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A Shipboard Outbreak of Tuberculosis in Mississippi and Louisiana, 1993 to 1994

In the 1960s and 1970s, several tuberculosis (TB) outbreaks onboard ship were reported by the US Navy.¹⁻⁵ We describe here a large shipboard outbreak of TB among a closely confined civilian occupational group. Its occurrence demonstrated a lack of awareness of crowding as an important risk factor for TB transmission.

Employees of the Mat Sinking Unit (US Army Corps of Engineers) are housed in cramped quarters on six quarterboats on the Mississippi River. At the time of this outbreak, there was no routine pre-employment TB screening. In early 1994, the Mississippi State Health Department was notified that one employee with active pulmonary TB had remained undiagnosed for 3 months during the 1993 work season, despite several visits to health care personnel. To determine the extent of TB transmission and to determine risk factors for infection, we screened all employees without a documented previous positive skin test or history of TB with Mantoux tuberculin skin testing. Previous tubercu-

lin skin testing results were available for roughly two thirds of the workforce. All persons with current and historic positive test results were referred for chest x-ray. Sputum examination and further investigation were carried out as indicated; mycobacterial isolates were subject to restriction fragment length polymorphism testing.^{6,7} Risk factors for transmitting TB were determined by a questionnaire survey of all available 1993 season employees. The working and living conditions on the barges, along with the types of ventilation systems in the cabins, mess halls, and lounges, were thoroughly inspected.

Tuberculin skin tests were completed on 393 (92%) of 429 susceptible employees, and 237 questionnaires were completed about risk factors. Eight additional patients with TB were identified, including three with bacteriologically confirmed disease (and mycobacterial isolates identical to the index case) and five with clinical cases. Four of the eight patients, including the index patient, lived on the same quarterboat. Of 393 employees without a documented prior positive tuberculin skin test, 128 (33%) were found to be positive (≥ 5 mm induration); 40 (17%) of 232 employees with a documented prior negative test showed test conversion. Univariate analysis identified four statistically significant risk factors for having a positive tuberculin skin test: Black race, living on the same quarterboat as the index patient, eating in the back mess hall, and using the onboard lounge facilities. In a logistic regression model, however, only use of lounge facilities remained statistically significant (odds ratio [OR] = 2.9, 95% confidence interval [CI] = 1.4, 6.4). Sixty-three (49%) of the 128 employees with positive tests reported use of the lounge facilities; no particular lounge could be identified that carried a higher risk than the others.

All patients were treated with standard four-drug TB chemotherapy under direct supervision. After negative evaluation for TB disease, all individuals with positive tuberculin skin tests were given secondary prophylaxis with Isoniazid under direct supervision.

Widespread transmission of TB appears to have occurred throughout the quarterboats, favored by the cramped living conditions. The outbreak could have been prevented or limited by timely intervention. In this and similar settings, a high index of suspicion for TB disease and prompt identification and treatment of TB cases are essential.^{8,9} Regular TB

screening is also important to identify infected persons at risk of developing TB disease and transmitting infection. □

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The Adequacy of One Sputum Smear for Diagnosing Pulmonary Tuberculosis

In his recent editorial¹ on tuberculosis control policies in resource-poor countries, Kevin De Cock made highly rel-

evant comments on the recommendations of the World Health Organization (WHO)² and the International Union Against Tuberculosis and Lung Diseases (IUATLD)³ to examine three sputum smears for the diagnosis of tuberculosis. He suggests that treating patients as soon as they have one positive smear might be more appropriate. This assertion is grounded on a personal communication of Wilkinson. According to Wilkinson, over 75% of patients generally are diagnosed on the first smear and over 95% on the first two smears.

We would like to reinforce this statement with scientific references. Studies done in the 1950s and 1970s on the marginal benefit of several smears demonstrated that most cases are detected on the first two smears. In 1959, Andrews and Radhakrishna reported that 73% and 84% of the culture-positive pulmonary tuberculosis patients in their study were diagnosed by one and two smears respectively.⁴ Another study in India of eight consecutive sputum specimens corroborated these findings with 79% of all new tuberculosis cases being detected with one smear, 95% with two smears, and 98% with three (see Table 1).⁵ In terms of cost, for each smear, the average risk of false positives among noncases is 0.7% for technical reasons inherent in the test and 1% to 3% for a lack of reading reliability.⁵

A cost-effectiveness analysis (cost expressed in terms of workload and false-positive results) is presented in the table assuming a prevalence of 100 new tuberculosis cases out of 1000 patients presenting symptoms suggestive of tuberculosis (cough for more than 3 weeks, hemoptysis, and so forth).

A diagnosis strategy based on three serial smears maximizes sensitivity, but it has substantial drawbacks. First, as shown in the table, it implies a greatly increased number of false-positive patients who will be put on treatment. In optimal conditions, the lack of specificity is low. However, field studies in Peru⁶ and India⁵ have shown that the proportion of false positives among nontuberculosis cases can be as high as 3% to 5% in peripheral laboratories. Second, carrying out three sputum smear examinations for each patient suspected of having tuberculosis may overload these laboratories, with subsequent further decrease in the quality of smear preparation and in reading reliability and thus more false positives and/or false negatives. With a diagnosis strategy of one single smear, 20% to 25% of the new tuberculosis cases might be missed at the first consultation. However,

TABLE 1—Number of Cases of Tuberculosis Detected and Number of False-Positive Results Produced by Each Successive Sample of Sputum Smear Examination, India, 1976

Smear No.	No. Slides ^a	No. New Tuberculosis Cases Detected	Return	False Positives out of 900 Noncases		Total False Positives
				Technical 0.7%	Reading 1% to 3%	
1	1000	79	1/13	6	12	18
2	903	16	1/56	6	11	17
3	870	3	1/290	6	11	17
Total	2773	98/100	1/28	18	34	52

Note. Gold standard is culture of sputum.
Source. Base data is from Toman.⁵
^aFor each subsequent smear examination, the false-positive and the true-positive cases already detected have been left out.

these patients are generally less infectious⁵ and may be identified in a further contact if their symptoms do not improve.

We therefore believe with De Cock that the WHO and IUATLD recommendations on diagnosis strategy in tuberculosis control programs for resource-poor countries should be reconsidered. De Cock proposes that "Operational research should assess the policy of treating all patients who have one positive smear and performing a second and final smear examination on those initially negative."¹ (p1072) We agree with his proposal, but we suggest also the following alternative policy: doing only one sputum smear examination, with the highest quality, on every patient suspected of having tuberculosis and encouraging smear-negative patients to consult again if symptoms do not abate within 15 days of symptomatic treatment. Without greatly affecting the number of tuberculosis patients detected, this strategy may considerably decrease the number of false-positive cases and the laboratories' workload, which, in turn, may improve the quality of smear preparation and reading.

We believe the latter alternative could be highly successful, especially in countries with an increasing caseload associated with human immunodeficiency virus. Related operational research may be conducted quite easily. □

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Misusing the Term 'Artificial Fluoridation'

I found Elizabeth Hunt's article fascinating on the history of involvement (or lack thereof) of waterworks engineers in endorsing and promoting community water fluoridation in the 1940s and early 1950s.¹ The point made by the author is vital. Any professional group that avoids taking a position on important, controversial issues that may be fraught with