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Tuberculosis Case Detection in a State Prison System

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SYNOPSIS

Objective. This study was designed to describe the epidemiology of tuberculosis (TB) among inmates in the Georgia state prison system; to evaluate the effectiveness of the TB case detection methods used; to evaluate the use of contact tracing for inmate TB cases; and to determine rates of completion of therapy.

Methods. Using a standardized form, the authors abstracted data from reports to the Centers for Disease Control and Prevention, prison hospital medical charts, and county health department records for all patients with TB treated in the Georgia Department of Corrections prison system from 1991 through 1995.

Results. A total of 142 cases of tuberculosis were treated in the prison during the five-year period. Approximately two-thirds were detected by active case finding, either at the county jail prior to transfer to the prison system (31%) or at the prison intake evaluation (37%). Routine screening procedures at entry, following Centers for Disease Control and Prevention guidelines, had a sensitivity of 96%. Contact investigations were carried out in county jails or in the community for only 25% of cases detected at entry to prison. For those released from prison still on treatment, 38% were lost to follow-up before completion of therapy.

Conclusions. The Georgia prison system is doing an effective job of TB case detection and treatment among incarcerated inmates. Closer cooperation between the prison system and local health departments is needed to improve contact tracing and completion of therapy for this high risk population. Some cases detected at entry to prison appear to have been missed in the county jails.

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Correctional facilities have been recognized as a source of tuberculosis (TB) transmission to inmates, employees, and the community at large for decades.[1] In recent years, numerous TB outbreaks have occurred in the United States, exacerbated by the rapid rate of progression to disease among people infected with the human immunodeficiency virus (HIV).[2,3] Several states have reported case rates among inmates to be 7 to 11 times the rate in the general population.[4] In a 29-state survey of TB in correctional facilities, inmates were found to have a case rate 3.9 times the rate of people of similar age living in the community.[5]

To reduce transmission, the Centers for Disease Control and Prevention (CDC) has issued guidelines for TB control in correctional facilities.[4] Little is known, however, about the effectiveness of these policies. We evaluated case detection methods within the Georgia Department of Corrections (DOC) prison system as well as the relationships between prison health services and local TB control programs to determine specific ways in which TB control within these institutions could be improved.

The purposes of the present study were to evaluate the epidemiology of TB disease in, and TB transmission within, Georgia's state prison system; to evaluate the effectiveness of CDC's recommended TB case detection methods[4] in this setting; to evaluate the use of contact tracing for inmate TB cases; and to determine the rate of completion of therapy among cases.

Georgia prison system's TB control policy. Georgia's prison system houses inmates in 38 state correctional facilities and in leased space in more than 100 other facilities. Inmates new to the prison system spend several weeks at a diagnostic center for an evaluation that includes a TB symptom screen and mandatory HIV testing. Those without a history of previous active TB or a previous positive tuberculin (Purified Protein Derivative [PPD]) test verified through state records undergo PPD testing. Inmates with an induration of 10 millimeters (mm) or greater when tested receive chest X-rays. New inmates who have a history of active TB or a previous positive PPD, are HIV-seropositive, or are older than age 39 also have chest X-rays.

An inmate with a chest X-ray suspicious for TB is transferred to respiratory isolation in the prison hospital for evaluation. Inmates who are tuberculin-negative at intake undergo tuberculin testing annually, with chest X-rays for those with positive PPDs. Inmates with medical complaints are evaluated at medical clinics on-site at the facilities in which they are housed. If there is a case of potentially infectious TB within a facility, exposed inmates undergo tuberculin testing immediately and, if the initial PPD is negative, again 12 weeks later. Preventive therapy is prescribed according to CDC guidelines and administered as directly observed therapy.[6]

All inmates with suspected or confirmed TB are transferred to the central prison hospital for evaluation and treatment until their prison term ends. For inmates still on treatment at the time of release from prison, the prison medical staff arranges follow-up at the appropriate county TB program. The prison hospital reports cases to the Department of Corrections central office and to the state, district, and county health departments at the time of detection.

METHODS

Data collection. Using a standardized form, one of the authors (NNB) and two research assistants abstracted data for each person treated in the prison hospital from January 1, 1991, through December 31, 1995. The sources of data were *Reports of a Verified Case of Tuberculosis (RVCTs),* prison hospital medical charts, and county TB program records. Medical records from county jails were not available.

