Abstract

Objectives. This study evaluated the efficacy of radiographic screening for tuberculosis in correctional facilities.

Methods. Inmates at an admission facility in New York, NY, were screened for tuberculosis by registry cross-match, symptom interviews, tuberculin testing, and chest radiography.

Results. Thirty-two cases of tuberculosis were detected among 4172 inmate admissions (767 cases per 100,000). Twenty-five inmates (78%) were previously diagnosed but incompletely treated; all were identified by registry cross-match. Seven inmates (22%) were newly diagnosed, of whom four (57%) were asymptomatic, had negative skin tests, and were detected only by their abnormal radiographs.

Conclusions. Screening strategies that limit radiographic testing to inmates with either positive skin tests or symptoms may result in missed opportunities for diagnosing active tuberculosis. (Am J Public Health. 1997;87:1335–1337)

Introduction

Inmates have long been recognized to be at a higher risk than the general population for active tuberculosis. The incidence of tuberculosis among inmates in New York increased from 15.4 per 100,000 in the mid-1970s to 105.5 per 100,000 in 1986; most cases occurred in inmates who were infected with the human immunodeficiency virus (HIV). Recent reports of tuberculosis outbreaks in correctional settings have focused attention on the potential for intraprison transmission resulting from tuberculosis cases not recognized during admission screening.

Unfortunately, policymakers have few formal studies to guide recommendations for tuberculosis screening among inmates. In 1992, the New York City Department of Health convened an expert advisory panel to address the problem of tuberculosis in the city's correctional facilities; this panel recommended screening chest radiographs for all inmate admissions, regardless of tuberculin skin test status or symptom history. Before implementing this recommendation city-wide, the health department first evaluated the efficacy of radiographic screening at the inmate admission facility in Manhattan.

Methods

Manhattan House is the admission facility in the borough of Manhattan for all adult male detainees who, after arraignment, are not released on their own recognizance or are unable to meet bail. Approximately 2000 inmates are admitted to Manhattan House each month. When an inmate is admitted to the facility, the clinical staff obtains a medical history and performs a physical examination and tuberculin skin test. However, the usefulness of tuberculin testing in this setting is limited by the frequent transfer or release of inmates before skin tests can be interpreted and by the high prevalence of HIV infection, which can cause cutaneous anergy to tuberculin antigen. Since October 1992, all new inmates have had screening chest radiographs.

We included all inmates admitted to Manhattan House during an 11-week study period (May 14 through July 31, 1993). If an inmate was admitted more than once, only the first admission was included. Repeat admissions under aliases were excluded by obtaining a list of any previously used aliases from New York State's inmate identification number registry, which identifies inmates based on fingerprint identifiers, name, and date of birth.

The case definition for active tuberculosis included both (1) previously diagnosed (by microbiologic or clinical

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criteria\textsuperscript{15}, incompletely treated tuberculosis,\textsuperscript{13} and (2) previously undiagnosed tuberculosis (in an inmate who was diagnosed at the time of admission by microbiologic or clinical criteria). Inmates who had previously diagnosed, incompletely treated tuberculosis were detected by matching both admission and alias names from the daily admission log against the computerized New York City Tuberculosis Registry. To detect additional cases not reported to the registry, we asked inmates, during a standardized interview, whether they had ever been diagnosed with tuberculosis. Noncompliance with therapy was defined as two consecutive missed clinic appointments or discontinuation of antimycobacterial therapy for 14 consecutive days, except under the circumstances of an adverse drug reaction.\textsuperscript{14}

As a means of detecting inmates who had previously undiagnosed tuberculosis, all admissions were screened by (1) interviewing for symptoms suggestive of active tuberculosis (persistent fever or cough for 3 weeks or longer), (2) tuberculin skin tests performed via the Mantoux method with 5 tuberculin units, and (3) standard frontal-view chest radiographs. Consulting radiologists read all radiographs on-site within 24 hours. Because of the high prevalence of HIV infection among inmates, a lower limit of 5 mm was used for defining a positive tuberculin skin test result.\textsuperscript{15}

A sputum specimen for acid-fast staining and mycobacterial culture was requested if an inmate met any of the following criteria: persistent symptoms of fever or cough, tuberculosis history, or abnormal radiographic findings suggestive of tuberculosis. All sputum specimens were induced with aerosolized saline\textsuperscript{16}; attempts were made to obtain three samples from each inmate who met the preceding criteria. Standard laboratory procedures were used for acid-fast staining and microscopy, mycobacterial culture, and testing for drug susceptibility.\textsuperscript{17}

Epi Info 5.0 software\textsuperscript{18} was used in analyzing data. The study protocol was approved by the New York City Department of Health's Institutional Review Board.

**Results**

During the 11-week observation period, 4172 inmates were admitted to Manhattan House. The median age of inmates was 30 years (range = 15 to 87 years); one quarter were born outside the United States. A total of 1817 (44\%) inmates reported having had HIV tests. Of 135 (7\%) reporting positive tests, 31 (23\%) said they had the acquired immunodeficiency syndrome (AIDS).

