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Der Pharmacia Lettre, 2017, 9 (2):142-152
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Seroprevalence of Blood Borne Pathogens among Health Care Workers and Their Hepatitis B Vaccination Status in Tertiary Care Hospitals in India

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ABSTRACT

Background and Aim: Occupational exposure to blood-borne pathogens, mainly human immunodeficiency virus (HIV), hepatitis B (HBV) and hepatitis C (HCV), poses a serious risk to healthcare workers (HCWs), especially in developing countries, due to the high prevalence of these pathogens and fewer safety precautions. The aim of this study was to investigate the seroprevalence of HBV, HCV, and HIV infections and to measure the vaccination practices in HCWs at three tertiary care hospitals in Delhi, India.

Method: In a descriptive (cross-sectional) study, the HCWs of three tertiary hospitals were selected by simple random sampling and divided into four different groups (nurses, laboratory and operational theater technicians, doctors, and housekeeping workers). The participants were screened for the presence of hepatitis B surface antigen (HBs Ag), antibody to hepatitis B surface antigen (anti HBs), antibody to hepatitis C (anti HCV), and antibody to HIV (anti HIV). From June 2010 to April 2012, a structured questionnaire was administered to 850 HCWs after obtaining consent.

Results: Among 850 HCWs, 51.8% were nurses and 50.6% were female with a mean (SD) age of 34(8.7) years. The overall seroprevalence of HBsAg, anti-HCV, and anti-HIV was 1.1%, 0.3%, and 0.1%, respectively. There was a

high proportion of HBsAg positivity among housekeeping workers (4.9%) followed by nurses (3.3%). Out of 9 positive cases of HBsAg, 66% (6) were never vaccinated and out of a total of 11 positive subjects, 72 % (8) had previous exposure in the workplace. Complete HBV vaccination was done in 78.2% (605) of the HCWs and 11.3% (75) were partially vaccinated. Only 20.1% had checked their anti-HBs. Protective (>10 IU/mL) anti-HBs was seen in 70.6% (600) of the participants, indicating that nearly one third of HCWs were not protected against HBV infection. The majority of the study subjects (63.6%) believed that they were immunized against hepatitis B and did not need to check the immunity titer.

Conclusion: Not all HCWs were vaccinated and the majority of vaccinated subjects did not know their immunity level. Housekeeping workers had a high seropositivity rate of infections and a low rate of vaccination against HBV. Institutional policy and training were found to be of paramount importance to improve the quality of health in HCWs.

KEYWORDS: Hepatitis B vaccination, Blood-borne Pathogens, Seroprevalence, Healthcare workers

INTRODUCTION

HCWs have the responsibility of caring for patients as their clinical duty and they may therefore encounter chemical, physical, ergonomic, or psycho-social hazards. Most of them work around patients or biological samples, which exposes them to occupational hazards mainly for blood borne pathogens (BBPs) [1]. BBPs are microorganisms that can cause disease when transferred from an infected person to another person.

HIV, HBV and HCV are members of different virus families. Despite their different life cycles and modes of gene expression, the most important route of transmission is via the blood or body fluids [2,3].

The World Health Organization (WHO) has estimated that the global burden of disease due to occupational exposure to HBV and HCV infections is about 40% and 4% of HIV infections among HCWs are attributable to exposure at work [4]. Transmission of BBPs is related to the source patient (e.g. the titer of the virus in the source patient's blood), the injury (e.g. the quantity of the blood transferred during exposure), and the condition of the recipient individual (e.g. immunologic status). In the health care setting, the most common mechanism of transmission is percutaneous injuries which could be through needle-stick or other sharp injuries; however, there is a lower risk of infection through contact with mucous membrane of the eye, mouth, nose or non-intact skin with blood, tissue, or other body fluids that are potentially infectious [5].

There were many cases of HBV transmission from infected patients to health care workers before widespread hepatitis B vaccination of HCWs; it is estimated that 12000 HCWs per year were infected by HBV [6]. Prospective studies showed that small quantities of blood were sufficient for HBV transmission; therefore, it is the most easily transmitted BBP. The risk of HBV transmission after a percutaneous exposure is about 6 to 30% if a HCW has never been vaccinated [7] risk of HCV transmission is nearly 1.8% (0 - 10%) [8,9], and the risk of HIV transmission is

approximately 0.3%. HBV is extremely contagious; it is nearly 10 times more infectious than HCV and 100 times more than HIV [10].

