

# Occupational Exposures to Blood and Body Fluids among Health Care Workers at University Hospitals

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## SUMMARY

**Introduction** Occupational exposure to blood and body fluids is a serious concern of health care workers and presents a major risk of transmission of infections such as human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV).

**Objective** The aim of this study was to determine the frequency and circumstances of occupational blood and body fluid exposures among health care workers.

**Methods** Cross-sectional study was conducted in three university hospitals in Belgrade. Anonymous questionnaire was used containing data about demographic characteristics, self-reported blood and body fluid exposures and circumstances of percutaneous injuries.

**Results** Questionnaire was filled in and returned by 216 health care workers (78.2% of nurses and 21.8% of doctors). 60.6% of participants-health care workers had sustained at least one needlestick injury during their professional practice; 25.9% of them in the last 12 months. Of occupational groups, nurses had higher risk to experience needlestick injuries than doctors ( $p=0.05$ ). The majority of the exposures occurred in the operating theatre ( $p=0.001$ ). Among factors contributing to the occurrence of needlestick injuries, recapping needles ( $p=0.003$ ) and decontamination/cleaning instruments after surgery ( $p=0.001$ ) were more frequent among nurses, while use of a needle before intervention was common among doctors ( $p=0.004$ ). Only 41.2% of health care workers had reported their injuries to a supervisor in order to obtain medical attention. 50.2% of health care workers were vaccinated with three doses of hepatitis B vaccine.

**Conclusion** There is a high rate of needlestick injuries in the daily hospital routine. Implementation of safety devices would lead to improvement in health and safety of medical staff.

**Keywords:** occupational exposure; health care workers; blood; body fluids

## INTRODUCTION

Increasingly frequent use of invasive techniques, application of new therapeutic methods, increase in the number of persons infected with blood-borne diseases (hepatitis B, hepatitis C and HIV), as well as longer survival of infected individuals, all combined keep the occupational exposure of health care providers topical. Health care providers are in direct risk of being infected with diseases transmitted by blood during their working hours, due to exposure to biological material and patient's body fluids (blood, urine, feces, sputum) through the skin and mucous-membrane lesions, as well as due to accidental injuries with contaminated objects.

The exposure of health care workers occurs during so-called accidents. The term accident implies "exposure of a health care worker (HCW) to blood or body fluids through percutaneous lesions or through the introduction of the blood or a body fluid by way of the mucous membrane or skin lesions" [1]. Needle stick injuries and other percutaneous injuries with sharp objects are the major means of occupational injuries of HCWs [2, 3].

Although there are over twenty blood-borne diseases, diseases caused by hepatitis B virus (HBV) and hepatitis C virus (HCV), as well as human immunodeficiency virus (HIV) are pathogens of greatest concern for HCWs [4]. It is estimated that the risk of HIV infection after needlestick injury is approximately 0.3%, of hepatitis B infection 30%, and of hepatitis C 3% [5, 6]. The frequency of needle stick injuries and the prevalence of these blood-borne diseases in general population have a significant impact on the infection risk among HCWs [7].

Several studies have shown that there is higher incidence of accidents in operating theaters than in other wards [8, 9]. According to the research into the occupational exposure of HCWs in Europe, the incidence of accidents among nurses/technicians is higher than among physicians [10, 11].

Because many people with bloodborne infections do not have symptoms, it is necessary to apply standard precaution measures to all clients and patients, which are prepared by the US Centers for Disease Control and Prevention [12]. Therefore, many countries accepted these recommendations for prevention of such ac-

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cidents [13, 14]. However, studies conducted with the aim to evaluate the reporting of accidents have shown that the compliance with the standard precautions amongst HCWs are low as well as that the propensity to avoid medical assistance after accidents is very frequent [15, 16]. On the other hand, the assessment and treatment of the consequences of such accidents is a huge burden on society in terms of the costs of treatment and the absence from work, as well as of the distress and anxiety at work [17, 18, 19].

## OBJECTIVE

The aim of this paper was to examine the frequency, place and circumstances of the occurrence of accidents among HCWs.

## METHODS

In February 2011, a cross-sectional study was conducted among the health care workers in the surgical department of the Emergency Center of the Clinical Center of Serbia, in the surgical and otorhinolaryngology departments of the Clinical-Hospital Center Zemun, and the Clinical-Hospital Center "Dragiša Mišović" (neonatology ward). The staff included in the study (physicians and nurses/technicians) were working at the neonatology and surgery wards, as well as at the surgical admission unit.

