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## Research Article

# EDUCATIONAL PROGRAMS LEAD TO RAPID IMPROVEMENT IN UNDERREPORTING OF ACCIDENTAL EXPOSURES TO INFECTIOUS MATERIALS AMONG NURSES: A RETROSPECTIVE STUDY FROM INDIA

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### ABSTRACT

**Background:** Nurses are at high risk of occupational transmission of HIV, Hepatitis B and Hepatitis C virus infections by accidental exposure. In many developing countries awareness about this potential hazard is still poor and underreporting of accidental exposures is prevalent. Educational programs in this setting will show impact in form of improvement in underreporting before showing actual reduction of incidences. **Method and material:** This was retrospective observational study done at rural based tertiary care centre of India. We analyzed reported incidences of all 234 accidental exposures to nursing staffs and nursing students occurred in ten years period and compared data of pre-educational period of years 2004 to 2007 with period of years 2008 to 2013 during which educational programs were ongoing. **Results:** We observed 22 times rise in reporting of incidences (from ten to 224). Indirect evidences of increased awareness were also observed. 86% incidences were reported within 15 minutes of incidence in 2008-2013 period against none in 2004-2007 period. In six out of eight cases of exposure to HIV, post exposure prophylaxis was received within 12 hours in 2008-2013 period against one out of three cases in 2004-2007 period. **Conclusion:** We observed rapid improvement in underreporting of accidental exposures as an impact of educational programs. Increased awareness was also demonstrated by timely reporting of incidences and taking post exposure prophylaxis for HIV early. Educational programs in developing countries will show impact in form of improvement in underreporting in initial phase; reduction in actual incidence will occur in later phase.

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## INTRODUCTION

Occupational transmission of blood borne pathogens like HIV, Hepatitis B virus (HBV) and Hepatitis C virus (HCV) is known to occur in health care setting. WHO estimated 3 million incidences of needle stick injuries occurring to HCW every year worldwide (Hulme P, 2009). Centre for Disease Control and Prevention, USA estimated approximately 1000 incidences of HIV, 66000 of HBV and 16000 of HCV transmitted by percutaneous injuries to health care worker (HCW) by the year 2000 (Zafar A et al, 2009). Nurses form one of largest subgroups of HCWs. Being directly involved in patient care; they are at high risk of accidental exposures and consequently occupational transmission of infections (Honda M et al, 2011; Hulme P, 2009; Joardar GK et al, 2009; Mohammadi N et al, 2011; Yang YH et al, 2007; Yang YH et al, 2013). Educational programs are one of most effective tools to increase awareness and reduce incidences of such occupational transmissions. Various studies have demonstrated the impact of such educational programs in reducing incidences of needle stick injuries (Brusaferro S et al, 2009; El Beltagy K et al, 2012; Lin

Yang L et al, 2011; Mobasherizadeh S et al, 2005; Zafar A et al, 2009).

Where this holds true more for established and advanced health centres mainly of developed countries, scenario is quite different in developing countries. According to WHO report, 90% health care associated infections from sharp injuries occur in developing countries (El Beltagy K et al, 2012). So on one hand, incidences of sharp injuries are more frequent; on the other hand awareness about this potential occupational health hazard is poor among HCWs. Moreover, there is lack of well structured system of reporting as well as monitoring of such incidences. Various studies have shown significant rate of underreporting of accidental exposures due to these reasons (Askarian M et al, 2012; Balkhy H et al, 2011; Honda M et al, 2011; Joardar GK et al, 2009). In such scenario, initial focus should be to spread awareness among HCWs and to establish a system whereby all incidences of accidental exposures are reported. When awareness increases through educational programs, initially it is likely to show increased reporting of incidences of accidental exposures. This happens due to

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improvement in underreporting. Such reporting is going to reduce only later phase, once actual improvement in infection control occurs due to sustained awareness.

Our study, done at one rural based hospital of India, showed sharp rise in number of reporting of incidences as well as improvement in awareness about different aspects of occupational transmission as an impact of educational programs.

## **METHOD AND MATERIAL**

### ***Study setting and Design***

This was a retrospective observational study. This study was done at 550 beds rural based tertiary care teaching hospital situated in western part of India.

