Awareness of blood-borne infections and burden of occupational exposures to blood and body fluids among health care personnel in a tertiary care teaching hospital

Abstract

Background and Objectives: Occupational exposures (OEs) to blood and body fluids (BBFs) pose significant risk of transmission of blood-borne infections (BBIs) to health care personnel (HCP) and are grossly underreported. We aimed to study the awareness of BBIs and their prevention, burden of OEs, assess factors contributing to them and their poor reporting and assess the practices for their prevention among HCP.

Materials and Methods: This cross-sectional study conducted at a tertiary care teaching hospital located in south India used a self-administered questionnaire to assess the awareness of BBIs, attitude and practice of HCP for prevention of OEs, and to quantify the burden of exposures. All formally self-reported OEs during the study period of 2 years were documented prospectively.

Results: Majority (369/401, 92%) of HCP surveyed had fair general awareness of BBIs. Though 90% were aware of the concept of universal precautions (UPs), self-reported adherence to barrier precautions was acceptable in only 80%. Overall, 56% and 46% of HCP were aware of human immunodeficiency virus (HIV) and hepatitis B post-exposure prophylaxis (PEP) respectively. Eighteen percent (74/401) were either not vaccinated or incompletely vaccinated against hepatitis B. Recapping of used needles was reported by 79% (317/401). Nearly half (208/401) reported OEs over preceding year and 70% (146/208) of exposed had not formally reported them. Over the 2-year study period, 53 formally self-reported exposures were documented prospectively. Needle stick injuries accounted for 83% of the exposures, and appropriate personal protective devices were not being used during 47% of exposures. Though doctors had the highest awareness, they reported lowest adherence to barrier precautions and highest burden of exposures (P < 0.05).

Conclusion: Though majority of HCP had fair awareness of BBIs, it did not translate into adequate adherence to UPs and safe practices. High burden of OEs and their poor reporting emphasize the need to motivate our HCP to adhere to safe work practices and to promptly seek professional counselling after exposures. There is an urgent need to educate HCP about the availability and effectiveness of PEP for HIV and hepatitis B. A uniform national policy for prevention and reporting of OEs has to be framed.

Key words: Awareness, blood-borne infection, needle-stick injury, occupational exposures, post-exposure prophylaxis, reporting

INTRODUCTION

Contaminated needle stick injuries (NSIs), sharp injuries, and splash of infected blood and body fluids (BBFs) on to damaged skin or mucous membranes pose significant risk of transmission of blood borne infections (BBIs) such as human immunodeficiency virus (HIV), hepatitis B and C to healthcare personnel (HCP). According to the World Health Organization (WHO) estimates, approximately 40% of...
hepatitis B and C infections and 2.5% of the HIV infections among HCP globally are attributable to infected BBF exposures at work.\(^1\) WHO has also reported that 90% of these infections among HCP in the developing world are attributable to occupational exposures (OEs) and 90% of reporting of OEs is from the developed world.\(^2\) NSIs, which account for the bulk of OEs, are estimated to occur in 600,000 to 1000,000 HCP in United States and 100,000 in United Kingdom annually.\(^3\) Failure to report an exposure increases the likelihood of consequential infection by precluding testing of source patient for BBIs and post-exposure prophylaxis (PEP) to the exposed person.\(^4\) In addition, formal reporting of exposures is required for generation of data for formulating a uniform national policy for the prevention and treatment of occupationally acquired BBIs. OEs can be prevented or reduced by observing "universal precautions" (UPs) and employing safe strategies at workplace. Few studies from different parts of India have reported on the burden of NSIs.\(^5\)–\(^10\) However, factors contributing to poor adherence to UPs and safe practices at workplace in our country are still incompletely understood. Understanding these factors would help in exploring ways to reduce OEs, through educational programs aimed at creating awareness and changing attitude and practice.

There is gross underreporting of OEs in our country, and exposure data at national level is lacking. Hence, further studies are required to quantify this problem and to study the factors contributing to them. This study was conducted to assess the awareness of BBIs and their prevention among different HCP. OEs can be prevented or reduced by observing "universal precautions" (UPs) and employing safe strategies at workplace. Few studies from different parts of India have reported on the burden of NSIs.\(^5\)–\(^10\) However, factors contributing to poor adherence to UPs and safe practices at workplace in our country are still incompletely understood. Understanding these factors would help in exploring ways to reduce OEs, through educational programs aimed at creating awareness and changing attitude and practice.

