Editorial

Tuberculosis and Infection Control: What Now?

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In this issue of *Infection Control and Hospital Epidemiology,* a potpourri of tuberculosis (TB)-related articles are being published.[1-7] Tuberculosis-related issues have been an important focus for the past decade for those in infection control and hospital epidemiology, especially in urban areas where the large majority of TB cases occur,[8] but also, because of federal regulations, for those in low-endemic areas or areas where no TB cases occur (approximately half of the counties in the United States).

The resurgence of TB beginning in the mid-1980s in the United States (in large part, due to failure and underfunding of the public health infrastructure and to the epidemic of human immunodeficiency virus [HIV] infection) and outbreaks of TB have highlighted the risk of nosocomial transmission of TB.[9,10] These outbreaks affected both healthcare workers (HCWs) and patients. The fact that outbreaks in New York and Miami, among others, involved multidrug-resistant (MDR) strains that were associated with high morbidity and mortality among HIV-infected individuals punctuated the importance of effective TB infection control measures. Commingling of patients with unsuspected TB and those who were quite immunosuppressed led to amplification of nosocomial transmission. A decade ago, few institutions were prepared for the changing epidemiology of TB.

Several recent studies have demonstrated that infection control measures are effective in preventing nosocomial transmission of TB,[11-13] and two reports in this issue, from institutions in Kentucky[1] and New York,[2] provide additional data on decreases in HCW tuberculin skin-test (TST) conversions following implementation of TB infection control measures. In most studies, multiple interventions (administrative controls, environmental controls, and respiratory protection) were initiated at approximately the same time, making it more difficult to identify the most crucial aspect of the program. The importance of TB infection control measures in contributing to the decline in TB cases in the United States, as well as the reduction in the number of MDR-TB cases in New York City, often has been understated. Increased federal funding for TB control activities and expansion of directly observed therapy clearly are important in efforts to prevent TB, but the initial decline in TB cases and in MDR TB in the United States beginning in 1993 likely was due, in large part, to interruption of TB transmission within healthcare facilities. Unfortunately, increased funding for TB control in the United States in the last 5 years often has not trickled down to inner-city hospitals, which frequently are the first line in the battle against TB.

From our experience and that of others, it appears clear that administrative controls are the most important component of a TB infection control program. At Grady Memorial Hospital in Atlanta, we were able to decrease TB exposure episodes markedly and concomitantly to decrease HCW TST conversions after implementing an expanded respiratory isolation policy.[11] We continue to isolate appropriately approximately 95% of those subsequently diagnosed with TB. We were able to reduce TST conver-

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sion rates markedly during a period of time in which we had isolation rooms that would be considered suboptimal by Centers for Disease Control and Prevention (CDC) guidelines[14] (rooms that were under negative pressure but had less than six air changes per hour) and were using submicron masks. Implementation of better-engineered isolation rooms (>12 air changes per hour) with the completion of renovations to the hospital may have put us in better compliance with regulatory agencies and made the staff feel more secure, but has had little impact on further reducing low rates of HCW TST conversions. In addition, the termination of outbreaks and reduction of TST conversion rates at several institutions took place before introduction of National Institute for Occupational Safety and Health-approved masks and fit testing.[2,15,16] United States healthcare institutions are required by regulatory mandates to develop a "respiratory protection program" (including fit testing), which can be time-consuming, expensive, and logistically difficult.[17] Data published to date suggest that the impact of formal fit testing on proper mask use is small.[18] These federal mandates also have turned some well-meaning (trying to comply fully with the Occupational Safety and Health Administration [OSHA] regulations) but misguided infection control practitioners into "facial hair police." These types of processes divert time, effort, and resources away from what truly is effective in preventing nosocomial transmission of TB, as well as from other important infection control activities such as preventing nosocomial bloodstream infections or transmission of highly resistant pathogens such as vancomycin-resistant *Enterococcus* or preparing for the onslaught of vancomycin-resistant *Staphylococcus aureus.* At a time when US healthcare institutions are under enormous pressure due to healthcare reform, market forces, and managed care, it is essential that federal regulatory agencies look carefully at scientific data when issuing regulations. As noted in the report by Kellerman et al[3] from the CDC, which examines costs of selected TB control measures, when no information exists, guidelines are created by consensus. This is reasonable in times of crisis (eg, outbreaks of MDR TB). However, given our further knowledge about what is and what is not effective, it is important that guidelines be updated periodically and that there be coordination among federal agencies that issue guidelines and those that have regulatory functions (eg, OSHA).