### ***Population under study, inclusion and exclusion criteria***

Hospital Infection Control Committee (HICC) started maintaining records of all incidences of accidental exposures, reported to designated physician, since 2003. Record was mentioning about name, age, sex, category of HCW, place of incidence, date and time of actual incidence, date and time of reporting the incidence, type of material to which exposure occurred, circumstances of exposure, source case's status about HIV, HBV & HCV, and details of Post exposure prophylaxis (PEP) advised. Our study included details of all reported incidences of occupational exposures to nursing staff and nursing students between the period from 1<sup>st</sup> January 2004 to 31<sup>st</sup> Dec 2013. There were 234 incidences of accidental exposure reported during this period. There were no exclusion criteria. Missing information was mentioned as 'details not available'. HICC permission was taken for academic use of these data. Human Research Ethics Committee approval was taken. This being retrospective study, waiver of consent was considered by Ethics Committee. Privacy and confidentiality of exposed health care workers as well as source patients were maintained at all levels.

## **DETAILS OF METHODOLOGY**

HICC organized first educational session about accidental exposures and its health hazards in year 2006, which covered large group of nurses but further details were not available. Since 2008, such educational programs were regularized and frequency was increased. Nurses were called in small group of 25-30 to attend educational sessions and all the nurses working across different areas of the hospital (approximate number was 380) were covered in similar way during 2008. Nursing students were also focused in similar way. Lectures were delivered by designated physicians, infection control nurses (ICN) or other members of HICC. Educational lectures were focusing on various routes of occupational transmissions of blood borne infections, percentage risk of transmission, various modes of transmission, potentially infectious and least infectious materials, common circumstances of transmission, preventive measures, importance of early reporting, importance of early PEP therapy for HIV and Hepatitis B vaccination. It also focused on existing system of reporting like whom to report, how to report, when to report etc. Re-sensitization was done again in year 2009 for all the on board nurses and nursing students. Newly joined nurses were also included in these

sessions. Additionally onsite training was also started periodically by ICN during her visits to different areas of the hospital. Such visits were 10-12 in a year. In subsequent years from 2010 to 2013, four to six lectures per year continued to occur for on board nurses as well as all newly admitted nursing students in small groups. Educational lectures were delivered to newly joined nurses within six months of their joining. Onsite training by ICN also continued during this period. Moreover importance of occupational transmission was also highlighted in infection control week celebrated four times during period of 2008 to 2013. As all the record of educational programs' details was not available, additional necessary information was gathered verbally from past and present secretaries of HICC as well as ICN.

To study the impact of these educational programs, we divided these ten years data into two groups; in first group, data was included of pre-educational period from 2004 to 2007 and in the second group, data was included of period from 2008 to 2013 during which educational programs were ongoing. We compared the data of both these groups in form of number of reporting of incidences, place of incidence, time interval within which reporting occurred after actual incidence, mode of exposure, material to which exposure occurred, circumstances of exposure, number of incidences of exposure to HIV, HBV and/or HCV positive source and interval within which PEP for HIV was started. Information of increase in number of employed nurses and increase in bed occupancy rate was collected from hospital administration.

### ***Primary and secondary outcomes***

Primary outcome was to demonstrate improvement in underreporting. Secondary outcome was to study impact of educational programs by comparing differences time interval to report, reporting from different places of the hospital, reporting of different modes of exposure as well as exposures to different material, with reduced time interval in starting PEP for HIV.

### ***Statistical Analysis***

The data was presented using descriptive statistics, frequency and proportions.

## **RESULTS**

Ten cases of accidental exposures to infectious materials were reported to HICC in period 2004-2007 against 224 in period 2008-2013 by nursing staffs & nursing students causing 22 times rise in incidences of reporting of accidental exposures [Table 1].

**Table 1** Year wise number of reporting of incidences

Study period years 2004-2007		Study period years 2008-2013	
Year	Number of reporting of incidences	Year	Number of reporting of incidences
2004	4	2008	7
2005	3	2009	31
2006	2	2010	69
2007	1	2011	34
Total (4 years period)	10	Total (4 years period)	141
--	--	2012	54
--	--	2013	29
Total (4 years period)	10	Total (6 years period)	224

We compared equal period in both the study groups of four years, 14 times (10 to 141) rise in reporting of incidences was observed [Table 1]. Yearwise trend showed sharp rise in reporting of incidences in 2009 and it continued in subsequent years as shown in [Figure 1].

