Pulmonary tuberculosis in the Dhaka Central Jail: Control and prevention of transmission

The global burden of tuberculosis (TB) is still very high. Correctional facilities are particularly burdened with TB as a result of an aggregation of risk factors. Active screening for symptomatic pulmonary TB of all the inmates inside Dhaka Central Jail (DCJ) revealed that the TB prevalence among inmates was about 20-fold higher than the general population in Bangladesh. We describe the results of an evaluation of the first four years of an intervention aimed at controlling and preventing TB transmission in DCJ which included active screening for pulmonary TB upon entry and during incarceration in DCJ, use of microscopy to detect acid fast bacilli and culture to detect *Mycobacterium tuberculosis*, immediate isolation of persons with confirmed TB, and early initiation of anti-TB treatment. The number of pulmonary TB cases declined significantly, from 33 cases identified during the first quarter to 12 TB cases in the final quarter of the study period. We found that active screening upon entry and during incarceration was key for controlling TB in DCJ. However, an effective referral mechanism for treatment on release will need to be implemented to prevent transmission in the community.

Tuberculosis (TB) continues to be a major public health challenge in low- and middle-income countries. Even with the encouraging progress made in controlling the spread of TB during the past two decades, the global burden of TB is still very high. In 2011, there were an estimated 8.7 million incident cases and 1.4 million deaths from TB (1). Almost 60% of the world's TB cases are in the Southeast Asia and Western Pacific regions (1). Bangladesh is currently ranked 6th among 22 countries with a high burden of TB (2).

Correctional facilities are difficult settings for TB control. Incarcerated persons often come from socioeconomic groups in which TB prevalence is high and they frequently engage in behaviours, such as alcohol and drug use, that may increase their risk for infection (3). Many inmates have acquired TB before incarceration and many of the correctional facilities in the world are extremely overcrowded (3,4). Confining a high-risk population in an overcrowded setting with poor hygiene and inadequate ventilation creates an ideal environment for transmission of TB (4,5). The core elements of effective TB control in any setting are early case detection and successful treatment. There are three main strategies for finding TB cases in correctional facilities: case-finding through self-referral, screening on entry and active case-finding among inmates (3). These strategies are complementary and

should be established at the same time. Using one strategy in isolation is unlikely to effectively detect TB cases in correctional facilities (3).

It has been estimated that approximately 10 million persons are incarcerated worldwide on any given day (6). Many are from marginalized and disadvantaged segments of society where the risk of TB infection is high (3). The presence of people at high risk for TB coupled with overcrowded conditions in jails and prisons facilitates acquisition and transmission of TB (7). The prevalence of TB in correctional facilities greatly exceeds the prevalence of TB in the general population, often being five to 10 times and in some cases up to 50 times higher (7-9).

Data on TB in correctional facilities in Bangladesh are scarce. The investigation team from icddr,b started active screening for pulmonary TB among incarcerated persons at Dhaka Central Jail (DCJ), the largest correctional facility in Bangladesh, in 2005 to determine the prevalence of TB in DCJ and determine associated risk factors (10). Active screening for pulmonary TB consisted of asking all inmates upon entry and during incarceration in DCJ about symptoms of TB. Microscopy was used to detect acid fast bacilli (AFB) and culture was used to detect *Mycobacterium tuberculosis* among those with symptoms suggestive of pulmonary TB.

DCJ houses about 11,000 inmates at any time, although its official capacity is only 2,600 inmates (10). From October 2005 to September 2007, approximately 11,000 incarcerated persons in DCJ were actively screened for TB by the study team and the prevalence of TB was found to be 2,227 per 100,000 population, which was more than 20 times higher than in the general population of Bangladesh (10,11). A risk factor analysis showed that factors associated with developing active TB included history of exposure to TB patients, previous history of imprisonment, and malnutrition (defined as body mass index [BMI] <18.5 kg/m^2) (10). Among cases with history of exposure to TB patients, 75% were exposed in DCJ and 37% of cases were detected within six months of arriving at DCJ, suggesting that a substantial number of inmates enter DCJ with active TB or during the early stages of infection (10).

