Economic Impact of Needle Sticks Injuries – A Retrospective Study from A Tertiary Care Hospital

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ABSTRACT

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Background: Needle stick injuries (NSI)s involve loss of economy at different levels to an institution which is often not addressed in many of the related studies. An assessment of such issues in terms of the money involved can actually help in planning cost effective strategies in preventing them by policy makers and hence we decided to conduct this study

Objectives: We attempted to find out the direct and indirect costs involved in managing the occupational exposures by the institution during a 2 year period

Materials and Method: This was a retrospective observational study on all the reported cases of occupational exposures (OEs) to health care workers (HCWs) that had occurred during the study period. Direct and indirect costs involved were calculated as per the CDC definition.

Results: We found that on an average each occupational exposure costs INR 4791 to the in-stitution in total which include INR 3556 and INR 1235 as direct and indirect costs respectively.

Discussion: The economic burden on the institution in managing occupational exposures to HCWs is considerable and warrants implementation of effective preventive strategies to minimize this loss. The results of the present study represent issues faced by any similar establishment in a developing country and can be used to plan cost effective intervention strategies

Keywords: Needle stick injuries, Direct costs of NSI, Indirect costs of NSI, Occupational exposures

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BACK GROUND

Occupational exposures (OEs) to blood and body fluids occur frequently to health care workers (HCWs) in a hospital. Needle stick injuries (NSIs) and splashes to mucous membranes are common accidental exposures reported to health care personnel. World Health Organization reports that, out of the 35 million health-care workers worldwide, 2 million experience percutaneous exposure to infectious diseases every year. Exposures to infectious body fluids have the potential to transmit any of the blood borne pathogens,[1,2] however the majority are by HIV, HBV and HCV. Also 37.6% of Hepatitis B, 39% of Hepatitis C and 4.4% of HIV/AIDS in health care workers around the world are due to needle stick injuries.[3] In our centre we found that occupational exposures are occurring at a rate of 2.8% per annum.[4]

The financial impact of NSI includes both direct and indirect costs. The direct costs include that of the base line and follow up investigations for the source and the health care worker, post exposure prophylaxis including vaccines and medicines that may be required. The indirect expenses include the loss of productivity due to absence from duty of HCW and the time and the efforts involved by the treating team. The psychological trauma and legal implications following such injuries also are considerable.

OBJECTIVES

This study attempts to find out the economic impact associated with OEs to body fluids among HCWs in our hospital.

MATERIALS AND METHOD

This is a descriptive and retrospective study on the occupational exposures (OEs) to blood and body fluids by HCWs in a 1800 bedded tertiary care teaching hospital. We tried to estimate the expenses incurred on the hospital due to the OEs that had occurred during

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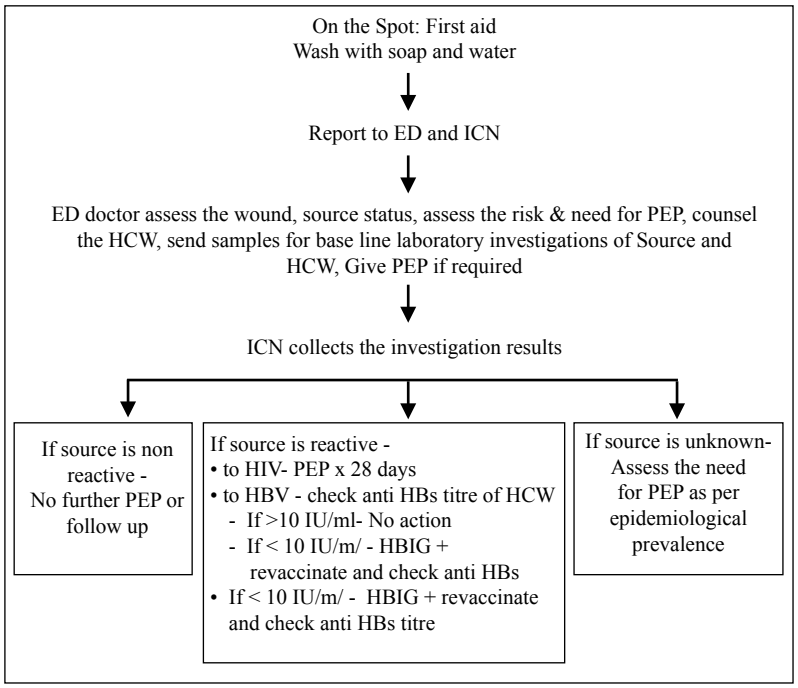

ED- Emergency department; PEP – post exposure prophylaxis; ICN – Infection control nurse; HBIG-Hepatitis B Immunoglobulin; HCW-health care worker

Figure 1. **Protocol for management of occupational exposures in our centre**

a two year period from June 2015 to May 2017. The study was done after obtaining institutional ethical clearance.

