

## Occupational exposure to blood and bodily fluids among healthcare workers in Serbian general hospitals

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The risk of occupational bloodborne infections (HBV, HCV, and HIV) among healthcare workers remains a serious issue in developing countries. The aim of this study was to estimate occupational exposure to bloodborne infections among general hospital workers in Serbia. This cross-sectional study was conducted in the spring of 2013 and included 5,247 healthcare workers from 17 general hospitals. The questionnaire was anonymous, self-completed, and included socio-demographic information with details of blood and bodily fluid exposure over the career and in the previous year (2012). Significant predictors of sharps injuries were determined with multiple logistic regressions. The distribution of accidents in 2012 was equal between the genders (39 %), but in entire career it was more prevalent in women (67 %). The most vulnerable group were nurses. Most medical doctors, nurses, and laboratory technicians reported stabs or skin contact with patients' blood/other bodily fluid/tissue as their last accident. Healthcare workers from the north/west part of the country reported a significantly lower number of accidents over the entire career than the rest of the country ( $p < 0.001$ ). The south of Serbia stood out as the most accident-prone in 2012 ( $p = 0.042$ ).

**KEY WORDS:** *bloodborne infections; occupational risk; predictive modelling; sharps injuries*

Every working day, over 59 million healthcare workers (HCW) in the world run the risk of getting infected with hepatitis, AIDS, or tuberculosis by accidental exposure to patient's blood and other bodily fluids (1). This global issue is even more pronounced in developing countries, where the risk is underappreciated, overlooked, and poorly prevented. There are currently more than 90,000 healthcare workers in Serbia, 22 thousand of whom are medical doctors and 62 thousand nurses (2).

The most common sources of exposure to bloodborne infections in the healthcare sector are needlestick and sharps injuries. Sharps injuries include stabs or cuts with a sharp object, such as syringe or surgical needles, scalpels, lancets, or broken glass. However, they are not the only way of exposure to patient's blood or bodily fluids. Others include exposure through mucosa or skin damaged in some other way. Global estimates from a decade ago speak of 0.18–4.68 sharps injuries per healthcare worker a year (3). For the countries of the EUR B region, which includes Serbia (former Yugoslavia), the number of sharp injuries was almost one. These injuries were estimated to cause 690 HCV, 6400 HBV, and 1 HIV infections among healthcare workers a year (3).

In May 2010, the European Union implemented the Framework Agreement on prevention of sharps injuries in the hospitals and healthcare sector by Council directive

2010/32/EU (4). This document contains necessary information about occupational sharps injuries. Not being a member state yet, Serbia is not obliged to nor has it kept a national record of occupational blood and infectious bodily fluid exposures, including those involving occupational needlestick injuries and injuries due to sharps or splashes of blood/bodily fluids. It does not even have national guidelines for post-exposure prophylaxis.

Only a few cross-sectional studies have been conducted in Serbia on sharp injuries or splash exposures among healthcare workers, those in 2003 (5), 2011 (6), and 2012 (7). However, their findings are limited by an unrepresentative sample, which was modest in the number of participants, covered only some departments, did not distinguish between primary, secondary, and tertiary healthcare services, and was not nationwide.

The aim of our study was to make up for this lack of information with a new and comprehensive, nationwide survey of occupational sharps injuries and splash exposures, so as to have some baseline information by the time Serbia adopts the Council directive 2010/32/EU (4). This study makes part of a bigger survey of occupational sharps injuries among healthcare workers (HCWs) in Southeast Europe.

### PARTICIPANTS AND METHODS

This cross-sectional survey was conducted in 17 (of 36) Serbian general hospitals in the spring of 2013 and included

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HCWs who routinely work with blood (physicians, nurses, laboratory technicians, and support staff such as cleaners and workers in laundry and sterilisation). We used a geographically stratified design, with Serbia divided into six regions. Our random selection included one hospital from the west of Serbia, four from the east, two from central Serbia, two from the south, four from Vojvodina, and four from Belgrade. Ethics committees and/or responsible persons from the management of each hospital approved the survey.