The *RVCT* is the official form by which reports of cases are submitted to the Division of TB Elimination, CDC. From the *RVCT* we determined whether an inmate treated in the prison hospital represented a verified TB case and the final outcomes of cases.

From the hospital medical chart, we determined the age, gender, HIV status, and site of TB disease (pulmonary or extra-pulmonary) for each inmate with active TB, and the acid-fast bacilli smear and *M. tuberculosis* culture status and antibiotic susceptibility of their TB strains. The duration of symptoms for each inmate prior to the diagnosis of TB was taken from the hospital admission note. From information in the medical charts we also determined at what point during incarceration TB was diagnosed—at the county jail prior to transfer to the state prison system, during medical intake to the prison system, within six months of entry into prison and considered missed at intake evaluation, or six or more months after entering prison. We calculated duration of hospital stay from admission and discharge dates as recorded in the medical charts.

Because some inmates with active TB were diagnosed either at the county jail prior to transfer to the state prison system or at intake into prison, we explored whether contact investigations had been conducted in the communities or jails where the inmates had been

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located just prior to diagnosis. To do this, we reviewed all county TB program records of contact investigations for inmates diagnosed in jail or during prison intake among the subset of inmates with active TB admitted between January 1, 1993, and December 31, 1995.

Statistical analysis. To calculate the rate ratio of prison cases of TB compared with cases in the general state population, we compared the observed with the expected incidence rate. For the numerator of the observed rate, we included all cases diagnosed six months or more after admission and excluded cases detected on intake evaluation or less than six months after admission to prison. For the denominator, we used the year-end prison population. For the expected case rate, the numerator was all reported cases from the state excluding the prison incident cases included in the numerator for the observed rate. For the denominator, we used the Georgia state population from the 1990 Census.[7]

To calculate the prevalence of TB among the population entering the prison system, the numerator was the number of cases detected at a county jail prior to an inmate's transfer to the prison system plus those diagnosed at entry to the system or within the first six months after admission. The denominator was the number of total admissions to the prison system during the same time period.

To calculate the prevalence of HIV infection among the inmate population, we used the number of inmates with a positive ELISA for HIV with a confirmatory Western blot as the numerator, and the total inmate population as the denominator.

We used chi-square tests or Fisher's exact tests for between-group comparisons. Analysis was done using Epi-Info, Version 6.0.[8]

RESULTS

Epidemiology of TB and treatment outcomes. From 1991 through 1995, 142 inmates with TB were treated in the prison hospital. The median age was 36 years (range 19-64). Of these inmates, 132 (93%) were male and 10 (7%) female; 58 (41%) were HIV-seropositive. The prevalence of HIV-seropositivity among inmates during the five-year period was 3%.

Of the inmates treated for TB in the hospital, 125 (88%) had pulmonary disease, according to their medical charts. Of these, 43 were acid-fast bacilli smear-positive and *M. tuberculosis* culture-positive, 50 were smear-negative and culture-positive, and 32 were culture-negative. Fourteen were isoniazid-resistant, and one was resistant to rifampin, ethambutol, and pyrazinamide.

The average stay in the prison hospital for the 142 inmates was 204 days. Ninety-three (65%) inmates completed treatment while incarcerated, 10 (7%) died while under treatment, and 39 (27%) were released prior to completing treatment. All 10 deaths were among HIV-seropositive patients. *RVCT* records indicated that among the 39 inmates released prior to completion of therapy, 23 (59%) completed treatment after release, one died prior to completing treatment, and 15 (38%) were lost to follow-up.

From the prison hospital medical charts of the 142 inmates, we were able to determine at what point during incarceration TB was diagnosed—at the county jail prior to transfer to the prison system (44 cases), during medical evaluation on intake into prison (53), within 16 weeks of entry into prison and considered missed at intake evaluation (2), or six or more months after entering prison (43).

The majority (70%) of those treated for TB in prison were diagnosed at county jails or during (or shortly after) intake to the prison system, representing prevalent cases at entry into prison (although they were newly diagnosed incident cases for the state population). The annual rate of admissions to the prison system ranged from 19,079 in 1991 to 15,937 in 1995, with a five-year total of 87,518 admissions. The prevalence of TB among new entrants for the five-year period was 113 per 100,000.