The cost of the OE was calculated under two categories as per the CDC definitions - direct and indirect costs.[5]

- Direct costs included cost of baseline and follow-up laboratory testing of an exposed healthcare worker, testing the source patient and cost of post-exposure prophylaxis (PEP) and other treatments provided.
- Indirect costs included lost productivity associated with the time required for reporting and receiving initial and follow-up treatment for the exposed HCW, time spent by the healthcare provider to evaluate and treat an exposed employee and to evaluate and test the source patient, including obtaining informed consent for testing

Collection of data:

Data regarding the OE was collected from the register for occupational exposures maintained by the Hospital Infection Control Committee (HICC).The hospital policy on management of occupational exposure is shown in **Figure 1.** The policy is based on based on the NACO guidelines for HIV and CDC guidelines for HBV and HCV.[6] Since all the hospital staff are immunized against Hepatitis B, quantitative estimation of anti HBS titre of the HCW also is done. All the details are documented in the OE Register.

Data on the baseline and follow up laboratory investigations done for exposed HCW and the source (if known), details of PEP, vaccines and immunoglobulin given during the study period were collected. Expenditure met by the institution in each of the above mentioned categories was calculated. The time spent by the exposed HCW on each of these incidents for reporting and receiving treatment and getting counseled for the investigations and the time spent by the infection control nurse for evaluating the injury, counseling and arranging for the investigations were calculated.

RESULTS

There were 172 incident reports of OEs to HCWs in the OE register during the study period of two years. Among them 161(93.6%) incidents were needle stick injuries and 11 were splashes to mucous membranes.

Among the 172 incidents the source of exposure could be identified in 93(54%) cases and all of them were patients. In 79(46%) cases the source was unknown.

Direct Costs

1. Cost of baseline investigations:

The cost of the baseline laboratory tests for the 172 exposed and 93 source patients HCWs was INR 2,93,300 which include ELISA for HIV, HBV, HCV and anti HBs antibody titre(for HCW only) as shown in **Table 1.**

Among the 93 source patients 16(17%) were reactive and 77 nonreactive to the base line HIV,

Table 1. Cost of baseline investigations

Category	HIV @INR 200 ($)	HBV @INR 140 ($)	HCV @INR 280 ($)	anti HBs @INR 750 ($)	Total INR ($)
exposed HCW (n=172)	34400 (529.25)	24080 (370.5)	48160 (741)	129000 (1984.5)	235640 (3625.2)
source patients (n=93)	18600 (286)	13020 (200)	26040 (400.61)	-	- 57660 (887)
Total	53000 (803)	37100 (570)	74200 (1141.5)	129000 (1984.5)	293300 (4512.3)

Table 2. Cost of HIV PEP

Category	Number	expenditure INR($)
exposed HCWs with source known & positive	3	22600 (347.6)
exposed HCWs with unknown source	8	60264(927)
immediate first dose	146	39420(606.4)
Total expense		122284(1884)

HBV and HCV tests by ELISA tests. Of the 16 reactive sources 3 were reactive in tests for HIV, 7 to HBV, 5 to HCV and one to syphilis.

2. Cost of post exposure prophylaxis:

Cost of HIV PEP: All the three HCWs who got exposure to HIV reactive patients were given PEP with anti retroviral agents for 28 days as per the institutional policy based on NACO guidelines for which the amount spent was INR 22600. After the risk assessment 8 HCWs with unknown source were also advised 28 days prophylaxis and they had taken it which cost INR 60264. One hundred and forty six HCWs had received first dose of HIV PEP before the results of the laboratory tests became available which had cost INR 39420. Thus the total amount spent for HIV PEP was INR 122284 (as shown in **Table 2**)

Cost of HBV PEP: Protective levels of anti HBs antibodies (10 mIU/ml) were present in six of the seven HCWs who got exposure to HBV reactive patients. Hep B immunoglobulin (0.06 IU/ml) was administered to the HCW who was not having protective titre of anti HBs antibodies along with full course of the Hep B vaccine which had cost INR 5000/-.

In one subject anti HBs titre was <100 mIU/ml who was given one booster dose of Hepatitis B vaccine as per the hospital policy. In the cases where sources were unknown, five of the HCWs on screening for anti HBs titre showed less than 10 mIU/ml. They were advised to take the full course or booster dose of Hepatitis B vaccine accordingly. The amount spent for Hep B vaccine and booster doses include INR 1200. Thus the amount spent for Hep B prophylaxis was INR 6200. One HCW who was exposed to syphilis patient's blood was given penicillin prophylaxis which cost INR 20.

Tetanus prophylaxis was given in 96 cases spending INR 1152.

