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OCCUPATIONAL EXPOSURE TO BLOOD AND BIOLOGICAL FLUIDS IN HEALTHCARE WORKERS IN HOSPITAL CARE AND STATUS OF PRE- AND POST-EXPOSURE PREVENTION

DISSERTATION SUMMARY

for acquiring a PhD degree

in the field of higher education: 7. "Health and Sports";
professional field: 7.1. "Medicine";
doctoral program: "Hygiene"

Supervisor:

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SOFIA, 2022 г.

The dissertation work is presented on 176 standard pages and illustrated with 51 figures and 27 tables. The bibliography includes 300 literary sources, of which 21 are in Cyrillic. There are 8 publications related to the dissertation work.

CONTENTS

ABBREVIATIONS USED

NSSI needlestick and sharps injuries

HBV hepatitis B virus

HCV hepatitis C virus

HIV human immunodeficiency viruses

WHO World Health Organization

OSH occupational safety and health

Ab antibodies

DCC diagnostic-consultative center

HCWs healthcare workers

HBIG hepatitis B immunoglobulin

HBs Ag surface antigen of hepatitis B virus

I. INTRODUCTION

The health and social care sector is one of the largest in Europe, employing around 10% of EU workers. Ensuring healthy and safe working conditions for health workers is fundamental to the good functioning and sustainability of health systems. Due to the presence of biological, chemical, physical, ergonomic and psychosocial hazards, the health sector is considered one of the most dangerous. In the spectrum of health care risks, an important place is occupied by sharps injuries (NSSI), in which exposure to blood and biological fluids is possible, leading to the risk of infection with blood-borne pathogens. Infectious diseases from blood-borne pathogens and accidental exposure are identified as emerging, potentially increasing risks. The significance of the risk is related to the high frequency of injuries - at least 16 billion injections are given worldwide each year and about 3 million healthcare workers have percutaneous exposure to blood-borne pathogens - 2 million to HBV, 0.9 million to HCV and 170,000 to HIV. According to WHO estimates, occupational exposures are responsible for about 40% of HBV and HCV infections and 4.5% of HIV infections in healthcare workers worldwide. According to the European OSH agency EU-OSHA, there are around 1 million sharps injuries in Europe every year, many of which go unreported. To limit the risk of injuries to healthcare workers, in 2010 the European Union adopted Directive 2010/32/EU, which introduced a framework agreement for the prevention of sharps injuries and the reduction of blood-borne infections among healthcare workers. The directive has been transposed into our national legislation with Ordinance No. 3 of the Ministry of Health /2013, which establishes a medical standard for the prevention and control of nosocomial infections.

The data available in our country on injuries with sharp objects and exposure to blood and biological fluids and on the immunization status of healthcare workers show wide variations. The European Risk Observatory recommends at European level the harmonization of monitoring systems with regard to data collection and national surveillance of the types of incidents and circumstances of blood-borne infections. In this connection, the present study was conducted.

II. AIM AND OBJECTIVES

AIM

The aim is to evaluate the frequency of occupational exposure to blood and biological fluids among healthcare workers in hospital care in the city of Sofia, to characterize pre- and post-exposure prophylaxis among workers, their perception of the risk of infection with blood-borne pathogens, as well as to evaluate the practical implementation of Directive 2010/32/EU, transposed in our country by Ordinance No. 3 of the Ministry of Health /2013.

OBJECTIVES

1. Assessment of frequency and characteristics of occupational exposure to blood and biological fluids in main occupational groups in hospital care
2. Characteristics of incidents by type and reasons
3. Characteristics of the workers' immunization status
4. Assessment of post-exposure prophylaxis
5. Characterization of hospital workers' perception of the risk of infection from blood exposure and their assessment of the state of infection prevention in the hospital
6. Assessment of the risk of NSSI in relation to characteristics of the work organization and the functional status of the workers
7. Development of recommendations to improve the implementation of the legislation for the prevention of infections with blood-borne pathogens.

III. CONTINGENT AND METHODS

III.1. Contingent

The study covered a contingent of 2,744 healthcare workers from 19 hospitals in the city of Sofia. Health workers were mostly women (87.3%) with an average age of 48.08 ± 11.9 years, as follows: 763 doctors, 1427 nurses, 208 laboratory technicians, 176 midwives, 77 rehabilitators, 93 orderlies. The average working experience of the examined persons is 24.8±12.6 years.

III. 2. Methods

2. 1. A standardized blood exposure self-assessment questionnaire "Exposure of hospital personnel to blood and blood-borne infections" was adapted, which is used in studies around the world, incl. in the Southeast European region. It includes 18 questions about the presence of a blood/body fluid exposure incident for the work experience and the previous year, the number, type, circumstances and reasons for the incidents, the extent of their reporting and reasons for under-reporting. Questions about the immunization status of healthcare workers against hepatitis B (complete or incomplete vaccination, Ab titer tested and for what period), post-exposure prophylaxis, perception of the risk of infection with blood-borne pathogens, assessment of the state of safety and prevention of workplace infections are included. Questions about the presence of contamination of healthcare workers after an incident are included too. Detailed information about the last incident experienced is contained in 9 questions and it is about its type and the circumstances in which it occurred, the main reason, whether it was reported and to which official it was reported, and for what reasons it was not reported. Post-exposure prophylaxis is covered by questions about advice received on safety procedures, offering a blood test and/or other preventive procedure. It contains a question about the infectious status of the source patient (known or not). Health workers' perception of the risk of infection with blood-borne pathogens (HBV, HCV, HIV) in the case of a blood contact incident is included in a separate question with the possibility of indicating an approximate percentage of the probability of infection. Information about the workers' subjective assessment of the state of safety and infection prevention in their hospital is based on its assessment as adequate, excellent, inadequate or bad, as well as for a response for lack of opinion on the matter.

2. 2. In 2018, a transversal study and assessment of occupational exposure to blood and biological fluids among hospital healthcare workers was conducted. The questionnaire "Exposure of hospital personnel to blood and blood-borne infections" was completed anonymously, along with a questionnaire about characteristics of work and organization of shift regimes, stress, fatigue and subjective assessment of health status. The workplace and work organization questionnaire includes information on previous and current work schedules: shift work, night shifts, length of shifts, number of night shifts per month. Questions about overtime, second job and hours worked per week are included: 21 – 40 hours, 41 – 50 hours, 51 – 60 hours and > 61 hours / week.

