A SURVEY OF OCCUPATIONAL RISK EXPOSURES AND BEHAVIOUR OF HEALTHCARE WORKERS

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ABSTRACT
To reduce the risk of transmission of microorganisms standard precautions are taken for all patients expected to be exposed to blood, body fluids, or have contacts with mucous membranes and non-intact skin. These preventive measures are by far the best way to protect healthcare workers from adverse infections.

AIM: To analyze occupational risk exposure of healthcare workers occurring when the latter come into contact with blood or other potentially infectious liquid in order to assess some aspects of the application of standard preventive measures.

PATIENTS AND METHODS: 680 healthcare workers (186 physicians, 330 nurses, and 164 hospital orderlies) were included in an anonymous survey conducted at St George University Hospital, Plovdiv in 2009. The questionnaire consisted of 14 questions grouped in 3 clusters. Occupational risk exposure was defined as recommended by the Centers for Disease Control and Prevention (CDC). We used descriptive statistics, parametric and non-parametric analysis.

RESULTS: Occupational exposure was reported by 81% of the respondents for the last year with predominance of percutaneous injuries (62%). Nurses sustained the most risk exposures (86%). We found a correlation between the job category and the occupational exposure ($\chi^2 = 14.3, df = 2, \ p < 0.001$). No correlation was found between length of service and injury intensity ($\chi^2 = 1.69, df = 2, \ p > 0.05$). Immunisation against hepatitis virus B infection received 64.3 ± 3.8% of the healthcare personnel. Immunization covered 48.2% of the ancillary workers, which is less than the mean coverage for the respondents. Job position was found to correlate with the immunisation coverage ($\chi^2 = 24.41, df = 2, \ p < 0.001$). Ninety-two percent of the healthcare workers used personal protective equipment (disposable gloves), but only 74.6% of them did this during emergencies ($\ p < 0.001$).

CONCLUSION: Post-exposure follow-ups and the overall behaviour pattern after occupational risk exposure are random and non-systematic in nature. A better prevention of healthcare personnel would require a long-term training with constant knowledge upgrading, invasive procedures perfection and permanent control.

Keywords: healthcare worker, occupational risk exposures, immunization

INTRODUCTION
Patients with clinically manifested infection, and especially those with the unrecognized (atypical, asymptomatic) forms of these conditions are potentially a source of infection in healthcare facilities. There are a lot of pathogens that can be transmitted within hospitals.1 Needlestick injuries alone have been found to cause occupational exposure to more than 20 pathogens.1-3 These facts made it necessary to change the general principles and the recommendations for the prevention of healthcare workers. Between 1970 and 1996 the US Centers for Disease Control and Prevention (CDC) published six consecutive guidelines for prevention of infectious agents transmission in healthcare settings.4 The standard precautions introduced by CDC in 1996 apply to all patients that are expected to be exposed to blood, body fluids, mucous membranes and non-intact skin. They are applied to reduce the risk of microorganism transmission and remain one of the best ways health care workers can protect themselves against exposures.5 These preventive
measures are also included in the Medical Standard for Prevention and Control of Nosocomial Infections officially endorsed in Bulgaria in 2010.\textsuperscript{6} Aim: The aim of the present study was to analyze cases of occupational risk exposure to blood or other potentially infectious liquids among three categories of hospital personnel so that we can assess specific aspects of the standard precautions application.

**PATIENTS AND METHODS**

Six hundred and eighty subjects (hospital based personnel - 186 physicians, 330 nurses, 164 hospital orderlies) were recruited for the anonymous survey conducted at St George University Hospital, Plovdiv in 2009. The observation units were selected on a stochastic principle. The questionnaire we used consists of 14 questions arranged in three groups. The first group of questions concerns the length of service in a health setting and hepatitis B immunization. Questions as to whether respondents sustained an occupational exposure to biological substances while at work within one year are included in the second group. The third group includes questions related to the behaviour of healthcare workers in the event of an incident at work. By length of experience, the subjects were divided in 3 groups: group I – less than 5 years (n = 119), group II – 5-10 years (n = 103) and group III – more than 10 years (n = 458). By place of work they were allocated into 7 groups: clinics of surgery (424), clinics of obstetrics and gynecology (96), intensive care units (54), internal diseases clinics (34), burn treatment centres (32), hemodialysis centres (26) and toxicology departments (14). Occupational risk exposure was defined as recommended by CDC (2001): an exposure is a percutaneous injury (e.g., needlestick or other cut with a sharp object), or contact of mucous membrane or nonintact skin (e.g., chapped or abraded skin, skin dermatitis) with blood or certain other potentially infectious body fluids that take place at work.