A questionnaire with open-ended and closed questions was prepared for the purpose of this study. It had 28 questions, including those about demographic characteristics (age, gender, occupation, job, length of employment), about the number of accidents during working hours, about the place and circumstances of accidents, as well as about the measures taken after an accident. In addition, the questionnaire included questions on vaccination for hepatitis B. The questionnaire was anonymous and self-administrated; the HCWs were informed that the participation in the study was non-compulsory. The methods of descriptive and analytical statistics (chi-square test and Student t-test) were used for data processing. Computer processing was done using the SPSS 15.0 software package for Microsoft Windows.

## RESULTS

### Demographic characteristics of the study population

The answers to the questionnaire were provided by 216 HCWs (68% out of 317 employees worked at the time of the survey), out of which 44.4% were employed in the Emergency Center of the Clinical Center of Serbia, 42.1% in the Clinical Hospital Center Zemun and 13.4% in the Clinical Hospital Center "Dragiša Mišović". The demographic characteristics of the respondents were shown in Table 1. There were more women (67.1%) than men (32.9%). Mean

**Table 1.** Demographic characteristics of respondents

Demographic characteristics		Number (%)
Gender	Males	71 (32.9)
	Females	145 (67.1)
Occupation	Doctors	47 (21.8)
	Nurses/medical technicians	169 (78.2)
Wards	Clinical ward	83 (38.4)
	Operating theatre	69 (31.9)
	Surgical intensive care units	42 (19.4)
	Surgical admission units	22 (10.2)
Working shift	All	124 (57.4)
	Only first shift	14 (6.5)
	Only day shift	78 (36.1)

age of the respondents was  $36.6 \pm 10.24$ , without any significant differences in terms of occupation (doctors/nurses-medical technicians) ( $t$ -test=1.28; DF=158;  $p=0.20$ ). The mean work experience was  $12.6 \pm 9.75$  years (ranging from 1 to 37 years) without any significant difference related to their occupation ( $p=0.27$ ). The HCWs were most often employed in clinical wards (38.4%) and operating theaters (31.9%), post-surgery intensive care (19.4%) and surgery admission units (10.2%). The highest percentage (57.4%) of the respondents reported that they worked all shifts, whereas 42.6% reported that they worked only day shifts.

### Occupational exposure to blood and body fluids in accidents

Out of a total number of respondents, only 85 (39.4%) had not had any accident, whereas the self-reported life time risk of at least one needle stick or sharp injury among HCWs was 60.6% (131 respondents). Of those, 75 (34.7%) HCWs had the accidents at any time during their work years, and 56 (25.9%) during the previous year. The accidents were significantly associated with females (chi-square=3.84;  $p=0.05$ ). Nurses/medical technicians had significantly higher percent of accidents than physicians ( $\chi^2=6.44$ ;  $p=0.04$ ). A total number of accidents was 204: 81 HCWs had one accident, 31 HCWs had two, 17 HCWs had three and two HCWs had five accidents during their work experience.

Accident distribution by the unit types where HCWs worked was shown in Table 2. There was a statistically significant difference in location where the accident occurred, that is, accidents occurred significantly more often in the operating theaters than in other wards ( $\chi^2=15.75$ ; DF=3;  $p=0.001$ ).

**Table 2.** Accident distribution by the unit type

Unit type	Number (%)		
	Accidents		Total
	No	Yes	
Surgical admission ward	8 (9.4)	14 (10.7)	22 (10.2)
Clinical wards	44 (51.8)	39 (29.8)	83 (38.4)
Operating theaters	15 (17.6)	54 (41.2)	69 (31.9)
Surgical intensive care units	18 (21.2)	24 (18.3)	42 (19.4)
Total	85 (100.0)	131 (100.0)	216 (100.0)

$\chi^2=15.75$ ; DF=3;  $p=0.001$

**Table 3.** Place of accidents by the job category

Location	Doctors	Nurses/medical technicians	p*
	n=128		
	Number (%) of accidents		
Patient's rooms	2 (5.9)	38 (40.4)	<0.0001
Corridors	1 (2.9)	4 (4.3)	0.599
Operating theatre	23 (67.6)	41 (43.6)	0.016
Surgical admission units	16 (47.1)	17 (18.1)	0.001
Other	1 (2.9)	4 (4.3)	0.599

\* according to chi-square or Fisher test

**Table 4.** Nature of accidents by the job category

Activity	Doctors	Nurses/medical technicians	p*
	n=123		
	Number (%) of accidents		
Before using needle/ sharp devices	16 (50.0)	28 (30.8)	0.05
Handling with contaminated needle/ sharp devices	18 (56.3)	45 (49.5)	0.518
Recapping	3 (9.4)	33 (36.3)	0.003
During disposition to sharp containers	2 (6.3)	10 (11.0)	0.730
Cleaning up after surgical procedure	1 (3.1)	26 (28.6)	0.002
Other	7 (21.9)	6 (6.6)	0.016