Stressors and resources are assessed with a 30-question questionnaire based on the short version of the German Job Stress Analysis Questionnaire (Keller M et al, 2010). Participants answered how often they felt emotionally and physically exhausted during the past 4 weeks on a five-point scale included in the Danish SHORT COPSOQ II questionnaire. Questions to assess sleep quality and fatigue are included in the Karolinska Institutet Sleep Quality Questionnaire (KSS), a calculated sleep quality index (SQI), and a survey on the presence and degree of fatigue at the end of the workday and after work (9 questions about the physical and mental state of workers).

2. 3. Statistical processing

Data were entered and processed with the IBM SPSS Statistics 15.0 statistical package. ANOVA, $\chi 2$-test, regression and correlation analysis, odds ratio (OR) were used. The main factors influencing the frequency of incidents were determined with an accepted level of significance $p<0.05$.

IV. RESULTS

IV.1. Estimation of the frequency of occupational exposure to blood and body fluids

63.2% of the surveyed healthcare workers stated that there was an incident of contact with blood/biological fluids during their work experience. The largest share of them are those who have had an incident several times (Fig. 1).

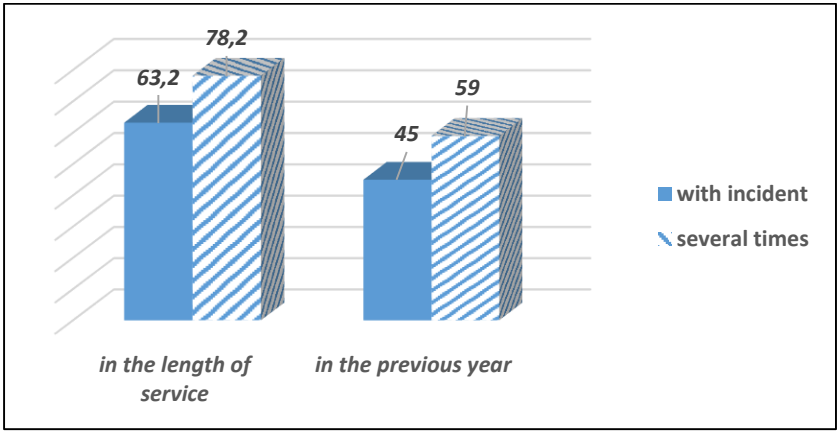

Fig. 1. Frequency of incidents of contact with blood and/or biological materials in hospital healthcare workers (%)

Incident rates are highest in emergency hospitals, followed by university and specialized hospitals with similar rates. In all types of hospitals, more than 50% of respondents had an incident during their working experience. The usual workplaces with the highest frequency of incidents – over 70% – are delivery rooms, surgical wards and emergency rooms.

The proportions of health workers with an incident do not show significant differences in the age decades up to 70 years and have close values of almost 60%. The dependence of the frequency of incidents on the usual workplace and the education of the examined workers is significant. Higher education and work in delivery rooms, surgical wards and emergency care (due to the nature of the work) were reliably associated with a higher frequency of incidents of contact with blood/biological materials (Table 1).

Table 1. Factors affecting Incident frequency

Predictors	Dependent-frequency of incidents		
	ß	t	p
Usual workplace	0.070	3.547	0.000
	r^2= 0.5% F=12.580 p= 0.000		
Education	- 0.054	- 2.720	0.007
	r^2=0.3% F=7.397 p=0.007		

IV.2. Characteristics of blood/biological fluid exposure incidents by type and reason

Characteristics of incidents by type

The most common incident is needle stick, followed by contact of biological material with the skin or mucous membranes, cut with glass, scalpel or other object, patient bite (Fig. 2). Respondents were given the opportunity to indicate more than one answer.

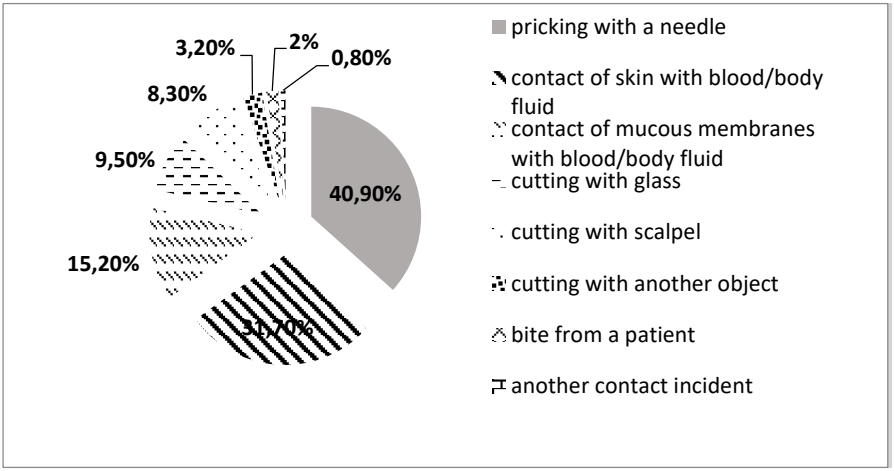

Fig. 2. Types of incidents – frequency (%)

Incidents occurred during all professional activities, with the highest frequency before a medical procedure (30%), followed by injection (21.9%) and blood collection (21.6%). Disposing of the object and cleaning incidents have a total share of 21%, which is equal to those of specific medical activities (giving an injection, surgical procedure). Recapping a needle resulted in 14.7% of incidents.

Reasons of incidents

The reasons given in the last incident were mainly time pressure when performing the activity (38.9%), unexpected reaction of the patient (33.7%) and carelessness of the person performing the manipulation (24.4%) or a helping colleague (7.7%). Worker fatigue is a causal factor in 10.6% of incidents. In all types of incidents, the three main causes are present with varying proportions.

IV.3. Frequency and reasons of incidents in the health workers professional groups. Reporting

Midwives have the highest frequency of incidents (83.8%). Nurses had a higher incident rate than physicians (67.9 vs. 62%). Workers with low education (secondary), who are mainly orderlies, have a lower frequency of accidents (Fig.3). The differences are significant (χ^2 =140.74, p=0.000).