From 1991 through 1995, the year-end prison inmate population increased from 23,760 to 34,266 despite the decrease in admissions, reflecting the longer sentences

mandated by state law. The mean TB incidence rate for the five-year period was 32 per 100,000 inmates per year. The average case rate for the general state population during this period was 12 per 100,000 (Unpublished data, Georgia TB Control Program, 1991–1995). Thus the ratio of the observed to the expected rate was 2.6.

Cases detected in jails versus in prison. The 53 inmates diagnosed with TB on entry to the prison system may have represented either cases missed while in jail or cases of rapid progression to disease from new infection acquired in jail. The 53 came from 17 different jails, and jail medical records were not available to us. We found no significant difference between the 44 inmates whose hospital records showed they had been diagnosed in county jails and the 53 diagnosed at intake to the prison system in terms of demographic and disease variables including age, "race," gender, site of TB disease (pulmonary versus extra-pulmonary), and acid-fast bacilli smear status of pulmonary cases (data not shown). We also compared HIV status in the two groups because HIV infection might have led to more rapid progression to disease from new infection; there was no difference between the two groups in the proportions of HIV-seropositive individuals (data not shown).

Evaluating case detection methods. To evaluate the effectiveness of TB case detection methods among new and longer-term inmates in the prison system, we determined from hospital medical charts why each inmate had initially been evaluated for TB. As shown in the Table, routine screening measures such as PPD testing or chest X-rays detected a large proportion (74%) of the cases diagnosed at entry to prison (chest X-rays were routine for those with known previous positive PPD tests or HIV infection and those age 40 or older). Among 87,518 people entering prison, two cases appeared to have been missed on intake; both were diagnosed four months after intake evaluation. Thus the sensitivity of the intake evaluation was 53/55 or 96%.

The majority (72%) of incident cases among longer-term inmates were detected during evaluation for symptoms; fewer cases (19%) were detected by routine screening (annual tuberculin testing for all inmates and chest X-rays at 40th birthdays). Contact evaluations within the prison detected four cases (9%).

The median duration of symptoms prior to diagnosis among the longer-term inmates was two months. The duration of incarceration prior to developing symptoms of disease among the incident cases ranged from six months to 19 years, with a median of 1.5 years. Seventeen of 43 (39%) longer-term inmates diagnosed with TB in prison were HIV-seropositive; 42 of 99 (42%) diagnosed in county jails prior to prison intake or on intake into the prison system were HIV-seropositive.

Contact investigations. From 1993 to 1995, of 76 TB

Table. Reason for medical evaluation, inmates diagnosed with tuberculosis (TB) after transfer to Georgia Department of Corrections, 1991–1995 (*N* = 96)

Reason for evaluation	TB diagnosed during intake[a] (n = 53)		TB diagnosed among longer-term inmates (n = 43)		Rate ratio	95% CI
	Number	Percent	Number	Percent		
Symptoms	13	24	31	72	0.34	0.20,0.57
Routine screening	39	74	8	19	3.96	2.07,7.54
PPD test	21	—	6	—	—	—
Chest X-ray[b]	18	—	2	—	—	—
Contact evaluation	—	—	4	9	—	—
History of TB[c]	1	2	—	—	—	—

[a]Does not include 44 inmates transferred from county jails to the prison system as TB suspects or cases.

[b]New inmates who have a history of active TB or a previous positive tuberculin test, who are HIV-seropositive, or who are older than age 39 receive chest X-rays. Chest X-rays are also given to longer-term inmates at their 40th birthday or may be given pre-operatively for unrelated conditions.

[c]Patient reported being on treatment for TB prior to arrest and incarceration at the county jail, which was verified with the county health department.

CI = confidence interval

PPD = purified protein derivative

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cases treated in prison, 56 were diagnosed among new admissions. For 14 (25%) of the 56 cases among new admissions, contact investigations had been conducted by health departments in the counties where inmates had lived or been jailed.

DISCUSSION

We used data from the *RVCT*, state prison hospital medical charts, and county health department records to investigate the epidemiology and control of TB in a state prison system. We found that in this system a larger burden of TB cases came from active case finding done on entry to the system than from new cases of disease in longer-term inmates. TB screening protocols at intake, which follow CDC guidelines,[4] appear to have been effective in detecting cases, while screening protocols for longer-term inmates, also following CDC guidelines, appear to have been less efficient at early detection of new cases. The high number of cases detected at entry to the prison may indicate that some cases were missed in the county jails. We also found that for people with TB entering and leaving prison, ties with local public health programs were weak, as indicated by inadequate contact investigations and follow-up treatment.