\* according to chi-square or Fisher test

**Table 5.** Mean number of procedures during which there were accidents by the job category

Procedures	Mean±SD		p*
	Doctors	Nurses/medical technicians	
Needlestick injury with therapy needle	0.43±1.13	2.21±3.81	0.014
Needlestick injury with surgical needle	5.73±18.43	0.98±2.18	0.019
Sharp object injury	3.70±3.72	1.49±3.19	0.002
Contact with non-intact skin	20.40±90.85	16.88±108.13	0.874
Through the eye conjunctiva	6.10±18.91	2.52±5.65	0.116

\* according to t-test

Table 3 shows the most frequent locations of accidents in relation to occupation. Nurses/medical technicians injured themselves significantly more often in patient's rooms ( $p<0.0001$ ), whereas physicians had higher proportion of accidents in admission units ( $p=0.001$ ) and operating theaters ( $p=0.01$ ).

Although there were more accidents in HCWs who worked all shifts (62.5%) in comparison to those who worked only day shifts, no statistical significance was established ( $p>0.05$ ).

Statistical data processing found that HCWs who carried out the forbidden procedure of recapping a used needle were more prone to accidents (86.5%) in comparison to those who reported proper needle handling, but this difference was not statistically significant ( $p=0.07$ ).

The results presented in Table 4 show that physicians had significantly higher number of accidents before using

ing a needle or a sharp object ( $p=0.04$ ), whereas nurses had higher number of them during the needle recapping ( $p=0.003$ ) and during washing and cleaning instruments after the surgical procedures ( $p=0.001$ ).

An average number of procedures during which the accidents occurred in relation to occupation was shown in Table 5. Nurses/medical technicians had significantly higher number of needlestick injuries with needles used for therapy administration, whereas physicians had significantly higher number of accidents during manipulation of surgical needles and sharp instruments. Physicians and nurses/medical technicians also reported contact with the blood and body fluids through non-intact skin and eye (conjunctiva) as one of very frequent way of contacts, but there was no significant difference according to job category.

Only 41.2% persons who had experienced accidents actually reported them to the responsible persons in their institutions, whereas 21.4% did not know that they were supposed to report them. The number of physicians who did not report an accident was significantly higher ( $p=0.001$ ) than the number of nurses/medical technicians.

### Immunization against hepatitis B virus

At the time when the study was conducted, 50.2% respondents were fully vaccinated with three dosages of the vaccine, whereas 8.1% received one dosage, and 15.2% received two dosages of the vaccine. Although physicians were more often immunized (80.9%) in comparison to nurses/medical technicians (71.3%), there was no statistically significant difference ( $p=0.132$ ) in terms of respondent's occupation.

### DISCUSSION

Published estimates of the annual number of accidents vary widely among HCWs in developed countries: from 28.000 in Italy to 400.000 in the USA and 700.000 in Germany [20]. The number of published studies on the occupational exposure of HCWS in Eastern Europe to blood is rather small [19, 21]. Two-thirds of our respondents had at least one accident during their career, about a quarter of them during the previous year. Nurses/medical technicians had accidents more often than physicians, what is contrary to the published papers in both developed and less developed countries, reporting usually that physicians are more prone to injuries involving exposure to blood [22, 23]. However, there are studies with results similar to ours, that is, which have shown that nurses/medical technicians had the highest rate of accidents in comparison to all other categories of health care providers [24, 25]. It is a well-established fact that physicians report accidents to the responsible persons much more rarely than other HCWs categories nurses/medical technicians [17, 18]. Underreporting rates of 22% to 82% have been noted [26, 27, 28]. In our study, we noticed that almost two-thirds of HCWs

had not reported accidents, physicians most often among them. It is possible that the frequency of accidents in physicians was higher than the one reported in this study, but that they considered the accidents insignificant and hence did not report them, which resulted in those accidents being unrecorded in this research.

The frequency of annual rate of accidents in our respondents was higher than in health care providers in some less developed countries [25, 29], but much higher than in the developed ones [22]. Our results are in concordance with the results of a study conducted in Turkey [5]. Although over fifteen years have passed since standard precautions have been defined [12], and recommended to be taken by all HCWs when they are in contact with all patients, it is a fact that they are often neglected.

