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**Protection of health workers employed in tertiary health institution from hepatitis B virus infection**

Заштита здравствених радника запослених у терцијарној здравственој установи од инфекције вирусом хепатитиса Б

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## Protection of health workers employed in tertiary health institution from hepatitis B virus infection

### Заштита здравствених радника запослених у терцијарној здравственој установи од инфекције вирусом хепатитиса Б

#### SUMMARY

**Introduction/Objective** More than 300 million people around the world are infected with Hepatitis B Virus (HBV). It is transmitted through blood, blood derivatives, sexually, and vertically, and healthcare workers, due to the nature of their work, represent a vulnerable group.

The aim of this research is to: determine the coverage of vaccination against HBV infection of health workers working in a tertiary health institution-the Clinical Centre (CC) of Vojvodina, the level of protection by determining anti HBs antibodies, the exposure degree, the degree of examinee's compliance with implemented protection measures in the work place, and the level of knowledge about post-exposure prophylaxis (PEP) measures.

**Methods** The research was conducted as a descriptive analytical cross section study, in which a Questionnaire on protection of health workers from blood-borne diseases (BBD) was used as an instrument for research, and blood sampling to determination HBs antibody titer. The sample covered one hundred health care workers.

**Results** The research showed a large coverage of vaccination against HBV infection (97%). Aside from continuous seroprophylaxis, 7% of examinees did not have protective anti HBs antibodies. Health workers' level of exposure to HBV infection incidence is 90%. Protection measures in the work place are applied by 89% examinees, whereas 86% is familiar with the PEP measures.

**Conclusion** The research showed a large coverage of health workers using specific HBV infection protection, insufficiently implemented protection, high exposure to HBV infection incidence, incomplete compliance with safety measures and insufficient knowledge of PEP measures.

**Keywords:** anti HBs antibodies; health workers; hepatitis B; incident; safety at work

#### САЖЕТАК

**Увод/циљ** Вирусом хепатитиса Б (ХБВ) инфицирано је више од 300 милиона људи широм света. Преноси се путем крви, крвних деривата, сексуалним путем и вертикално, а здравствени радници због природе свог посла представљају вулнерабилну групу.

Циљ овог истраживања био је: да се утврди обухват вакцинацијом против ХБВ инфекције здравствених радника радно ангажованих у терцијарној здравственој установи-Клиничком центру (КЦ) Војводине, ниво те заштите одређивањем титра анти ХБс антитела, степен изложености, степен поштовања мера заштите на радном месту испитаника, и степен познавања мера постекспозиционе профилаксе (ПЕП).

**Метод** Истраживање је спроведено као дескриптивно аналитичка студија пресека, у којој је као инструмент истраживања коришћен Упитник о заштити здравствених радника против крвно-трансмисивних болести, а узоркована је крв за одређивање титра анти ХБс антитела. Узорак је чинила једна стотина здравствених радника.

**Резултати** Истраживање је показало висок ниво обухвата вакцинацијом против ХБВ инфекције (97%). Поред континуиране серопротекције одређен број испитаника нема заштитни титар антитела (7%). Ниво експозиције здравствених радника настанку ХБВ инфекције износи 90%. Заштитне мере на радном месту користи 89% испитаника, док 86% познаје мере ПЕП.

**Закључак** Истраживање је показало висок ниво обухвата здравствених радника специфичном заштитом против ХБВ инфекције, недовољан степен спроведене заштите, висок ниво изложености настанку ХБВ инфекције, непотпуно поштовање мера заштите, и недовољно познавање мера ПЕП.

**Кључне речи:** титар антитела, здравствени радници, хепатитис Б, акциденти, заштита на раду

## INTRODUCTION

Hepatitis B virus infection represents a global public health problem, due to its high rate of prevalence and severe consequences upon the health of the affected [1,2]. Data by the World Health Organization (WHO) indicate that a third of the world population is infected with the hepatitis B virus, and between 10 and 30 million newly infected people are

registered annually, whereas as much as one million people die as a consequence of the infection caused by the virus [3,4].

Health care workers (HCWs) has a occupational risk to BBD [5,6]. The main BBD prevention measure in health institutions is to avoid exposure (professional exposure), apply hepatitis B vaccines and adequate PEP [7,8]. In the Republic of Serbia there is no precise data on the coverage and the degree of HCWs specific protection from hepatitis B virus, the number and type of incidents in the work place and PEP, even though there are certain legal provisions governing this issue (Rulebook on immunization and protection measures using medicines, Law on Protection of Population Against Infectious Diseases, European Guide for prevention of blood-borne diseases transmission, Statistical Yearbook of the Republic of Serbia) [1,9-12].