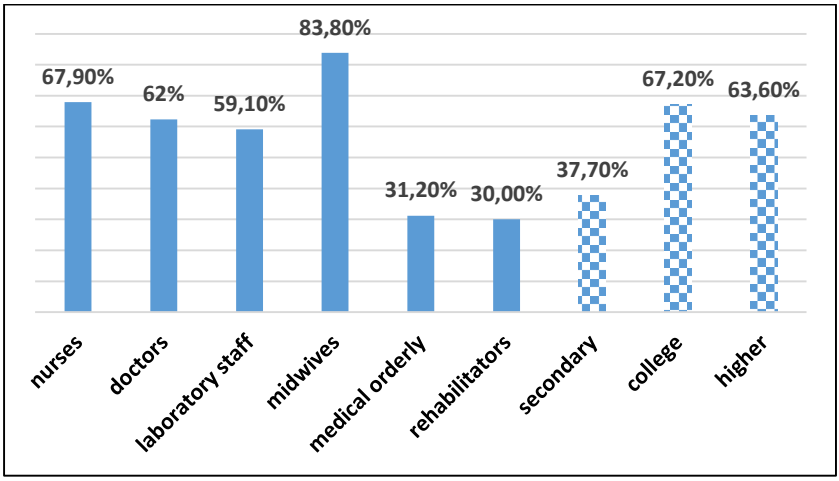

Fig.3. Position and education of workers and presence of incident

The largest studied group of health workers - nurses, are affected by incidents to varying degrees, the highest frequency is among nurses in surgical wards and in emergency/intensive care units (over 70%). Among doctors, with the greatest frequency are the incidents among surgeons, obstetricians and gynecologists, urologists (over 80%) and anesthesiologists (74%), lower frequencies among neurologists and internists - about 40%.

Differences were found in the frequency of the types of incidents in the occupational groups: needle stick was the most common recent incident in nurses (60.9%), laboratory staff (53.5%), midwives (50.4%) and second frequency in doctors and orderlies. For doctors, rehabilitators and orderlies, skin contact with blood or body fluid is most common (48.9%, 78.9%, 36.8%, respectively). This type of incident is the second most frequent among the occupations with the most common hollow needle punctures. For orderlies, the third most frequent incident is glass cutting.

Table 2. Reasons for the last incident by position (%)

Position	Reason of last accident			
	Time pressure	Fatigue	Carelessness (mainly own)	Unforeseen patient response
Doctors	33	11.4	37.8	31.2
Nurses	43.3	10.9	31.1	35.5
Laboratory staff	28.6	12	24.2	42.8
Rehabilitators	21	10.5	21.1	47.4
Orderlies	14.3	9	28.6	
Midwives	44	6.8	26.3	28.8

The most common reason for an incident among health workers, "time pressure", is the main reason for nurses and midwives (Table 2). For the orderlies, their own carelessness is the leading cause of incidents. Among doctors, it is also a leading factor, and the inattention of a colleague has a 10.7% share. Unanticipated patient reactions cause the majority of incidents

for laboratory personnel and rehabilitators. In positions with another leading cause of an incident, time pressure is the second most frequent reason.

Incident reporting

32.5% of health workers reported always in case of an incident. A large part of the workers did not report an incident (46.5%), and the main reason given by the respondents was that the incident/patient did not seem risky (Fig. 4). 17.2% are respondents who do not know that incident reporting is required.

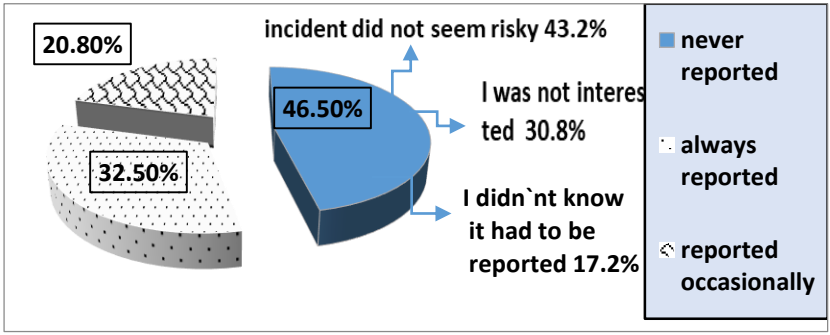

Fig.4. Incident reporting and main reasons for under-reporting in the last incident

It was mainly reported to the head nurse (30.8%) and to the head of the ward (7.1%). Only 2.1% reported to the hospital's infection control authority. In the emergency hospital, the highest proportion of workers who did not report the last incident was found (61.4%); none reported to hospital infection control. The relatively highest rate of reporting to the control body is observed in private hospitals. Healthcare workers who did not report had the relatively lowest proportion in university hospitals, but it nevertheless approached 50%. Differences between hospitals in reporting the last incident were significant ($\chi^2 = 27.106$, $p=0.04$). The usual workplaces in which the proportion of underreporters was the highest (over 60%) were imaging and emergency care, significant differences ($\chi^2 = 58.934$, $p=0.009$).

In occupational groups, those who did not report incidents in the length of service have the highest share among doctors and orderlies, followed by midwives, nurses and rehabilitators, the differences are significant ($\chi^2 = 48.168$, $p=0.001$) (fig. 5).

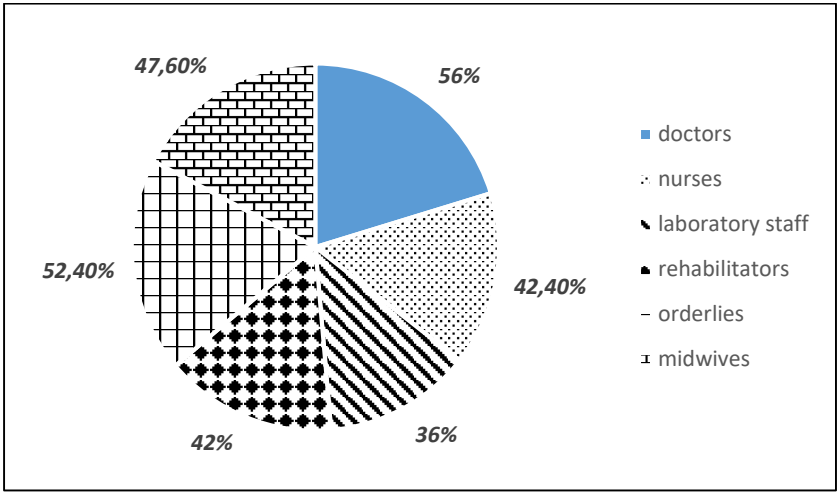

Fig.5. Share of under-reporting incidents by occupational group (%)