**MATERIALS AND METHODS**

This cross-sectional study was carried out at a tertiary care teaching hospital located in south India between 4th September 2012 and 31st August 2014. HCP such as doctors (residents, interns, and faculty members), staff nurses, and laboratory technicians (LTs) serving in our hospital for at least 1 year and willing to participate in the study were included. HCP who did not come in regular contact with BBFs were excluded. Our hospital had approximately 1400 HCP, and a convenient minimum sample of 350, to include at least 25% of HCP, was considered. This sample, which was selected by simple random sampling method, was considered to represent all the HCP of our hospital. A self-administered 30-item questionnaire structured to assess the awareness of BBIs and their prevention, attitude and practice of HCP for prevention of OEs and BBIs, availability and utilization of PPDs and safe practices at workplace, and to quantify the burden of exposures retrospectively over the preceding year was circulated among HCP. Participants were briefed and familiarized with answering the questionnaire. Exposure was defined as skin prick, cut, or scratch injury from needles, scalpel blade, scissors or other sharps contaminated with BBFs, cutaneous or mucosal splash exposure to BBFs and study participants were instructed to report these exposures. Data sought on previous exposures was limited to preceding 1 year to avoid recall bias. Anonymous reporting ensured confidentiality of data.

A hospital-based registry documented all formally self-reported percutaneous and mucocutaneous exposures prospectively during 2-year study period. Details sought from the exposed HCP visiting post-exposure services such as job category, circumstances of exposure, infectivity of source (when traceable), adherence to safe practices when the exposure occurred, hepatitis B vaccination and protection status, post-exposure management, and follow-up were entered in a proforma and confidentiality was ensured. The study protocol was approved by the institute scientific and ethics committees.

Statistical analysis was done with the Statistical Package for the Social Sciences software version 20 (Released in 2014 by IBM Corporation, Armonk, New York); analysis was carried out at 5% level of significance and a \(P\) value < 0.05 was considered significant. All categorical and ordinal data has been presented as frequencies and percentages and compared by using Chi-square or Fisher’s exact tests. The normality of continuous data was assessed and data has been expressed as mean with standard deviation or median with range. Comparison of the continuous data was carried out by using independent student \(t\)-test or Mann–Whitney \(U\)-test.

**RESULTS**

**Results of the questionnaire-based survey**

Out of the 470 questionnaires distributed, 401 participants (139 males and 262 females) returned the questionnaire, with a response rate of 85.3%. Among respondents, 261 (65.1%) were staff nurses, 120 (29.9%) were doctors and 20 (5%) were laboratory technicians (LTs). The mean age of study participants was 28.5 years (±5.3 years). Table 1 shows the awareness of BBIs and their prevention among different HCP. Majority (369/401, 92%) of HCP had fair (i.e., intermediate to high level, Table 1) general awareness of BBIs. Doctors had the highest general awareness of BBIs compared to other HCP (\(P < 0.05\), Chi-square test). Ninety percent (359/401) of the HCP were aware of the concept of UPs. Overall, 56% and 46% of HCP were aware of HIV and hepatitis B PEP respectively. Doctors had the highest awareness of PEP for both HIV and hepatitis B (\(P < 0.05\), Chi-square test) compared to other HCP. Thirty-eight percent (152/401) of HCP did not know where post-exposure counselling, testing, and prophylaxis were available in our hospital during routine and odd working hours.

Figure 1 shows the reported adherence to the use of PPDs such as gloves, face masks, etc. in situations likely to expose
HCP to BBFs. The self-reported use of PPDs was fairly adequate (always/often in Figure 1) in 80% (321/401) of HCP. Doctors reported least adherence to PPD use compared to other HCP ($P < 0.05$). Figure 2 shows the reasons reported for nonutilization of PPDs in situations where there was a risk of exposure. Forty-five percent (93/207) of the HCP who did not use PPDs regularly opined that it was not always necessary to use PPDs. Eighteen percent (74/401) were either not vaccinated or incompletely vaccinated for hepatitis B. Among those completely vaccinated, only 19% (62/327) had checked their anti-HBs antibody titres, i.e., post-vaccination protection status. Two-hand recapping of used needles was reported by 79% (317/401) of HCP [Figure 3]. Doctors reported highest compliance with non-recapping of used needles compared to other HCP ($P < 0.05$). Although 97.5% (390/401) reported that they had access to needle destroyers to dispose contaminated needles, only 71% (278/390) reported their regular use.