**STATISTICS**

The data we obtained were analysed by analysis of frequency distribution: descriptive statistic, non-parametric analysis $\chi^2$ (Pearson chi-square test), Fisher’s exact test, and Student’s t-test. Level of significance was accepted at $p < 0.05$. Data were analysed using SPSS v 11. The graphic presentation of results was performed on Microsoft EXCEL v. 2007.

**RESULTS**

There is a very high number of personnel that reported occupational exposure for one year: 551 people out of 680 (81\%). Percutaneous injuries are predominant (62\%, 420/680), followed by skin exposure to blood (15\%, 104/680) (Fig. 1). The difference was significant as assessed by Student-Fisher criterion ($p < 0.05$).

The number of percutaneous injuries per doctor, nurse and hospital orderly for one year was 0.63 (118/186), 0.62 (206/330) and 0.6 (97/164), respectively.

Nurses were found to be the healthcare worker group that reports the most risk exposures (86\%, 284/330) (Table 1). We found a correlation between the job position (the nature of work done) and the occupational exposure ($\text{Pearson’s } \chi^2 = 14.3, \text{ df } = 2, p < 0.001$). The review we did of the relevant literature showed that there is a discussion of similar findings going on.\textsuperscript{2,7-9}

Of 551 respondents 242 (44\%) reported to have experienced one injury per year and 309 (56\%) – 2 and more than 2 injuries. In physicians and nurses those that reported two and more than two exposures were the most numerous (63\% and 60\%, respectively), while the injury reports by hospital orderlies were predominantly for a single injury (59\%). Higher relative percentage of subjects that suffered a single exposure has been reported by some researchers\textsuperscript{3,10} with physicians and particularly surgeons prominently having the most number of occupational exposures per year\textsuperscript{2,10,11}.

Healthcare workers with more than 10 years of professional experience were found to have the
highest relative percentage of occupational risk exposures (82.3%, 377/458), followed by the 5-10-year group (79.6%, 82/103) (Table 1). The non-parametric analysis showed no correlation between the length of service and frequency of injuries (Pearson’s \( \chi^2 = 1.69, \text{df} = 2, p > 0.05 \)). Similar results have been reported by other authors.\textsuperscript{12,13}

Table 1. Distribution of hospital staff by risk exposure and job category

<table>
<thead>
<tr>
<th>Variable</th>
<th>No injuries n (%)</th>
<th>With injuries n (%)</th>
<th>Pearson chi-square ( \chi^2 )</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job position</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physicians</td>
<td>37 (20)</td>
<td>149 (80)</td>
<td>( \chi^2 = 14.3 )</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Nurses</td>
<td>46 (14)</td>
<td>284 (86)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital orderlies</td>
<td>46 (28)</td>
<td>118 (72)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of professional experience</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 5 yrs</td>
<td>27 (22.7)</td>
<td>92 (77.3)</td>
<td>( \chi^2 = 1.69 )</td>
<td>&gt; 0.05</td>
</tr>
<tr>
<td>5 - 10 yrs</td>
<td>21 (20.4)</td>
<td>82 (79.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 10 yrs</td>
<td>81 (17.7)</td>
<td>377 (82.3)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

With respect to the procedure performed at the moment of professional exposure (Fig. 3) the highest relative percentage is attributed to needlestick and/or syringe manipulations (venepuncture, infusion application, blood sampling, intramuscular injections) - 34% (190/551), followed by injuries from other activities (decontamination of instruments, handling and transportation of hospital waste) - 30% (163/551) (p > 0.05).