The questionnaire was based on a Croatian self-reporting questionnaire on exposure to bloodborne infections (8) and on a questionnaire previously used in Serbia (7). To test the questionnaire, we ran a pilot study at the Serbian Institute of Occupational Health (data not presented) and revised it to improve clarity for HCWs.

The final questionnaire contained 34 multiple-choice questions adjusted to Serbian population. It was anonymous, and all participants were informed about its aim and instructed how to complete it.

The information collected included socio-demographic data such as age, gender, education level, specialty (for physicians), hospital department, the number of blood and bodily fluid (BBF) exposures over the entire career (expressed as none, one, or more than one), and details about exposures in 2012. Details about the most recent accident included the type of activity preceding the accident, objects and instruments involved, patient's HIV/HBV/HCV status, hours on duty, and whether the accidents were reported or not. The questionnaire also investigated how much the participants knew about the health risks from BBF exposure, whether they were vaccinated against HBV, and which post-exposure treatment they received.

The questionnaire was answered by 5,762 participants (response rate 88 %), but we excluded 515 participants who did not fill more than 50 % of the questionnaire. The analysis, therefore, included the answers of 5,247 participants, who submitted completed or partly incomplete forms. Hence the difference in total numbers of respondents to specific questions.

#### *Data management and analysis*

The questionnaire forms were created and answers scanned with the Remark optical mark recognition software (Remark Office OMR®, Remark, Mulvern, PA, USA). Readings were stored in Microsoft Excel spreadsheets (Microsoft, Redmond, WA, USA).

The chi-square and Fisher's exact test were used to look for associations between reported sharps injuries and variables such as demographic, workplace, and workday characteristics over the previous year (2012) and the entire career.

Multivariate logistic regression was used to evaluate the strength of association between these variables and identify the most important predictors of increased BBF

exposure in HCWs over the career and in 2012. Belgrade (the capital) was selected as the reference region for calculating predictors, being the most advanced in equipment and training in the country. Other reference variables were the lowest age and work experience groups.

Statistical analysis was done using the IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp, Armonk, NY, USA).

## RESULTS AND DISCUSSION

Table 1 shows the demographic information about the study population. Their characteristics were fairly similar across the six regions, with deviation lower than 10 %.

Nearly 66 % of the respondents reported at least one BBF exposure in their career, and 39 % reported at least one such accident in 2012 (Table 2). Compared to the neighbouring and EU countries, our one-year BBF exposure prevalence among HCWs was lower than in Montenegro (9) and France (10), but higher than in Bosnia and Herzegovina (11) and Germany (12).

Another Serbian study (6) reported much lower career and one-year prevalence (35 % and 26 %, respectively) in university hospitals than in general hospitals and clinics. Similar was observed in the 2004 French study referenced above (10). Perhaps university hospitals have better medical equipment, devices, or safety measures than general hospitals.

The 2012 exposure prevalence varied across the Serbian regions ( $p < 0.001$ ) with south Serbia reporting the highest (49 %). This may point to safety training issues, work overload, or weaker management, organisation and financial support. Some of the issues can be cost-effectively addressed by quality training programmes for HCWs.

The distribution of accidents in 2012 was equal between the genders (39 %). Over the entire career, however, it was significantly more prevalent in women ( $p < 0.05$ ).

As expected, the prevalence was higher in the surgical specialties (surgery, gynaecology and anaesthesiology) and in respondents working in the operating room (60 %), intensive care unit (48 %), dialysis ward (45 %), and delivery room (43 %).

Table 3 shows the details about BBF exposure accidents in 2012 and differences in their prevalence between medical doctors, nurses/lab workers, and other occupations. If more than one accident had been reported, only the details of the last accident were collected. As expected, the most frequent types of accident were stabs and blood-skin contact. The latter suggests that many Serbian HCWs do not wear protective gloves.