Several protection strategies have been implemented to maximize the safety of HCWs, including implementation of universal precautions, routine hepatitis B vaccination, post-exposure prophylaxis, engineered safety devices, etc. [11]. The effectiveness of the administration of post-exposure prophylaxis varies from 75 to more than 90% for the prevention of HBV infection. As for HIV, it has also been shown to lower the risk of infection after sharp injuries. However, there is no known way of preventing HCV acquisition following needle-stick injury (NSI) [12].

These facilities are available to HCWs in all countries; however, the risks are higher in developing countries due to the higher prevalence of infection and suboptimal infection control practices (Gershon et al., 1995) because it will involve some costs. Moreover, 90% of the infections occur in developing countries where awareness and potential risks of BBP infections are not properly discussed and practiced [13].

Despite a safe and effective hepatitis B vaccine since 1982, the vaccination coverage among HCWs varies from 6.2% to 80% in different regions [14], and the rate of anti HBs titer measurement after vaccination is very low [15].

On the other hand, even in developed countries like the United States, 52% of the HCWs experience one or more percutaneous injuries in their career. A cross-sectional survey reported that the majority of NSIs were not reported to the hospital administration and only 10 % of them knew about the availability of PEP services in the hospital [16], although reporting is important for reasons of treatment and prevention.

A number of studies have emphasized low awareness of HCWs about the risks of transmission in the workplace, hepatitis B immunization, post-exposure prophylaxis besides failure to implement universal precautions [17-19]. Furthermore, little data has been published based on factors related to HCV, HBV, and HIV and there is a paucity of data from India in this field.

Therefore, in the present study, we aimed to investigate the seroprevalence of HBV, HCV, and HIV infection and to measure the vaccination practices among different category of HCWs at three tertiary care hospitals in Delhi, India. To the best of our knowledge, few studies have been carried out among such HCWs in India.

MATERIAL & METHODS

This study was carried out at 2 university hospitals and one super speciality hospital in New Delhi, India between 2010 and 2012. The study protocol was approved for ethical clearance by the institutional ethics committees.

After written consent was obtained, 900 healthy HCWs were randomly enrolled. They received explanation on the objective of the study. An administered questionnaire was used to collect data, including demographic parameters

(gender, marital status, age, duration of employment, education, occupation, and working department), exposure to blood or blood products, history of non-occupational risk factors, hepatitis B vaccination status, the immune status, and barriers to vaccination. The study population was subdivided into four groups according to activities performed. Each participant gave informed consent and received HIV/AIDS counseling.

Laboratory Technique

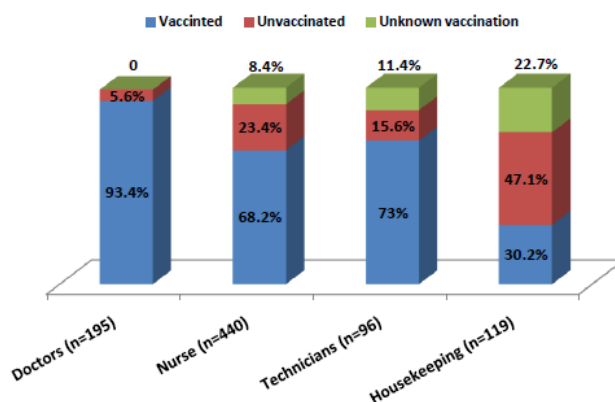
Blood samples were collected from the participants and each patient was assured of confidentiality in case of positive results. Viral markers of hepatitis were measured by ELISA (Enzyme-Linked immunosorbent assay) using a commercial kit (SD HBsAg, SD HCV ELISA 3.0, India) including HBsAg and anti-HCV, and quantitative testing for anti-HBs was performed using the ARCHITECT Anti-HBs assay. Screening for HIV was done via the SD BIOLINE HIV-1/2 3.0 test approved by the WHO. Initially, positive samples were retested in duplicate and defined as positive if at least one of the re-tests was positive.