In contrast to the high relative percentage of reported occupational exposures (81%), only 64.3% \( \pm \) 3.8% (437 respondents out of 680) of all healthcare workers (incl. physicians, nurses and ancillary personnel) reported having immunisation against hepatitis B. We found no statistically significant difference in the immunisation coverage between the length-of-service groups: it was 59.7% for the group with more than 5 years, 69.9% for the 5-to-10-year group, and 64.2% for the group with less than 10 years of professional experience (p > 0.05).

The distribution of immunised subjects by job position is: physicians - 68.8%, nurses - 69.7%,
and hospital orderlies - 48.2%. The immunization coverage for hospital orderlies is smaller than that for all respondents, with the difference between orderlies and nurses ($t = 4.63, p < 0.05$) and between orderlies and physicians ($t = 3.98, p < 0.05$) reaching statistical significance. The non-parametric test shows a correlation between job position and immunisation coverage ($\chi^2 = 24.41$, $df = 2$, $p < 0.05$). These results clearly suggest that ancillary personnel is inadequately covered by the immunisation procedures which is consistent with the results of other researchers. 14,15

Ninety-two percent of the healthcare workers in the study (626/680) reported use of personal protective equipment while at work (mainly disposable gloves). However, the relative percentages of people actually using protective equipment during professional exposure (74.6%, 411/551) is significantly lower than that of subjects using it at work ($t = 8.2$, $p < 0.001$). Use of personal protective equipment by job position (commonly at work and during professional exposure) is presented in Table 2.

Analysis of behaviour after an occupational exposure takes place shows that many healthcare workers take no measures to protect themselves (78.7%). Twenty percent of healthcare workers did not respond to this question, and only 1.3% (9 respondents out of 680) followed partially the established algorithm of behaviour: registration, local antisepsics, injury type assessment, consultation, tests and/or bioproduct prophylaxis if necessary.

**DISCUSSION**

According to the approved Medical Standard for Prevention and Control of Nosocomial Infections in Bulgaria, complete evaluation of infection risk for any medical personnel should be carried out regularly at a 5-year interval based on injury type, performed immunizations, etc.6

As seen in a number of studies, percutaneous injuries clearly carry the highest risk of infection: 6 to 30% for HBV, mean 1.8% for HCV (range 0-7%), 0.3% for HIV.1 The results of this study are therefore all the more alarming because of the very high percentage of reported percutaneous injuries (62%) we obtained. In 2007 Voynova et al. found even greater percentage (72.5%).16 Unlike us, other researchers abroad report significantly lower percentage of injuries (in particular percutaneous injuries and cutting): 29.3% 17, 31.6% and 52.9% 18, 34.8%12, 31.4% 11, 45.2% 19, 56.96% 13.

It is worth a note that a considerable number of the incidents occurring at work remain underreported (between 40% and 80%).2 The evidence provided by prospective studies with aggressive monitoring suggests that the needlestick injury incidence is significantly higher than reported through passive

**Table 2. Distribution of hospital-based healthcare workers by job position and use of personal protective equipment**

<table>
<thead>
<tr>
<th>Regularity of use</th>
<th>Routine use of gloves at work</th>
<th>Use of gloves during professional exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Physicians (%)</td>
<td>Nurses (%)</td>
</tr>
<tr>
<td>Yes</td>
<td>97.3</td>
<td>86.7</td>
</tr>
<tr>
<td>No</td>
<td>2.7</td>
<td>12.4</td>
</tr>
<tr>
<td>Did not respond</td>
<td>0</td>
<td>0.9</td>
</tr>
</tbody>
</table>
surveillance, ranging from 14 to 839 needlestick injuries per 1,000 health care workers per year.\textsuperscript{20}

Comparison between all the various studies becomes difficult as each employs different methods of occupational injury calculation: it is either a relative percentage of all observation units, or the number of injuries per occupation or per 100 doctors (nurses), the number of injuries per 1000 healthcare workers per year, or the number of injuries per 100 full-time health workers per year, or number of injuries per 100000 devices.\textsuperscript{7,11}

