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Risks and prevention of TB in professional settings

Risks in Health care facilities in Eastern Europe

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Transmission of *Mycobacterium tuberculosis* from individuals with tuberculosis (TB) to other patients and to health-care workers (HCWs) is a well-known nosocomial hazard. The risk of exposure is likely to be related to the prevalence of TB in the community served and the degree of contact with TB patients.

With the advent of effective antibiotic therapy decreasing incidence was described in high-income countries (World Bank classification) and, consequently, the risk of acquiring TB infection declined.

Outbreaks associated to HIV epidemic in the late 1980s' stimulated substantial investment in administrative, personal and engineering infection control measures in many hospitals in developed countries.

Implementation of a full hierarchy of these measures lead to successful reduction in transmission. The situation is different in low- and middle-income countries, which account for more than 90% of the global TB burden; the risk of TB among HCWs has received less attention and remains less well defined. Fewer epidemiological studies have documented prevalence or incidence of latent TB infection and/or TB disease.

Although documenting occupational transmission in high-prevalence areas is difficult because of the background widespread community transmission, it has been suggested that absence of TB infection control practices is a major contributor to *M. tuberculosis* transmission.

While the International Union Against Tuberculosis and Lung Disease and the World Health Organization (WHO) issued recommendations for infection control within health facilities, the limited resources available precluded and preclude the implementation of more expensive and essential infection control measures.

I reviewed the available published literature regarding prevalence and incidence of TB infection and/or TB disease among HCWs in Eastern Europe.

I searched PubMed from 1960 to February 2007 entering the terms ‘tuberculosis’, ‘health personnel or health care workers’, and ‘nosocomial tuberculosis’; then, I identified only papers related to Eastern Europe; additional studies not captured by the electronic search were found by searching reference lists of relevant articles.

Eastern Europe is a concept of a geopolitical region recently influenced by the Cold War. Its borders are defined more by culture than by clear and precise geography. Throughout history and to a lesser extent today Eastern Europe has been distinguishable from Western Europe and other regions due to cultural, religious, economic, and historical reasons. According to UN and CIA definitions, I consider Eastern Europe to consist of the following countries: Belarus, Bulgaria, Czech Republic, Hungary, Moldova, Poland, Romania, Russia (a transcontinental country), Slovakia, Ukraine, Albania, Bosnia, Croatia, Serbia, Macedonia, Montenegro, Kosovo.

My strategy was aimed to identify all the available full papers published in the English language. Only five studies assessed whether HCWs have a higher hazard of acquiring TB disease or latent TB infection than the general population.

All the studies but three were performed in Russia.

The first study describing health personnel risk of acquiring TB in Eastern Europe was published in 1997; it was aimed to assess the risk of TB disease for medical nurses in institutions specialising in the treatment of lung diseases in Zagreb, Croatia. During the study period TB morbidity in Croatia was among the highest in Europe. A greater risk existed for HCWs, as well as those employed in building companies, the wood industry and forestry. The author (i.e., Babus V) studied pulmonary TB frequency among medical nurses from 1978 to 1992. It was found that the incidence was 6 to 17 times greater among medical nurses employed in institutions in which there was regular exposure to patients with TB. The cumulative incidence (i.e. an epidemiological indicator useful for assessing TB morbidity risk) was 5 to 12 times greater among nurses aged 20-49 working at high-exposure settings. Relative TB morbidity risk for medical nurses, if employed in a chest service, was up to 17 times higher than among medical nurses in the control institutions. Babus V stated that this difference among employed medical nurses confirmed the fact that the risk might be avoidable when these personnel are provided with the basic safety measures against the disease.

Another epidemiological study was published in 2000; it is a retrospective review of TB morbidity among HCWs (physicians, nurses and laboratory technicians) employed at the Institute for Pulmonary Diseases (IPD) of Serbia in Belgrade over a 12-year period (1986-1997).

In Serbia annual incidence rate was among the highest in Europe. Of an average 267 employed HCWs, pulmonary TB occurred in nine (six nurses and three laboratory technicians). Cumulative incidence for HCWs was 3,451/100,000, compared to 454/100,000 in the general population, for an

incidence rate ratio of 7.6; average annual incidence rate among HCWs in the above-mentioned institution was 328/100,000, while in the general population it was 38/100,000. Results from this study are consistent with the opinion that exogenous reinfection in continued heavy exposure to *M. tuberculosis* might be responsible for adult TB. Therefore, the control of transmission of TB in the hospital appeared inadequate; the economic situation in the country might add a level of complexity, as the only available control measures were natural room ventilation (wards with doors closed and windows open) and the use of UV light.