Most participants reported that their last accident happened during blood draw (18 %) or while preparing to insert the needle in a patient (17 %).

Most medical doctors had the latest BBF exposure during surgery (55 %), whereas most nurses and laboratory



**Table 2** Prevalence of accidents by variables

		Career prevalence			One-year prevalence (2012)		
		N	%	p-value	N	%	p-value
Region	Total	3439	66		2066	39	
	Belgrade	971	69		588	41	
	Central Serbia	321	70		199	43	
	East Serbia	480	69	<0.05	291	42	<0.05
	South Serbia	348	69		251	49	
	Vojvodina	785	65		457	38	
	West Serbia	534	57		280	29	
Gender	Men	608	61	<0.05	393	39	0.945
	Women	2821	67		1670	39	
Age group (years)	<25	115	55		88	41	
	25-34	911	68		630	47	
	35-44	1073	69	<0.05	597	38	<0.05
	45-54	976	65		560	37	
	55+	318	61		164	31	
Job title	Medical doctor	503	54		336	36	
	Nurse	2350	72		1413	43	
	Laboratory technician	263	68	<0.05	150	39	<0.05
	Cleaning staff	242	55		125	27	
	Other <sup>a</sup>	57	42		31	22	
Work experience (years)	<5	328	56		256	43	
	5-20	1723	68	<0.05	1061	42	<0.05
	20+	1360	67		733	35	
Specialty	Nonsurgical	1635	63		963	36	
	Surgical	1249	76	<0.05	820	49	<0.05
	Outpatient units <sup>b</sup>	622	60		325	96	
Department, unit, ward	Surgical room	403	81		301	60	
	Endoscopy and dialysis department	202	72		115	79	
	Delivery room	177	65	<0.05	119	43	<0.05
	Intensive care units	253	72		168	48	
	Radiology and internal medicine	737	59		456	72	
	Surgical wards	486	72		298	43	
	Laboratory	361	68		193	36	
	Other <sup>c</sup>	139	48		67	23	

<sup>a</sup> workers in laundry and sterilisation

<sup>b</sup> includes receiving and emergency care, department/policlinic

<sup>c</sup> physical medicine and rehabilitation, dermatovenerology

<sup>d</sup> Chi-square test of association

technicians reported exposure during blood draw (21 %) and recapping (19 %). We can only speculate why, as we did not collect a detailed description of the procedures. Perhaps some hospitals still draw blood with a syringe instead of vacutainer tubes, which are much safer to use. As for recapping, our findings are much higher than the reports from Poland (6.9 %) (13) and France (5.9 %) (10), even though many Serbian hospitals have guidelines for safe needle disposal.

Our results, however, single out one group as highly at risk of stabs: the so called “others”, the support staff: cleaners, launderers, and sterilisation room attendants. This group has reported the highest rate of stabs of all, as well as the highest rate of BBF exposure during disposal of sharps and waste and during cleaning. They most consistently pointed their finger to inappropriate waste disposal and disregard of other staff (medical doctors and nurses/lab technicians) for them as the main causes of exposure. We believe that this group is quite neglected in

