THE RISK OF OCCUPATIONAL HIV EXPOSURE AMONG THAI HEALTHCARE WORKERS

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Abstract. To analyze the incidence of occupational exposure to HIV in a large group of healthcare workers at the 2 Thai Red Cross hospitals, prospectively collected during a seven-year period in order to find out the causes and circumstances that prone to exposure, the interventions that may minimize the exposure and the consequences of the accidents. The first 200 incident reports from 198 hospital workers of the Thai Red Cross Society who had occupational exposure to HIV-infected blood and body fluids during 1991-1997 were analyzed. We analyzed the demographic data, the timing and place of exposure, the nature and cause of exposure, HIV status at baseline and at follow-up at 3, 6 and 12 months as well as the received antiretroviral prophylaxis. All of the 198 HCW had negative anti-HIV at baseline and remained negative throughout the one-year follow-up although only 55% submitted the results of their anti-HIV testing at 6 months. However, none claimed for work-related life insurance against HIV during those 7 years indicating that nosocomial rate of transmission is less than 1 in 200 or less than 0.5%. Analysis of the incidents indicated that the risk group was the 20-40 years old nursing personnel who worked in the medical wards during the regular working hours. The procedures that were responsible for most of the injuries were venepuncture, intravenous access, injection and waste collection. Most of the injuries could be prevented if the work place safety guidelines were strictly followed and if personnel were more careful at work. The results can be used to implement more effective preventive measures for hospitals in Thailand. Postexposure management at the Thai Red Cross hospitals conformed with the international guidelines. However, only 78% of those who should receive postexposure prophylaxis were recommended for treatment and only 69% of those recommended actually took the treatment. This emphasizes the need to educate clinicians involved in postexposure care as well as to ensure them and the injured subjects about the safety of the antiretroviral prophylaxis.

INTRODUCTION

Acquired immunodeficiency syndrome or AIDS is the disease that was most mentioned in the last decade due to its high infectious rate, worldwide spread, multitudes of complications that lead to high morbidity and mortality. It is caused by the infection with the human immunodeficiency virus (HIV), the RNA virus in the *Retroviridae* family. HIV infects and destroys T-lymphocytes resulting in progressive impairment of T cell functions which are primarily responsible for various HIV-related complications (Fauci and Lane, 1997) . In spite of the rapid progress in the basic and clinical HIV researches, it is still not possible to find cure or effective preventive vaccine. The advent of highly active antiretroviral therapy (HAART) which includes reverse transcriptase inhibitors and protease inhibitors offers the hope to the patients to live longer with better quality of life (Lifson, 1998). However, they are expensive and carry a lot of side effects. Therefore, the best way to control HIV infection is prevention by risk reduction.

There are 3 well documented modes of HIV transmission. The first one is by sexual contact in which blood and high-risk secretions (seminal fluid and vaginal secretion) are exchanged. The second one is by vertical transmission from HIV infected mother to her child. The last one is by inoculation of infected blood or high-risk secretions either by needle sharing or by needle-stick injuries, or by splashing onto mucous membrane/broken skin (Friedland and Klein, 1987). However, there is no evidence that HIV infection can spread through saliva, tear or urine. Nowadays, most hospitals in Thailand are facing a large number of HIV patients. As a result, healthcare workers (HCW) are at a greater risk to contact HIV infection through their work. Most hospitals are trying to control and solve this problem in order to reduce the incidence of occupational HIV transmission. This report is the first study in Thailand to analyze the incidence, the cause and effect of the occupational exposure to HIV in Thai HCW using the data of the Thai Red Cross Society

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which has been prospectively collected since 1991. It is hoped to arrive at some intervention strategies that may reduce the risk of future exposure.

MATERIALS AND METHODS

To enhance the work morale, the Thai Red Cross Society (TRCS) has adopted a policy to insure its employees against job-related HIV infection since early 1991. In order to establish that the HIV infection is caused by that particular accidental exposure, all healthcare workers (HCW) are required to report the incidents immediately to their work supervisors to witness the accident. They then need to consult an infectious disease expert or a senior medical house-staff on duty within 2 hours after exposure to determine the need and the type of antiretroviral prophylaxis. They also need to get an HIV serological testing within a few days of exposure and the results have to be negative. Anti-HIV test will be repeated at 3, 6 and 12 months after exposure and all the results including the incident report forms will be confidentially reported to the Director of the Thai Red Cross AIDS Research Center. Anyone with established work-related HIV infection will be compensated with a large sum of money and will be cared by the hospital throughout the course of infection. After death, patient's family will immediately receive another amount of compensation money. As a result of this policy, almost all work-related accidents in all TRCS employees will be reported, at least at the time of injury.