OE to BBFs was reported by 52% (208/401) of HCP during the preceding year. A total of 377 exposures were reported by 208 HCP, giving rise to a mean exposure of 1.81/person/year among those exposed. The exposed HCP included 77.5% (93/120) of doctors, 42.1% (110/261) of nurses, and 25% (5/20) of LTs. Doctors had highest burden of exposures ($P < 0.001$, Chi-square test) compared to other HCP. NSIs accounted for 72% (271/377), mucocutaneous splashes for 20% (76/377), and sharp injuries for 8% (30/377) of the exposures. NSIs were reported by 43% (172/401) of HCP, mucocutaneous splash exposures by 17.7% (71/401), and sharp injuries by 7.7% (31/401). Hollow bore needles accounted for 77% of NSIs. Table 2 shows NSIs among different HCP. Appropriate PPDs were being utilized during 90% (340/377) of exposures, but was tested for BBIs in only 55.7% (210/377) of these exposures. Only 30% (62/208) of exposed had formally reported and sought post-exposure counselling. There was no significant association between HCP category and reporting of exposures. Source was known in 90% (340/377) of exposures, but was tested for BBIs in only 59% (202/340) of the exposures. Twelve percent (25/208) of the exposed HCP had received PEP/treatment. Eighteen HCP had received HIV PEP, 5 hepatitis B (HB) vaccine alone, 1 HIV PEP + HB vaccine, and 1 received HIV PEP + HB immunoglobulin + HB vaccine.

**Results of prospectively documented exposures**

Fifty-three formally self-reported OEs [Table 3] were documented in the registry prospectively during the 2-year study period. Doctors accounted for majority (36/53, 68%) of these exposures. Most (44/53, 83%) of the exposures resulted from NSIs, and hollow bore needles accounted for 35% (18/53) of these. The majority of OEs (77/103, 75%) were resulted from NSIs, and hollow bore needles accounted for 77% (93/120) of doctors, 42.1% (110/261) of nurses, and 25% (5/20) of LTs. Doctors had highest burden of exposures ($P < 0.001$, Chi-square test) compared to other HCP. NSIs accounted for 72% (271/377), mucocutaneous splashes for 20% (76/377), and sharp injuries for 8% (30/377) of the exposures. NSIs were reported by 43% (172/401) of HCP, mucocutaneous splash exposures by 17.7% (71/401), and sharp injuries by 7.7% (31/401). Hollow bore needles accounted for 77% of NSIs. Table 2 shows NSIs among different HCP. Appropriate PPDs were being utilized during 90% (340/377) of exposures, but was tested for BBIs in only 59% (202/340) of the exposures. Twelve percent (25/208) of the exposed HCP had received PEP/treatment. Eighteen HCP had received HIV PEP, 5 hepatitis B (HB) vaccine alone, 1 HIV PEP + HB vaccine, and 1 received HIV PEP + HB immunoglobulin + HB vaccine.
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Table 2: Needle stick injuries among health care personnel (HCP) during the preceding year (n = 401)

| Job category     | No. of needle stick injuries during previous year |
|------------------|--------------------------------------------------|
|                  | None no., (%) | 1 no., (%) | 2 no., (%) | 3 no., (%) | 4 no., (%) | 5 or more no., (%) |
| Doctors          | 39 (32.5)     | 43 (35.8)  | 20 (16.7)  | 4 (3.3)    | 5 (4.2)    | 9 (7.5)            | 120                   |
| Staff nurses     | 172 (65.9)    | 51 (19.5)  | 18 (6.9)   | 10 (3.8)   | 2 (0.8)    | 8 (3.1)            | 261                   |
| Lab technicians  | 18 (90)       | 2 (10)     | 0          | 0          | 0          | 0                 | 20                    |
| Total            | 229 (57.1)    | 96 (23.9)  | 38 (9.5)   | 14 (3.5)   | 7 (1.7)    | 17 (4.2)          | 401                   |