Among the main reasons for under-reporting shown in Fig.4, the respondents also answered not knowing who to report to (5.7%), not knowing that there are procedures that can reduce the risk of infection after the incident (2.3%) as well as for not knowing the risk of infections (1.6%). The share of healthcare workers reporting the last incident is highest among those aged 31-40 and decreases in the following age decades (Fig.6)

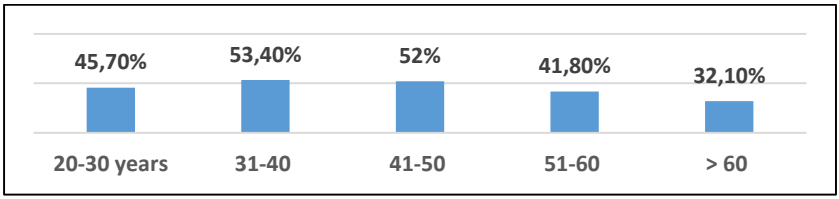

Fig. 6. Last incident reported by age

IV.4. Characteristic of the immunization status of the examined healthcare workers

A large proportion of healthcare workers (41.6%) were not vaccinated against hepatitis B. 47.2% received 3 doses of vaccine, but only 25.2% had immunity confirmed (Fig. 7).

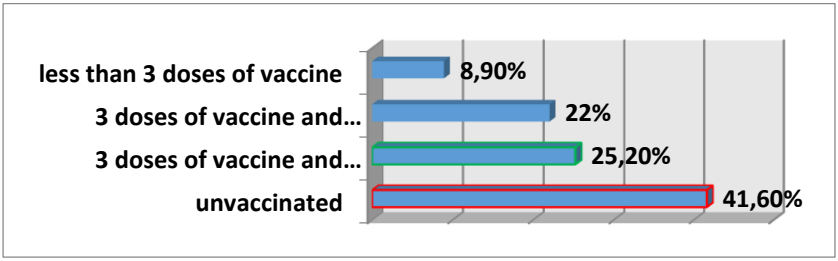

Fig. 7. Vaccination against hepatitis B among the examined health workers 56.7% of the respondents declared that they had never been tested for the antibody titer against the hepatitis B virus. In those who received 3 doses of vaccine with a proven Ab titer, this confirmation was immediately after vaccination for 36%, after more than 3 months for 29%, several times examined Ab in the length of service have 34% of them. Significant differences were found in the immunization status of healthcare workers from different types of hospitals. In emergency care, there is the lowest share of correctly vaccinated (15.3%), the highest share of workers with unconfirmed immunity after 3 doses of vaccinations, it is among the leaders in the share of unvaccinated (45.6%). The correctly vaccinated have the largest share in private hospitals (33.8%). Tracking the vaccination status according to the age of the health workers, an increasing share of the unvaccinated with each subsequent age decade and a decreasing share of the vaccinated according to the established rules (fig. 8), with the differences being statistically significant.

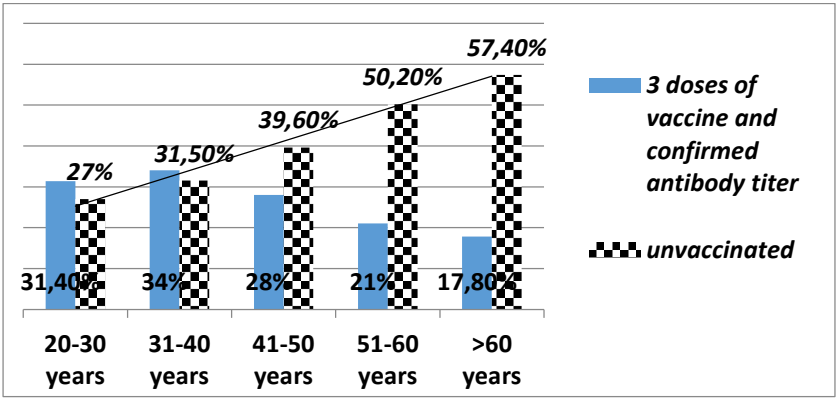

Fig. 8. Age and hepatitis B vaccination

Table 3. Vaccination status in occupational groups (%)

Position	3 doses and confirmed Ab titer	3 doses without confirmed Ab titer	under 3 doses	Unvaccinated
Doctors	35.6	27.5	9.9	26.8
Nurses	25	22.2	9	43.5
Laboratory staff	21.3	11.8	10	56.8
Rehabilitators	2.9	7.3	8.8	80.9
Orderlies	10.6	9	10.6	69.7
Midviwes	15.7	23.5	8.5	52.3

In the professional group of doctors, the share of the unvaccinated is the smallest (26.8%), and the correctly vaccinated - the largest (35.6%), and they are the only professional group in which those immunized with 3 doses and a proven Ab titer are more than the unvaccinated. According to the usual place of work of the respondents, only in surgical departments the share of the correctly vaccinated exceeds that of the unvaccinated and is comparatively the highest (37.6%). The next largest share of properly vaccinated workers are established in intensive care units. In physiotherapy departments, imaging diagnostics, in maternity wards and DCC, the non-vaccinated significantly predominate (table 4).

Table 4. Usual workplace and vaccinations

Usual workplace	Unvaccinated (%)	Complete vaccination and tested Ab titer (%)
Surgical department	27	37.6
Intensive care	35.6	29.8
Emergency	38.5	26.7
Ward	41.5	24.7
Reception department	41	24.3

Laboratory	48	21.6
Imaging diagnostics	61	17
Maternity ward	51.8	14.3
DCC	51.3	8
Physiotherapy	86	0

The wards with the highest share of non-vaccinated are orthopedic and neurological (57 and 51%), and sterilization and hemodialysis wards lead in terms of the share of correctly vaccinated workers (57.1 and 57.7%).

In blood incidents with patients not known to be infected and those of unknown status, unvaccinated HCWs were about 2 times more likely than vaccinated HCWs. In incidents with unknown blood, the proportion of unvaccinated people is the highest.

Regression analysis shows dependence of coverage of hepatitis B vaccination on the type of hospital, age, position and usual work place. Incident reporting was negatively related to vaccination coverage, workers unvaccinated and with non-observed vaccination procedure reporting less.