One year later, Kruuner A et al. investigated the risk of tuberculosis in HCWs in Estonia; the Authors underlined the potential threat of nosocomial spread of TB due to a changing epidemiological situation in the Baltic states since the 1990s (TB incidence increase and emergence of multidrug resistance –MDR-). Cases of TB registered among HCWs from 1994 to 1998 were evaluated retrospectively and combined with bacteriological data. The incidence of TB disease among

HCWs (mean 91/100,000/year) was 1.5 to three times higher than in the general population. In a chest hospital, the incidence was 30 to 90 times higher, and was highest among physicians. Among those TB disease cases confirmed by culture drug resistance was detected in 49%, 38% of whom had MDR TB. This study illustrates how TB in HCWs is often MDR after MDR-TB becomes more common in the general population. The prevention of nosocomial spread of tuberculosis is particularly important when MDR-TB is being exposed in the hospital environment.

Degree of patient infectivity, intimacy and duration of contact and lack of effective anti-tuberculosis therapy are factors thought to be essential to the risk of spreading TB.

The Authors conclude that the complete elimination of risk among HCWs is an unrealistic goal; the main objective of the infection control plan is to reduce this risk to as low a level as possible. A combination of administrative, engineering and personal respiratory control measures needs to be employed to further reduce the risk of TB transmission.

In 2005 Dimitrova B and colleagues compared the rates of TB in HCWs working in TB services, general health services (GHS) and the general population in a region (Samara Oblast) of the Russian Federation during the 9-year period from 1994 to 2002. TB incidence rate among staff employed at the TB services was ten times higher than among the general population, reaching 741/100,000 person years at risk. Staff working at in-patient TB facilities were found to be at highest risk, with an incidence rate ratio of 17.7 compared to HCWs at the GHS (1,216.7 per 100,000 person years/68.8 per 100,000 person years). The findings of this study showed that HCWs at TB services in the Russian Federation were at substantially increased risk for TB, suggesting significant risks from nosocomial transmission. Authors underlined that control of institutional

spread of TB in the Russian Federation was an area that required urgent attention, especially given the epidemic of human immunodeficiency virus that Russia was witnessing.

Another Russian paper was published recently (February 2007); a cross-sectional study was conducted to assess the prevalence of and risk factors for latent TB infection (LTBI) among unexposed students, minimally exposed medical students, primary care health providers, and TB hospital health providers in Samara, Russian Federation (October 2004 - October 2005). LTBI was seen in 40.8% of staff and was significantly higher in doctors and nurses (39.1%) than in students (8.7%) (relative risk 4.5) and in TB service versus primary health doctors and nurses: respectively 46.9% versus 29.3% (relative risk 1.6). There was a gradient of LTBI, proportional to exposure, in medical students, primary health care providers, and TB doctors: respectively, 10.1%, 25.5% and 55%. LTBI was also high in TB laboratory workers (61.1%). The Authors concluded highlighting the useful role of IFN- γ assays in screening HCWs with a high risk of LTBI and who were BCG vaccinated (national policy in Russia). Multivariate analysis demonstrated that work in a TB clinic was the only significant risk factor for LTBI (OR 1.9).

The aim of a recent paper accepted by The International Journal of Tuberculosis and Lung Disease (Sotgiu G, Sorete Arbore A, Cojocariu V, Piana A, Ferrara G, Cirillo DM, Matteelli A, Castiglia P, Ditiu L, Spanevello A, Zellweger JP, Mihaescu T and Migliori GB) was to assess whether HCWs in one of the major Romanian university hospitals had a higher hazard of acquiring TB disease than the general population, in order to develop infection control measures.

Romania, a middle income country recently joining the European Community, reports one of the highest TB rates in the whole Europe; the incidence rate notified in 2005 was very high (134 cases per 100,000 population), although its trend has reversed. All records of cases diagnosed as TB disease among HCWs from 1971 to 2003 were reviewed, cross checking between laboratory records (documentation of positive sputum smears or *M. tuberculosis* cultures) and medical records (documentation of TB diagnosis and treatment).

It was identified a high incidence rate of TB, particularly pulmonary TB, among HCWs. Incidence of TB among hospital staff was approximately ten times higher compared to the general population of Romania (average relative risk: 11). The attributable risk was as elevated as 846, showing an elevated hazard of acquiring TB disease from occupational exposure, independent of population risk. These data might be the result of the lack of implementation of effective infection control measures. Infection prevention measures in Romania health services were very limited during the study period, due mainly to the lack of economic resources and difficulties related to implement structural changes in historical buildings.

In summary, there is consistent epidemiologic evidence that TB is an important occupational disease in HCWs in Eastern Europe. There is clear evidence of heavy exposure, with little or no infection-control measures in place.

Thus, it is not surprising that there is evidence of excess prevalence of latent TB infection (Russia), as well as a higher incidence of TB disease among HCWs than in the general populations (Croatia, Serbia, Estonia, Russia and Romania).

Reduction of occupational risk should be a priority. Currently available data are limited, but they suggest that relatively simple interventions, such as early diagnosis of TB, isolation of infectious TB patients, adoption of proper bio-safety cabinets in all laboratories performing culture and drug susceptibility testing, adequate individual protection measures as well as proper infection control plans in all institutions, education and training of HCWs, might be effective.