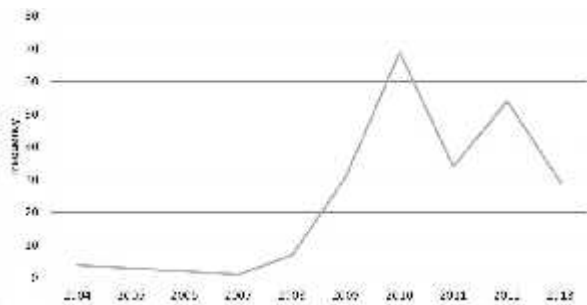


Figure 1 Yearwise trend of reporting of incidences of accidental exposure

As per information from hospital administration, there was approximate 15% increase (from average 330 to average 380) in nursing staff from period of 2004-2007 to period of 2008-2013 and approximately 10% increase (from average 250 to 280) in bed occupancy by patients.

In both the periods, incidences were reported from ICUs, emergency ward and general wards but cases were also reported from OPDs, operation theatre, radiology department, labour room and dialysis unit in period 2008-2013. There were no case reports from these places in period 2004-2007.

Time interval of reporting of incidence to designated physician from actual time of incidence showed that before 2007, none of the reporting happened before 15 minutes. After 2007, 86% reporting occurred within 15 minutes, out of which 46% were within five minutes as shown in [Table 2].

Table 2 Time interval of reporting of incidence to designated physician from actual time of incidence

Time interval of reporting of incidence to designated physician from actual time of incidence	Year 2004-2007 (%)	Year 2008-2013 (%)
Within 5 minutes	0 (0)	103 (46)
6-15 minutes	0 (0)	89 (39.7)
More than 15.01 minutes	8 (80)	31 (13.9)
Details not available	2 (20)	1 (0.4)
Total	10 (100)	224 (100)

In period 2004-2007, seven incidences were due to needle injury or sharp cuts and three incidences were due to exposure to non-intact skin. In period 2008-2013, although 208 incidences were due to needle injury or sharp cut and eight were due to non-intact skin; five incidences were also reported of exposures to mucus membrane and three of exposure to intact skin; no such exposures reported in pre-educational period.

Blood was the most common body fluid to which exposure had occurred in both the periods but five incidences of exposure to non infectious material and one incidence to least infectious material was also reported in period 2008-2013; no such exposures reported in pre-educational period. Least infectious material included exposure to saliva, sputum, tears, vomitus, urine, feces (unless contains visible blood) and non-infectious material included exposure to material which does not contain any infectious body fluid.

Most common circumstance of exposure was taking peripheral IV access in 2004-2007 period, while it was checking random blood sugar by glucometer in 2008-2013 period as shown in [Table 3].

Table 3 Circumstances of exposure

Circumstances of exposure	Year 2004-2007	Year 2008-2013
While checking RBS by glucometer	0	75
While taking peripheral IV access	5	42
While taking blood sample from peripheral veins	3	36
While giving IV / IM drugs	0	13
While giving insulin	0	8
While cutting needle through needle cutter	0	11
Used needle kept open in tray, bed or wash basin	0	7
While taking sample for arterial blood gas analysis	0	3
Injury while cutting through knife blade	2	2
While taking central line	0	1
While taking / assisting sutures	0	3

Exposure to HIV, HBV & HCV is shown in detail in [Table 4]; no case of sero-conversion was reported in either of the periods of available data.

Table 4 Exposure to HIV, HBV and HCV

Exposure to	Year 2004-2007	Year 2008-2013
HIV	7	8
Hepatitis B	3	16
Hepatitis C*	0	4
Total exposures where source was positive for infectious viruses	10	28
Out of total incidences reported	10	224

(\*Hepatitis C was not tested in 7 of the total 10 incidences in 2004-2007 period and 2 of the total 224 incidences in 2008-2013 period.)

PEP for HIV started early in 2008-2013 period as shown in [Table 5].