The total cost of PEP met by the institution was INR 129656 (1994.6$)

Table 3. Summary of Direct costs

Category	Baseline tests		PEP INR	Follow up INR
	Source INR	HCW INR		
HIV	18600	34400	122284	57000
HBV	13020	153080	6200	11810
HCV	26040	48160		119800
Others syphilis, tetanus	-	-	1172	150
Total	57660	235640	129656	188760
Grand Total	611716 (9411 $)			

3. Cost of the follow up laboratory investigations:

In 95 HCWs (whose source status was unknown or reactive) follow up was done by HIV and HCV ELISA at 6 weeks, 3months and 6 months that had cost INR 57,000 and INR 79,800 respectively. HBV ELISA was repeated in 4 HCWs with low anti HBs titre which cost INR 560. Anti HBs antibody titre was repeated in 15 HCWs who had taken vaccine or booster doses which had cost INR 11250. In 5 incidents where the sources were reactive in HCV ELISA, PCR was done for the early detection of infection at 6 weeks and 3 months following exposure that had cost INR 40,000. Repeat RPR test was done for the HCW exposed to syphilitic blood that had cost INR 150. Thus the total amount spent for follow up laboratory investigations was INR 188760.

Thus the total direct cost met by the institution for 172 occupational exposures was INR 611716 which cost on an average INR 3556 per needle stick injury **(Table 3).**

All of them remained nonreactive in the follow up screening at 4 weeks, 3 months and 6 months.

Indirect Costs:

Indirect cost was calculated in terms of time spent on managing the episodes of NSIs by the exposed HCWs, infection control nurses and other staff and the doctors **(Figure 2).** Three of the exposed HCWs whose sources were positive had lost approximately one week on an average on account of their absence from duty while they were taking HIV PEP which is equivalent to loss of approximately 168 hours. Rest of the HCWs had lost on an average 3 hours with a total loss of approximately 507 hours. Approximately

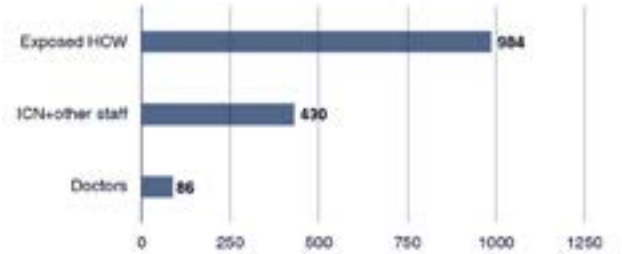

Figure 2. **Average time in hours lost for managing NSIs in two years**

Table 4. Direct and Indirect cost of NSI

Category	Type of work up	Cost in INR	% of Total cost
Direct		**611716**	74
	initial lab tests	293300	35.58
	PEP	129656	15.7
	follow up lab tests	188760	22.9
Indirect		**212440**	26
Total		**824156**	

309 hours were spent during the follow up sessions for them. Thus the total loss for the exposed HCWs was approximately 984 hours. Each episode of OE had resulted in a loss of approximately 2 hours for the infection control nurses and half an hour for the other ward staff with a total loss of 430 hours. The doctors had spent around 30 minutes on each episode on assessing the risk, counseling for investigations and PEP and prescribing medicines depending on the situation which resulted in a loss of around 86 hours for them during these 2 years. Thus approximately 1500 hours of the hospital staff was utilized during the study period which would be 8.72 hours per incident (523 minutes)

Converting the time lost into money in terms of the wages involved per hour we found that a total of INR 2,12,440/ $3268 was lost during these 2 years on OEs. This included INR 176750 for nursing staff (@ INR 25000 as average salary) and INR 35690 for doctors (@ INR 10000 as average salary). Thus the indirect cost of NSI during the study period per episode is approximately INR 1235 ($ 19).

The total expenses met by institution during the study period (Direct + Indirect costs) was INR 824156 ($ 12679) with an average of INR 4791 ($ 73.7) per exposure. Direct cost comprised of seventy four percent of the total expenses as shown in **Table 4**

DISCUSSION

Assessing the economic impact of NSIs is an important component of effective implementation of sharp injury prevention strategies in a health care system. But there are few studies from India that include this aspect of the needle stick injuries occurring to health care workers. In the present study we attempted to measure the financial loss to the institution due to needle stick injuries occurring to HCWs. Both direct and indirect losses were assessed. Understanding the problem in terms of cost- direct and indirect- would have more potential to influence the policy planners and managers as they are more familiar with planning in terms of money value.

During the two year study period a total of 172 incidents of occupational exposures had been registered in our hospital. Among them 161 were needle stick injuries and 11 were splashes to mucous membrane.

