

## Original research

# A COUNTRYWIDE ASSESSMENT OF TUBERCULOSIS AMONG HEALTH-CARE WORKERS IN TUBERCULOSIS HEALTH-CARE FACILITIES IN TAJIKISTAN, 2009–2014

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## ABSTRACT

The transmission of *Mycobacterium tuberculosis* from patients to health-care workers (HCWs) is an issue of global concern, particularly in countries with a high burden of multidrug-resistant tuberculosis (MDR-TB), such as Tajikistan.

This countrywide study (2009–2014) determined the number of registered tuberculosis (TB) cases and the notification rate among HCWs in TB health-care facilities, compared with the general population; their characteristics; and treatment outcomes.

TB notification rates among staff working in TB facilities ranged from two to ten times higher than those in the general population (6-year average: 585/100 000 versus 89/100 000 respectively). There were 44 staff working in TB facilities with TB: 9 doctors, 13 nurses, 11 nurse assistants, 5 laboratory technicians and 6 non-medical staff (two gardeners, one guard, one electrician, one administrator and one cleaner). Six had previously treated TB and all previous episodes were related to work in TB facilities. Two others had MDR-TB and one had extremely

drug-resistant TB (XDR-TB). Five staff (two with MDR-TB) had diabetes mellitus and one of these died. Treatment success was 89% on a short-course regimen, compared with 60% for retreatment and 33% for MDR/XDR-TB regimens.

TB case notification among staff is high and all types of workers are being affected; the TB risk is recurrent and treatment outcomes for retreatment and drug-resistant TB are poor. We advocate urgent action to improve TB infection control in Tajikistan.

**Keywords:** DIABETES MELLITUS, DRUG-RESISTANT TUBERCULOSIS, INFECTION CONTROL STAFF, OPERATIONAL RESEARCH, SORT IT, TREATMENT OUTCOMES

## INTRODUCTION

The risk of transmission of *Mycobacterium tuberculosis* from patients to health-care workers (HCWs) is an issue of concern in many low- and

middle-income countries (1, 2). Most health-care facilities in these countries lack resources to prevent nosocomial transmission of tuberculosis (TB). The risk of TB transmission is considerably higher for HCWs who are in close contact with TB patients, such as in specialized TB health-care facilities (1).

The Republic of Tajikistan is one of the countries in the world with a high burden of multidrug-resistant TB (MDR-TB – resistance to both isoniazid and rifampicin). In 2014, multidrug resistance in new and previously treated TB was estimated to be 13% and 56% respectively (3).

These high percentages of MDR-TB in Tajikistan make TB in health-care workers (HCWs) an issue of serious concern. Based on the data of the Republican Centre for the Protection of the Population from Tuberculosis, 67 TB cases were reported among HCWs in TB and non-TB facilities between 2009 and 2013 (4). However, in the published literature, no evaluation has so far compared case notification rates in the general population with those among HCWs. If rates of TB are found to be higher among HCWs than in the general population, it would imply a higher risk of acquiring TB within health facilities than in the community. Health facilities can be “hot spots” for acquiring and transmitting TB and, as such, rates of TB notification among HCWs serve as a proxy to assess the efficacy of infection control measures in these settings.

In addition, knowledge of the type of HCWs with TB, the type of TB (including pattern of drug resistance), and their treatment outcomes would be very useful to guide efforts for TB prevention and control among HCWs. This is of particular importance, as several countries in this region have scaled up (or are scaling up) access to TB diagnostics and treatment, including for MDR-TB (4, 5). This has resulted in the diagnosis of larger numbers of patients with TB and MDR-TB, whose management involves hospitalization. In turn, this may be associated with hospital overcrowding and is likely to increase the risk of nosocomial transmission of TB in HCWs.

In 2005, a study from Belarus documented a high risk of TB in HCWs in all health facilities in the country, with absolute TB numbers increasing from 15 in 2000 to 28 in 2004 (6). There are, however, only a few published studies from eastern Europe and central Asia among HCWs working within specialized TB facilities where the prevalence of MDR-TB is high.

This study thus aimed to document the countrywide notification of TB in HCWs in specialized TB health-care facilities in Tajikistan, and compared it with the prevalence of TB documented for the general

population. Specific objectives were to determine: (i) the number of registered cases and case notification rates for TB among HCWs working in TB health-care facilities (including doctors, nurses, nurse assistants and non-medical staff); (ii) the characteristics and patterns of TB, stratified by type of HCW; and (iii) treatment outcomes in relation to drug-susceptibility patterns of TB.