Table 3 Accident characteristics by job title and activity in 2012

	Job title												p-value
	Accidents in the previous year			Medical doctors			Nurses/lab workers			Other			
	N	%	Total	N	%	N	%	N	%	N	%		
Frequency	982	48	158	47	743	48	81	52					
More than one	1073	52	178	53	820	52	75	48					
Stab	2161	63	285	57	1648	63	228	77					
Cut	1080	32	117	23	879	34	84	28				<0.05	
Contact blood-skin	1753	51	279	55	1397	54	77	26					
Contact blood-mucosa	606	18	126	25	447	17	33	11					
Morning	2323	73	371	79	1753	71	199	72					
Afternoon	517	16	55	12	402	16	60	22				<0.05	
Evening	363	11	43	9	304	12	16	6					
Before using sharps	542	17	83	18	449	18	10	4					
Drawing blood	567	18	35	8	520	21	12	4					
Injection	352	11	15	3	329	13	8	3					
During surgical intervention	510	16	254	55	245	10	11	4				<0.05	
Recapping	495	15	29	6	459	19	7	2					
During disposition to sharp containers	368	11	29	6	297	12	42	15					
After disposition	105	3	8	2	56	2	41	15					
During cleaning up	264	8	12	3	102	4	150	53					
Lack of experience	77	2	22	5	44	2	11	4					
Inappropriate handling of instruments	107	3	14	3	85	3	8	3					
Sudden patient moves	908	28	128	27	762	31	18	6					
Haste	1083	34	116	25	922	37	45	16					
Absence of waste disposal containers	117	4	2	0	80	3	35	13				<0.05	
Inappropriate waste disposal	114	4	3	1	47	2	64	23					
Fatigue	191	6	26	6	152	6	13	5					
Personal inattention	376	12	104	22	253	10	19	7					
Inattention of other person	249	8	54	12	129	5	66	24					

**Table 4** Predictive significance of variables for BBF exposure over the entire career

		P	OR	95 % CI for OR	
				Lower	Upper
Region	Belgrade (ref)	0.000			
	Central Serbia	0.036	.752	.575	.982
	East Serbia	0.374	.900	.712	1.136
	South Serbia	0.194	.847	.660	1.088
	Vojvodina	0.000	.683	.561	.832
	West Serbia	0.000	.495	.404	.607
Gender	Gender (Female)	0.227	1.113	.936	1.324
	<25 (ref)	0.200			
Age	25-34	0.234	1.244	.868	1.781
	35-44	0.057	1.474	.989	2.198
	45-54	0.069	1.503	.969	2.332
	55+	0.286	1.306	.800	2.132
Job title	Medical doctor	0.000			
	Nurse/laboratory technician	0.000	2.165	1.813	2.584
	Other <sup>a</sup>	0.607	.912	.642	1.296
Work experience	<5 years	0.001			
	5-20 years	0.000	1.629	1.263	2.101
	20+ years	0.017	1.487	1.074	2.058
Specialty	Surgical branches	0.000	1.915	1.656	2.215
	Constant	0.003	.577		

<sup>a</sup>Support staff, (cleaners, workers in laundry and sterilisation)  
OR - odds ratio  
CI - confidence interval

terms of safety instructions and procedures, as they are not directly involved in medical care, and this issue needs to be addressed in every hospital.

That accidents prevail in the morning shift (73 %) is not a surprise, as morning shifts see much more activity. Some studies (14) have shown the evening shift as critical, but most other studies worldwide report results consistent with ours (7, 15, 16).

The main cause of accidents is haste, especially among nurses, followed by sudden patient moves. Medical doctors are the group that most often reported their own inattention as the cause of BBF exposure of all groups.

Tables 4 and 5 show which of the variables stand out as significant predictors of BBF exposure over the entire career and in 2012, respectively. Compared to Belgrade, only Vojvodina (highly developed northern region of Serbia) and west Serbia had significantly (30-50 %) lower odds of BBF exposure over the entire career. In 2012, south Serbia had significantly (20 %) higher, and west Serbia significantly (35 %) lower odds of BBF exposure. For now, we can only speculate about the reasons for these differences.

Gender was not a significant predictor of BBF exposure, and, interestingly, neither was age. In contrast, work experience longer than five years turned out to be a significant BBF exposure predictor over the entire career, which is expected, as the risk grows over the years. In 2012,

however, work experience was not a significant predictor of BBF exposure, which also makes sense, as experienced staff makes fewer mistakes.

Nurses and laboratory technicians had double the odds of medical doctors having BBF exposure over the career, but only 30 % higher odds in 2012.

