

# Occupational exposure to body fluids among healthcare workers: a report from Iran

Hadadi A, Afhami S, Karbakhsh M, Esmailpour N

## ABSTRACT

**Introduction:** Healthcare workers (HCWs) are at substantial risk of acquiring blood-borne infections through contact with body fluids of patients. The main objectives of this study were to determine the epidemiological characteristics and risk factors of the occupational exposures to body fluids.

**Methods:** This cross-sectional study was conducted from December 2004 to June 2005 among HCWs from three University hospitals in Tehran, Iran, who had the potential for high risk exposures during the year preceding the study.

**Results:** Of 900 HCWs studied, 391 (43.4 percent) had at least one occupational exposure to blood and other infected fluids. Overall, 476 exposures had occurred (0.53 exposures per person-year). The highest exposure rate (per person-year) was observed among housekeeping staff nurses (0.78) and nurses (0.63), and occurred most commonly in the medical wards (23.0 percent). HCWs with a working experience of more than ten years had an odds of exposure of 0.5 times compared to those with less than five years' job experience. Percutaneous injury was reported in 280 participants. The history of hepatitis B (HBV) vaccination was positive in 85.9 percent of the exposed HCWs. Hand-washing and consultation with an infectious disease specialist was reported in 91.0 and 29.0 percent of the cases, respectively. There were 72 exposures to human immunodeficiency virus, HBV and hepatitis C, with exposure to HBV being the most common. In 237 of the exposure occasions, the viral status of the source was unknown.

**Conclusion:** Type of job, years of experience and specific hospital wards were the risk factors for exposure.

**Keywords:** body fluids exposure, health personnel, needlestick injury, occupational exposures, occupational hazards

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## INTRODUCTION

Healthcare workers (HCWs) are at risk of acquiring hepatitis B (HBV), hepatitis C (HCV) and human immunodeficiency virus (HIV) infections via exposure to patients' blood and body fluids. The annual incidence of occupational exposure is reported to be 3.5/100 HCWs.<sup>(1)</sup> Overall, 37% of HBV, 3% of HCV and 4% of HIV infections in HCWs are due to occupational exposures.<sup>(2)</sup> In other countries, these occupational exposures are routinely reported to their Centres of Diseases Control, but in Iran, such a registry or surveillance system has not been completely developed yet. We designed this study to primarily find out the prevalence and characteristics of these exposures, and their contributing factors in the current setting, which can then be used as a basis for developing a surveillance system. The knowledge of risk factors and the circumstances in which these exposures occur in our hospitals can be very useful for developing proper preventive guidelines and educational programmes.

## METHODS

This cross-sectional study was conducted from December 2004 to June 2005 in three of the teaching hospitals of Tehran University of Medical Sciences, Iran. The inclusion criterion was being at risk; HCWs in different job categories including the attending staff, residents, interns as well as laboratory and housekeeping personnel who had the potential for high risk exposures during the year preceding the study. The data collection was done via interview, based on a questionnaire eliciting data regarding age, gender, job category, job experience, and frequency of exposures during the year prior to the study. The characteristics of the occupational exposures were also asked, including the type of body fluid and its source, route of exposure and the procedure during which the exposure occurred, ward and time of exposure occurrence, and viral status of the source patient. Moreover, the use of protective measures by the HCW, his/her HBV immunisation status and antibody titre, counselling, control of serological status, and prophylactic management following the exposure were also asked.

Department of Infectious Diseases, Sina Hospital, Hassan Abad Square, Imam Khomini Street, Tehran 11367-46911, Iran

Hadadi A, MD  
Associate Professor

Department of Infectious Diseases, Shariati Hospital, Jalal Ale Ahmad Highway, Tehran 14117-13135, Iran

Afhami S, MD  
Associate Professor

Esmailpour N, MD  
Assistant Professor

Department of Community Medicine, School of Medicine, Medical Sciences, University of Tehran, Poursina St, Ghods St, Enghelab Ave, Tehran 14176-13151, Iran

Karbakhsh M, MD  
Assistant Professor

**Correspondence to:**  
Dr Azar Hadadi  
Tel: (98) 21 6671 6546  
Fax: (98) 21 6671 6546  
Email: hadadiaz@sina.tums.ac.ir

**Table I. Characteristics of all study subjects and their comparisons between those with and without history of occupational exposure to blood and body fluids.**