Table 3: Prospectively documented exposures among health care personnel (n=53)

| Job category | NSIs* | Mucocutaneous splash | Sharp injury | Total (No., %) |
|--------------|-------|-----------------------|--------------|----------------|
| Residents    | 21    | 2                     | 1            | 24 (45.2)      |
| Interns      | 8     | 3                     | -            | 12 (22.6)      |
| Staff nurses | 11    | 1                     | 1            | 12 (22.6)      |
| Lab technicians | 2   | 1                     | -            | 3 (5.7)        |
| Support staff | 2    | -                     | -            | 2 (3.8)        |
| Total        | 44    | 7                     | 2            | 53 (100)       |

* Hollow bore needles accounted for 41/44 (93.2%) of needle stick injuries (NSIs) and 25/44 (57%) of NSIs occurred while trying to recap contaminated needles with two hands.

for 93% (44/44) of NSIs. NSIs occurred during two-hand recapping of contaminated needles in 57% (25/44), after blood sampling/administering intravenous or intramuscular injection/suturing/establishing intravenous access in 29.5% (13/44), during disposal/after disposal of needle (stuck by needle discarded improperly) in 13.6% (6/44) of HCP. Only 53% (28/53) of the HCP were using appropriate PPDs at the time of exposure. Eight of the 53 HCP (15%) were not vaccinated for hepatitis B and 13% (7/53) were incompletely vaccinated. Source patient could be identified in 90% (48/53) of the exposures. The source was tested for BBIs in 38 exposures (79%), and in 10 exposures (21%), source could not be tested because of delayed reporting and discharge/demise of the patient. Among 38 source patients tested for BBIs, 26 were uninfected, 6 were HIV positive, 3 hepatitis B positive, 2 HCV positive, and 1 was both HIV and HBV positive. Appropriate post-exposure measures/prophylaxis, as per the standard guidelines, have been prescribed to HCP exposed to infected BBFs and all of them have remained uninfected on further follow-up at 3 and 6 months after exposure.

DISCUSSION

The present study is unique in that it studied the burden of OEs both retrospectively over the preceding year as well as prospectively over a 2-year period, in addition to assessing the awareness of BBIs, attitude, and practice at workplace among a large section of HCP in a tertiary care teaching hospital. This was done to ascertain both formally reported and unreported exposures and to assess actual real life practices at workplace for exposure prevention. There was adequate representation of different classes of HCP such as doctors (including junior and senior residents, interns and faculty), nursing staff, and LTs in this questionnaire-based survey. The 85% response rate in the present study is similar to 87% response reported in two previous studies from India.[7,9]

Awareness of blood-borne infections and their prevention

Awareness of BBIs in the current study is considerably higher compared to 38–55% awareness of transmission of blood borne viruses among HCP reported in a study from United Kingdom.[11] The higher general awareness level, especially among nurses and LTs in the present study is most probably a result of awareness programs conducted in our hospital. Nearly 90% were aware of the concept of UPs in the present study, which was comparable across different categories of HCP. Similar awareness of UPs has been reported among doctors and nurses in studies from India[12] and West Indies.[13] Approximately half of the HCP were unaware of HIV and hepatitis B PEP in the present study. Similar low awareness levels of 36% for HIV PEP[14] and hepatitis B[15] PEP among HCP have been reported from India. However, higher level of awareness of HIV PEP[9] has been reported as well. Doctors had the highest awareness of HIV PEP in present study, which is similar to a previous study.[9] It is noteworthy that awareness of PEP and its effectiveness in prevention of BBIs may influence reporting and seeking of PEP. Only about 60% were aware of the availability and place of availability of PEP in our hospital, which is comparable with the results of another Indian study.[16] Hence, there is an urgent need to educate HCP regarding the effectiveness and availability of HIV and hepatitis B PEP as well as to motivate them to seek prompt
and timely post-exposure consultation whenever there is an exposure.

**Attitude and practices towards prevention of blood-borne infections**

Though 80% of HCP surveyed reported fairly adequate use of PPDs in situations likely to expose them to BBIs, nearly half of the HCP who suffered exposures prospectively during the 2-year study period were not using appropriate PPDs at the time of exposure. Hence, there seems to be an exaggeration of the use of PPDs in our questionnaire-based survey. The self-reported use of PPDs was least among doctors. Less than two-thirds of HCP reported to consistent utilization of PPDs in a Nigerian study.[16] Doctors were least likely to wear gloves while drawing blood from patients, compared to other HCP in a study reported from Birmingham, UK.[14] Two Indian studies have reported practice of barrier precautions by only 57% of HCP[5,17] and doctors reported higher rates of compliance compared to nurses in one study.[17] The reasons cited [Figure 2] by those HCP who did not use PPDs included difficulty/inconvenience at work caused by PPD use (71%), nonavailability (64%), and lack of time or emergency nature of work (37%). Only about one-half of the HCP opined that adequate equipment and supplies were provided to implement UPs in one Indian study.[14] Nearly half in the present study felt that it was not necessary always to use PPDs. This emphasizes the fact that mere awareness of BBIs and UPs does not guarantee an attitude ensuring compliance.