Infections caused by HBV among HCWs can be prevented by the vaccination [13]. However, success of vaccination is not absolute, and correlate with the achieved immunological response, representing by level of HBs antibodies. Post-vaccination immunity has been established is the anti HBs antibodies control, the suitable level of which is  $>10\text{mUI/ml}$  [14]. There are a several factor that influence on the level of HBs antibodies: vaccine factors (dose, schedule, place of vaccine administration, time after vaccination), and host factors (senior age (40+), male, obesity, smoking and chronic diseases) [12].

Beyond the level of HBs antibodies, that other factors affecting infection risk increase with health workers are: type of needle used, i.e. instrument that caused the injury, characteristics and severity of the injury, type and amount of potentially infected fluid i.e. inoculum, the patient's viremia degree [12].

However, the only conclusive evidence that a post-vaccination immunity has been established is the anti HBs antibodies control, the suitable level of which is  $>10\text{mUI/ml}$  [14],

and yet, in our country these levels are not monitored after health workers complete the HBV infection immunization procedure.

The aim of this research was to determine: the coverage of vaccination against HBV infection, the level of protection against HBV infection by determining anti HBs antibodies, employee exposure, compliance with the work safety measures and knowledge about the PEP measures.

## **METHODS**

The research was conducted as a descriptive analytical cross section study. Data were collected by surveying examinees with a questionnaire which they filled out themselves and by blood sampling in order to determine anti HBs antibodies (in February and March of 2019).

The research included 100 (one hundred) health workers employed in a tertiary health institution in the Republic of Serbia-the CC Vojvodina in Novi Sad, in the organizational units in which employees very often come into contact with patients' biological material, i.e. where employees are more exposed due to the nature of services provided to patients (Infectious Disease clinic, Emergency Center, Centre for Laboratory Medicine, and Dialysis Unit).

Along with survey questionnaires, the examinees received a designated data sheet with basic information about the research. The examinees were required to sign an informed consent.

The questionnaire on BBD protection of health workers was used as the research tool designed specifically for this purpose, based on literature data and examiner's experience.

The questionnaire on BBD protection of health workers consists of (forty) questions divided into four parts. The first part relates to general questions, regarding socio-demographic data and the work place itself, and contains 10 (ten) questions. The second part of the questionnaire contains questions relating to safety measures in the work place and contains 11 (eleven) questions. The third part examines incident situations in the examinees' work place and it contains 11 (eleven) questions, while the final (fourth) part deals with examinees' vaccination status and integrates 8 (eight) questions.

Examinees were tested after the survey, i.e. their blood was taken to determine anti HBs antibodies in the Laboratory for Virus Examinations in the Centre for laboratory medicine of the CC Vojvodina, on a mini Vidas apparatus (bioMerieux, Lyon) using ELFA method.

The study involved workers engaged for immediate care and treating patients in tertiary health protection, with at least one year of service and voluntary consent for participation in the research. The research was approved by the Ethical Council of the CC Vojvodina on 29th January 2019 in the Consent decision no.00-52.

The IBM SPSS (Statistical Package for Social Sciences 20) program package was used for statistical data processing. Methods of descriptive and inferential statistics were used for data analysis. Numerical marks with normal placement were described using arithmetic mean and standard deviation (SD).

Existence of correlation between variables was examined with the Spearman's rank correlation, and the strength of bonds was determined with guidelines provided by Cohen (small correlation  $r = 0.10$  to  $0.29$ ; medium correlation  $r = 0.30$  to  $0.49$ ; large correlation  $r = 0.50$  to  $1.0$ ) [15].

## RESULTS

The average age of examinees was  $\bar{x} = 43.13$  years (SD = 10.22 years), average height  $\bar{x} = 168.17$  cm (SD = 7.83cm), average body weight  $\bar{x} = 70.59$  kg (SD = 14.44 kg). The examinees had an average of  $\bar{x} = 18.83$  years of service (SD = 10.15 years).

Ninety examinees 90/100 (90%) were female, and ten 10/100 (10%) male.

The examinees were mostly medical nurses-technicians employed in internal medicine fields, who perform their work obligations in wards, working in shifts (Table 1).