The similar results we obtained for the rate of needlestick injuries (needlestick injury/job position/year) in the three categories of hospital-based healthcare workers can be accounted for by the lack of functioning instruction system for dealing with sharp cutting or piercing instruments, safe injury prevention devices, (needles, syringes and scalpels with safeguarded mechanisms), and puncture-resistant sharps disposal containers for collection and transportation of hazardous hospital waste. By comparison, the average number of injuries per healthcare worker per year in the USA varies between 0.67 in 1991 and 0.096 in 1998.\textsuperscript{21} Some authors have found differences in that parameter between different professional categories.\textsuperscript{2,22}

Our results suggest no correlation between length of employment and occupational injuries, unlike the results reported in an extensive study of the Texas Health Department (2007)\textsuperscript{23} and in the study of F. Alberoni et al.\textsuperscript{17} both concluding that the greater number of risk exposures is a direct consequence of poorer professional experience.

We think that the great number and variety of risk procedures in the DARICU and their use in emergencies can be explained by the extremely high relative percentage of reported occupational exposures. The evidence in literature suggests that surgery departments and intensive care units are associated with the highest number of occupational accidents.\textsuperscript{11,13,23} A disturbing fact is that internal disease clinics, usually considered low-risk departments, also show high relative percentage of sustained risk exposures (70.6\%, 24/34).

The group of healthcare workers who reported occupational exposure during wound bandaging or while assisting to it (12\%, 66/551) is of some interest as we could not find similar findings elsewhere.\textsuperscript{2,11,13} This could be explained by the greater interest of most surveys to percutaneous injuries predominantly as these exposures carry a greater risk for infection with blood-borne pathogens. It is also highly suggestive of irregular use of personal protective equipment (primarily gloves). Nurses reporting the most occupational exposures use the least protection both while performing common procedures (2.4\%, 41/330) and during occurring risk exposures (30.3\%, 100/330). This may be related to the insufficient level of instruction about the existent occupational hazards and inadequate training to use personal protective equipment. Use of protection equipment varies in a broad range as seen in a number of studies employing questionnaires: 42.2\% in Iran\textsuperscript{15}, less than 50\% in Banya Luka, Bosnia and Herzegovina\textsuperscript{3}, 58\% in India\textsuperscript{12}, 65.1\% in Malaysia\textsuperscript{18}, 70.4\% in Germany\textsuperscript{11}, as high as 84.6\% in the USA\textsuperscript{23}.

Measures have been implemented only in 1.3\% of all cases of occupational exposure. Post-exposure tests to the personnel are rarely done; the behaviour of affected people after the exposure is rather inadequate in spite of the fact that in 2006 the University Hospital introduced an algorithm for postexposure prophylaxis of healthcare workers in cases of hepatitis B and C virus infection and in HIV/AIDS; exposure log and report receipts and final exposure report. In contrast to the results registered by using questionnaires, the results from using official hospital reports showed only one occupational risk exposure over a 5-year period. The absence of registration is an especially disturbing fact which both indicates underestimation of this problem and shows inability to properly use post-exposure prophylaxis.

The relatively low immunization rate (64.3\%) predisposes to nosocomial hepatitis B virus infections along the entire chain from patient to personnel. This is clearly indicative of organisational failure to abide by the risk protection regulations and protect healthcare workers from risk exposures to biological agents during work.\textsuperscript{24} Poor knowledge and underestimation of the occupational hazards to infect healthcare staff (largely the ancillary workers) and financial reasons (irregular provision of vaccines) influence the level of vaccine protected subjects. The immunization coverage of healthcare workers reported by authors abroad is significantly higher: Poland – 100\%\textsuperscript{25}, Italy 85.3\%\textsuperscript{26}, Brazil 86.4\%\textsuperscript{27}. Our coverage rate is similar to that in Pakistan – 64.6\%\textsuperscript{28}, and Syria – 56.1\%\textsuperscript{3}. High vaccinal coverage (85-93\%) was found in the European Union countries in a large scale European research on immunisation against HBV infection for healthcare employees; 14 of the 25 countries have also introduced postvaccinal testing of the immunized subjects.\textsuperscript{29}
CONCLUSIONS

Healthcare workers are at a high risk of getting nosocomial infections, irrespective of the job category. The results suggest improper application of the standard precautions: high percentage of risk exposures (81%), percutaneous injuries (62%), use of personal protective equipment (gloves) during professional exposures (74.6%), low immunization coverage with hepatitis B vaccine (64.3%), post-exposure prophylaxis only in 1.3%.