The odds of BBF exposure over the career were twice as high in the surgical branches vs. non-surgical ones, and 65 % higher in 2012. The most vulnerable working places in general hospitals were operating rooms, which was also reported by Treacle (17) and Jagger (18).

There are several limitations to this study, as it has not investigated the incidence of sharps injuries or how frequently HCWs come in contact with blood or bodily fluid on a daily basis. Despite these limitations, our study boasts a large sample size and gives a relatively reliable idea about the current state of BBF exposure in Serbian general hospitals. By pinpointing significant predictors (bolded in Tables 4 and 5), this study has singled out safety issues for specific geographical areas, medical branches, and working groups that need addressing, at least in the form of raising awareness of exposure risks. The results of our study can also serve as a baseline for future longitudinal studies as part of the EU "Framework Agreement on prevention of sharps injuries in the hospital and healthcare sector".

**Table 5** Predictive significance of variables for BBF exposure in 2012

		P	OR	95 % CI for OR	
				Lower	Upper
Region	Belgrade (ref)	0.000			
	Central Serbia	0.839	1.026	.804	1.309
	East Serbia	0.825	1.024	.832	1.260
	South Serbia	0.042	1.262	1.009	1.579
	Vojvodina	0.076	.849	.709	1.017
	West Serbia	0.000	.633	.521	.769
Gender	Gender (F)	0.690	1.034	.876	1.222
	<25 (ref)	0.195			
Age	25-34	0.465	1.139	.803	1.615
	35-44	0.913	.979	.668	1.435
	45-54	0.548	1.137	.747	1.730
	55+	0.763	.929	.578	1.496
Job title	Medical doctor (ref)	0.000			
	Nurse/ laboratory technician	0.004	1.294	1.087	1.541
	Other <sup>a</sup>	0.035	.663	.452	.971
Work experience	<5 years (ref)	0.018			
	5-20 years	0.936	1.010	.793	1.286
	20+ years	0.069	.752	.553	1.023
Specialty	Surgical branches	0.000	1.663	1.462	1.892
	Constant	0.001	.543		

<sup>a</sup> Support staff (cleaners, workers in laundry and sterilisation)  
 OR - odds ratio  
 CI - confidence interval

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### Profesionalna izloženost krvi i tjelesnim tekućinama zdravstvenih radnika u općim bolnicama u Srbiji

Rizik od profesionalnih krvnoprenosivih bolesti (HBV, HCV, HIV) među zdravstvenim radnicima i dalje je ozbiljan problem u zemljama u razvoju. Cilj presječnoga ispitivanja, koje je provedeno u proljeće 2013. i u kojem je sudjelovalo 5.247 ispitanika iz 17 općih bolnica, bio je procijeniti profesionalnu izloženost zdravstvenih radnika u Srbiji krvnoprenosivim bolestima. Upitnik je bio anonim i sadržavao je opće podatke i podatke o prethodnoj izloženosti krvi i tjelesnim tekućinama. Korištena je analiza multiple logističke regresije za određivanje značajnih prediktivnih čimbenika ubodnih incidenata. U prethodnoj godini broj ozljeda bio je jednak i u muškoj i u ženskoj populaciji (39 %), a tijekom cijelog radnog staža prevalencija je bila viša u ženskoj populaciji (67 %). Najveći broj ozljeda imale su medicinske sestre/tehničari. Najveći broj liječnika, medicinskih sestara i laboratorijskih radnika kao posljednji incident navode ubod ili kontakt kože s krvlju pacijenta, drugim tjelesnim tekućinama ili tkivima. Razlike među regijama bile su značajne u sjevernom/zapadnom području Srbije, gdje je rizik od incidenata bio niži tijekom cijelog radnog staža ( $p < 0,001$ ), i na jugu, gdje je rizik tijekom prethodne godine bio povišen ( $p = 0,042$ ).

KLJUČNE RIJEČI: *krvoprenosive bolesti; profesionalni rizik; prediktivni čimbenici; ubodni incidenti*