In January 2009, the icddr,b team established ongoing active screening for pulmonary TB at DCJ and a system to isolate and treat those inmates found to have pulmonary TB. The objective of this study was to describe findings from the first four years (January 2009 to December 2012) of the screening and intervention programme.

Beginning in January 2009, every inmate entering DCJ was screened for symptoms of pulmonary TB using a simple questionnaire. In addition, we developed a system to screen inmates who had entered DCJ before the start of the analysis period and to rescreen those who had been screened on entry by conducting active screening sequentially in the DCJ blocks in which

inmates were housed. Screening began in one of the 17 housing blocks at DCJ and was successively carried out in the other blocks until screening in each of the 17 blocks was completed, then the process was repeated. Inmates were classified as having suspected pulmonary TB if they reported having a cough for ≥3 weeks. We collected three sputum samples from all suspected cases and the samples were transported to the icddr,b Tuberculosis Laboratory in a cool box, in accordance with standard laboratory guidelines for TB, and processed on the same day. We examined specimens for the presence of AFB using microscopy by Ziehl-Neelsen staining and specimens were cultured on Lowenstein-Jensen solid media. Inmates were classified as having confirmed pulmonary TB if AFB were detected either by microscopy or on culture. We immediately isolated inmates with confirmed pulmonary TB and DCJ Hospital staff started them on anti-TB treatment following the National Tuberculosis Control Programme guidelines (Figure 1). We also performed drug-susceptibility testing (DST) using the proportion method for *M. tuberculosis* isolated on culture to determine whether confirmed TB cases were infected with multidrug-resistant TB (MDR-TB). Cases identified with MDR-TB were given second line TB treatment. Data were analyzed using regression models to assess the association between changes in incidence of TB from quarter to quarter (linear regression coefficient (ß) with 95% confidence intervals).

During the study period, the icddr,b team screened 140,055 inmates and a total of 2,462 suspected TB cases were identified, of whom 298 (12%) were found to have pulmonary TB on the basis of positive AFB results on microscopy and/or *M. tuberculosis* isolated on culture (Table 1). Sixty (20%) of the inmates with pulmonary TB had negative AFB results on microscopy but positive results on culture. The proportion of confirmed pulmonary TB cases among those screened was almost seven times higher among male (0.2%, 296/133,475) than female (0.03%, 2/6,580) inmates. Of the DST results available from 91 patients with pulmonary TB, only one (1.1%) was found to have MDR-TB.

During the study period, the number of pulmonary TB cases detected quarterly decreased from 33 cases during the first quarter of the study period to 12 in the final quarter of the study period and a trend analysis showed a statistically significant decline over the study period (p=0.005) (Figure 2).