The follow-up monitoring and the overall behaviour after incidents related to risk exposure are random and non-systematic. A serious problem in the hospital is the absence of official registration of all sustained occupational exposures; it is practically impossible to conduct a proper post-exposure prophylaxis that would include subsequent monitoring of the cases of exposure. We would suggest one reliable method for registration that may involve the senior nurse in every clinical department to implement an aggressive monitoring policy and report any event of occupational exposure to the doctor responsible for the infection prophylaxis in the hospital. Continuing education and training that would lead to knowledge enhancement, invasive procedure perfection and constant control are needed to improve the prevention of occupational risk exposures. The results of this study should make the hospital nosocomial infections prevention and control committee and the hospital management to focus their attention on three major aspects of this problem: organizational, educational and financial.

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ПРОФЕССИОНАЛЬНЫЕ РИСКОВЫЕ ЭКСПОЗИЦИИ И ПОВЕДЕНИЕ МЕДИЦИНСКОГО ПЕРСОНАЛА – АНКЕТНОЕ ИССЛЕДОВАНИЕ

А. Кеворкян, Н. Петрова, Н. Ангелова

РЕЗЮМЕ

ВВЕДЕНИЕ: Стандартные предохранительные меры направлены ко всем пациентам в случаях возможного контакта с кровью, телесными жидкостями, слизью и неинтактной кожей. Применение этих мер ставит задачу редуцировать риск передачи микроорганизмов и остается одним из лучших способов протекции медицинского состава.

ЦЕЛЬ: Анализировать профессиональные рисковые экспозиции, возникающие при контакте с кровью и с другой потенциально инфекционной жидкостью и оценить некоторые аспекты применения стандартных предохранительных мер.

ПАЦИЕНТЫ И МЕТОДЫ: В анкетном анкетном исследовании, проведенном в 2009 г. В УМБАЛ «Св. Георгий» г. Пловдив участвуют 680 работников здравоохранения (186 врачей, 330 медицинских сестер и 164 санитары). Анкета содержит 14 вопросов, разделенных на 3 группы. Применены дефиниции CDC о профессиональной рисковой экспозиции и декретивная статистика, параметрический и непараметрический анализ.

РЕЗУЛЬТАТЫ: Профессиональную рисковую экспозицию за календарный год декларировали 81% участвовавших в анкете. Преобладают инциденты с перкутанной инъекцией – 62%. Медицинские сестры составляют группу с самыми высоким процентом рисковых экспозиций – 86%. Установлена ассоциация между сущностью проведенной деятельности и профессиональной экспозицией ($\chi^2 = 14.3, df = 2, p < 0.001$). Ассоциация между продолжительностью трудового стажа и интенсивностью ранений ($\chi^2 = 1.6$, $df = 2, p < 0.05$) недоказана. 64,3 ± 3,8% работников здравоохранения иммунизированы от гепатита В. Процент вакцинированного персонала – 48.2%; этот процент ниже среднего. Установлена ассоциация между должностью и иммунизацией ($\chi^2 = 24.41, df = 2, p < 0.001$). Личные предохранительные средства (одноразовые перчатки) пользуют 92% работников здравоохранения, но возникшего инцидента этот процент – 74.6% ($p < 0.001$).

ЗАКЛЮЧЕНИЕ: Постэкспозиционное прослеживание и целостное поведение при возникшей профессиональной рисковой экспозиции носит случайный и несистематизированный характер. В целях улучшения превенции медицинского персонала необходима продуманная подготовка процесс обучения, прецизирование инвазивных манипуляций и перманентный контроль.