Based on the research conducted in the UK, it may be noted that 50%-80% of accidents may be prevented by using safety equipment (capped needles or so-called Vacutainers for venipuncture), whereas 77%-82% of them can be prevented by providing written recommendations and observing the prescribed rules in practice [30]. Although the price of safety equipment is relatively high in our circumstances, the experience from other countries tells us that it usually becomes lower once the equipment comes into regular usage in the given country.

## REFERENCES

1. Siegel J, Rhinehart E, Jackson M, Chiarello L, and the Healthcare Infection Control Practices Advisory Committee. 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings. Available from: <http://www.cdc.gov/hicpac/pdf/isolation/Isolation2007.pdf>.
2. Sepkowitz KA. Occupationally acquired infections in health care workers. Part II. *Ann Intern Med*. 1996; 125:917-28.
3. Panlilio AL, Orelie JG, Srivastava PU, Jagger J, Cohn RD, Cardo DM, et al. Estimate of the annual number of percutaneous injuries among hospital-based healthcare workers in the United States, 1997-1998. *Infect Control Hosp Epidemiol*. 2004; 25:556-62.
4. Calver J. Occupational Health Services. *Am J Infect Control*. 1997; 25:363-5.
5. Azap A, Ergonul, Memikoglu K, Yesilkaya A, Altunsoy A, Bozkurt, et al. Occupational exposure to blood and body fluids among health care workers in Ankara, Turkey. *Am J Infect Control*. 2005; 33:48-52.
6. Dobie DK, Worthington T, Farouqi M, Elliot TSJ. Avoiding the point. *Lancet*. 2002; 259:1254.
7. Berry A, Greene ES. The risk of needlestick-transmitted diseases in the practice of anesthesiology. *Anesthesiology*. 1992; 77:1007-21.
8. Lorentz J, Hill L, Samimi B. Occupational needlestick injuries in a metropolitan police force. *Am J Prev Med*. 2000; 18:146-50.
9. Myers D, Epling C, Dement J, Hunt D. Risk of sharp device-related blood and body fluid exposure in operating rooms. *Infect Control Hosp Epidemiol*. 2008; 29(12):1139-48.
10. Public Health Laboratory Service AIDS & STD Centre. Occupational Transmission of HIV: Summary of Published Reports. London: PHL; 1999.
11. May D, Brewer S. Sharps injury: prevention and management. *Nurs Stand*. 2001; 15:45-52.
12. Centers for Disease Control and Prevention (CDC). Updated U.S. Public Health Service Guidelines for the Management of Occupational Exposures to HBV, HCV, and HIV and Recommendations for Postexposure Prophylaxis. *MMWR Recomm Rep*. 2001; 50(RR-11):1-52.
13. Occupational Safety and Health Administration. Occupational exposure to bloodborne pathogens: needlesticks and other sharps injuries; final rule. *Fed Reg*. 2001; 66:5317.
14. Panlilio AL, Cardo DM, Grohskopf LA, Heneine W, Ross CS; U.S. Public Health Service. Updated U.S. Public Health Service guidelines for the management of occupational exposures to HIV and recommendations for postexposure prophylaxis. *MMWR Recomm Rep*. 2005; 54(RR-9):1-17.
15. Diprose P, Deakin CD, Smedley J. Ignorance of post-exposure prophylaxis guidelines following HIV needlestick injury may increase the risk of seroconversion. *Br J Anaesth*. 2000; 84:767-70.
16. Grabenstein J. Vaccines for workers; immune aspects of occupational health. *Hosp Pharm*. 2001; 36:534-46.
17. Shapiro C. Occupational risk of infection with hepatitis B and hepatitis C virus. *Surg Clin North Am*. 1995; 78:1047-56.
18. David HT, David YM. Living with needlestick injuries. *J Can Dent Assoc*. 1997; 63:283-6.
19. Salihović P, Puvačić S. Occupational exposure and prevention of viral hepatitis B in health care personnel in the Canton of Sarajevo. *Med Arh*. 2004; 58(1):27-30.
20. Saia M, Hofmann F, Sharman J, Abiteboul D, Campins M, Burkowitz J, et al. Needlestick Injuries: Incidence and Cost in the United States, United Kingdom, Germany, France, Italy, and Spain. *Biomed Int*. 2010; 1:41-9.
21. Gańczak M, Bohatyrewicz A, Korzeń M, Karakiewicz B. The comparison of sharps injuries reported by doctors versus nurses from surgical wards in the context of the prevalence of HBV, HCV and HIV infections. *Pol Przegl Chir*. 2012; 84(4):190-5.
22. Wicker S, Jung J, Allwinn R, Gottschalk R, Rabenau HF. Prevalence and prevention of needlestick injuries among health care workers in a German university hospital. *Int Arch Occup Environ Health*. 2008; 81(3):3475-4.
23. Foster TM, Lee MG, McGaw CD, Frankson MA. Prevalence of needlestick injuries and other high risk exposures among healthcare workers in Jamaica. *West Indian Med J*. 2010; 59(2):153-8.
24. Tabak N, Shiaabana AM, Shasha S. The health beliefs of hospital staff and the reporting of needlestick injury. *J Clin Nurs*. 2006; 15(10):1228-39.
25. Smith DR, Choe MA, Jeong JS, Jeon MY, Chae YR, An GJ. Epidemiology of needlestick and sharps injuries among professional Korean nurses. *J Prof Nurs*. 2006; 22(6):359-66.
26. Tarantola A, Abiteboul D, Rachline A. Infection risks following accidental exposure to blood or body fluids in health care workers:

In addition to these measures, immunization for hepatitis B is the most effective prevention against this disease. However, only a half of health care providers in our study was fully immunized, with three vaccine dosages. Since the HbsAg testing is not done in our country, contrary to the common practice in other countries [5], we cannot comment the immune status of HCWs in terms of HBV infection. It is, therefore, necessary to promote immunization against this disease, especially since it is a legal obligation of health care workers.

## CONCLUSION

Based on the above, it may be concluded that high frequency of accidents of health care providers during their work in hospitals was recorded. Use of safety equipment would improve the safety and health of health care providers.

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- a review of pathogens transmitted in published cases. *Am J Infect Control.* 2006; 34:367-75.
27. Schmid K, Schwager C, Drexler H. Needlestick injuries and other occupational exposures to body fluids amongst employees and medical students of a German university: incidence and follow-up. *J Hosp Infect.* 2007; 65:124-30.
  28. Colombo C, Ledergerber F, Zysset F, Francioli P, Cavassini M, Lazor-Blanchet C, et al. Exposition au risque infectieux VIH, VHB et VHC chez le personnel des établissements de soins en Suisse de 2001 à fin juin 2008. *BAG Bulletin.* 2010; 3:36-42.
  29. Reda AA, Fisseha S, Mengistie B, Vandeweerd JM. Standard precautions: occupational exposure and behavior of health care workers in Ethiopia. *PLoS One.* 2010; 5(12):e14420.
  30. Gabriel J. Reducing needlestick and sharps injuries among healthcare workers. *Nurs Stand.* 2009; 23(22):41-4.

## Професионална изложеност здравствених радника крвљу и телесним течностима у универзитетским болницама

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### КРАТАК САДРЖАЈ

**Увод** Професионална изложеност крвљу и телесним течностима је значајан проблем у вези са здрављем здравствених радника, јер може да доведе до преношења вируса, као што су ХИВ и вируси хепатитиса Б и Ц.

**Циљ рада** Циљ овог рада био је сагледавање учесталости, места и начина настанка акцидента, као и могућих узрока који су довели до њихове појаве код здравствених радника.

**Методе рада** Урађена је студија преваленције међу здравственим радницима три универзитетске болнице у Београду. Коришћен је анонимни упитник који је обухватао податке о демографским одликама испитаника, изложености крвљу и телесним течностима и околностима под којима је до акцидента дошло.

**Резултати** Упитник је попунило и вратило 216 здравствених радника (78,2% медицинских сестара/техничара и 21,8% лекара). Бар један акцидент током радног стажа доживело је 60,6% здравствених радника, а 25,9% њих у последњих 12

месеци. Медицинске сестре/техничари су чешће имали акциденте него лекари ( $p=0,05$ ). Акцидент је значајно чешће настао у операционој сали ( $p=0,001$ ). Међу факторима који су допринели настанку акцидента поновно затварање игле ( $p=0,003$ ) и прање и чишћење инструмената након хируршке интервенције ( $p=0,001$ ) били су чешћи код медицинских сестара/техничара, док је код лекара акцидент чешће настао пре коришћења игле ( $p=0,004$ ). Само 41,2% здравствених радника пријавило је акцидент својим надлежним. Вакцинисано трима дозама вакцине против хепатитиса Б било је 50,2% испитаника.

**Закључак** Забележена је висока учесталост акцидента здравствених радника током њиховог рада у болници. Примена безбедне медицинске опреме побољшала би сигурност и здравље запослених.

**Кључне речи:** професионална изложеност; здравствени радници; крв; телесне течности