Vaccination coverage in the observed sample is 97/100-97%. Completed HBV vaccination was listed by 87/100-87% of the examinees, majority of whom indicated that the time passed from the vaccination was 5 to 10 years. Testing for blood-borne diseases during employment was reported by 41/100-41% of the examinees (Table 2).

Out of the total examinee number, 7/100 (7%) do not have anti HBs antibodies for HBV infection, i.e. their values are lower than 10mUI/ml (Table 3).

Carrying out medical tasks in which they come into contact with blood and other patients' body fluids is listed by 90/100 (90%) of examinees, out of whom 77/100 (77%) believe that they are exposed to a constant HBV infection risk (Table 4).

The incident situation in the work mentioned most by examinees was exposure to patients' biological material through skin 53/100 (53%) and by needle prick 36/100 (36%) (Table 5).

Safety measures while working with patients are applied by 89/100 (89%) of examinees. Out of the safety measures the examinees use in their work place during care and treatment procedures, the highest percentage of examinees specified the use of protective gloves 88/100 (88%), while use of safety glasses was reported by the lowest percentage of examinees 24/100 (24%).

Eighty-seven examinees 87/100-87% confirmed that the employee safety was carried out continuously in their institution (Table 6).

An equal percentage of the examinees is aware of the meaning of the PEP term (92/100-92%) and the department they need to contact for help after being exposed (92/100-92%). Incidents in the work place as adverse events were mentioned by 22/100 (22%) of examinees, while 97/100 (97%) dispose infective waste according to the rules of profession (Table 7).

Correlation of certain variables was examined with the aim to determine the relation between age, gender, body mass index (BMI), field of medicine in which the examinees work, work place and years of service with certain factors affecting the health workers' protection from HBV infection (vaccination completeness, titer HBs antibodies, exposure to the risk of infection, number of interventions, use of protective equipment, number of incidents and more) (Table 8).

Years of age have a weak positive statistically important correlation with testing during employment (older employees were seldom tested during employment), and the time passed from vaccination (with older examinees more time passed since vaccination).

The variable gender has a low statistically important correlation with testing during employment (female examinees are more often tested) (Table 8).

## **DISCUSSION**

Due to disease risks of health professionals, in most countries vaccination for HBV infection is mandatory. However, health workers' vaccination ranges from 15% in Africa to 75% in Australia, the USA and New Zealand [16].

Studies conducted in Nigeria, China, Tanzania, and the USA show that health workers' vaccination scope for HBV infection ranges from 18% (Nigeria) to 84% (USA) [17-20].

In our country, since 1989 health care professionals are subject to mandatory hepatitis B immunization according to epidemiological indications.

An epidemiological study was carried out in the Republic of Serbia on the territory of Nišava and Toplica districts (from 2000 to 2009 year), which determined that the health workers' vaccination coverage for hepatitis B was 31% [21].

In December 2015 a research was carried out for predictors of vaccination status connected with immunization for hepatitis B with persons working in the CC of Serbia (Belgrade) in a cross-section study. Prevalence of vaccination in the examined sample was 66% [22].

Our research with HCWs employed in the facility of tertiary health care showed a high vaccination coverage 97/100 (97%). The obtained results show an increase in the coverage degree, and the fact that important steps are taken in educating health workers on protection from BBD.

When it comes to personal protection, 89/100 (89%) of examinees use protective measures when performing professional duties and most often these include gloves 88/100 (88%), while protective glasses are most rarely used 24/100 (24%).

In the Republic of Serbia, a research was carried out on the territory of the Autonomous Province (AP) of Vojvodina related to the importance of blood-borne infection prevention and control for decrease of professional risks amongst health care workers. The research results showed that health professionals of AP Vojvodina have a high rate (more than 80%) of professional exposure to these infections [23]. The same was confirmed by our



research, viz. 90% of examinees carry out medical tasks during which they come into contact with patients' biological waste.

Some countries (Sudan) recognized the need to study the exposure of HCWs to HBV infection in the work place when performing care and treatment activities. The obtained results showed a high level (above 65%) of infection exposure [24].

WHO estimates that every year around 66,000 health care professionals are infected with HBV, and 600.000 to 800.000 health professionals experience an incident in the work place in the form of a cut or needle prick [14,25].