The TB incidence rate in the state prison system that we calculated was higher than the rate in the general population of the state (rate ratio 2.6), although not as high as has been reported by others.[5] *RVCT* prison cases included inmates transferred as TB suspects from county jails, cases detected at intake to prison, and incident cases in the prison population. Basing the incidence rate on *RVCT* reports from the prison system would have more than doubled the rate, when in actuality the larger burden of TB was from active case finding upon entry.

For the five-year period, we calculated a prevalence of TB of 113 per 100,000 among newly admitted prison inmates. A high prevalence of disease (2700 per 100,000) among 702 inmates entering jail over a nine-month period has been reported in Barcelona, Spain,[9] but our data are the first resulting from looking at cases in a prison over several years. Most recent reports about TB in correctional institutions have focused on intra-institutional transmission of infection and rapid progression to disease.[2,3,10] TB transmission within the Georgia state prison system was not a major problem, as most cases were detected upon inmates' entry into the system. Whether most cases of TB within a correctional institution are prevalent or incident cases probably depends on a variety of factors, including the effectiveness of screening protocols, the proportion of HIV-seropositive inmates, and the rate of population turnover. The large proportion of prevalent cases detected and treated in our state prison system underscores the contribution the correctional health service is making to public health by active case finding among a high risk population.

The prison TB control program appears to be effective in case finding among new admissions; only two cases were missed during the intake evaluation. Routine tuberculin skin testing and routine chest X-rays (in those who had an induration of 10 mm or greater or a previous positive PPD, those who were HIV-seropositive, and those who were older than age 39) and evaluation of TB suspects transferred from jails detected the largest proportion of cases (74%). The remainder of patients were identified when they were medically evaluated because they presented with symptoms suggestive of TB.

Not unexpectedly, incident cases among longer-term inmates were more likely to be detected because of symptoms (72%) than through routine screening procedures (19%). Because 40% of incident cases were in HIV-seropositive inmates but only 3% of the total prison population was HIV-seropositive, more frequent screening of HIV-infected inmates might detect TB earlier in

that group. Also, since more than half of the cases in longer-term inmates occurred within two years of entry into prison, rescreening of inmates at 6 and 18 months after intake as well as at 12 months, as is currently done, might detect cases earlier. Although annual tuberculin skin testing was of limited usefulness in case detection because most cases were detected in other ways, it is important for surveillance, potentially revealing unsuspected transmission through clusters of new infections. Also, the correctional system may provide an opportunity for preventive therapy for infected inmates, many of whom have limited access to health care prior to and following incarceration.[11]

It is uncertain whether the 53 cases detected on entry to the prison system represent people with new infection acquired in jail and rapid progression to active disease or cases missed during incarceration in jail. The 53 inmates came from 17 different county jails. Jail medical records transferred to the state prison system were incomplete, and information regarding length of incarceration in jail prior to transfer was not available to us. As noted above, there were no demographic or clinical differences between those with TB detected in the jails and those detected at entry to prison that would explain differential evaluation of some jail inmates for TB. The strongest indication that cases detected at prison intake may have been missed in the jails and were not cases of rapid progression to disease after new infection was that HIV infection, the most potent risk factor known for rapid progression to active disease,[12] was about equally prevalent among cases detected in jail and cases detected at intake to the prison system.

The high prevalence of disease among inmates arriving from jail raises the question of whether there is a similar prevalence among jail inmates who do not go on to the state prison system but are released back to the community. Only a minority of inmates incarcerated in county jails in Georgia are sentenced to the state prison. The effectiveness in increasing case detection of high speed mini–chest X-ray TB screening during admission evaluation at a large urban jail has recently been reported.[13] This technique holds promise for the large urban jail, but three-fourths of our cases came from smaller county jails that would not be able to afford the equipment. Algorithms for symptom screens have been suggested by the CDC and need to be evaluated in various jail settings.[4]

Finally, our data suggest that the current interface between the prison health system and county TB programs is ineffective. Among people with TB entering prison, including those detected either in jail or at intake, a contact investigation was conducted at the jail or in the community where the inmate had been prior to diagnosis for only 25%. Of the inmates with TB released from prison prior to completion of therapy, 38% were lost to follow-up. Local TB programs need to involve themselves in case management for inmates with TB at entry to or discharge from the state prison system.

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