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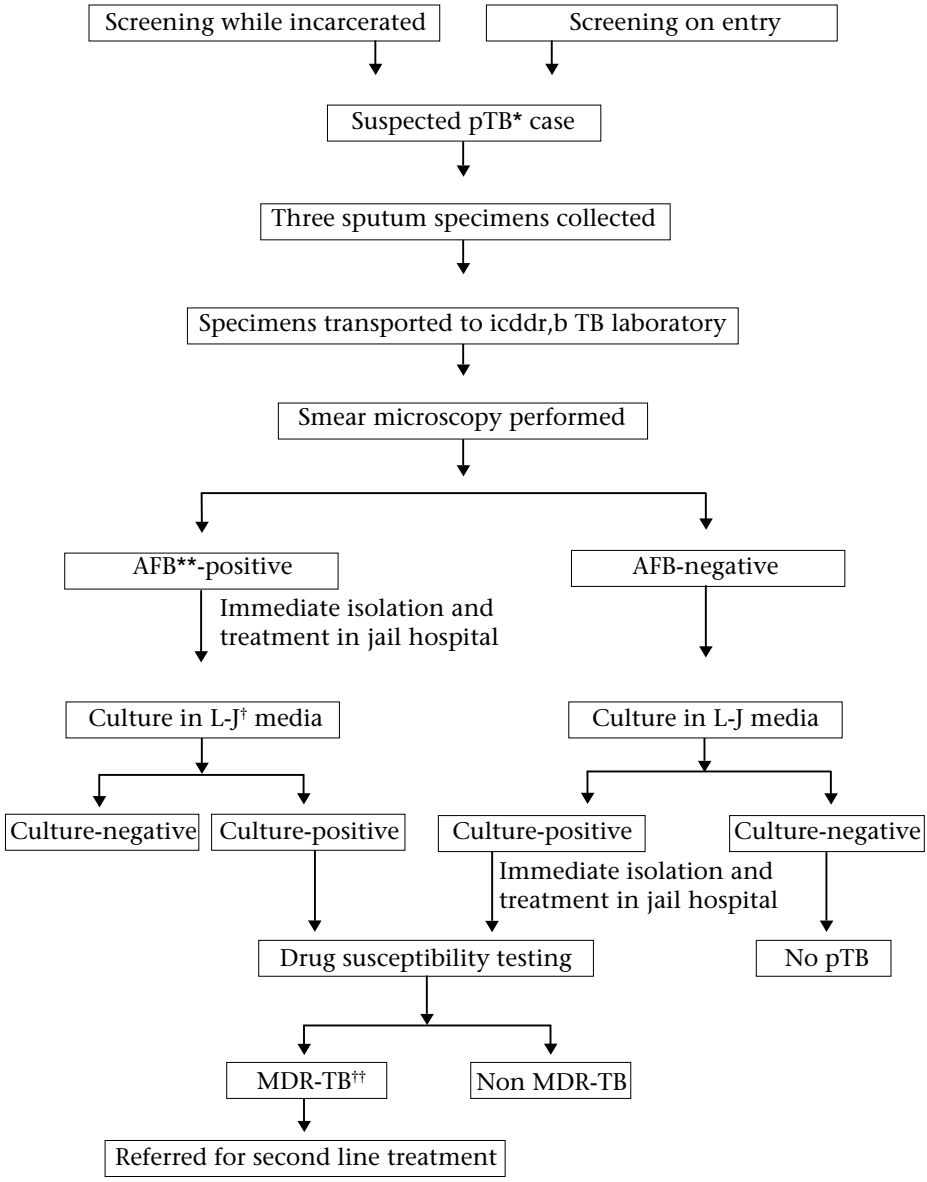
Figure 1: Flow chart of pulmonary tuberculosis (pTB) intervention at Dhaka Central Jail, January 2009 to December 2012



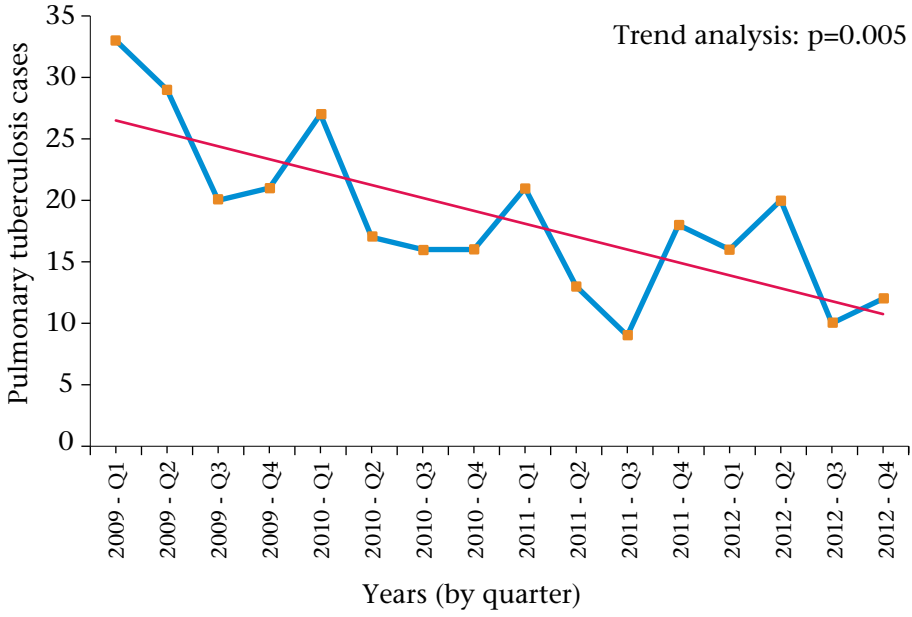
*pTB: pulmonary TB case
**AFB: acid fast bacilli
†L-J: Lowenstein-Jensen
††MDR-TB: Multidrug-resistant tuberculosis