IV. 5. Assessment of post-exposure prophylaxis

At the time of the last incident of blood contact, the infectious status of the source patient was unknown in 25.6% of incidents. In 12.3% of recent incidents, healthcare workers did not know they were serving infected individuals. Infected blood-borne pathogen(s) was the source patient's blood in 8% of recent incidents (n=84), the most cases with HBV- 43, followed by HCV – 27. Therefore, infected or potentially at risk of infection is blood in 45.9% of recent incidents. In the largest proportion (52.5%) the source patients were not contagious in the last incident. After the last reported incident, 14.8% of respondents did not receive advice on safety procedures, and 11.4% were advised by someone other than professionally competent. Workers received advice mainly from the head nurse (45.7%), the infection control authority advised workers in the event of an accident in only 13.5% of cases. Involvement of the infection control authority as a consultant to incident reporters differs across hospital types, being most pronounced in private hospitals and weakest in acute care hospitals. After the last incident,

a small part of health workers (27%) was offered a preventive procedure, and for 12.8% it was vaccination against hepatitis B (Fig.9).

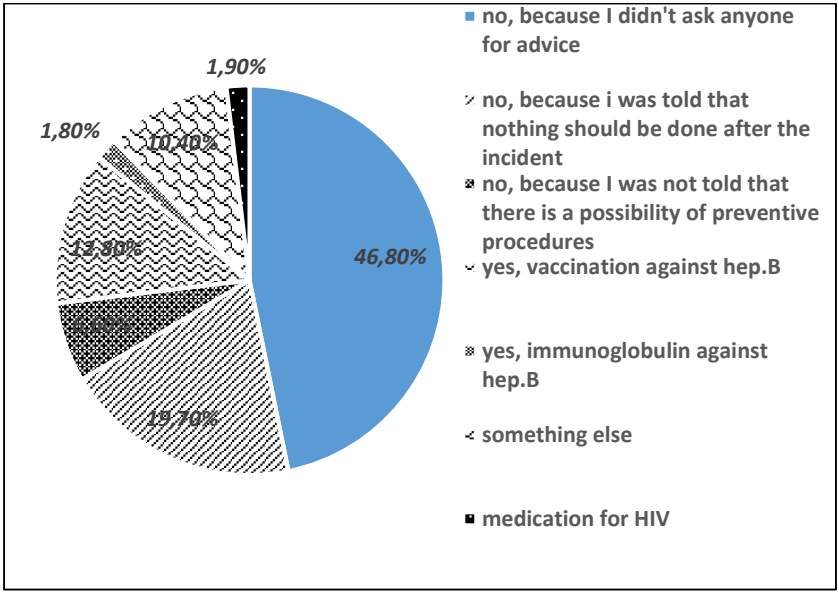

Fig. 9. Suggested preventive procedures after the last incident

Differences between hospitals in offering a preventive procedure show statistical significance (χ^2 = 75.017, p=0.008).

After the last incident, 51.5% of workers were not offered a blood test for bloodborne pathogens. Emergency hospitals lead in the proportion of healthcare workers not offered a post-incident blood test (64.8%). Differences between hospitals were significant (χ^2 = 55.06, p=0.022).

After incident, 83.3% of the workers did not have an infection, 28 persons declared an existing infection with hepatitis B, and 9 - with hepatitis C. 14.3% did not know if they had an infection. Among midwives, the proportion of people infected with hepatitis B is the highest, followed by nurses and laboratory workers.

IV.6. Hospital health workers' risk perception of infection from exposure to infected blood and subjective assessment of the state of safety and infection prevention in the hospital

Health care workers predominant estimate the probability of acquiring blood-borne pathogens from the blood of an infected patient after a needle stick incident to be high (50-99%) at equal risk for HBV and HCV (Fig. 10). The 100% probability of infection was reported by the highest proportion of healthcare workers for HIV (15%), and the lowest for HBV infection (10.4%). Those who answered that there was no risk of infection with blood-borne pathogens had the highest share regarding HBV (9.7%).

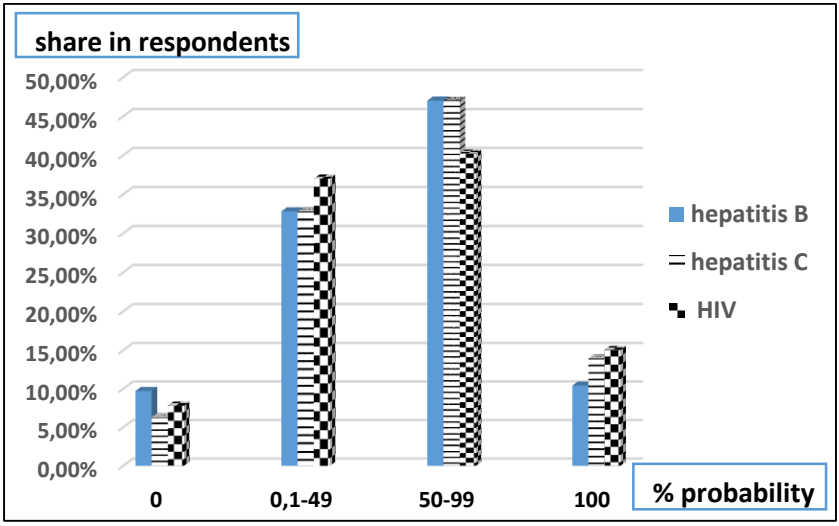

Fig. 10. Estimating the probability of acquiring HBV, HCV or HIV from the blood of an infected patient after a needle stick incident

Emergency workers most often rated the likelihood of infection with blood-borne pathogens by incident as high, with significant differences between hospitals.

The majority of hospital workers assess the state of safety and infection prevention at work as adequate (62.5%), and as bad or inadequate – 16.7%. Those who cannot judge are 7.4% of the respondents. There were significant differences between the types of hospitals regarding workers' assessment of the state of safety and infection prevention (χ^2=118.882, p=0.000).

In the emergency hospitals, the largest share of workers assess the state as bad (23.5% - a difference of 15.3 - 20 percentage points from other hospitals) and the smallest - as adequate and excellent. Emergency workers who cannot

judge have the second highest share after city hospitals. Those working in private hospitals give the highest proportion of assessment for adequate and excellent condition and the least for ignorance on the matter, as well as the lowest proportion of assessment for poor and inadequate condition.