Nearly a fifth of HCP were either not vaccinated or incompletely vaccinated with hepatitis B vaccine and only a minority of those completely vaccinated had checked their post-vaccination protection status in the present study. Low rates of hepatitis B vaccination coverage, awareness of vaccination status, and post-vaccination protection status have been reported among Indian HCP in other studies.[5,14,15] Only a fifth of HCP complied with avoidance of two-hand recapping of used needles in present study [Figure 3], which is significantly lower compared to previous studies.[8,14,16] Approximately one-third of HCP in a Nigerian study[8] and two-thirds in another Indian study[6] regularly recapped needles. Despite availability, nearly one-third did not utilize needle destroyers for the disposal of contaminated needles in the present study. The latter is an important measure to reduce the NSIs that needs to be emphasized upon to HCP.

**Burden of occupational exposures**

OE to BBFs was reported by nearly half of HCP during the preceding year and only 53 formally self-reported exposures were documented in the registry prospectively during two year study period. This suggests that most of the exposures remained unreported. The stigma associated with BBIs, the fear of a positive result and its subsequent devastating consequences on career, denial of personal risk, and perceived inability to influence the outcome following exposure may be some of the factors responsible for poor reporting of exposures. At the same time, it is essential to ensure that the process of reporting exposures is simple and efficient. Provision of an electronic reporting system may improve reporting of such exposures.[19] The burden of exposures in the present study is higher compared to that reported in previous Indian studies,[6,9,10] but similar to that reported in a Nigerian study.[19] The higher burden may be due to lower adherence to barrier precautions. Exposure burden was the highest among doctors, similar to findings in other studies.[10,16] However, some studies have reported higher burden among nurses.[6,9,12] The higher burden of exposures among doctors compared to nurses in the present study may be because blood sampling and intravenous cannulation of patients in our hospital is done mostly by resident doctors and poor adherence to barrier precautions among doctors.

NSIs from hollow bore needles accounted for most of the OEs in the present study, similar to previous studies.[5-10] More than half of NSIs in the present study resulted during two hand recapping of needles, which is much higher compared to 8–34% reported in a previous Indian studies. [5,6,9,10] Hence, there is an urgent need to educate and persuade our HCP to give up this harmful practice. Other situations during which NSIs occurred were not different between present study and previous studies.[5-8,10] Despite the source being known in majority of exposures, source was not tested for BBIs in approximately one-third of the instances in the present study, which is similar to a previous study.[16] Approximately one-fifth of HCP who suffered OEs prospectively during the 2-year study period took HIV PEP, similar to another Indian study.[5]

**Limitations**

Self-reported practices and attitudes HCP could not be verified objectively, and it is likely that adherence to UPs and safe practices might have been exaggerated in questionnaire-based survey. However, study of burden of OEs prospectively over a period of 2 years enabled the assessment of actual real life practices at workplace for exposure prevention. Support staff such as house-keeping staff could not be included in the questionnaire based survey because of their illiteracy. The need to recollect exposures during preceding year might have resulted in recall bias.

**CONCLUSION**

There is scope for improvement in practices being followed for OE and BBI prevention among HCP. The present study reiterates that mere awareness of BBIs and their prevention does not guarantee for an attitude that ensures adherence to safe practices at workplace. Educational programs, apart from creating awareness, should be designed to bring about changes in the attitude of HCP to ensure adherence to safe practices.
practices. High burden of NSIs emphasizes the need for strict adherence to safe practices and demands for introduction of safety engineered needles and sharps. Poor reporting of OEs is a real concern. Provision of a simple, hassle-free reporting system and improving awareness of availability and effectiveness of post-exposure prophylactic measures for prevention of BBIs might improve reporting. A uniform national policy for prevention and reporting of OEs has to be framed. Professional training of HCP should incorporate training in OE and BBI prevention.

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Conflicts of interest
There are no conflicts of interest.

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