Effective administrative controls include measures to ensure that patients are screened carefully and appropriately for TB, those at risk are isolated on admission, a diagnosis is made promptly, and appropriate anti-TB therapy is initiated. This often has been accomplished by implementation of expanded respiratory isolation criteria that mandate what types of patients must be isolated on admission. Given that approximately half of Grady Memorial Hospital patients with TB are co-infected with HIV, hospital policy requires that anyone who is HIV-infected with an abnormal chest radiograph, anyone with TB in the differential diagnosis, as well as anyone who has an order to culture a respiratory specimen for acid-fast bacilli (AFB), be required to be placed in respiratory isolation until TB is ruled out by three negative AFB sputum smears.[11] While these types of policies (including the reports of Uyamadu et al[1] and Bangsberg et al[2]) have worked well in detecting those with TB, leading to proper isolation and prevention of nosocomial transmission, the methods that have been used by hospitals, while very effective, have not been very elegant and clearly have led to overisolation.[15,19] Few institutions have the capacity to isolate every patient admitted with community-acquired pneumonia, as was done by Uyamadu,[1] nor is that necessary at most institutions. What makes the process difficult, however, is that there is essentially no room for error, as a single patient with unsuspected TB can lead to transmission to multiple patients[20] or HCWs.

What is an acceptable rule-out ratio, or ratio of the number of patients initially isolated but who later have TB ruled out, compared to that of those who are determined to have positive cultures for *Mycobacterium tuberculosis*? There are a number of similarities between "rule out TB" (ROTB) and "rule out myocardial infarction" (ROMI). Current management strategy of patients with chest pain is to maintain a low threshold for admission, to ensure that no individuals with an acute MI or unstable angina are missed.[21] Similarly, current recommendations and experience argue that a high degree of suspicion is necessary in order not to miss a patient with TB. Currently, in general, less than 10% of patients admitted to ROMI have a documented myocardial infarction.[21] Is this what we should accept or expect to see for TB? In our experience in Atlanta, only approximately 1 of 8 patients isolated has TB confirmed,[19] and approximately 1 in 7 has been positive in reports from New York City hospitals.[15] In this issue of *Infection Control and Hospital Epidemiology,* Mylotte et al[4] report 1 in 10 positive in Buffalo; later, only 1 in 28 patients isolated had positive cultures for *M tuberculosis* when the number of TB patients being cared for at their institution

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decreased. In a low endemic area, if strict isolation guidelines were followed, only 1 in 92 isolated patients would have had confirmed TB.[22]

The question becomes, how can we better predict those who will have TB and thus have a more targeted and less costly, but still highly effective, isolation policy? Are there relatively simple and useful predictors available at the time of admission that could be used to help predict who will have TB? The article by Mylotte and colleagues[4] begins to address this issue. Mylotte et al identify predictors that helped to decrease the stay of patients in isolation rooms. Their article does not report how effective the model would be in trying to reduce the ROTB ratio and was not used as the criteria for deciding who needed to be isolated. A recent publication by this same group[23] is an effort to validate further a more refined model or decision tree for predicting pulmonary TB, but requires information (ie, CD4 counts) that frequently may not be available at the time of hospital admission. By multivariate analysis, a number of clinical predictors for TB were identified (eg, chest radiograph with upper lobe infiltrate or cavity, prior positive TST) among patients at Grady Memorial Hospital, and a hypothetical policy was developed to determine which patients should be isolated.[19] This model would have reduced the degree of overisolation by approximately 50% (to 1 in 4), but would have resulted in a significant decrease in the sensitivity of the policy (from 96% to 81%). The decreased sensitivity of the hypothetical policy made it unacceptable. Further work is needed to determine if it is possible to identify clinical predictors, available at the time of admission, that would decrease the overuse of isolation while maintaining an extremely high level of sensitivity for detecting patients with TB.