Completion rates for tuberculosis screening were as follows: registry match, 100\% (n = 4172); interview, 94\% (n = 3933); chest radiographs, 87\% (n = 3643); and tuberculin skin tests, 75\% (n = 3144). The overall rate of tuberculin positivity was 38\% (1201/3144). Among the 3433 inmates who had tuberculin tests, 986 (29\%) were transferred or released before their tests could be read. Among the 402 (10\%) inmates meeting criteria for sputum induction, three sputum specimens were obtained from 80\% and at least one from 86\%.

Thirty-two cases of active tuberculosis were detected (prevalence: 767 per 100,000). Twenty-five (78\%) inmates had been diagnosed before the study and at the time of admission had not completed treatment. Seven (22\%) inmates were newly diagnosed, six of whom had sputum positive on culture. The remaining culture-negative inmate had a positive tuberculin test and an upper lobe infiltrate that responded to antituberculous medications.

Of the 32 inmates with active tuberculosis, 21 (66\%) reported having been tested for HIV, 6 (29\%) with a positive test result. None of the inmates with previously undiagnosed tuberculosis reported a history of HIV seropositivity. Only 2 inmates subsequently agreed to testing; both were HIV negative. Among inmates who reported having been tested for HIV, those who reported a positive test result were more likely to have active tuberculosis (6/135; 4\%) than those who reported a negative result (15/1682; 1\%) (prevalence ratio = 5.0, exact 95\% confidence interval [CI]\textsuperscript{19} = 1.6, 13.3).

All 25 inmates who had previously diagnosed, incompletely treated tuberculosis were listed in the New York City Tuberculosis Registry. Of these inmates, 8 (32\%) did not admit to tuberculosis when interviewed and were discovered solely by the registry match. Twenty-two inmates were listed on the registry under the same name used on admission. Three inmates were admitted under aliases; all 3 had denied a history of tuberculosis when interviewed and were detected only by cross-matching of their aliases with the registry.

Of the 25 inmates who had previously diagnosed, incompletely treated tuberculosis, only 5 were on antituberculosis medications when arraigned. Twenty (80\%) had been noncompliant with therapy. Their median duration of treatment was 1 month (range = 0 to 4 months); the median time off therapy was 18 months (range = 1 month to 4 years). Mycobacterial cultures were still positive in 4 inmates lost to follow-up; 2 had developed resistance to isoniazid since their initial diagnoses.

Of the seven inmates who had previously undiagnosed tuberculosis, three had either positive tuberculin skin test results or symptom histories that would have prompted a diagnostic radiograph using standard screening criteria. The remaining four inmates were asymptomatic, had negative skin test results, and were identified only by their abnormal screening radiographs.

**Discussion**

Tuberculosis control in correctional facilities requires early recognition of active cases during admission screening. Outbreaks in correctional institutions have resulted, at least partly, from the absence of adequate screening programs for early detection of active tuberculosis and prevention of transmission to other inmates and correctional staff.\textsuperscript{6-8}

Tuberculosis was prevalent among inmates admitted to Manhattan House; most cases had been diagnosed previously. We found the previously diagnosed cases by cross-matching the daily admission log from Manhattan House with the New York City Tuberculosis Registry. Tuberculosis screening protocols should be able to detect all inmates who have active tuberculosis, regardless of whether they are contagious at the time of admission. Most previously diagnosed inmates had been noncompliant with antituberculous therapy before incarceration; four were still culture positive: all these were potentially contagious to other inmates since, if unidentified and untreated while incarcerated, their disease could have progressed.

Our findings support new recommendations of the Centers for Disease Control and Prevention advising radiographic screening in correctional facilities where the inmate population changes rapidly and where tuberculosis and HIV infection are prevalent.\textsuperscript{20} Screening strategies that limit radiographic testing to inmates who have either positive tuberculin skin test results or symptoms may result in missed opportunities for diagnosing previously unrecognized cases. Tuberculin skin testing was an impractical screening tool during our
study, since almost one third of inmates were transferred or released before their skin tests were read. The screening radiographs of all inmate admissions detected four inmates with previously undiagnosed tuberculosis that was undetected either by tuberculin skin testing or by symptom interviews; all had positive sputum cultures. Symptom histories may be unreliable if inmates are apprehensive about reporting their illness to correctional health staff.

Radiographic screening has been replaced by tuberculin skin testing in most correctional facilities in the United States. However, a few facilities in large urban areas have continued or reinstated universal screening. Cook County Jail in Chicago discontinued radiographic screening in 1975 but resumed in 1992 as a result of concern that tuberculin skin testing was insufficiently sensitive. Of 28 cases of tuberculosis detected among the 28,997 inmates screened radiographically over a 6-month period, half had not been diagnosed before the inmate’s incarceration.21

Based on the evaluation reported in this study, we recommend that tuberculosis control programs in urban settings with high tuberculosis prevalence consider the following protocol for detecting inmates with active disease. Where confidentiality laws permit, tuberculosis registries should be made rapidly accessible to correctional health staff so that, on admission, inmates’ names and aliases can be matched against the registry. Universal radiography of all inmates should be used in facilities where both tuberculosis and HIV are highly prevalent. Where rapid movement of inmates undermines the usefulness of tuberculin skin testing, radiographic screening is likely to be the more effective tool for detecting previously undiagnosed tuberculosis. □

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