The descriptive data in this study were derived from the 209 incidental reports submitted to the Thai Red Cross AIDS Research Center from July 1991 to December 1997. The incident report form contains the following informations : demographic data; date, time and place of exposure as well as the nature of exposure; the HIV status of the source patient and of the HCW at the time of exposure; and the chemoprophylaxis recommended and actually taken by the HCW. The follow-up HIV status was obtained from the follow-up incident report form as complete as possible.

RESULTS

The incidence of occupational risk exposure

Of the 6 Divisions and the 4 Specialized Units of TRCS which have direct patient contact, all incident reports came only from 2 Divisions, namely, the Chulalongkorn Medical School Hospital in Bangkok and the Somdej Si Racha Hospital in Chon Buri Province, 90 km southeast of Bangkok. Of the 209 incidents reported to the Thai Red Cross AIDS Research Center, 9 were excluded from analysis. These are the cases of having no chance of acquiring HIV infection (Lifson, 1998; Friedland and Klein, 1987): 4 were stuck by needles, prepared to use with HIV patients, 3 exposed to saline from the IV set of the HIV patients by their mucous membranes, and the remaining 2 had skin contact with urine from the HIV patients.

Therefore, only 200 incidents were subjected to analysis, 166 from Chulalongkorn Hospital and 34 from Somdej Si Racha Hospital. These 200 incidents were from 198 individuals during the 7 years period (1991-1997). There was one individual who was exposed 3 times. This is a surgical staff at the Chulalongkorn Medical School Hospital who had skin contact with high-risk body fluids on three occasions; July 1991, October 1994 and June 1997.

The annual incidence of the 200 analyzable cases from 1991 to 1997 is shown in Fig 1. The incidence was highest in 1994 and reached plateau in 1996-1997. The change in annual incidence was reflected only by reports from Chulalongkorn Hospital whereas those from Somdej Si Racha Hospital seemed to be relatively stable during the last 5 years.

Category of healthcare workers at risk

Nurses constituted the largest group of HCW at risk (103 of 200 or 51.5%) , followed by nurse-aids (32 of 200 or 16%), doctors (20 of 200 or 10%), medical students and laboratory technicians (11 of 200 or 5.5% each). The other 23 healthcare workers were housekeepers (13 of 200 or 6.5%), paramedics (5 of 200 or 2.5%) and laundry workers (5 of 200 or 2.5%)

Age and sex

Table 1 summarizes the age and sex of the 200 HCW at risk. Female HCW were 4.7 times more common than male HCW and HCW between 21-30 years were at the highest risk.

Places of accidents

Places of the accidental injury were categorized into high-risk and low-risk wards. The former includes emergency room, operating room, delivery room, ICU (intensive care unit) , IMCU (intermediate care unit) and CCU (coronary care unit) where many blood-exposure procedures are done in hurry. The latter includes the general wards of all fields of

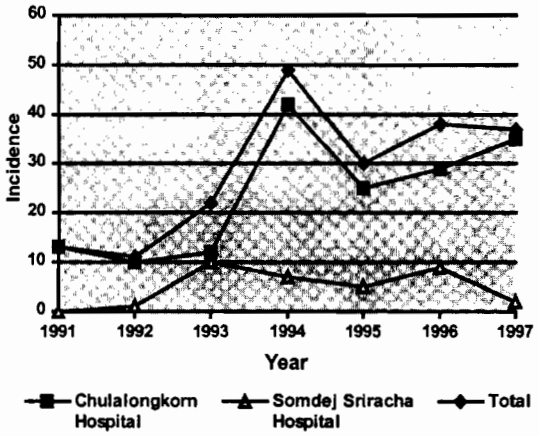

Fig 1–Annual incidence of the 200 analyzable cases by hospital and years.

medicine as listed in Table 2. The result are contrary to what have been expected (Table 2), the highest exposure rate occurred in the medical ward (58 or 28.5%), followed by the emergency room (29 or 14.5%). The ratio of low risk to high risk ward was 2:1

Hours of exposure

Hours of exposure were subdivided according to the three 8-hour working shifts, namely, 0.00-8.00, 8.00-16.00 and 16.00-24.00. As shown in Table 3, accident occurred most often during the normal working hour, *ie*, 8.00-16.00.

Types of exposure

Of the 200 incidents, 158 (79%) were needle-stick injury whereas 42 (21%) were non-stick body fluid exposure. We further analyzed the needle-stick injury group which was the major group according to patient's serological status and degree of injury (Table 4) and according to the anatomical area of injury (Table 5). It is evident that of the 158 needle-stick injuries, 108 could be considered as high-risk exposure, *ie*, puncture with sharp objects used in HIV-positive or HIV-negative individuals with risk behaviors which resulted in bleeding of the injured sites (Table 4). Further more, 145 of the 158 cases (91.8%) injury occurred at hand area, and predominantly on the left hand (68.3%) especially the left index finger and the left thumb (24.1 and 17.1% of all needle-stick injuries respectively; Table 5).