Table 1: Tuberculosis screening at the Dhaka Central Jail, January 2009 to December 2012

	Male n (%)	Female n (%)	Total
Inmates screened	133,475	6,580	140,055
Suspected pulmonary TB cases, number (%)*	2,455 (1.8)	7 (0.1)	2,462 (1.8)
Samples culture-positive for TB, number (%)†±	296 (12.1)	2 (28.6)	298 (12.1)
Samples positive on microscopy for acid fast bacilli, number (%)**	236 (79.7)	2 (100)	238 (79.9)
Confirmed pulmonary TB cases, number (%)*	296 (0.2)	2 (0.03)	298 (0.2)

*Proportion among inmates screened
†Proportion among suspected cases
± Three sputum samples were collected from each of the 2,462 suspected cases for testing
**Proportion among culture-positive TB samples

Figure 2: Pulmonary tuberculosis cases detected in the Dhaka Central Jail, January 2009 to December 2012



Comments

We identified a substantial number of pulmonary TB cases in DCJ during the 48-month study period. A considerable proportion (20%) of culture-positive cases had negative results for AFB on microscopy. The declining trend in detected pulmonary TB cases suggests that implementing active screening upon entry and during incarceration in DCJ, diagnostic testing of suspected cases, immediate isolation of inmates with laboratory-confirmed TB and early initiation of effective anti-TB treatment significantly reduced the TB case burden and TB transmission in DCJ.

This study was subject to at least one limitation. We screened inmates for symptoms suggestive of pulmonary TB but it is likely that we failed to detect all pulmonary TB cases. The use of chest radiography for those with symptoms would have enhanced detection of pulmonary TB, particularly among the 20% of inmates who had *M. tuberculosis* isolated on culture but negative results on microscopy, and could have reduced the time from detection to isolation and treatment and assisting with the control of TB transmission.

The conditions that favor TB transmission in correctional facilities also put the general community at risk from onward transmission by staff and visitors, as well as by inmates upon their release (3). The interventions taken at DCJ likely contributed to the declining trend in case detection. These interventions could be scaled up and replicated in other correctional facilities in Bangladesh and other countries in an effort to control TB in these difficult settings. One potential improvement to the intervention would be the use of rapid molecular tests, such as GeneXpert, which can detect TB in just hours compared to the 4-6 weeks necessary for isolation of *M. tuberculosis* on culture. GeneXpert has the added benefit of identifying MDR-TB (12) and thus can inform decisions about which TB treatment regimen to initiate. Use of GeneXpert would be particularly helpful for persons with negative results for AFB on microscopy, but for whom *M. tuberculosis* is isolated on culture. Future studies should evaluate the impact GeneXpert can have on reducing the delay in beginning treatment and improving treatment outcomes among incarcerated populations.

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Surveillance updates

With each issue of HSB, updates of surveillance data described in earlier issues are provided. These updated tables and figures represent the most recent observation period available at the time of publication. We hope these updates will be helpful to health professionals who are interested in current patterns of disease and drug resistance in Bangladesh.