Among the economic impacts, the direct costs as per the CDC definition include the costs of baseline and follow up investigations for the exposed HCW and the source and post exposure prophylaxis given. In our study the cost of the immediate laboratory work up was found to be 35% of the total cost. In a similar study laboratory costs for the exposed health care personnel comprises 25% of the overall costs of the management of the HIV exposure where as laboratory costs for the source patient comprised only 4%.[7] In our study 38.5% of the direct costs was for the laboratory work up of exposed HCW whereas the work up of source comprised only 9% of the direct costs.

In the baseline workup the source patients were found reactive to blood borne pathogens only in 9% (16/172) of the total NSIs. A similar study had reported that 19(61%) of the 31 observations involved HIV exposures and only 8(25%) involved source patients who were uninfected or had unknown infection status.[7] In the CDC's occupational surveillance system (NaSH), only approximately 5% of the reported exposures to blood and body fluids involved source patients infected with HIV and approximately 12% involved any blood and blood borne pathogens which is similar to our findings.[7]

Expenditure on PEP during the study period by the institution was INR 129656 which was 21% of the total direct cost. The cost of HBV prophylaxis was only 4.8% of our total PEP cost and 1% of the total direct cost. As a part of the health worker safety policy of the hospital all the HCWs are provided free HBV vaccination which has drastically reduced the requirement of HBV PEP in our study.

The total direct cost of occupational exposure management incurred on the institution was INR 611716 (9411 $) which on an average was INR 3556 (54.7 $) per incident. CDC estimated that average baseline expenses associated with NSI or other blood exposures ranged from less $ 500 to $3000.[8] A review by Alice et al[9] had reported that in most of the studies the direct costs were represented by laboratory tests but the tests performed on source patient and HCW varied to a great in different studies. In US the estimated average cost per exposure to the healthcare institution ranged from $51 to $3,766 (in 2002 US dollars) according to a review by Lee et al[10]. They had observed that the variability in costs was a result of differences in

study methodology and/or the protocols for exposure management in the study institutions. Jagger et al[11] had reported an average direct cost of percutaneous injuries from two hospitals as $ 671 and $ 539. At a tertiary care hospital in Mumbai approximately INR 9000 per HCW per NSI episode are incurred as short term costs.[12] The average cost of the post exposure management for staff observed in a centre from South India,[13] inclusive of the vaccination and patient blood sample, was INR 9180 ($144) whereas a similar other studies from South India had reported the direct costs of NSI on an average as INR 2802 and INR.2086 respectively.[8,14] Cost of initial post exposure treatment varies widely and depends on the situation faced by the injured workers. Also cost associated with NSI could be dramatically higher if the injury resulted in an infection and could be several hundred dollars or even millions of dollars(OSHA).[9,15]

Although the risk of transmission may be low, the psychological trauma and legal implications that follow such injuries can be considerable. Exposed HCW face the uncertainty of their infection status in the immediate period following the injury. Explaining to their families that they are taking anti-retroviral drugs for possible HIV infection from an NSI is causing additional trauma. Issues like anxiety, personal impact, adverse effect on work performance etc cannot be always calculated in money. The indirect costs as per the CDC definitions are calculated in terms of the loss of productivity associated with time spent by the exposed HCW and the hospital staff for reporting, injury assessment, investigations etc.

In the present study we also attempted to analyse the indirect expenses involved in terms of the time lost by the involved HCWs and other hospital staff. We found that approximately 523 minutes were lost per episode of occupational exposure for various procedures involved. On converting this loss of time into the money involved according to the wages of the hospital staff we found that approximately INR 1235(19 $) was spent on each episode of OE. A similar study reported that HCP exposed to HIV spent a mean of 459 minutes for reporting exposures and engaging in follow up of exposures which represented a mean of $249 in wages.[7]

These cost data derived from our study could be used to perform a cost effective analysis of adopting preventive measures like use of safety devices or providing training to HCWs on safe handling of sharp in our hospital.

CONCLUSION

The management of occupational exposure is expensive and imparts significant economic burden on the institution. The costs could be much higher than we estimated if we consider the fact that such incidents are largely underreported. Hospitals should analyze the root cause of such incidents and devise plans for the prevention of such mishaps. We would like to emphasize that Hepatitis B vaccination for HCWs should be made mandatory in all hospitals at the time of joining itself since it can protect the HCW against HBV which is much more transmissible than HIV and HCV. The hospitals should have a clear cut NSI policy to capture all incidents occurring in the hospital with an active PEP program. Along with repeated awareness classes strategies to implement the use of safe needle less devices can reduce such injuries to a great extent

END NOTE

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Editor's Remarks: All Health Care Workers have experienced Occupational Exposures. This original research retrospective and descriptive study deals with the expenses incurred to the hospital due to OEs and details a plan to fight these expenses by a multi-pronged strategy.

Conflict of Interest: None declared

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