Table 5 PEP for HIV started within

PEP for HIV started	Year 2004-2007	Year 2008-2013
Within 12 hours	1	6
12.01 to 72 hours	1	2
PEP not indicated (>72 hours)	1	0
Details not available	4	0

## DISCUSSION

### Improvement in underreporting

Twenty two times increase of reporting of incidences of accidental exposure in 2008-2013 period was observed. There was 15% increase in nursing staff and approximately 10% increase in bed occupancy by patients from period of 2004-2007 to period of 2008-2013. We could not get the details of percentage increase in procedures, involving risk to HCW, over this ten year period. Yet these factors were unlikely to cause twenty two times increase in reporting of accidental exposures solely. Result showed that even when we compared equal period in both the study groups of four years, 14 times (10 to 141) rise in reporting of incidences was observed. Hence different number of years in both study periods was also not contributing factor. With all these observations we believe that

increased awareness among nurses due to educational programs was important contributing factor in this sharp rise in reporting of incidences. This also shows that incidences were very likely happening with same proportion in pre-education period also but because of lack of awareness they were not reported. Educational programs spread awareness about reporting all the incidences of accidental exposures as well as about the system of reporting e.g. whom to report, how to report, when to report. This caused sharp rise in 2008-2013 period.

As shown in Figure 1, yearwise trend showed sharp rise in period 2009 and this also continued in 2010. As all the nurses were covered under educational campaign, good awareness about reporting was there from beginning of 2009. Further year wise analysis suggests incidences were highest in 2010 and showing declining trend after that except some rise in 2012. This possibly suggests improvement in the infection control practices and hence reduced actual incidences. Nevertheless to establish that actual incidences have reduced, it will require further monitoring of data in subsequent years. While various studies have demonstrated reduction in incidences of accidental exposures as an impact of educational programs or other interventions (Brusaferro S *et al*, 2009; El Beltagy K *et al*, 2012; Lin Yang L *et al*, 2011; Mobasherizadeh S *et al*, 2005; Zafar A *et al*, 2009), this more holds true where primary awareness to report all the incidences as well as about dedicated system is already there to report and record such incidences. In resource limited and developing countries like India, where underreporting is still prevalent, educational programs would show its impact by initial rise in number of reporting. This was well demonstrated in our study. In later phase it will show gradual decline due to improvement in infection control practice and actual reduced incidences. Similar trend was also observed in our study from 2011.

In a study by Hanan H. Balkhy and colleagues from Saudi Arabia showed significantly lower rate of needle injuries when they compared their data with US data (Balkhy H *et al*, 2011). One of the reasons thought was underreporting of the incidences. Study by Zafar A and colleagues from Pakistan also showed increased trend of reporting in initial year, although it was in pre-intervention period (Zafar A *et al*, 2009). Yang YH and colleagues from Taiwan studied impact of educational programme among soon graduate vocational nursing school students showed increased reporting from 37% to 55.6% among nursing staffs with reduced incidences from 50 % pre test to 25 % post test Yang YH *et al*, 2007. Although underreporting was identified in various studies (Askarian M *et al*, 2012; Balkhy H *et al*, 2011; Honda M *et al*, 2011; Joardar GK *et al*, 2009), we could not find any other study demonstrating rapid improvement in underreporting of incidences of accidental exposure.

#### **Places of accidental exposures**

Reporting from ICUs, IMCs and emergency wards was increased proportionally but reporting also occurred from OT, labour room, OPD, radiology department & dialysis unit which had not occurred in earlier period. This suggests widespread awareness among nursing staffs and nursing students working at different areas of the hospital as these were covered by educational programs.

#### **Time interval of reporting of incidence to designated physician from actual time of incidence**

Reporting of accidental exposures to the designated physician should be as early as possible to initiate further post exposure prophylaxis measures at earliest. In case where victim requires taking PEP for HIV or HBV, earlier the treatment taken, is more effective. Before 2007, none of the reporting happened before 15 minutes. After 2007, 86% reporting occurred within 15 minutes, out of which 46% were within five minutes [Table 2]. This was result as an impact of educational program as importance of quick reporting was well highlighted during educational programs.

#### **Reporting of exposures by different routes**

Although exposure by needle injury remained the most common mode of exposure during both periods, five incidences of exposure by mucus membrane and three incidences by exposure to intact skin reported after 2007; it shows that awareness about significance of various modes of exposure especially other than needle injury was increased among nurses and they started reporting of exposures by these modes also. Although transmission of infection does not occur with intact skin, this suggests increased awareness to atleast report the incidence.