Variable	Total population (n = 900)	Not exposed (n = 509)	Exposed at least once (n = 391)	p-value
Age (years)	31.06 ± 7.53	31.4 ± 8.0	30.6 ± 6.9	0.76*
Gender				
Male	475	276 (54.2)	200 (51.4)	0.38†
Female	424	233 (45.8)	191 (48.6)	
Job category				
Nurse	200 (22.2)	98 (19.3)	102 (26.1)	< 0.001‡
Housekeeper	130 (14.4)	51 (10)	79 (20.2)	
Resident	170 (18.9)	94 (18.5)	76 (19.4)	
Intern	200 (22.2)	134 (26.3)	66 (16.9)	
Lab technician	120 (13.3)	77 (15.1)	43 (11)	
Attending staff	80 (8.9)	55 (10.8)	25 (6.4)	
Job experience (years)				
< 5	226 (50.38)	123 (43.8)	143 (57.9)	< 0.001‡
5–10	115 (21.78)	56 (19.9)	59 (23.88)	
> 10	147 (27.84)	102 (36.3)	45 (18.21)	
Hepatitis B vaccination status				
Not vaccinated	121 (27.2)	63 (12.4)	58 (14.8)	0.69‡
One dose	35 (3.9)	19 (3.7)	16 (4.1)	
Two doses	65 (7.2)	39 (7.7)	26 (6.6)	
Three doses	679 (75.4)	388 (76.2)	291 (74.4)	
Hepatitis B titre				
Satisfactory	360 (40)	195 (43.7)	166 (49.7)	0.2†
Unsatisfactory	40 (4.4)	22 (4.9)	18 (5.4)	
Unknown	378 (42)	229 (51.3)	149 (44.9)	

Data is expressed as no. (%) or mean ± standard deviation.

\* Student's *t*-test; †  $\chi^2$  test; ‡ Mann-Whitney U test

An exposure was defined as a percutaneous injury (e.g. a needlestick or a cut by sharp objects) or the contact of mucus membranes or non-intact skin with blood, tissue or other body fluids (amniotic, cerebrospinal, pleural, peritoneal and pericardial fluids) that are considered to be potentially infectious. Considering the prevalence of at least one exposure at 30% in one year, a sample size of about 900 would have been required for sampling error to be no larger than 3%, at a 5% type one error. The quota sampling method was used in proportion to the size of the job categories: 200 nurses, 200 interns, 170 residents, 130 housekeepers, 120 technicians and 80 attending staff. 990 personnel were approached, and 900 participants consented, producing a 91% response rate.

The data was double-entered to the Statistical Package for Social Sciences version 11.5 (SPSS Inc, Chicago, IL, USA) and the discrepancies were checked for and removed. For determining the association of categorical and continuous variables, the assumption of normality was tested using Kolmogorov-Smirnov test and Student's *t*-test, or Wilcoxon rank sum test, when necessary. For comparing categorical and ordinal variables,  $\chi^2$  and Mann-Whitney U tests were used, respectively. Logistic regression test was also used for multivariate analysis and adjusted odds-ratios (OR) were reported.

## RESULTS

A total of 990 HCWs were approached, and 900 agreed to participate in the data collection process and entered the study (response rate 91%). The characteristics of

the study subjects are shown in Table I. During the one year preceding the study, 476 exposures to infectious body fluids had occurred in 391 HCWs, representing an overall rate of 0.53 per person-year. 314 HCWs (34.9%) reported a history of one exposure, 69 (7.7%) reported two exposures and eight (0.9%) reported three or more exposures. Comparison of the characteristics of HCWs with and without history of exposure is also presented in Table I. There was no significant difference between the prevalence of exposure among male and female personnel (42% vs. 45%,  $p = 0.4$ ).

About 54% of the personnel with less than five years of working experience were exposed at least once during the previous year; however, this was 30.6% among the personnel with more than ten years of experience. There was a significant correlation between work experience of more than ten years and the rate of occupational exposure ( $p < 0.001$ ). Nurses had the highest rate of exposure (26%), and there was a significant difference between nursing and other job categories ( $p < 0.001$ ) (Table I). Injury rates (per person-year) reported in the housekeeping staff were the highest (0.78), followed by nurses (0.63), residents (0.56), technicians (0.37), interns (0.4) and specialists (0.36). As shown in Table II, with interns as the reference group for comparison, odds of exposure in nurses (OR = 2.1), housekeeping staff (OR = 3.1), and residents (OR = 1.6) were higher than in interns. Moreover, HCWs with a job experience of more than ten years had 0.5 times the odds of exposure compared to those with less than five years job experience.

