Tuberculosis Risks for Health Care Workers in Africa

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(See the article by Corbett et al. on pages 317–23)

Prevention of tuberculosis infection among health care workers (HCWs) lost attention after the introduction of chemotherapy in the 1950s. In countries with a low incidence of tuberculosis, it regained importance with the recent resurgence of tuberculosis and with the emergence of HIV infection and multidrug resistance [1]. HIV infection in HCWs increases their risk of disease following infection; multidrug resistance carries a high risk of treatment failure and death, and their combination, in particular, sparked several nosocomial outbreaks of multidrug-resistant tuberculosis [1]. Important contributing factors to nosocomial tuberculosis transmission include delayed diagnosis and ineffective treatment of patients with infectious tuberculosis, poor ventilation and air recirculation, inadequate infection-control and isolation practices, and unrecognized (multiple-)drug resistance [1, 2]. In low-incidence countries, rigorous implementation of infection-control guidelines proved to be effective for containment of outbreaks of nosocomial disease and in decreasing the rate of infection among HCWs from as high as 10% to ≤1% per year [2].

The increased attention for prevention of nosocomial tuberculosis infection has had little resonance in the mainly resource-poor countries that have a high incidence of tuberculosis. In particular, there are concerns about sub-Saharan Africa, where the HIV epidemic resulted in large increases in the tuberculosis case load for health care services, as well as a high prevalence of HIV infection among HCWs themselves. Data are limited. There have been a small number of published studies on tuberculosis infection risks among hospital staff in sub-Saharan Africa. These studies were either analyses of tuberculosis notification rates or cross-sectional studies of tuberculin skin test (TST) reactivity [3–8]. Each of these studies suggested substantial infection risks, but the interpretation of findings was hampered by a lack of suitable control populations, age standardization, or information on the prevalence of HIV infection among the HCWs involved.

In this issue of Clinical Infectious Diseases, Corbett et al. [10] present data from a prospective study that compared TST conversions in a cohort of nursing trainees at 2 hospitals with TST conversions in a concurrent control cohort of polytechnic school students, both of which groups were in Zimbabwe. In this well-designed study, the cohorts had similar baseline characteristics, and the authors adequately controlled for the boosting of TST responses. Using the American Thoracic Society criteria, they observed a conversion rate among the nursing students of 19.3 conversions per 100 person-years, compared with 6.0 conversions per 100 person-years among the polytechnic school students—a highly significant difference. Applying stricter criteria for TST conversion, the observed conversion rate among the nurses was still 12.5 conversions per 100 person-years. Taking these as the range of the most likely values, these conversion rates reflect an average risk of tuberculosis infection of 1:8 to 1:5 per year, an astonishingly high figure. Moreover, the nursing students had a baseline prevalence of HIV infection of 7.8% and an annual rate of HIV test result conversion of ~1.3 conversions per 100 person-years.

The risk of tuberculosis disease will be particularly high among these HIV-infected nurses.

How well these results represent the risks of tuberculosis infection among HCWs elsewhere in sub-Saharan Africa is unknown. The nursing students reported contact with 20,868 patients with tuberculosis during 315 person-years of training (i.e., on average, there were 66 contacts with patients with tuberculosis per student per year). This number is high, but it is probably not extreme in many African hospitals. Whether the conditions in these 2 Zimbabwean hospitals were extremely conducive to nosocomial infection is also unknown. Long delays between hospital admission and...
initiation of effective treatment may play an important role. In a study that involved hospitals in Malawi, tuberculosis treatment was started >5 days after hospital admission for 52% of patients and >10 days after admission for 15% [9].

Multidrug-resistant and extensively drug-resistant (XDR) tuberculosis are emerging in sub-Saharan Africa. Although Corbett et al. [10] offer no data on mycobacterial drug resistance among the patients with tuberculosis in their study, the high rates of infection observed in their study raise concerns about the potential for nosocomial outbreaks of multidrug-resistant and XDR tuberculosis in similar settings, both among HCWs and among patients admitted to the wards or attending outpatient departments. A recent outbreak of XDR tuberculosis in South Africa included several HCWs. Nosocomial spread to other patients—in particular, spread to those who were HIV infected—probably also played a role [11].

How should these risks be reduced? Several of the infection-control measures that have been used successfully in high-income countries are too expensive to be widely applied in resource-poor settings [9, 12]. However, effective infection control entails measures at 3 levels (administrative, environmental, and personal respiratory protection), and there is a hierarchy in their effectiveness and prioritization [2, 12]. Administrative controls, aimed at preventing generation of infectious droplet nuclei, are the most effective. These include measures to reduce delays in diagnosis and in administration of treatment, isolation of patients with infectious tuberculosis, and use of surgical masks by patients when outside their wards. Administrative controls are primarily managerial measures that can be implemented without high costs. Environmental controls, which are second in effectiveness, are aimed at reducing the concentration of droplet nuclei in the air in high-risk areas. Although some environmental measures are expensive (e.g., mechanical ventilation to produce negative air pressure and UV germicidal irradiation), natural ventilation by having open waiting areas and opening ward windows is generally possible in the African climate. Moreover, the often abundant sunlight offers an alternative source of UV light. Personal respiratory controls are the least effective and are aimed at preventing inhalation of infectious droplet nuclei. Because disposable paper or cloth surgical masks offer little protection against inhalation of droplet nuclei, the options come down to the use of more expensive respirators. Respirators may not be affordable in most resource-poor settings, but if administrative and environmental controls are in place, their added protective value should be limited, except in high-risk situations (e.g., during bronchoscopy) or when dealing with patients who have multidrug-resistant infection.

This thinking underlies the guidelines published in 1999 by the World Health Organization [12] and a forthcoming addendum that focuses on settings with a high prevalence of HIV infection and on prevention of transmission of multidrug-resistant infection. The theory sounds logical, but are the limited measures proposed in these guidelines indeed effective? Again, data are scarce. Two studies from middle-income countries (Brazil and Thailand), also cited by Corbett et al. [10], did show that implementation of tuberculosis infection–control measures had an effect on TST conversion rates [13, 14]. However, in both studies, the control measures included sophisticated environmental controls and use of respirators. The only study from Africa gave sobering results; it was performed among 40 hospitals in Malawi 1 year after introduction of national tuberculosis infection–control guidelines that were limited to administrative measures and natural ventilation [9]. Although staff stated that infection control had improved, there was no change in the average treatment delay, and the tuberculosis case rate among hospital staff did not decrease. Possible explanations were poor staff motivation, poor implementation, and shortage of laboratory staff to do timely smear examinations. In addition, the 1-year period may have been too short to see the effects of the intervention. The authors recommended that hospitals should appoint an individual or infection-control committee to be responsible for the implementation and monitoring of infection–control procedures, that more laboratory staff should be employed, and that workplace programs should be developed that address infection control—in particular, for HIV-infected HCWs [9]. Clearly, more operational research is needed to identify the critical factors for failure or success of tuberculosis infection–control policies in resource-poor settings. The study by Corbett et al. [10] puts the spotlight on the rather neglected area of tuberculosis risks for HCWs in sub-Saharan Africa. There is urgent need for evaluations of the effectiveness of infection control in resource-poor countries and for better solutions where current guidelines prove to be ineffective.

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