

An Unanswered Health Disparity: Tuberculosis Among Correctional Inmates, 1993 Through 2003

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Tuberculosis (TB) is an important health problem in correctional systems in many parts of the United States. Although the incident TB case rate for the general population has remained at fewer than 10 cases per 100 000 persons since 1993,¹ substantially higher case rates, some as high as 10 times that of the general population, have been reported in correctional populations.²⁻⁴ The TB case rate reported from 1 urban jail was 72.1 cases per 100 000 inmates, representing 10% of the county's cases.⁵ Furthermore, studies have found the prevalence of latent TB infection (LTBI) among inmates to be as high as 25%.⁶⁻¹⁰ Other studies have shown a correlation between length of incarceration and positive tuberculin skin test responses, indicating transmission may have occurred in these facilities.^{11,12}

A disproportionately high percentage of TB cases in the United States occur among persons incarcerated in correctional facilities. In 2003, 3.2% of all TB cases nationwide occurred among residents of correctional facilities.¹ In contrast, 0.7% of the total US population were confined in prisons and jails in 2003, a population that was increasing at an average annual rate of 3.7% from 1995 through 2003.¹³ One notable reason for the high rates of TB in correctional institutions is the greater proportion of persons who are at high risk for TB but who can not access standard public health interventions. Transmission risks particular to correctional institutions include close living quarters, poor ventilation, and overcrowding.^{5,14,15}

Owing to the occurrence of TB outbreaks and the documentation of high rates of TB in correctional systems, the Centers for Disease Control and Prevention (CDC), in 1993, began asking state health departments to report whether those newly diagnosed with TB were residents of correctional facilities. We analyzed data reported to the national TB surveillance system from 1993 through 2003

Objectives: We sought to describe disparities and trends in tuberculosis (TB) risk factors and treatment outcomes between correctional inmate and noninmate populations.

Methods: We analyzed data reported to the national TB surveillance system from 1993 through 2003. We compared characteristics between inmate and noninmate men aged 15-64 years.

Results: Of the 210976 total US TB cases, 3.8% (7820) were reported from correctional systems. Federal and state prison case rates were 29.4 and 24.2 cases per 100 000 inmates, respectively, which were considerably higher than those in the noninmate population (6.7 per 100 000 people). Inmates with TB were more likely to have at least 1 TB risk factor compared with noninmates (60.1% vs 42.0%, respectively) and to receive directly observed therapy (65.0% vs 41.0%, respectively); however, they were less likely to complete treatment (76.8% vs 89.4%, respectively). Among inmates, 58.9% completed treatment within 12 months compared with 73.2% of noninmates.

Conclusions: Tuberculosis case rates in prison systems remain higher than in the general population. Inmates with TB are less likely than noninmates to complete treatment. (*Am J Public Health*. 2005;95:1800-1805. doi:10.2105/AJPH.2004.055442)

to define trends in correctional TB cases and describe characteristics of individuals with TB who are residents of correctional facilities.

METHODS

An inmate TB patient was defined as a person who was incarcerated in a correctional facility at the time TB was diagnosed. We analyzed data from TB cases reported to the national TB surveillance system from 1993 through 2003 among inmates of correctional systems (including federal and state prisons, local jails, and juvenile facilities, and other facilities such as immigration detention centers) in the 50 states and the District of Columbia. For comparative purposes, all calculations and comparisons for risk-factor characteristics, clinical presentation, drug resistance, and treatment outcomes were performed only for males aged 15 to 64 years, a group that comprised 85.5% of inmate cases.

Variables in the national TB case report are collected uniformly throughout the country with the exception of human immunodeficiency virus (HIV) status. California

does not report individual HIV test results but does submit the results of TB and AIDS registry cross-matches. California TB patients with an AIDS match were classified as HIV-infected; all others were classified as having an unknown HIV status. All 2003 California cases are classified as unknown HIV status.

Completion-of-therapy calculations were done for persons who were alive at diagnosis, had an initial drug regimen of 1 or more anti-TB drugs, did not die during therapy, and did not have an initial *Mycobacterium tuberculosis* isolate resistant to rifampin. Timely completion of therapy was defined as completion of treatment within 12 months. The latest year for which information on treatment outcomes is available is 2001.