## METHODS

### STUDY DESIGN

This was a retrospective cohort study.

### SETTING

#### General setting

The Republic of Tajikistan is a mountainous country with an area of 142 600 km<sup>2</sup>; 93% of the country is made up of mountainous land. The population is approximately eight million, of which 5.9 million (73.6%) live in rural areas (7). Tajikistan borders Afghanistan, Uzbekistan, Kyrgyzstan and China. The country is classified as a low-income country (8). The health system is financed mainly by public funds. The average life expectancy is approximately 73 years (9).

#### The National Tuberculosis Programme

In 2002, the country set up a National Tuberculosis Programme, which follows World Health Organization (WHO) guidelines for TB (10, 11), and this is applied countrywide. TB infection control measures in the country are implemented by a network of TB institutions and through the primary health-care system. The country operates 58 TB centres, 4 regional centres and 29 TB hospitals (12). The total number of beds in TB hospitals in the Republic is more than 1500. The prison system has one TB hospital with a specific ward for patients with MDR-TB. Funding for TB activities is mainly from international donor organizations (about 80%). Public funding for TB in 2013 amounted to 2.5% of the total budget allocated for health (4).

#### TB treatment and infection control measures

TB patients, including patients with drug-resistant forms, receive standardized treatment regimens in accordance with national guidelines, which in turn are based on WHO guidelines (10, 11, 13). The intensive phase of treatment is started through inpatient hospital

care. For drug-sensitive cases, patients may stay in the hospital for two months or more, and in cases of MDR-TB or extensively drug-resistant TB (XDR-TB), patients remain in the hospital for up to eight months.

In accordance with WHO recommendations (14), national guidelines on infection control in TB facilities were developed. However, infection control measures for TB differ across institutions; for example, some use natural ventilation, some use ultraviolet irradiators and others use filters. Furthermore, employees in TB facilities are not always provided with sufficient personal respirators (FFP2 and FFP3), or they are not always used properly, thus increasing the risk of infection. Routine information, education and communication on infection control measures, and refresher training, have to be conducted for all staff (medical and non-medical); however, they are oriented mainly to doctors, nurses and nurse assistants (15).

## STUDY POPULATION

This study includes all HCWs who worked in TB health facilities in Tajikistan from 2009 to 2014 and who developed TB during this period.

## DATA COLLECTION AND STATISTICAL ANALYSIS

Data related to the study objectives were sourced from patient master cards at the Republican Centre for the Protection of the Population from Tuberculosis and from the State Sanitary and Epidemiological Surveillance Service. Data on HCW populations by year and by HCW type were obtained from the Agency on Statistics under [the] President of the Republic of Tajikistan (7). Case notification rates were standardized per 100 000 population. TB treatment outcomes were defined in line with WHO guidelines (10). Summary statistics were used to report results.

EpiData software was used for data entry and analysis (version 3.1 for entry and version 2.2.2.182 for analysis, EpiData Association, Odense, Denmark).

## ETHICAL APPROVAL

The study was approved by the Ministry of Health and Social Protection of the Population and the National Ethics Review Board of Tajikistan. Ethical approval was also received from the Ethics Advisory Group of the International Union Against Tuberculosis and Lung Disease, Paris, France.

## RESULTS

### TB CASE NOTIFICATION RATES AMONG HEALTH-CARE WORKERS AND THE GENERAL POPULATION

Table 1 shows the number and trends in diagnosed cases of TB and case notification rates for the period 2009–2014 of all staff in specialized TB health-care facilities, and in the general population. Compared with the general population, TB case rates among staff working in TB health-care facilities were two to ten times higher than in the general population. The average TB case notification rate for the six-year period among HCWs was 585/100 000 compared with 89/100 000 in the general population.