The regression analysis (Table 5) establishes a dependence of the employees' opinion on the state of safety and prevention of infections by the type of hospital, with the largest share of those who gave a poor assessment in emergency care. The dependence of the assessment on the age of the workers is significant, the youngest show the highest share of bad assessment. The rating is dependent on usual workplace and education, with the highest proportions of poor rating for usual jobs in emergency and admissions departments.

Table 5. Dependence of subjective assessment on safety status and infection prevention

Dependent	Predictors			
Opinion on the state of safety and infection prevention	Type of hospital	Age	Education	Usual workplace
	ß=0.069 t=3.072 p=0.002	ß=0.071 t=3.136 p=0.002	ß=-0.057 t=-2.503 p=0.012	ß=0.057 t=2.507 p=0.012
R^2=1.9% F=9.853 p=0.000				

IV.7. Assessment of the risk of NSSI in relation to the characteristics of the work organization and the functional state of the workers

1. Characteristics of work activity

The frequency of incidents in the previous year shows significant differences in relation to characteristics of work activity. With high work pressure, lack of influence on its organization, lack of safety from outsiders and patients, the frequency of incidents is higher. A correlation was established with the frequency of incidents in the previous year of high work pressure (r= .097**), the inability to influence its organization (r= -.081**), the lack of safety from outsiders and patients (r= -.084**). * p<0.05 ** p<0.01

Table 6. Regression dependences of incident frequency on work characteristics

Predictors	Dependent Frequency of incidents in the previous year
High work pressure	β= 0.086 t=3.018 p=0.003
Emotional load from patients	β= - 0.059 t= - 2.068 p=0.039
Influence on work organization	β= - 0.058 t= - 2.058 p=0.040
Even distribution of work	NS
Safety from outsiders, patients	β= - 0.086 t= - 3.019 p=0.003
* R^2 =2.3%; F =7.333; p=0.000	

2. Organization of working hours

The frequency of incidents in the previous year shows significant differences in relation to the way working hours are organized. A higher frequency of incidents in the previous year was found for those working on rotating and 12-hour shifts, those who often work overtime (after working hours), those with more than 5 night shifts per month. Correlational dependences of the frequency of incidents in the previous year with the regime of rotating shifts (r= .127**), excessive working hours per week (r= .060*), increased number of night shifts per month (r= .148**) are established. p<0.05** p<0.01

The results of a stepwise regression analysis show a relationship between the frequency of incidents in the previous year and the higher number of night shifts per month (Table 7).

Table 7. Regression dependences of incident frequency on work organization factors

Dependent	Predictor Number of night shifts per month
frequency of incidents in the previous year	β= 0.133 t= 4.701 p=0.000 * R^2 =1.8%; F =22.1; p= 0.000

3. Fatigue

Significant are the established differences in the frequency of incidents in the previous year in connection with the presence of symptoms of fatigue among workers. The frequency of incidents in the previous year is correlated with fatigue among workers: physically exhausted (r= .103**), morning fatigue (r= -.061*), frequent presence of fatigue (r= .072**). * p<0.05 ** p<0.01

The regression analysis establishes a dependence of the frequency of incidents on the state of fatigue (Table 8).

Table 8. Regression relations between incident frequency in the previous year and fatigue

Dependent	Predictor
frequency of incidents in the previous year	Physical exhaustion after work β= 0.094 t= 3.281 p=0.001 I usually rest on the second day β= - 0.069 t= -2.368 p=0.018
	* R^2=1.3% F=8.207 p=0.000

Analysis of the risk of having an incident in the previous year showed a significantly increased risk in the presence of high work pressure (OR=1.903 (1.216-2.979, 95% confidence interval, p=0.005).

V. DISCUSSION

Data from our study show a high frequency of contact incidents with blood and/or biological materials among hospital healthcare workers. Of the 2,744 persons surveyed, 63.2% had an incident during their work experience, and 45% in the previous year, multiple accidents prevail. In all hospitals, more than 50% of respondents declared an incident, with a significantly higher frequency in emergency hospitals - 73.4%. In the literature, a wide range of health care workers who have had NSSI has been found - from 14.9% to 69.4% (1), and modern meta-analyses find a high global prevalence of NSSI in health workers - 56.2% during the work experience and 44.5 % in the previous 12 months (2,3).

Our data are consistent with the literature on the uneven prevalence of NSSI among healthcare workers (4), finding the highest frequency (83.3%) of incidents in midwives. Next are nurses with 67.9%, doctors-62%, laboratory staff-59.1%, orderlies-31.2%, rehabilitators-30%, and the differences are significant. For nurses, the incidence was highest in surgical wards at 75.8% and in emergency/intensive care at 71.6%. Among doctors, surgeons, obstetricians and gynecologists, urologists - more than 80%, and anesthesiologists - 74% have the highest incidence of accidents. The results confirm the established significantly higher risk of injury in surgeons and surgical nurses (5,6) and the high incidence in nurses (7,8,9,10).

In our results, the frequency of incidents is significantly dependent on the usual workplace. It is the highest in maternity wards - 84.2%, followed by jobs in surgical departments and emergency care (over 70%). The frequency is lower in reception departments, DCC, physiotherapy and imaging departments. Literature data also show a higher incidence of incidents in surgery and emergency care workers than in outpatient units (10).

The age of the workers in this study was not a determinant of incident rates. Workers who had an incident show close proportions of almost 60% in all decades up to 70 years of age.

Needles are a major identified cause of injury among nurses by many authors (1,7,10). This is also confirmed in our study. The most frequent is percutaneous exposure, mainly from a puncture with a hollow needle, followed by skin contact with blood and body fluid - 31.7%, cuts with a scalpel,

glass or other object - 21%, bites 2%. We found a high risk in cleaning and disposal activities - a frequency of 21%, which was also identified in other studies (11). The main reason (38.9%) for the occurrence of the last incident, according to the respondents, was time pressure. Doctors and paramedics cited inattention as the most common cause, while for laboratory technicians and rehabilitators, an incident caused mainly an unanticipated patient reaction. These are the reasons established by other authors as well (12,13). Fatigue as a causal factor has a share of 10.6% and ranks fourth.