For the non-stick body fluid exposure group, the incidents were analyzed according to the type of body fluid, patient's serological status and the exposure area. Type of body fluid was further categorized into high-risk and low-risk fluids. The former includes blood, cerebrospinal fluid (CSF), semen, vaginal secretion and any blood-stained fluid whereas the latter group includes urine, saliva and any body fluid without blood-staining (Fauci, 1997; Friedland and Klein, 1987) (Table 6). Of the 42 non-stick body fluid exposure, 27 (64.3%) could be considered as high-risk exposure, *eg*, exposure to high-risk body fluids from HIV-positive individuals or

Table 1
Age and sex category of the HCW at risk.

Age range (years)	Male	Female	Total
<20	3	3	6
21-30	22	105	127
31-40	9	37	46
41-50	1	18	19
51-60	0	2	2
Total	35	165	200

Table 2
Places of the accident categorized into high-risk and low-risk wards.

Ward	Number	Percentage
High-risk wards	67	33.5
Emergency room	29	14.5
Operating room	19	9.5
Delivery room	9	4.5
ICU+IMCU+CCU	10	5
Low-risk wards	133	66.5
Medical ward	57	28.5
Surgical ward	19	9.5
Ob+Gyn ward	14	7.5
Pediatric ward	19	9.5
Other minor wards	24	12
Total	200	100

ICU = intensive care unit, IMCU = intermediate care unit, CCU = coronary care unit

Table 3
Time of exposure as subdivided by the three 8-hour working shifts.

8-hours working shift	No.	%
0.00-8.00	41	20.5
8.00-16.00	104	52.0
16.00-24.00	55	27.5
Total	200	100

Table 4
The needle-stick injury group categorized by patient's serological status and by degree of injury.

Patient's status	Bleeding	No bleeding	No record	Total
Known HIV positive	96	2	0	98
Known HIV negative				
with risk behavior	12	0	0	12
without risk behavior	25	0	1	26
Unknown HIV status	22	0	0	22
Total	155	2	1	158

Table 5
The anatomical area of all needle-stick injuries categorized into hand and non-hand areas as well as the specific areas of the hands.

Anatomical area of injury	No.	%
Right hand	46	29.1
Right thumb	9	5.7
Right index finger	19	12.0
Right middle finger	8	5.1
Right ring finger	4	2.5
Right little finger	1	0.6
Right dorsal area	3	1.9
Right palmar area	2	1.3
Left hand	99	62.7
Left thumb	27	17.1
Left index finger	38	24.1
Left middle finger	14	8.9
Left ring finger	8	5.0
Left little finger	6	3.8
Left dorsal area	4	2.5
Left palmar area	2	1.3
Total hand area	145	91.8
Non-hand area	13	8.2
Total	158	100

from HIV-negative individuals with risk behaviors onto their mucous membrane or broken skin (CDC, 1997; Fahey *et al,* 1991; Tokars *et al,* 1995).

Type of procedure resulting in injury

Total 200 incidents were classified according to the procedure resulting in injury. It is evident that venepuncture is the highest risk procedure resulting in injury for 52 or 26% (Fig 2). The other major procedures are intravenous access (37 or 18.5%) injection both intravenous and intramuscular (28 or 14%) and waste collection (25 or 12.5%). The remaining minor procedures are during surgery, delivery, lumbar puncture, pluerocentesis and paracentesis.

Situation of exposure

The 200 incidents were analyzed for reasons of injury. The main reasons were carelessness while performing procedures (54 or 27%) lack of protective barriers (*eg* goggles, gloves, mask, etc while performing fluid-spilled procedures (42 or 21%), inappropriate disposal of infected materials/ sharp objects (42 or 21%), recapping needles (31 or 15.5%), disconnection of needles (16 or 8%) and inflicted by other HCW (14 or 7%) (Fig 3).

Chemoprophylaxis

In order to determine who should receive postexposure chemoprophylaxis, the accidental injuries were subdivided into those with definite risk and those with low or no risk. The definite risk group includes HCW who was injured with sharp objects used in HIV-positive or HIV-negative individuals with risk behaviors which resulted in bleeding at the injured point and those who were exposed to the high-risk body fluids from HIV-positive or HIV-negative individuals with risk behaviors on their mucous membrane or broken skin. The other exposures were considered as low or no risk exposures (CDC, 1998).

As shown in Table 4 and Table 6, 135 incidents (67.5%) should be considered as the definite risk group which should be recommended to take postexposure antiretroviral chemoprophylaxis to reduce the chance of HIV transmission (CDC, 1996, 1998; Gerberding, 1997; Cardo *et al,* 1997; Joseph, 1997). However, only 112 or 78% of the cases that chemoprophylaxis was actually recommended by the consulting physicians. The other 23 instances were considered as low risk or no risk exposures by the consulting physicians, thus chemoprophylaxis was not recommended. Further analysis showed that only 77 of the 112 patients (68.8%) of which chemoprophylaxis was recommended agreed to take the antiretroviral chemoprophylaxis.