As pointed out in the report by Menzies[6] in this issue, we still do not have good data to tell us how soon AFB smear-positive patients on effective therapy are no longer infectious, and how long a patient who has recently begun to receive anti-TB drugs should be isolated.[15] Given that most patients are hospitalized for relatively short periods of time, and the lessons of the past decade, it would seem prudent to keep AFB smear-positive TB patients in isolation throughout their hospital stay. Newly introduced diagnostic tests do have the promise of improving the efficiency of our infection control measures and patient care. Currently, the positive predictive value of an AFB smear-positive specimen for TB in an HIV-infected patient can be less than 50% (in conversation with Beverly Metchock, PhD, May 1997). The introduction into clinical laboratories of rapid diagnostic tests for TB based on nucleic-acid amplification technology[24] has the potential to increase the efficiency of isolation room use and to provide cost savings by allowing AFB smear-positive patients (eg, HIV-infected patients with *Mycobacterium avium*-complex infection or colonization) who do not have TB to have isolation discontinued. Further work is needed in this area to validate this potential.

The notion that a one-size-fits-all approach is not appropriate in the field of TB infection control, the importance of risk assessment, and the concept of a hierarchy of control measures (administrative, engineering, respiratory protection) has been emphasized.[14,15,17] For those institutions at very low risk, the degree of full compliance with TB infection control measures may have little effect, as suggested by Woeltje et al[5] in this issue. Their study was carried out among Midwestern hospitals located in areas with a relatively low annual incidence of TB disease (4.4 to 8.8 cases per 100,000). The authors noted a wide range of TB infection control practices at different institutions within a healthcare system. The authors conclude that the degree of implementation of CDC-recommended infection control guidelines did not seem to influence HCW TST conversion rates, and nearly all hospitals had low conversion rates. The infectiousness of the few patients with TB at those institutions is not noted, and the efficiency of their administrative controls in appropriately isolating these patients is not stated. It is unclear if the low conversion rates are due to use of the most effective TB infection control measures (ie, administrative controls) or simply that the low conversion rates reflect the small numbers of patients with TB seen at these hospitals. Given the nature of the study, their evaluation could not control for a number of factors that could lead to bias. These could include selection bias as to the type of HCWs not tested at some of the hospitals, different brands of tuberculin reagent used at different hospitals, different protocols for reading test results, as well as demographic and socioeconomic factors that could reflect community exposure[25] and could differ among employees of different hospitals. Their experience does raise the question of what should be the minimum requirements at such institutions. What TB infection control measures should and must be implemented at such institutions? That which is truly necessary and cost-effective to protect HCW safety at these low-risk institutions needs further definition.

Where do we go from here? A number of issues, several of which are outlined below, require our further attention.

1. We need to continue to advocate for scientifically based guidelines and regulations. The Society

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for Healthcare Epidemiology of America needs to maintain a leadership role in this area and to partner with other relevant organizations such as the Infectious Diseases Society of America, the American Thoracic Society, and the Association of Practitioners in Infection Control. Data have emerged on what is effective and (what may not be effective); regulations should reflect this.

2. The cost effectiveness of TB infection control measures is an area in which additional data and better definition is needed. As noted by Kellerman et al,[3] "future studies should focus on identifying the most cost-effective TB control measures."

3. More efficient measures to avoid overisolation are needed that will not sacrifice the ability to detect patients with TB. Is this possible? Better definition of an appropriate ROTB ratio is needed.

4. There also needs to be better definition of the occupational risk of TB infection in non-outbreak settings, better tools to identify TB infection among HCWs (and others), and further investigation of the community risk of infection among HCWs.

Clearly, we have come a long way and learned a lot in the last decade in dealing with and preventing institutional transmission of TB. Nosocomial transmission of TB helped further fuel the resurgence of disease in the United States, and infection control measures to prevent institutional transmission have helped turn the tide. However, a number of issues still await further investigation and better definition.

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