State and federal prison population case rates were calculated with data from the US Bureau of Justice Statistics.^{13,16,17} Estimates of correctional populations are based on year-end counts of inmates for state and federal prisons in the 50 states, the District of Columbia, and the Federal Bureau of Prisons. Case rates were not calculated for

TABLE 1—Tuberculosis Cases Among Inmate and Noninmate Populations, by Prison Facility Category and Year: United States, 1993–2003

Year	Cases, No. (%) [Rate] ^{a,b}				
	Noninmate	Inmate ^c	Federal Prison	State Prison	Local Jail
1993	23 027 (96.0) [8.5]	953 (4.0)	28 (2.9) [31.3]	462 (48.5) [52.3]	407 (42.8)
1994	22 330 (95.2) [8.1]	1119 (4.8)	31 (2.8) [32.6]	470 (42.0) [48.9]	571 (51.1)
1995	21 545 (95.8) [7.8]	938 (4.2)	24 (2.6) [26.8]	332 (35.4) [33.5]	539 (57.5)
1996	20 319 (96.3) [7.3]	784 (3.7)	28 (3.6) [29.4]	295 (37.6) [28.4]	409 (52.2)
1997	18 951 (96.2) [6.7]	746 (3.8)	30 (4.0) [29.5]	220 (29.5) [20.5]	445 (59.7)
1998	17 601 (96.4) [6.2]	657 (3.6)	32 (4.9) [29.8]	188 (28.6) [16.8]	382 (57.9)
1999	16 873 (96.7) [5.9]	577 (3.3)	33 (5.7) [26.3]	163 (28.3) [14.4]	343 (59.3)
2000	15 707 (96.4) [5.4]	587 (3.6)	39 (6.6) [29.9]	172 (29.3) [14.6]	327 (55.6)
2001	15 384 (96.7) [5.3]	523 (3.3)	37 (7.1) [25.8]	141 (27.0) [11.6]	281 (53.5)
2002	14 556 (96.9) [4.9]	461 (3.1)	39 (8.5) [26.2]	124 (26.9) [10.3]	238 (51.6)
2003	14 355 (96.8) [4.8]	475 (3.2)	56 (11.8) [35.2]	81 (17.1) [6.6]	254 (53.5)
Total	200 648 (96.2) [6.7]	7820 (3.8)	377 (4.8) [29.4]	2648 (33.9) [24.2]	4196 (53.7)

^aRates are for cases per 100 000 persons per year from estimates of the US resident population.⁴³

^bInmate denominators include all inmates held in public and private adult federal and state facilities.

^cInmates are residents of federal prisons, state prisons, local jails, juvenile facilities, and other facilities; hence, the national total exceeds the number of inmates in federal and state prisons and jails.

jail inmates because accurate estimates for this population were not available, in part owing to the difficulty of removing recidivists from the population count.

RESULTS

From 1993 through 2003, US jurisdictions reported 210 976 cases of TB to the national TB surveillance system. Information about residence at a correctional facility at the time of TB diagnosis was reported for 208 468 (98.8%) patients, of whom 7820 (3.8%) were inmates. The percentage of TB cases in males aged 15 to 64 years reported as residing in a correctional facility was 9.2% for those born in the United States and 4.2% for those not born in the United States (odds ratio [OR]=2.2; 95% confidence interval [CI]=2.08, 2.33; $P<.001$).

Trends in Tuberculosis Cases and Rates

From 1993 through 2003, the percentage of TB cases among local jail inmates increased from 42.8% of all inmates with TB to 53.5% (χ^2 for trend= 57.8; $P<.001$), whereas cases among federal inmates increased from 2.9% to 11.8% (Table 1). Case rates for the 11 years studied were 29.4 per

100 000 for federal prisons and 24.2 for state prisons. In contrast, federal prisons in 1993 and in 2003 had nearly level TB case rates. In state prisons, case rates decreased from 52.3 in 1993 to 6.6 in 2003, a decline of 87.4%.

Two states, California and Texas, accounted for 42.7% of the 7820 reported TB cases among inmates from 1993 through 2003, and another 4 states (Florida, Georgia, Illinois, and New York) accounted for an additional 28.6% of reported TB cases. These same 6 states accounted for 56.9% of the 200 648 reported TB cases among noninmates.