#### **Reporting of exposures to different materials**

Reporting of exposure to non infectious material and least infectious material although suggests anxiety and panic among staff yet it suggests increased awareness and educational programs should continue to focus on spreading awareness about different infectious material other than blood.

#### **Circumstances of exposures**

There were reporting of incidences in 2008-2013 period with circumstances like checking RBS by glucometer; giving insulin; cutting needle through needle cutter; injury by needle kept open in tray, bed or wash basin, injury while taking arterial blood gas sample etc suggests again widespread awareness among staffs [Table 3]. At the same time, details of these types of circumstances can be focused in educational programs to minimize incidences by varieties of circumstances at particular health care centre.

#### **Exposures to HIV and Hepatitis B**

All cases reported during or before 2007 were of exposure to either HIV or HBV [Table 4]. Staff had tendency to report only those incidences where source patient was already detected positive for some of transmissible diseases. During educational programs importance of reporting all incidences, whether source status for potentially infectious viruses is known or unknown, was highlighted & impact was there.

Three incidences of exposure to Hepatitis B occurred before 2007 and 16 after that. There may various possible reasons for this difference. First, comparative study periods were four years Vs six years. Second, advancement in laboratory technology over these ten year period might have started detecting the cases with increased sensitivity. Third likely reason might be more detection of otherwise silent HBsAg positive carrier patients due to increased reporting. As 224

incidences of accidental exposure were reported in period 2008-2013, such silent carriers could be diagnosed during source testing. In the period of 2004-2007, staff had tendency to report those cases that were already detected positive before the accidental exposure and hence in remaining unreported exposures they remained undetected. Chance of transmission of Hepatitis B through accidental needle injury in non-vaccinated individual remains 6-30%. This suggests significance of reporting all accidental exposures irrespective whether they are already tested for potentially transmissible viruses or not.

#### **Timing within which PEP for HIV was started**

Benefit will be more if PEP for HIV is started early, preferably within two hours of exposure. Guidelines are suggestive that there is questionable role of PEP if started after 72 hours where side effects of Anti-retroviral (ARV) may over weigh the benefits & hence in such scenarios it is not recommended (Center for Disease Control & Prevention, 2001). It is not possible to comment over actual impact in our study as four out of seven cases detail was not available in 2004-2007 period but atleast awareness to take early PEP was evident in 2008-2013 period [Table 5]. Over and above focusing on reporting of all incidences as early as possible, HICC has also focused on early testing of all such samples by microbiology department & prompt availability of ARV.

While sharp rise in number of reporting in 2008-2013 was clear and direct evidence of impact of educational programs; reduced time interval to report, reporting from different places of the hospital, reporting of different modes of exposure as well as exposures to different material, with reduced time interval in starting PEP for HIV were indirect but equally important evidences of increased awareness among nurses about risk of occupational transmission.

#### **Limitations of the study**

There were various limitations also in our study. This was retrospective observational study; to study the impact of educational programs data was taken from reported incidences to HICC rather than by survey of all nurses. Neither educational interventions were well structured nor were all the details recorded. Baseline knowledge of nurses before participating in educational programs was not known. Detail of yearwise turnover of nurses was also not available. Nonetheless it clearly established impact of educational programs on improvement in underreporting as well as increased awareness about occupational transmission in an indirect way. It showed impact of educational programs over early reporting of incidences, reporting exposures to different modes as well as infectious & non-infectious material and taking PEP for HIV early; all these were adequately highlighted during educational programs.

#### **CONCLUSION**

Nurses, being directly involved in patient care, are at high risk of accidental exposure and consequently occupational transmission of blood borne pathogens like HIV, HBV and HCV. While studies from various countries, have demonstrated reduction in incidences of accidental exposures as an impact of educational programs and other interventions; underreporting is still highly prevalent in many health care centres mainly of developing countries. Even though it was retrospective study,

we observed rapid improvement in underreporting of incidences of accidental exposures which was likely because of increased awareness due to educational programs. Many health care centres of developing countries, where awareness about occupational transmission is poor, are likely to show similar improvement in underreporting after educational programs; reduction in reporting is going to occur in later phase with actual improvement in infection control practice. We also observed tendency to report the incidence timely without delay, reporting from different areas of the hospital and tendency to start PEP for HIV within time by victim HCWs. These also served as, although indirect, important evidences of increased awareness among nurses due to educational programs.

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