**Table II. Logistic regression results regarding the relationship between being exposed for at least once and the study variables.**

Variable	Odds-ratio	0.95 confidence interval for OR	p-value
Job category			
Intern	1	-	-
Nurse	2.11	1.41-3.17	< 0.001
Housekeeper	3.14	1.99-4.98	< 0.001
Resident	1.6	1.07-2.5	0.02
Lab technician	1.1	0.7-1.8	0.6
Attending staff	0.9	0.5-1.6	0.7
Job experience (years)			
< 5	1	-	-
5-10	1.02	0.65-1.60	0.93
> 10	0.48	0.28-0.82	0.008

Regarding the overall situation in which the exposures occurred, 56% had occurred in the morning shift, while 44% occurred on night and evening shifts. A remarkable proportion of exposures had occurred in the internal medicine wards (23%), followed by emergency rooms (21%), surgical wards (17.6%), operation rooms (16%), laboratories (9.5%), intensive care units (ICU) (5.3%) and others (7.3%); there was a significant association between the unit ward and the experience of injuries ( $p < 0.001$ ). 108 injuries (23%) happened in emergent and urgent conditions, and in 52 cases (10%), an unexpected movement of patients during a procedure was reported as the main reason for injuries.

The characteristics of the reported exposures are shown in Table III. Of 476 exposures, percutaneous injuries were the most common (59%). Among the cases with percutaneous injuries, hollow-bore needles were accounted for having the highest proportion of injuries with 60%, followed by solid sharp objects (lancet and suture needles) with 36%, and bistories causing 4% of the injuries. Fluid splash, cleaning, suturing, and recapping contributed to 39%, 15%, 13% and 9% to the causes of exposures, respectively. Blood was the source of exposure in 86% of the cases. In 38% of all exposure events, HCWs were not employing protective measures. Wearing of gloves, mask, gown and goggles were reported in 61%, 29%, 25% and 5% of the total exposures, respectively.

Considering the vaccination status of all HCWs, 778 (86.4%) were vaccinated, of whom just 677 had received complete doses of vaccination; about 98% of residents had received a complete course of vaccination while this was only 42% in housekeepers. Antibody status was unknown in 376 (40.3%) of them. The vaccination status of the exposed and unexposed HCWs is shown in Table I; 85% of the exposed workers had vaccination histories against HBV, while among all the exposed workers, only 49.7% reported documented immunity against HBV. Secondary preventive measures following exposure consisted of hand-washing in 435 cases (91.4%), consultation with an infectious disease specialist in 142 cases (29.8%), HBV

vaccination in five cases (1%), antiretroviral therapy in four cases, and no post exposure activity in 26 cases (5.5%).

In 50% of exposures, the viral status of the source patient was unknown. As shown in Table III, in this study, 66 HCWs reported at least one high risk exposure to blood-borne viruses (HBV, HCV or HIV). In fact, 72 high-risk exposures (15.1% of all exposures) had occurred with one or more than one of these viruses. Among these exposures, infection of sources with HBV was found in 42 cases (8.8%) and infection with HCV and HIV were observed in 7% and 3% of the cases, respectively. Consultation with infectious disease specialists was accomplished in 45 cases. Postexposure prophylaxis for HBV was performed in five exposed persons, and five persons exposed to HIV-positive patients received antiretroviral therapy for HIV (28.6%), while the remaining ten had no follow-up.

## DISCUSSION

Exposure to blood and other potentially infectious body fluids has, for a long time, been recognised as a potential health hazard in HCWs. In previous studies, injuries from contaminated needles and other sharp objects in healthcare settings have been associated with the transmission of more than 20 different blood-borne pathogens to the personnel.<sup>(3)</sup> In this study, 43% of the participants were exposed to contaminated body fluids at least once in the preceding year. Overall, a total of 476 exposures were recalled, which yielded a rate of exposure of 0.53 per person-year. In a study conducted in Saudi Arabia, the rates for needlestick injuries for nurses and doctors were 0.11 needlestick/nurse/year and 0.06 needlestick/doctor/year, respectively.<sup>(4)</sup> In a study in Singapore, exposure rates for each group of the personnel were reported as 7.5 exposures/100 HCWs, 17.6/100 housekeeping staff, 11/100 doctors and 6.9/100 nurses.<sup>(5)</sup> As mentioned in several studies from Greece, Denmark and Egypt, the rate of exposures based on job categories were different; for example, from 40.2% exposures per housekeeper in Egypt to 0.01% of them in Denmark, or 37.6% exposures per

**Table III. Characteristics of exposures reported.**

Variable	No. (%)
Route of exposure	
Percutaneous	280 (58.8)
Mucous membrane	116 (24.4)
Non-intact skin	80 (16.8)
Mechanism of exposure	
Fluid splash	186 (39.1)
Garbage collection	70 (14.7)
Suturing	62 (13.0)
Re-capping	45 (9.5)
Intravenous line	42 (8.82)
Surgical instruments	37 (7.8)
Injection	16 (3.4)
Others	18 (3.8)
Exposure source fluid	
Blood	412 (86.6)
Bloody fluid	38 (8.0)
Other contaminated fluids	26 (5.5)
Virus status of sources	
Virus free	167 (35.1)
Only HBV positive	30 (6.3)
Only HCV positive	21 (4.4)
Only HIV positive	7 (1.5)
HBV and HCV positive	7 (1.5)
HBV and HIV positive	4 (0.8)
HCV and HIV positive	2 (0.4)
HBV, HCV and HIV positive	1 (0.2)
Unknown	237 (49.8)