Demographic Characteristics

The characteristics of individuals with TB in correctional facilities differed from those with TB who did not reside in correctional facilities: inmates with TB were more likely to be male (89.4% vs 61.9%, respectively), US born (77.0% vs 58.3%, respectively), younger (median: 37 vs 45 years of age, respectively), and from racial and ethnic minority groups (81.7% vs 75.5%, respectively). Over time, an increasing proportion of TB cases were among foreign-born persons in both inmate and noninmate populations. The proportion of foreign-born in-

mates with TB had increased from 15.5% in 1993 to 40.3% by 2003; similarly, 30.6% of those with TB in the general population were foreign-born in 1993, and 53.6% were foreign-born in 2003.

Risk-Factor Characteristics

Excess alcohol use, injection drug use, non-injection drug use, and homelessness within 1 year prior to TB diagnosis in adult males aged 15 to 64 years were all more frequent in inmates with TB than in noninmates with TB (Table 2). Additionally, inmates were more likely than noninmates to report at least 1 TB risk factor including HIV-infection (60.1% vs 42.0%, respectively).

Inmates with TB were also more likely than noninmates with TB to be HIV infected. From 1993 through 2003, HIV infection was documented in 35.8% of inmates with TB in state prisons, in 20.7% of those in jail, and in 13.2% of those in federal prisons. Overall, of males with TB aged 15 to 64 years, 25.2% who were inmates were known to be HIV infected versus 18.0% of those who were non-inmates. A positive finding, however, is that HIV prevalence is declining in this setting. Among those with TB in state prisons, the prevalence of HIV infection decreased from 43.1% in 1993 to 11.6% in 2003. In federal prisons, the prevalence of HIV infection decreased from 23.8% in 1993 to 9.3% in 2003. In local jails in 1993, 22.8% of inmates with TB also were infected with HIV, whereas in 2003, 12.4% of inmates with TB were HIV infected.

Clinical Presentation and Drug Resistance

A higher proportion of inmates (90.3%) than noninmates (84.4%) had pulmonary TB. Results of sputum smears for acid-fast bacilli and sputum cultures were reported more often for inmates than for noninmates. Inmates compared with noninmates were less likely to have extrapulmonary TB (OR=0.60; 95% CI=0.55, 0.66; $P<.001$).

Table 3 presents the frequency of drug resistance of *M tuberculosis* isolates among inmate and noninmate patients. In general, drug-resistance levels were higher in those with a prior history of TB, those not born in the United States, those with HIV infection,

TABLE 2—Risk-Factor Characteristics of Inmate and Noninmate Populations (Males Aged 15–64 Years) With Tuberculosis, by Year: United States, 1994–2003

	Cases, No. (%)					
	Inmate			Noninmate		
	1994	2003	1994–2003	1994	2003	1994–2003
Excess alcohol use^a						
Yes	214 (21.4)	140 (33.6)	1762 (29.2)	2113 (21.0)	1489 (23.1)	18 682 (23.7)
No	505 (50.6)	245 (58.8)	3249 (53.8)	5357 (53.1)	4727 (73.4)	51915 (65.8)
Unknown	279 (28.0)	32 (7.7)	1033 (17.1)	2616 (25.9)	226 (3.5)	8366 (10.6)
Injecting drug use^a						
Yes	121 (12.1)	49 (11.8)	733 (12.1)	529 (5.3)	175 (2.7)	3197 (4.1)
No	570 (57.1)	327 (78.4)	4169 (69.0)	6806 (67.5)	6012 (93.3)	66 837 (84.6)
Unknown	307 (30.8)	41 (9.8)	1142 (18.9)	2751 (27.3)	255 (4.0)	8929 (11.3)
Noninjecting drug use^a						
Yes	211 (21.1)	127 (30.5)	1523 (25.2)	825 (8.2)	671 (10.4)	7754 (9.8)
No	480 (48.1)	251 (60.2)	3349 (55.4)	6326 (62.7)	5498 (85.4)	61 681 (78.1)
Unknown	307 (30.8)	39 (9.4)	1172 (19.4)	2935 (29.1)	273 (4.2)	9528 (12.1)
Homelessness^a						
Yes	126 (12.6)	65 (15.6)	906 (15.0)	1005 (10.0)	676 (10.5)	8359 (10.6)
No	726 (72.8)	326 (78.2)	4605 (76.2)	8165 (81.0)	5615 (87.2)	67 528 (85.5)
Unknown	146 (14.6)	26 (6.2)	533 (8.8)	916 (9.0)	151 (2.3)	3076 (3.9)
HIV status^b						
Infected	321 (32.2)	47 (11.3)	1454 (24.1)	2455 (24.3)	720 (11.2)	13 635 (17.3)
Noninfected	182 (18.2)	229 (54.9)	2261 (37.4)	2114 (21.0)	3243 (50.3)	30 678 (38.9)
Unknown	495 (49.6)	141 (33.8)	2329 (38.5)	5517 (54.7)	2479 (38.5)	34 650 (43.9)