The participated HCWs were grouped into four categories based on their profession, including doctors, nurses, laboratory and OT technicians, and housekeeping workers. The results were analyzed using the Chi-square test and Multivariate Logistic Regression (MLR) was applied to explore significant predictors amongst the socio-demographic factors and other variables for the vaccination status.

RESULTS

A total of 900 healthcare workers were included in this study and only 50 persons refused to participate in the study; hence, blood samples and data of 850 apparently healthy HCWs were available. They were grouped into 4 categories including resident doctors from all disciplines (n=195), nurses (n=440), laboratory and OT technicians (n=96), and housekeeping workers (n=119). Of 850 HCWs recruited in the study, 481 (50.6%) were female with a mean (mean \pm SD) age of 34 ± 8.7 years. Of them, 665 (78.2%) were vaccinated and 590 (88.7%) were fully vaccinated while 75 (11.3%) were partially vaccinated, i.e. they had not completed their full schedule of Hepatitis B vaccination. Most of them had missed their 3rd dose. However, 185 (21.8%) were not vaccinated at all.

Among 369 males in the study, 275 (74.5%) were vaccinated while out of 481 females, 390 (81.1%) were vaccinated (Table 1). The difference in age of vaccinated and unvaccinated HCWs was not significant. Among various groups of the healthcare workers included in this study, the rate of vaccination was very variable as shown in Figure 1.

Figure-1: Vaccination status among various groups of health care workers

However, 70.5% of the study subjects were immunized and had anti-HBs titer ≥ 10 mIU/ml; protective levels of anti-HBs antibody were significantly higher [81% (583 of 665)] in vaccinated than unvaccinated [33.7% (62 out of 185)] HCWs as shown in Table 1.

Table-1: Demography and proportion of HCWs having protective antibody titer among those vaccinated and unvaccinated

	Total	Vaccinated	Unvaccinated
N	850	665	185
Male: Female	369:481	275:390	94:91
Age in years (mean SD)	34 \pm 8.7	34.1 \pm 8.6	33.8 \pm 8.9
HCWs with protective anti-HBs titer (>10 mIU/ml)	600*	583	62
HCW without protective anti-HBsAg titres (<10 mIU/ml)	250	127	123

The highest level of immunity was found in the HCWs with a duration of service of less than 3 years (84.0%) while the lowest was in those who had more than 10 years of experience in the healthcare setting (77.1%) although the difference was not statistically significant ($p=0.127$). The protective level of anti-HBs was highly significant among HCWs who were working in the super speciality hospital where there were strict rules about hepatitis B vaccination or booster shots in the case of non-reactive response. Almost all of study subjects from this hospital had immunity levels of the anti-HBs titer while approximately 75% of the participants from other hospitals were immunized and the difference was statistically significant ($p<0.001$). Out of all vaccinated participants, 74.3% (494/665) had not checked their anti-HBs titers while the majority of the study subjects (63.6%) believed that they were immunized against hepatitis B and they did not need to check the immunity titer.

To find out the predictors of vaccination compliance among the study subjects, multivariate logistic regression was applied considering vaccination as a dependent variable/outcome. All variables (gender, job category, training, duration of work, and hospitals policy) that had $p<0.25$ in the Univariate analysis were entered into the model using the force entry method to explore significant independent predictors in the study subjects.

Finally, the female subjects were more likely to be vaccinated than males (OR=1.54, 95% C.I. 1.02-2.31, $p=0.037$). The odds of being vaccinated among doctors was 14.86 (95% C.I. 7.33-0.14, $p<0.001$), odds among nurses was 2.90 (95% C.I. 1.90-4.43, $p=0.019$), and among technician staffs was 4.80 times (95% C.I. 2.48 -9.26, $p=0.001$) more than housekeeping workers. HCWs with less than 3 years were less likely to be vaccinated as compared to HCWs with more than 3 years of work record. HCWs who worked in the hospitals that had policies for checking and offering hepatitis B vaccination were 5.02 times (95% C.I. 2.50-10.0, $p<0.001$) more likely to be vaccinated compared to HCWs of the hospitals with no strict rules and checking system (Table 2).

