuberculosis infection is highly prevalent among jail and prison populations worldwide, affecting 12 to 60% of inmates in surveyed systems.[9–11] However, TST results in foreign-born inmate populations in the United States have not been widely reported. The 31% prevalence of *M. tuberculosis* infection reported among foreign-born inmates in the federal prison system was significantly greater than that of US-born inmates, and

was remarkably similar to the 32% prevalence of *M. tuberculosis* infection estimated for the world population, as reported by the World Health Organization.[12]

Tuberculin skin test data and the reported prevalence of *M. tuberculosis* infection from this study can be considered only an estimate for several reasons: (*a*) the rapid turnover and recidivism of inmate populations, particularly in jail settings, is not captured in the existing BOP automated data systems, and this prevented identification of a definitive intake cohort; (*b*) based on data from the San Diego detention center intake cohort, TST data are not obtained in an estimated 10% of inmates in detention centers for administrative reasons; and (*c*) inmates frequently move to and from non-federal correctional systems before and immediately after incarceration, and this may prevent the reading of TST results.

Despite these limitations, this study found a strong association between foreign birth status and TST reactivity among federal inmates. Foreign birth status was a greater risk factor for *M. tuberculosis* infection among federal inmates than other associated risk factors, including age, race, and ethnicity. In a five-month period, the BOP identified 2,436 foreign-born inmates with latent *M. tuberculosis* infection entering its system. The structured setting of prison offers a strategic opportunity to provide both targeted tuberculin skin testing in high-risk populations and, when medically indicated, directly observed preventive therapy for latent TB infection in accordance with CDC guidelines.[6-7] In long-term jails and prisons, inmate adherence to treatment of latent tuberculosis has exceeded 90%.[13] Because most TB cases diagnosed in foreign-born populations in the United States result from infections acquired prior to immigration,[14] the treatment of latent TB infection in foreign-born inmates can significantly enhance national TB control efforts.

Effective TB control programs in correctional systems can reduce the incidence of the disease in foreign-born populations, not only by the treatment of latent infection, but through the identification of contagious TB cases in foreign-born individuals who might elude detection by community-based public health providers or by government screening programs that target legal immigrants and refugees.[15] Moreover, inadequate detection of TB cases in jails and prisons can result in outbreaks that affect large numbers of inmates and correctional staff people, as well as community-based populations.[16–22]

Jails and prisons in the United States have adopted various screening strategies to identify contagious cases of TB. Symptom screening, although effective as a rapid and inexpensive strategy for identifying and isolating infectious TB cases, may not adequately detect a disease that is frequently indolent and cryptic. Of TB cases diagnosed since 1997 in the BOP, only 50% of inmates disclosed TB-related symptoms at the time of diagnosis. Even fewer (three of 16) inmates treated for TB disease in a San Diego detention center over a one-year period reported TB symptoms. The sensitivity of symptom screening among foreign-born populations entering jails may be further diminished by language and cultural barriers.

Most US prisons and many US jails routinely screen inmates for TB by symptom review and TST, providing follow-up chest radiographs for inmates with reactive tests.[9] Universal chest radiograph screening for pulmonary TB has been effective in large urban jails where there is a high incidence of TB disease. Obtaining chest radiographs for all inmates entering New York City and Chicago jails streamlined the intake process and improved detection of active TB cases, permitting rapid isolation of inmates with contagious TB.[2–4] In this study, universal chest radiograph screening at the San Diego detention center was no more sensitive in the detection of active TB cases than the routine protocol for TB screening of inmates. Furthermore, universal chest radiography led to an eightfold increase in TB work-ups without detecting any additional cases of TB. The diagnosis of suspected TB cases within 24 hours of jail admission expedited isolation of TB suspects and minimized exposure to staff members and other inmates.

The failure of universal chest radiograph screening to detect TB cases in the San Diego intake cohort that would otherwise have been missed was affected, at least in part, by the high prevalence of *M. tuberculosis* infection in the screened population (48% of foreign-born inmates had positive TST results, and 40% of all entrants were TST positive) and by low rates of HIV infection and related anergy. The prevalence of HIV infection in the San Diego intake cohort was not determined, but random HIV testing of the federal inmate population has demonstrated minimal differences between foreign-born (0.72%) and US-born inmates (1.22%) (unpublished data).

Totally effective screening for TB is confounded by the lack of a completely sensitive and specific screening method. The CDC recommends screening by review of TB symptoms for all inmates entering US jails and prisons together with the strategic use of the TST and chest radiographs.[10] Despite its lack of sensitivity, TB symptom screening is rapid and inexpensive; it is essential for identification and treatment of TB infection among inmates in long-term jails and prisons. The use of targeted versus universal chest radiograph

screening for TB disease in jails and prisons, however, should depend on a variety of factors, such as the incidence of TB disease, prevalence of TB infection, suspected frequency of anergy among inmates, turnover of the inmate population, infection control considerations, and cost effectiveness. Priority should be given to a strategy that promotes the rapid isolation of suspected cases in the most cost-effective manner to prevent the spread of infection. Because of the significant incidence of TB disease and the importance of rapid diagnosis in an urban jail setting, the San Diego detention center described in this study continues to use chest radiographs to screen all new inmates for TB disease.

Tuberculosis control efforts in US jails and prisons have contributed significantly to the national decline in TB incidence since 1993.[23,24] The National Institute of Medicine recently highlighted the vital role of US correctional systems in the nation's future TB control efforts that must increasingly target foreign-born and other hard to reach populations.[25] Despite the primary role of ensuring public safety, US jails and prisons are becoming an essential component of the US public health infrastructure.

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