Note. The proportions of inmates and noninmates have 1994 as the baseline year owing to a substantially high proportion of missing data for 1993.

^a Reported in the year prior to diagnosis.

^b All 2003 California cases are classified as unknown HIV status.

and inmates. From 1993 through 2003, declines in drug resistance were greater for inmates than for noninmates: isoniazid resistance decreased (inmates, from 10.9% to 6.7%; noninmates, from 9.9% to 8.8%), as did levels of multidrug-resistant TB (inmates, from 3.3% to 0.6%; noninmates, from 3.4% to 1.1%), and resistance to any drug (inmates, from 15.2% to 11.5%; noninmates, from 14.9% to 13.6%).

Treatment Outcomes

In 1993, among patients for whom extended treatment was not warranted, treatment was completed within 12 months in 47.9% of inmates compared to 60.4% of noninmates. In 2001, rates of completion of therapy had improved to 63.6% and 80.1%, respectively. Rates of completion of therapy within 12 months were lower in persons

with TB risk factors and lowest for those who had HIV infection at the time of TB diagnosis, in both inmates and noninmates, but lower among inmates (Table 4).

Inmates were more likely to receive directly observed therapy for at least part of their therapy than were noninmates (Table 4); however, inmates were less likely to complete therapy. Lower completion rates among inmates compared with noninmates reflect higher levels of “incomplete treatment” categories (moved, lost, other, or unknown). A higher percentage of federal inmates (27.9%) were classified as “treatment incomplete” owing to a reported treatment outcome of “moved out of jurisdiction” compared with other inmates (9.0%) and noninmates (4.4%). In addition, 11.0% of local jail inmates had a reported treatment outcome of “lost,” compared with 7.1% of other inmates and 3.9% of noninmates.

DISCUSSION

The success of TB control in the United States is evident by the steady decline in cases among incarcerated populations along with declining rates in the communities from which inmates are drawn. Yet, our findings call attention to the epidemiology and health-related outcomes in correctional inmates that demonstrate marked disparities in TB rates, measures of risk including HIV infection, and TB treatment outcomes.

Substantially greater case rates in correctional systems are indicative of this disparity, especially in the federal prison system. In 2003, the TB case rate for federal prisons was 6.9 times the case rate in the general US population (5.1 cases per 100 000 population).¹ Paradoxically, enhanced screening in federal prisons may have resulted in better case detection and thus an apparent rise in the number of TB cases.¹⁸ The increasing proportion of inmates who are born in countries other than the United States also may be partly responsible for the increase in TB cases in federal prisons.¹⁹ Although we did not calculate the case rate among jail inmates because of unreliable population estimates, local studies indicate that case rates in jail populations are also greater than in the general population. In San Francisco, for example, jail inmates had a case rate of 72.1 cases per 100 000 inmates compared with a rate of 26.2 cases per 100 000 persons in the local population.⁵