The problem of underreporting of incidents persists(8,9,10), as our study also found. During the work experience, only 32.5% always reported, 21% reported sometimes, 46.5% never reported an incident with the most common reason being that the patient or incident did not seem risky, also due to reluctance to report (30.8%) or not knowing that this is mandatory (17.2%). A very small percentage (2%) of HCWs reported the latest incident to the hospital's infection control authority, and in the emergency department it was not reported at all. Insufficient activity of the infection control body in hospitals was established by another study in our country (14). Reporting workers had the lowest proportion by recent incidents with unknown patient infection status (25.6%) and this suggests an underestimation of risk.

Post-exposure prophylaxis is unsatisfactory – 51.5% of workers were not offered a blood test after the last incident, vaccination was offered to 12.8% and HBIG to <2%. In incidents with blood from an unknown patient, a blood test was offered to a very small proportion of workers (33.6%) and this speaks of an underestimation of the danger from a source with an unknown infectious status, which should be considered as potentially infected by the rules. In 84% of incidents involving unknown blood, no preventive procedure was offered. Workers without proven immunity after a reported last incident were offered vaccination to 8%, HBIG to 1.4%, +HBIG vaccine to 0.6%. In this group, patient status was unknown in 31% of incidents.

The studied hospital health workers generally did not correctly grade the risk of infection with HBV, HCV, HIV. Healthcare workers prevailing (but < 50%) estimate as high (50-99%) the risk of infection with blood-borne pathogens after a needle stick incident with equal risk for HBV and HCV. As zero (nonexistent) most persons assessed the risk of hepatitis B. 100% probability of infection was reported by the largest proportion of health workers for HIV,

and the smallest for HBV. This judgment of respondents is inconsistent with established data on the risk of infection after percutaneous trauma with a contaminated needle (1,15,16).

Our results for the pre-exposure prophylaxis of hospital healthcare workers (hepatitis B vaccine prophylaxis) show a low proportion of those vaccinated according to the established schedule with three doses of vaccine and subsequent confirmation of immunity (25.2%). In 65% of those serologically tested after 3 doses of vaccine, this was done at an incorrect time. The share of unvaccinated workers increases with age, only up to 40 years old are the vaccinated according to the rules more than the unvaccinated. In cases of contact with blood of unknown status, only 21% of workers have the correct vaccination. After an incident, only 8% of workers who were never tested for anti-HBs were offered hepatitis B vaccination. Emergency care has the most unfavorable characteristic - leading by a low share of correctly vaccinated (15%) and by a high share of those vaccinated with 3 doses without confirmed immunity, among the leading by share of unvaccinated.

Vaccination coverage by positions in our study shows that orderlies and rehabilitators have the highest unvaccinated share, while doctors have the lowest. In the usual workplaces, only in surgical departments are the correctly vaccinated more than the unvaccinated. In hemodialysis wards and in sterilization wards, which are considered high-risk for blood exposure, the correctly vaccinated have the highest share (almost 60%), which, however, also does not correspond to the optimal level.

Despite the identified gaps, the surveyed health workers mostly consider the state of safety and infection prevention in the hospital to be adequate (62.5%), while 16.7% consider it poor and inadequate. The workers who do not know and cannot give an opinion on the matter are 7.4%, mostly orderlies, laboratory workers, midwives. In emergency care, the largest share of respondents assessed the condition as bad (23.5% - a difference of 15.3 - 20 percentage points from other hospitals) and the smallest - as adequate and excellent; a high proportion have those who do not know how to characterize it. Among workers over 60 (n=400), ignorance is the most prevalent, and this speaks of insufficient awareness in this direction during their entire experience.

The usual workplaces with the most frequent assessment of poor condition are in reception wards and emergency care, in contrast to maternity wards, where the highest proportion is rated as adequate (80.7%) and the lowest as inadequate.

The results in our study confirm that adverse psychosocial factors influence incident rates. High work pressure, lack of influence on work organization, lack of safety from outsiders and patients correlate with the frequency of incidents in the previous year, and the risk of an incident is significantly increased in the presence of high work pressure (OR=1.903 (1.216-2.979, 95%CI, p=0.005).

The frequency of incidents in the previous year shows significant differences in relation to the way working hours are organized. The frequency of incidents in the previous year is higher in those who work rotating and 12-hour shifts, who frequently work overtime (after working hours), those with an increased number of night shifts per month, which other authors have also found (17,18). We also found significant differences in the frequency of incidents in the previous year in connection with the presence of fatigue among workers. The importance and necessity of improving the psychosocial environment and eliminating existing shortcomings and deficits in the practical application of the preventive procedures laid down in the regulations for the risk group of health workers is obvious. Our findings of low coverage with full vaccination, neglect of the potential danger of blood of unknown infectious status, high proportion of workers underreporting an incident, low coverage of post-exposure prophylaxis, inaccurate risk perception are indicators of inadequate knowledge of the investigated workers and an unsatisfactory level of safety and prevention of the risk of infection associated with exposure to blood and/or body fluids in an injury incident.

VI. CONCLUSIONS:

• A high frequency of incidents with injuries with sharp objects during the work experience and in the previous year was found among hospital health workers from 19 hospitals in the city of Sofia (respectively in 63.2 and 45% of the respondents), the most frequent incident was stabbing with needle, followed by contact of biological material with the skin or mucous membranes, cut by glass, scalpel or other object, bite by a patient.

• Midwives (83.8%), followed by nurses (67.9%) and doctors (62%) reported the highest frequency of incidents over the entire working experience. Nurses working in surgical wards and emergency/intensive care units reported incidents to the greatest extent (over 70%). Among doctors, with the highest frequency (over 80%) are the incidents with surgeons, obstetricians and gynecologists, urologists and anesthesiologists (74%).

• The main reason for the last incident was a time pressure when performing the relevant activity, followed by an unanticipated reaction of the patient, inattention and fatigue.

• A large proportion of healthcare workers (46.5%) did not report an incident with the main reason being that the incident/patient did not appear to be risky. Reporting was inversely regressed on age.

• For the examined healthcare workers, pre-exposure prophylaxis with hepatitis B vaccine does not have the necessary coverage - 41.6% of healthcare workers are not vaccinated. Only 25.2% of respondents had received three doses of vaccine with evidence of established immunity, with the highest proportion among doctors (35.6%), followed by nurses (25%), laboratory staff (21.3%), midwives (15.7%), orderlies (10.6%) and rehabilitators (2.9%).