Our research shows that the highest exposure is suffered by HCWs, who perform numerous medical tasks i.e. interventions during the day, and it is the nurses-technicians more than any other examinees. It is exactly the nurses-technicians who reported the highest number of incidents while working. The research carried out showed that younger nurses-technicians, especially those with higher BMI, have more frequent contacts with blood and other patients' body fluids (Table 8).

The aim of research conducted in China, India, Japan and Catalonia was to determine the level of health care professionals' protection against HBV infections after vaccination procedure has been completed. The acquired data indicate that the protection efficiency ranges between 64% (Catalonia) and 83% (Japan), i.e. these are the percentages of examinees with protective anti HBs antibodies [26-29].

Even though there is a permanent seroprophylaxis in the Clinical Centre of Vojvodina, 7/100 (7%) of examinees involved in this research do not have anti HBs antibodies (<10mIU/ml), which implies that the protection efficiency for HBV infection in the monitored sample is 93/100 (93%). All seven examinees who did not have a protective antibody titer were vaccinated with three doses of the vaccine. In four examinees the time

elapsed since the last of vaccine was one year, in two examinees between five and ten years, and in one more than ten years.

Among factors that influence the level of anti HBs antibodies, our study confirms the influence of BMI, because in comparison to anti HBs antibodies it has a low negative correlation (the higher the BMI, the lower the anti HBs antibodies-Table 8).

Higher exposure to infection and lower level of response to the vaccine with examinees who have a higher BMI is explained through certain metabolic disorders that change the immune system's response and thus contribute to the increased sensitivity to bacterial, viral or fungal infections [30].

Younger examinees are more familiar with the meaning of the PEP term, and the procedure after being exposed to a work place incident, even though 86/100 (86%) gave a positive reply to a question about their knowledge of the post exposure procedure.

Knowledge on prevention and control of BBD and PEP should be implemented into school curriculums of vocational schools and faculties. It is the basis for acquiring knowledge and skills, which should be improved from the moment of employment for every health worker and then continued during the entire working life.

## **CONCLUSION**

The conducted research showed a high overage HBV infection vaccination amongst HCWs 97/100 (97%), as well as high level of protection 93/100 (93%). Health workers' exposure in the observed tertiary health care institution is 90%. Safety measure against HBV infection are carried out by HCWs in 89/100 (89%) of the cases, whereas 86/100 (86%) of employees responded positively about being familiar with the PEP term.

Considering the fact that in our country there is no valid nor complete data on HCWs vaccination coverage for HBV infections, protection level of employees who underwent

immunization, number and type of incidents in the work place and PEP applied, activities of all relevant institutions in the country should be guided towards solving this increasing problem.

**Conflict of interest:** None declared.

Paper accepted

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**Table 1.** Structure of examinees in relation to workplace

<b>Branch of medicine</b>	<b>N</b>	<b>%</b>
surgery	13	13
internal medicine	66	66
general medicine	21	21
<b>Occupation</b>		
specialist doctor	15	15
doctor	5	5
graduate nurse	12	12
highly educated nurse	7	7
nurse	61	61
<b>Workplace</b>		
ambulance	18	18
department	75	75
intensive/semi-int. care unit	7	7
<b>Shift work</b>		
yes	54	54
no	46	46
<b>Total</b>	<b>100</b>	<b>100</b>

**Table 2.** Examinee structure according to vaccine status (coverage) against HBV infection

<b>Have you been vaccinated against HBV?</b>	<b>N</b>	<b>%</b>
yes	97	97
no	3	3
<b>Are you completely vaccinated against HBV?</b>		
yes	87	87
no	13	13
<b>When were you vaccinated against HBV?</b>		
a year ago	9	9
between five and ten years	51	51
more than ten years ago	37	37
I am not vaccinated	3	3
<b>Were you tested for BBD during employment?</b>		
yes	41	41
no	45	45
I do not remember	14	14
<b>Do you have HBV infection?</b>		
yes	0	0
no	100	100
<b>Total</b>	<b>100</b>	<b>100</b>

**Table 3.** Examinee structure by anti HBs antibodies values

<b>Anti HBsAt</b>	<b>min</b>		<b>max</b>	$\bar{x}$	<b>SD</b>
	3–10 (7)	11–500 (63)	$\geq 500$ (30)	247.94	199.704