Inmates, in contrast to noninmates, are more likely to have multiple risk factors for infection with *M tuberculosis* and for progression to TB disease. Inmates are also more likely to have drug-resistant TB. Special efforts are needed to mitigate the personal and public health toll created by these risk factors.^{20,21} The concentration of these factors in a congregate population has resulted in explosive outbreaks of TB, as demonstrated in a North Carolina outbreak involving 25 homeless patients, 72% of whom had a history of incarceration in the local county jail.²² Tuberculosis outbreaks and ongoing transmission have occurred even after inmates were screened for TB^{23–25} and also have been attributed to failure to complete treatment by inmates known to have LTBI.^{26,27}

TABLE 3—Characteristics of Persons Reported to Have Anti-Tuberculosis (TB) Drug-Resistance, by Inmate and Noninmate Populations (Males Aged 15–64 Years): United States, 1993–2003

	Cases, No. (%)			
	Inmate		Noninmate	
	No Prior TB	Prior TB	No Prior TB	Prior TB
Isoniazid resistance^a				
US born	301 (8.1)	26 (11.7)	2235 (5.8)	178 (8.2)
HIV infected	108 (9.5)	13 (18.6)	782 (8.4)	47 (9.5)
HIV noninfected	100 (7.6)	5 (6.0)	728 (4.8)	73 (8.2)
Foreign born	136 (11.0)	23 (34.2)	3319 (11.9)	308 (23.1)
Multidrug resistance^b				
US born	75 (2.0)	14 (6.3)	589 (1.5)	80 (3.7)
HIV infected	46 (4.0)	6 (8.6)	330 (3.5)	33 (6.7)
HIV noninfected	15 (1.1)	2 (2.4)	107 (0.7)	19 (2.1)
Foreign born	16 (1.5)	7 (9.2)	457 (1.6)	135 (10.2)
Resistance to at least 1 first-line drug				
US born	453 (12.1)	37 (16.6)	3875 (10.0)	289 (13.3)
HIV infected	155 (13.6)	20 (28.6)	1294 (13.8)	89 (18.1)
HIV noninfected	145 (10.9)	8 (9.5)	1218 (8.0)	109 (12.2)
Foreign born	234 (18.9)	31 (40.8)	5114 (18.2)	407 (30.5)

Note. HIV = human immunodeficiency virus.

^aResistance to at least the drug(s) indicated, but also may have resistance to additional first-line drugs.

^bResistance to isoniazid and rifampin.

TABLE 4—Tuberculosis (TB) Treatment Outcomes for Inmate and Noninmate Populations (Males Aged 15–64 Years): United States, 1993–2001

	Cases, No. (%)	
	Inmate	Noninmate
Directly observed therapy		
Yes, total direct	3499 (65.0)	27 320 (41.0)
Yes, direct and self	1018 (18.9)	16 761 (25.1)
No, self-administered	654 (12.2)	21 200 (31.8)
Unknown	211 (3.9)	1374 (2.1)
Completion of therapy		
Completed therapy	4133 (76.8)	59 629 (89.4)
Moved	550 (10.2)	2917 (4.4)
Lost	514 (9.6)	2621 (3.9)
Refused	36 (0.7)	540 (0.8)
Other/Unknown	149 (2.8)	998 (1.5)
Completion of TB therapy within 12 months by risk factor (%)		
Injecting drug use ^a	57.9	62.9
Noninjecting drug use ^a	61.8	69.6
Excess alcohol use ^a	63.8	73.4
Homelessness ^a	59.1	67.7
HIV-infected at TB diagnosis	44.8	54.5

^aReported in the year prior to TB diagnosis.

Despite elevated rates of HIV infection—the strongest risk factor for developing TB among adults who have LTBI²⁸—the HIV status of more than one third of inmates with TB is unknown. In a study of 20 large city and county jails, a review of inmate medical records found that only 48% of 376 inmates with LTBI had a known HIV status.²⁹ Although the CDC recommends routine HIV counseling and testing at intake to the correctional facility,³⁰ the majority of correctional systems currently do not offer universal HIV testing, a critical limitation for effective TB prevention and control and for the medical management of individual patients.³¹ Moreover, in HIV-infected persons infected with *M tuberculosis*, the progression to TB disease is often rapid and can cause difficult-to-control outbreaks.²⁷