nurse in Egypt to 3% in Greece.<sup>(6-8)</sup>

Compared to the reported prevalence of occupational exposures in the literature, the prevalence in our study was rather high. Some explanations could be that in the current study, reports of injuries were collected by face-to-face interview, rather than medical records or self-administered questionnaires, which may reflect prevalence estimations more realistically. However, there is a probability that some cases may have forgotten their exposures during the previous year. In other studies, shorter periods of exposure history were reviewed.<sup>(3,8)</sup> Moreover, HCWs in our teaching hospitals have to deal with a high load of patients. This fact, combined with the urgency of some interventions and unavailability of some protective devices, might have contributed to this high prevalence of exposures among the studied occupations. We also found that less experienced HCWs are at higher risk of occupational exposures. Considering the situation in the university-affiliated hospitals, where many of the routine procedures are performed by the students and personnel with less experience and skills, this may also explain a proportion of the observed high exposure frequency.

Although educational programmes for standard precautions for reducing occupational exposure risks are currently available for nurses, interns and residents of our hospitals, there still exists a large gap between their knowledge, attitude and practice. Therefore, new educational approaches which can effectively change the

practice of the personnel should be applied. Occupational exposure rates observed among housekeepers were the highest in the present study, and their odds of exposure was three times the reference group (interns). They are usually young men from the lower socioeconomic groups and with low educational background; no focused programmes are available to teach them the risks of occupational exposure to blood and other infected fluids, and they are not routinely vaccinated against HBV. If they want to get vaccinated, they have to bear the costs themselves as these costs are not covered by insurance. Therefore, the hospitals' administrators should consider specific protective measures for this high-risk group along with educating them on the necessity of vaccination and postexposure management.

In this study, similar to the findings by Azap et al in Turkey, HCWs with a longer professional life had less commonly reported exposures to blood borne pathogens.<sup>(3)</sup> A study from Saudi Arabia attributed this to hard work, little experience and refusal to use protective measures.<sup>(9)</sup> In our series, percutaneous exposure and exposure to blood had been the most common route, and body fluid, involved in the exposure, respectively. Percutaneous exposure occurred while cleaning (15%), suturing (13.3%), recapping (9.5%) and doing venipuncture (8.8%). This is comparable to the data from studies in Turkey, Denmark, China, Spain and West Africa as well as another survey in Iran.<sup>(3,7,11-14)</sup>

In this study, splashing fluids to mucus membrane and needlestick injuries were the frequent causes of occupational exposure in nursing practices. As more invasive procedures are performed in the morning shifts, most of the exposures happened then. In our study, 10% of the exposures happened following an unexpected movement in patients; this was reported to be 35% and 23% in reports from Egypt and Africa, respectively.<sup>(8,10)</sup>

In the current survey, hollow-bore needles were involved in 60% of percutaneous exposures as compared with Singapore (62.2%), Saudi Arabia (65%) and Australia (65.3%).<sup>(4,5,15)</sup> Hepatitis B vaccination coverage in this study was 85%, while in other studies, the vaccination coverage ranged between 18% and 85%.<sup>(2)</sup> Jahan reported 82% coverage in Saudi Arabia,<sup>(4)</sup> which shows the success of the free vaccination strategy of the university administration for the students and personnel. As mentioned before, vaccinations for the housekeeping personnel still need consideration.

15% of the cases were exposed to at least one virus (HBV, HCV or HIV). In a study in Turkey, 30% unknown source, 17% HBV positivity, 7% HCV positivity, and 3% HBV with HCV positivity were determined.<sup>(3)</sup> In our study, 38% of the exposed personnel had not received

care for postexposure prophylaxis. Management of the exposure depends on the results of antibody testing of the exposed HCWs and the source patient. The most common activities after being exposed to body fluids were hand washing (91.4%) and consultation with an infectious disease specialist (30%). In Azap et al's study in Turkey, 67% of the injured HCWs did not seek any medical advice, 29% received medical advice from an infectious disease specialist, and 3% received postexposure prophylaxis for Hepatitis B.<sup>(3)</sup>

In conclusion, injuries from sharp objects among HCWs are a widespread occupational hazard. In this study, job categories, work experience and specific hospital wards were the most important risk factors for exposure. An effective and goal-oriented educational programme targeting at HCWs, and an establishment of a surveillance system for registering, reporting and management of occupational exposure in hospitals, are required. The use of protective measures and vaccination against HBV are also important ways to prevent viral transmission among HCWs.

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