Table-2: Factors associated with vaccination status of study variables

Variables	B	SE	OR	95% C. I
Gender				
Male	0.433	0.207	1	1.05-2.03
Female			1.46	
Received training				
No	0.608	0.232	1	1.83-3.66
Yes			2.59	
Duration of service				
<3 years			1	
3-10 years	0.754	0.251	1.60	1.04-2.46
>10 years	0.952	0.241	1.29	0.88-1.90
Job category				
Housekeeping			1	
Doctor	3.024	0.405	14.86	7.33-0.14
Nurse	0.675	0.289	2.90	1.90-4.43
Technician	1.285	0.378	4.80	2.48 -9.26
Hospital policy				
No	1.932	0.389	1	2.50-10.08
Yes			5.02	
Constant	1.166	0.269		
*1 reference category, Nagelkerke R square 0.249, Total subjects 850.				

Hosmer & Lemeshow test for goodness of fit was applied ($p=0.402$). Nagelkerke R square was 0.249, implying that 24% of vaccination uptake of HCWs could be explained by this model.

A total of 9 (1.1%) HCWs were found to be positive for HBsAg; it was the highest in housekeeping personnel (4.9%) followed by nurses (3.3%) and in the same proportion in doctors and technicians (1.0%). Anti-HCV was

positive in three cases (0.13%). Among Anti-HCV positive cases, one was a doctor, one was a nurse, and the last one was an OT technician, and all of them were HCV-RNA positive. Co-infection of HBV and HCV was not reported. Only one out of 850 HCWs was found to be HIV positive. Out of 13 positive cases, 3 had a history of operation, 2 had tattooing, and 8 had a history of occupational exposure (the exposure incidence was not reported); one of these cases had both a history of tattooing and NSI. None of these positive cases were from the super specialty hospital.

DISCUSSION

Hepatitis B and C and HIV are the most common BBVs so far which have been identified as risk factors for transmission in the health-care setting. HCWs constitute a high-risk group for contracting blood-borne diseases from the patients. There is also a small risk that patients can become infected by the healthcare workers. Some of the studies conducted in India have revealed varying rates of HBV and HCV prevalence in various groups of health professional. In India, there is scarce data about HIV prevalence among HCWs.

The present study found that the overall seroprevalence of HBsAg, anti-HCV, and anti-HIV was 1.1%, 0.3% and 0.1%, respectively. Lower and higher prevalence rates were also detected as compared to similar study populations in different parts of the world. These results were in agreement with previous reports affirming that HCWs are at a low risk for HIV infection, as the HIV prevalence rate among HCWs has been reported to be 0.0% in low prevalence countries like Pakistan, Denmark, and India [19-22]. However, studies conducted in high prevalence countries like South Africa have reported an HIV seroprevalence of 11.5-15.57% which shows an elevated risk for health care workers [23].

Findings from a similar study conducted among health care workers in India found a comparable prevalence of HBV and HCV. The study was done in New Delhi where the HBsAg was 0.97%. Studies conducted by Kalaskar [24], showed that the seroprevalence of HBsAg was 1.1% and 1.0%, respectively. The HCV prevalence in the healthcare workers has been studied comprehensively in India and there are different reports from 0.0 to 4.0% [24,25]. This prevalence is similar to the result of a previous study in Delhi and Nigeria [11, 26] and also it is in accordance with a similar international study by Cabaravdic [27], as both studies reported the same seroprevalence of HCV in their study subjects.

Our result is in agreement with previous studies to prove the fact that the possibility of contracting HCV infection in HCWs is less than HBV infection. Ciorlia [28], reported an HBV seroprevalence of 0.8% among HCWs in Brazil where the rate of vaccination was similar to our study. In our study, according to occupational groups, the highest HBV positivity was found among housekeeping workers followed by nurses. It was interesting to note that the problem of poor vaccination coverage for HBV was seen among them. This was similar to earlier studies from India [12, 26], and the results of international studies which found non-professional staff like wards orderlies and ward boys were the categories at risk for occupational transmission of HBV [30,31]. The data about seropositivity of

BBPs in these workers is lacking but there is actually a need to focus on these groups as they are likely to be exposed during their job along with their low level of awareness. Hence, the present study attempted to include them in order to understand the magnitude of seropositivity in these categories.