• Post-exposure prophylaxis is also unsatisfactory – 51% of workers were not offered a blood test after the last incident, a small part of healthcare workers (27%) were offered a preventive procedure, and for 12.8% it was vaccination against hepatitis B and for <2% - HBIG.

• Healthcare workers have an inaccurate perception of the risk of infection in an incident with blood contaminated with any of the discussed pathogens. The probability of infection according to the respondents is high, but the risk

is the same for HBV and HCV, the infection is probably considered most often for HIV, a non-existent probability of infection is reported by the largest proportion of workers for HBV.

• An underestimation of the risk is found in blood incidents with unknown infectious status, which have a considerable share of 25.6%.

• The Hospital Infection Control Authority is under-involved – only 2.1% of recent incidents have been reported to it.

• In hospital emergency care, we find the highest proportions of workers who did not report an incident, those who, after reporting, were not advised on safety procedures and were not offered a blood test, the lowest participation of control infection authority.

• Unfavorable psychosocial factors related to the organization of work (shift mode, long working hours, increased number of night shifts per month), work characteristics (high pressure, emotional load, level of safety, influence on work organization) fatigue and stress of workers influence the frequency of NSSI.

• Our data on a high incidence of exposure to blood/body fluids in the hospital healthcare workers studied show serious gaps in all aspects of the application of Directive 2010/32 and Regulation No. 3 of the Ministry of Health / 2013.

VII. CONTRIBUTIONS

CONTRIBUTIONS OF A SCIENTIFIC - THEORETICAL CHARACTER

• In our country, for the first time, an assessment of NSSI was carried out in healthcare workers in hospital care, in parallel with an analysis of the causes of the injuries, perception of the risk of infection, influence of organizational characteristics of work and the functional state of the workers, pre- and post-exposure prophylaxis.

• An evaluation of the relationship between the NSSI and psychosocial factors - characteristics of work and work organization was carried out.

• The scope of measures for pre- and post-exposure prevention of infection with blood-borne pathogens among the professional groups of hospital health workers was evaluated.

CONTRIBUTIONS OF A SCIENTIFIC - APPLIED AND METHODICAL CHARACTER

• A questionnaire for self-assessment of exposure to blood/biological fluids and the prevention of infection with blood-borne pathogens in case of injury was adapted and implemented.

• A characterization and evaluation of the frequency of exposure to blood/biological fluids was carried out in the main professional groups of hospital health workers and depending on the type of hospital facility, workplace, patient status.

• Unsatisfactory incident reporting rates and coverage of pre- and post-exposure prophylaxis of infection with blood-borne pathogens were found.

• The health workers' perception of the risk of infection with HBV, HCV, HIV during occupational exposure to blood was characterized and evaluated.

• The application of Directive 2010/32/EU and Ordinance 3/2013 of the Ministry of Health was evaluated and the gaps established in practice in the prevention and control of blood exposures were characterized.

• Recommendations have been drawn up to eliminate gaps in the implementation of Directive 2010/32/EU and Ordinance 3/2013.

VIII. LIST OF PUBLICATIONS on the subject of the dissertation

• Irina Dimitrova-Toneva, Katya Vangelova. Occupational exposure to blood in hospital healthcare workers. Bulg. Journal of Public Health 2019; 2: 51-65.

• K. Vangelova, I. Dimitrova, I. Cekova, R. Stoyanova. The effect of work-related risk factors on health symptoms of hospital physicians. Ukrainian Journal of Occupational Health 2019; 15 (4): 281-288 (ISSN 2223-6757); DOI.org/10.33573/ujoh2019.04.

• Irina Dimitrova-Toneva, Katya Vangelova. Assessment of the practical application of Directive 2010/32/EU on the prevention of sharps injuries in healthcare. Medical Review 2019; LV /6/: 44-53.

• Vangelova K, Dimitrova-Toneva Ir. Biological hazards in the work environment. Health and Safety at Work 2019; 5: 6-26.

• Dimitrova-Toneva Ir. Characterization of immunization protection and post-exposure prophylaxis to blood-borne pathogens in hospital healthcare workers. Bulg. Journal of Public Health 2020, 12(1):3-20.

• Vangelova K, Dimitrova I, Cekova I, Stoyanova R. The effect of work-related risk factors on health symptoms of hospital nurses. Acta Medica Bulgarica 2021; 58 (1): 81-87. DOI: 10.2478/AMB-2021-0013

• Irina Dimitrova-Toneva. Back in focus: bloodborne pathogens - guidelines for hepatitis B immunization and post-exposure prophylaxis in healthcare workers. Health and Safety at Work 2021;7;38-53

• Irina Dimitrova-Toneva. Risk perception of hospital-based healthcare workers for infection with blood-borne pathogens and the prevention of infections. Bulgarian Journal of Public Health 2022;14(1);88-101

IX. PARTICIPATION IN SCIENTIFIC EVENTS in connection with the dissertation

1. Dimitrova-Toneva Ir, Vangelova K. Occupational exposure to blood in hospital health workers. First congress on occupational medicine and expertise of working capacity with an international conference on the EPSILON project. November 07-08, 2018, Sofia

2. K. Vangelova, I. Dimitrova, I. Cekova, R. Stoyanova. Work-Related Risk Factors In Hospital Physicians And Nurses In Sofia. 11th joint conference for occupational health in health workers, 22-24.11.2019, Hamburg, Germany

3. Irina Dimitrova-Toneva, Katya Vangelova. Sharp Injuries and Hospital Health Care Workers Exposure to Blood and Biological Fluids. 11th joint conference for occupational health in health workers, 22-24.11.2019, Hamburg, Germany

4. Ralitsa Stoyanova, Irina Cekova, Irina Dimitrova, Katya Vangelova. Impact of psychosocial working conditions on well-being of hospital nurses and midwives in Bulgaria. 6th International Conference on Wellbeing at Work: WELLBEING IN HECTIC TIMES ONLINE from 13 to 15 June 2022. https://www.waw2022.pl/

5. I. Cekova, I. Dimitrova, R. Stoyanova, K. Vangelova. The influence of night shift work and long working hours on sleep and fatigue in hospital healthcare workers in Bulgaria. 6th International Conference on Wellbeing at Work: WELLBEING IN HECTIC TIMES ONLINE from 13 to 15 June 2022. https://www.waw2022.pl/

X. LITERARY SOURCES

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