Outbreaks of both multidrug-resistant and drug-susceptible TB related to HIV coinfection have been documented in correctional facilities.^{3,4,27,32,33} These outbreaks are often attributed to the failure to detect TB disease early after entry into the facility or failure to complete treatment for LTBI resulting in TB transmission to other inmates, correctional facility employees,^{3,34,35} and community members.³⁶

Epidemiologic and operational studies have helped elucidate problem areas for TB prevention and control in correctional systems and the surrounding community.^{5,7,10,14,25,34–37} One such study in Memphis, Tenn, showed that 43% of community residents with TB had been incarcerated in the same jail at some time before their diagnosis, and this jail had experienced a TB outbreak lasting several years.¹⁴ A subsequent study revealed the strain in question was more prevalent in the surrounding community than it was prior to the jail outbreak.³⁵ In Maricopa County, Ariz, 24% of persons reported with TB during 1999 and 2000 had been incarcerated in the county jail prior to their TB diagnosis.³⁷ Additionally, it was discovered that the majority of persons (83%) who later had TB had not received any TB screening while in jail. These and other reports have highlighted the need for implementing infection control measures in correctional facilities.²⁴

Our data confirmed that health disparities in treatment outcomes exist for inmates with

TB. Inmates have lower treatment completion rates; even when individual risk groups are compared, the discrepancy in treatment completion for inmates persists (Table 4). Tuberculosis screening at entry to a correctional facility provides a unique opportunity for identifying individuals at risk for TB who might not otherwise have access to medical care and prevention services.³⁷ Correctional systems, especially jails, offer distinct logistical obstacles to screening and treatment; inmates are moved frequently or are released, making evaluation and completion of therapy difficult at best.¹⁴ Inmates are more likely to have treatment outcomes classified as "incomplete" owing to their moving out of the jurisdiction or being lost to treatment supervision.³⁸ Failure to complete treatment for TB is a cause for concern for the health of those individuals who did not receive a full course of curative therapy and for the communities in which they live.

One limitation of our study is that the national surveillance data identified only case-patients diagnosed during incarceration. Those with TB who may have progressed to disease before or after incarceration are not separately defined in our analysis. Standard TB-control activities and investigations may not elicit information about incarceration, resulting in possible underreporting of cases that are epidemiologically linked with incarceration.^{34,36} Failures to establish these connections hamper the effectiveness of public health interventions.^{22,35,36} Another limitation of the study is the difficulty of tracking outcomes when inmates are transferred within or between correctional systems. For that reason, our data may underestimate completion rates for some prison inmates.

Poor access to TB services and socioeconomic status play a role in the elevated TB rates among correctional inmates.³⁹ However, inmates are more likely to receive treatment by directly observed therapy, a patient-management practice that generally improves the success of treatment completion. Our finding of unacceptably low rates for the therapy completion among inmates is disturbing because of the possibility that these individuals may be the cause of future TB outbreaks in a given community.⁴⁰ To better ascertain and improve treatment completion rates among

inmates, health departments should enhance their capacity for tracking TB patients diagnosed or treated in correctional systems. To ensure that TB medical evaluations and therapy are completed for inmates, public health and corrections officials are obliged to develop policies that optimize discharge planning and case management for inmates released during TB evaluation or treatment.^{38,40} These policies should be reevaluated periodically to determine whether such practices should be modified to improve outcomes.^{2,41} ■

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This article was accepted May 20, 2005.

Contributors

The authors all conceptualized the study. J.R. MacNeil conducted analyses. M. Moore supervised the analyses. M.N. Lobato assisted with the interpretation of the data analyses and coauthored the article. All authors conceptualized ideas, interpreted findings, and reviewed drafts of the article.

Acknowledgment

We thank Robert Pratt for his careful scrutiny during data verification.

Human Participation Protection

No protocol approval was needed for this study. The national surveillance system has been classified by the CDC as a project not involving human subjects or research because the primary intent is a public health practice disease control activity, specifically routine disease surveillance. The data are used for disease control program or policy purposes.

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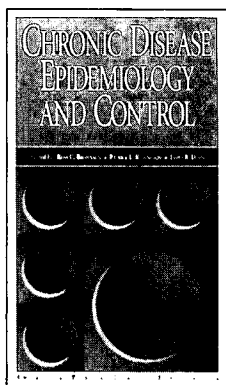
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