### DEMOGRAPHIC AND CLINICAL CHARACTERISTICS OF TUBERCULOSIS AMONG HEALTH-CARE WORKERS IN

**TABLE 1. NUMBERS AND NOTIFICATION RATES OF CASES OF TUBERCULOSIS AMONG STAFF WORKING IN SPECIALIZED TUBERCULOSIS HEALTH-CARE FACILITIES AND THE GENERAL POPULATION, TAJIKISTAN, 2009–2014**

Indicators	Years					
	2009	2010	2011	2012	2013	2014
<b>HCWs in TB health-care facilities</b>						
Number of cases	12	8	3	11	8	2
TB notification/ 100 000 HCWs	1066	679	243	814	581	128
<b>General population</b>						
Number of cases	7482	7641	7609	6929	6495	4529
TB notification/ 100 000 population	101	100	97	87	79	68

TB: tuberculosis.

<sup>a</sup> All those working in TB health-care facilities, including administrative personnel, gardeners, etc.

### SPECIALIZED TUBERCULOSIS HEALTH-CARE FACILITIES AND THE TYPE OF PERSONNEL AFFECTED

Among staff in specialized TB health-care facilities, 44 were diagnosed with TB. This included 9 doctors, 13 nurses, 11 nurse assistants, 5 laboratory technicians and 6 non-medical support staff (two gardeners, one guard, one electrician, one administrator and one cleaner). Their demographic and clinical characteristics are shown in Table 2.

More women than men were affected (61%), but this is probably due to more female staff working in TB

**TABLE 2. CHARACTERISTICS AND PATTERNS OF STAFF WORKING IN SPECIALIZED TUBERCULOSIS HEALTH-CARE FACILITIES, TAJIKISTAN, 2009–2014**

Characteristic	Doctors	Nurses	Nurse assistants	Laboratory personnel	Non-medical staff	All	
						n	%
<b>Sex</b>							
Male	8	2	0	2	5	17	39
Female	1	11	11	3	1	27	61
<b>Age, years</b>							
20–39	3	6	3	1	2	15	34
40–59	3	5	8	3	4	23	52
60+	3	2	0	1	0	6	14
<b>TB category</b>							
New	8	12	8	5	5	38	86
Previously treated	1	1	3	0	1	6	14
<b>TB type</b>							
Smear-positive PTB	4	7	5	1	6	23	52
Smear-negative PTB	5	6	6	4	0	21	48
<b>DST status</b>							
Susceptible	2	7	4	1	6	20	87
MDR-TB	1	0	1	0	0	2	9
XDR-TB	1					1	4
<b>Diabetes</b>							
Yes	1	1	1	2	0	5	11
No	5	11	9	2	6	33	75
No data	3	1	1	1	0	6	14
Total	9	13	11	5	6	44	

DST: drug-susceptibility test; MDR-TB: multi-drug-resistant tuberculosis; PTB: pulmonary tuberculosis; TB: tuberculosis; XDR-TB: extensively drug-resistant tuberculosis.

<sup>a</sup> Non-medical staff include two gardeners, one guard, one electrician, one administrator and one cleaner.

facilities. Of the 38 HCWs diagnosed with TB, five had previously treated TB and their previous TB episodes were all related to work in TB health-care facilities. There were two HCWs who developed MDR-TB, and one had XDR-TB. Five HCWs with TB also had diabetes mellitus. Diabetes status was unknown in six of the HCWs.

## TUBERCULOSIS TREATMENT OUTCOMES AMONG HEALTH-CARE WORKERS IN SPECIALIZED TUBERCULOSIS HEALTH-CARE FACILITIES

TB treatment outcomes stratified by type of treatment regimen are shown in Table 3. Among all staff placed on a short-course regimen (new first-line treatment), treatment success was 89%. This dropped to 60% and

33% in retreatment and MDR/XDR-TB respectively. For comparison, the treatment success rate among the general population placed on a short-course regimen in 2014 was 88% (16).

Of the five TB patients with diabetes as a comorbidity, two had MDR-TB and three had sputum smear-negative pulmonary TB. Of the three registered deaths, one patient had XDR-TB and one had diabetes (short-course regimen).

## DISCUSSION

This six-year audit of TB among staff working in specialized TB health-care facilities in Tajikistan revealed that TB case notification rates are up to ten-fold higher than those reported for the general population. All types of HCWs were affected, including non-medical support staff (such as gardeners and guards), with some HCWs acquiring MDR/XDR-TB. Those with retreatment and drug regimens for drug-resistant TB had worse treatment outcomes.