Paper accepted



**Table 4.** Examinee structure according to the degree of exposure to HBV infection and number of workplace incidents

<b>Exposure to infection risk</b>	<b>N</b>	<b>%</b>
yes	77	77
no	4	4
periodically	19	19
<b>Contact with biological material</b>		
yes	90	90
no	10	10
<b>Needle prick</b>		
yes	36	36
no	64	64
<b>Injury by a sharp object</b>		
yes	34	34
no	66	66
<b>Contact with blood through the skin</b>		
yes	53	53
no	47	47
<b>Contact with blood through the mucous membranes</b>		
yes	23	23
no	77	77
<b>Total</b>	100	100

**Table 5.** Review of mean values for the number of workplace incidents

<b>Number</b>	<b>N</b>	<b><math>\bar{x}</math></b>	<b>M</b>	<b>min</b>	<b>max</b>	<b>SD</b>
<b>Needle prick</b>	36	3.78	2.50	1	20	3.78
<b>Injury by a sharp object</b>	34	5.21	5.00	1	20	4.48
<b>Exposure through the skin</b>	53	7.34	4.00	1	110	14.94
<b>Exposure through the mucous membrane</b>	23	4.91	3.00	1	20	4.69

Paper accepted

**Table 6.** Examinee structure according to the use of protection measures in the workplace

<b>In working with patients use protection measures</b>	<b>N</b>	<b>%</b>
yes	89	89
no	11	11
<b>Use of gloves</b>		
almost never	4	4
seldom	5	5
always	88	88
only when I know that a patient has an infectious disease	3	3
<b>Use of a mask</b>		
almost never	8	8
seldom	21	21
always	60	60
only when I know that a patient has an infectious disease	11	11
<b>Use of safety glasses</b>		
almost never	52	52
seldom	15	15
always	24	24
only when I know that a patient has an infectious disease	9	9
<b>Protection of workers from HBV in your institution is enforced</b>		
continuously	87	87
sporadically	11	11
I am not informed	2	2
<b>Total</b>	<b>100</b>	<b>100</b>

**Table 7.** Examinee structure according to the degree of familiarity with the procedures that affect the protection in the workplace and PEP measures

<b>Existence of instructions for the protection of employees in the workplace</b>	<b>N</b>	<b>%</b>
yes	91	91
no	2	2
I am not sure	7	7
<b>Reporting incidents as adverse events</b>		
yes	22	22
no	29	29
I am not sure	19	19
<b>Knowledge of the term PEP</b>		
yes	92	92
no	3	3
I am not sure	5	5
<b>Knowledge of post exposure procedures</b>		
yes	86	86
no	8	8
I am not sure	6	6
<b>Knowledge of post-exposure help services</b>		
yes	92	92
no	4	4
I am not sure	4	4
<b>Disposal of infectious waste in accordance with the rules of the profession</b>		
yes, always	97	97
no, never	2	2
from time to time	1	1
<b>Total</b>	<b>100</b>	<b>100</b>

**Table 8.** Significant correlations of the examined variables

<b>Variable</b>	<b>Variable</b>	<b><math>\rho</math></b>	<b>p</b>
<b>Age</b>	employment testing	0.206	0.039
	number of interventions	-0.224	0.025
	knowledge of the term PEP	-0.303	0.002
	time since vaccination	0.243	0.015
<b>Gender</b>	employment testing	0.211	0.035
	vaccination completeness	-0.246	0.014
<b>BMI</b>	knowledge of the term PEP	-0.271	0.006
	anti HBs antibodies	-0.206	0.040
<b>Branch of medicine</b>	exposure to the risk of infection	0.208	0.037
	performing interventions	0.245	0.014
	spraying blood into the eye or other mucosa	0.243	0.015
	reporting incidents as adverse events	0.349	0.003
	disposal of infectious waste according to the rules of the profession	0.287	0.004
	testing for BBD	-0.385	0.000
<b>Occupation</b>	shift work	0.288	0.004
	performing interventions	-0.253	0.011
	number of interventions at 24h	0.433	0.000
	use of protective equipment	-0.364	0.000
<b>Workplace</b>	testing for BBD	-0.239	0.016
	exposure risk from BBD	-0.230	0.022
	disposal of infectious waste according to the rules of the profession	-0.203	0.43
	anti HBs antibodies	0.242	0.015
<b>Years of service</b>	knowledge of BBD	0.232	0.020
	employment testing	0.216	0.031
	number of incidents	-0.237	0.018
	knowledge of the term PEP	0.235	0.019
	time since vaccination	0.321	0.001