In our study, we found that out of 850 HCWs, 665 (78.2%) were partially vaccinated against hepatitis B; however, of those vaccinated; only one fifth (171/665) had checked their immunity and the majority of them (approx. 65%) were not aware of their immunity. Our study demonstrated that the vaccination coverage was high when compared with previous Indian studies. Sukriti [11], reported approximately 28% of their participants in Delhi, were never vaccinated and 17% were unaware of their vaccination status. Singhal [32], and Chaudhari [33], reported that approximately the same proportion (approx 57.0%) of HCWs was vaccinated against HBV. An earlier study Kumar [29], in India showed 42.4% (173/408) of the HCWs had received partial or full vaccination. It is known that HBV infection is predominantly a problem in resource-limited countries. The proportion of vaccinated HCWs differs in various countries; some countries like Kenya and Cameroon have low rates of vaccination compliance among HCWs (12.8% and 12.3%, respectively) [34,35], whereas 75% of HCWs in the USA have received hepatitis B vaccination [36]. Most developed countries recommend the need for immunization against HBV in the start of career in the healthcare setting but such policies are not employed in all healthcare settings. The reason for the high coverage of vaccination in our study compared to previous studies in Delhi is possibly non-compliance with HBV vaccination since pre-employment screening and vaccination are mandatory in one of our healthcare settings. Regarding this policy, almost all of the HCWs checked their anti-HBs titer and were vaccinated.

Regarding vaccination, the rate of HBsAg infection was 3.2% among non-vaccinated subjects and 0.4% among the vaccinated participants. Seropositive vaccinated HCWs did not check their anti-HBs titer after vaccination. Furthermore, it was seen among vaccinated HCWs that 19.2% of the individuals had anti-HBs titer lower than the protective level (<10 IU/L). So, they were still at risk of acquiring hepatitis B infection and strongly required booster doses of the HBV vaccine. These results are in concordance with a study done by Singhal [32], who found that almost 21% of the vaccinated HCWs had anti-HBs titer lower than the protective level (<10 IU/L).

The study findings may lead to a review of workplace related occupational health and safety regulations and policies such as introduction of a compulsory provision for vaccination; moreover, policies should be developed to mandate HCWs to test 1–2 months after completing their primary vaccination to know their baseline anti-HBs status.

The most frequently quoted reason among housekeeping workers who were not vaccinated in this study was ignorance due to lack of knowledge and lack of interest. On the other hand, the odds of being vaccinated was 20.58 times more in HCWs who were doctors, 3.61 times more in technicians, and 1.96 times more in nurses as compared to housekeeping workers ($p < 0.001$). It could be the main cause of putting them in the front line of high risk groups among HCWs in terms of blood-borne infections. The policy of the hospital regarding hepatitis B vaccination and receiving training on infection control were other predictors of vaccination acceptance. The health service has the responsibility of developing and implementing protocols for managing HCWs. It seems the hospital policy has an important role in immunization of all HCWs.

In conclusion, the results of the current study showed that despite the availability of vaccination against HBV, 29.5% of the HCWs were not immunized and that the hospital policy has a very important role in infection prevention.

Our study highlights the need for attention to housekeeping workers as they have a low educational background and are not formally trained in the health care setting and on the other hand often contact patients during their job. Our study also demonstrated that the environment and policy changes were the most important ways to improve the public health, providing the counterargument to those policy makers who argue that hospital policy has no role, and that health is determined by individual responsibility.

ACKNOWLEDGMENTS

We greatly appreciate the cooperation of health professionals and their valuable support during the data collection and our special acknowledgement to all laboratory workers in ILBS who co-operated with us during lab investigations. We also wish to thank all the healthcare workers who agreed to voluntarily participate in this study.

COMPETING INTERESTS STATEMENT

The authors declare that there is no conflict of interests regarding the publication of this paper.

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