The findings of this countrywide study are particularly relevant to Tajikistan, as it is one of the high-burden MDR-TB countries in the world. The difference in TB case notification between the general population and HCWs (496/100 000 population) is a rough measure of the TB transmission risk that

**TABLE 3. TUBERCULOSIS TREATMENT OUTCOMES AMONG STAFF WORKING IN SPECIALIZED TUBERCULOSIS HEALTH-CARE FACILITIES, TAJIKISTAN, 2009–2014**

Treatment outcomes	TB regimen <sup>a</sup>		
	Short course, n (%)	Retreatment, n (%)	MDR/XDR-TB, n (%)
Successful	32 (89)	3 (60)	1 (33)
Cured	28	3	1
Treatment completed	4		
Unsuccessful	4 (11)	2 (40)	2 (67)
Died	2		1
Failure		1	
Lost to follow-up	2	1	1

MDR-TB: multi-drug-resistant tuberculosis; TB: tuberculosis; XDR-TB: extensively drug-resistant tuberculosis.

<sup>a</sup> Treatment outcomes based on the treatment regimen applied:

- short course – for new susceptible cases (6 months)
- retreatment – for retreatment cases (8 months)
- MDR/XDR-TB – for MDR/XDR cases (18–24 months).

can be attributed to specialized TB health-care facilities – which is alarmingly high. Such high TB case notification rates compare well with what has been reported from other studies (1). Nevertheless, the findings are a wake-up call to review and improve existing administrative, environmental and personal protection measures in all TB health-care facilities in Tajikistan. These measures will need to align with existing WHO and national guidelines (17, 18).

Improving TB infection control may require additional infrastructure and financial resources, which should be made available. In addition, regular monitoring of levels of compliance with TB infection control is vital. One way of approaching this would be to integrate this activity (using check-lists) into the existing TB framework of quarterly supervision and reporting. Regular independent audits by external evaluators would also be needed, to ensure robust reporting standards. Innovative approaches to encouraging and motivating HCWs in TB health-care facilities to implement the existing guidelines could also be considered. For example, “certificates of excellence” and/or incentives (monetary or non-monetary) could be offered for health facilities that perform well.

The study strengths are that: (i) all TB health facilities in the country over a six-year period were included and so the study reflects the reality of health facilities in the country; (ii) the completeness of the reporting on TB among HCWs was almost 100%, owing to the use of the same diagnostic procedures for TB over the years studied and mandatory reporting of TB; (iii) data on yearly HCW populations allowed calculation of standardized rates and comparisons; and (iv) the study adhered to STROBE (Strengthening of Reporting of Observational Studies in Epidemiology) guidelines (19).

Study limitations are that it focused only on specialized TB health-care facilities and so the situation may not be representative of TB notification in other types of health-care facilities. The exact reasons behind the erratic trend observed in TB case notification over the study period are also unclear, and further evaluation may be warranted. In part, there might have been under-reporting of cases due to stigma. Four patients were also lost to follow-up and the database used did not include reasons behind this loss. This could be included in the future.

There are a number of additional policy and practice implications that merit discussion.

First, all types of HCWs acquired TB, with, surprisingly, a number of non-medical staff affected, including two gardeners, one guard and one electrician. The latter is a clear indication of the need to extend TB infection control and education outside the walls of the health-care facility. Specific information and education strategies that are better oriented for non-medical staff are needed.

Second, the fact that five laboratory technicians acquired TB is a proxy of possible shortcomings in infrastructural, technical and/or procedural factors at the laboratory level. This merits specific evaluation and focused action.

Third, five patients with retreatment TB had actually acquired their previous TB episode while working in the same health facilities and three TB cases were drug-resistant TB (including one XDR-TB patient who died). Recurrent and ongoing transmission is thus a reality and supports the call to improve TB infection control.

Fourth, five HCWs with TB had diabetes as a comorbidity, while in six HCWs, diabetes status was unknown. Since HCWs with diabetes are at considerably higher risk of acquiring TB and having worse outcomes, it is suggested that all HCWs (medical and non-medical) who are known to have diabetes should avoid working in TB health-care facilities (20). Screening for diabetes status should also be part of routine procedure for all HCWs in TB care. Including HIV screening to the algorithm may also be a worthwhile consideration (21).

Finally, treatment outcomes for HCWs who were on retreatment and drug-resistant TB regimens were poor, underlining the fact that in the absence of new and effective TB treatment, TB infection control is of prime concern.

In conclusion, this study has identified high rates of TB case notification among HCWs in specialized TB health-care facilities and urgent action is needed to improve the situation.

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