Of the 65 low or no risk group which chemo-

Table 6
The non-stick body fluid exposure group categorized by type of body fluid, patientís serological status and exposure area.

	Mucous membrane	Broken skin	Intact skin	Total
High-risk body fluids	20	8	8	36
HIV +	19	6	8	33
HIV – with risk behavior	1	1	0	2
HIV – without risk behavior	0	1	0	1
Unknown HIV status	0	0	0	0
Low-risk body fluids	4	2	0	6
HIV +	4	2	0	6
HIV – with risk behavior	0	0	0	0
HIV – without risk behavior	0	0	0	0
Unknown HIV status	0	0	0	0
Total	24	10	8	42

prophylaxis is not needed, 8 cases were recommended to take the chemoprophylaxis by infectious disease experts due to the presumed benefit as judged by individual experts. Of these 8 cases, only 4 accepted to take the chemoprophylaxis (50%).

Number of chemoprophylaxis consumption and various regimens were categorized by year as shown in Fig 4. Number of chemoprophylaxis consumption increased gradually from 1991 to 1996. Double nucleosides and triple regimens (double nucleosides plus 1 protease inhibitor) were first introduced into Thailand in 1995 and 1997 respectively (Fig 4).

Seroconversion surveillance

According to the protocol of the incident report, an attempt is made to get follow-up HIV status of every injured person at 3, 6 and 12 months after the incidents. Of the 200 incidents, 25 (12.5%) were lost to follow-up due to resignation (20), permission to leave for higher education (4) and accidental death (1).

Of the 175 incidents that could be followed, 114 and 110 cases reported back their anti-HIV status at 3 and 6 months respectively, representing an overall follow-up of 55% at 6 months whereas the other 65 cases did not respond even with additional reminders. However, no one claimed for compensation which could be assumed that none has seroconverted.

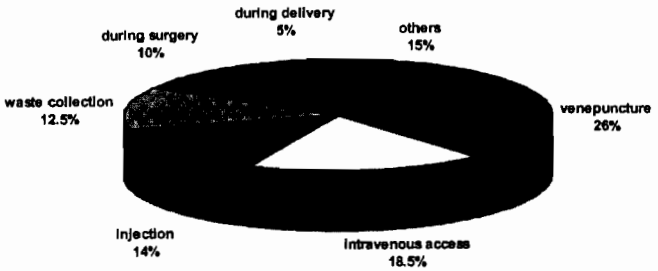

Fig 2–Type of procedure resulting in injury.

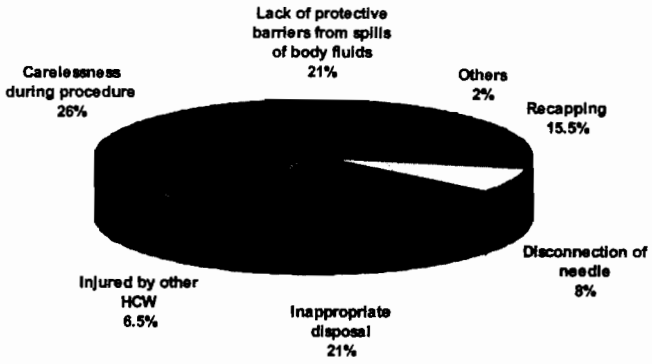

Fig 3–Possible reasons for the injury.

DISCUSSION

Results from many prospective studies indicate that the average risk of HIV transmission after a percutaneous exposure to HIV-infected body fluid

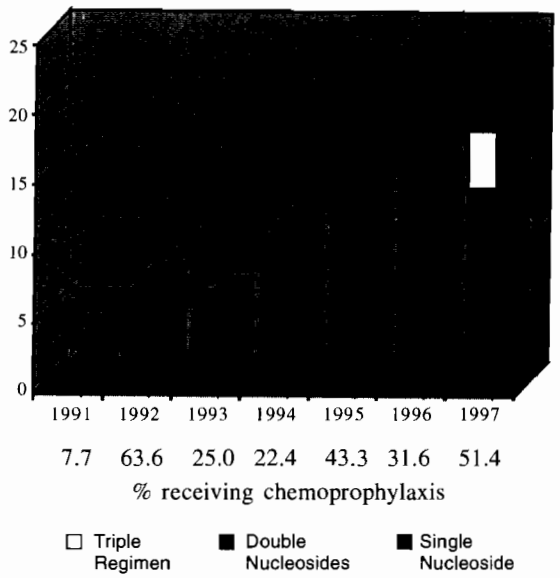

Fig 4–Trend of recommended postexposure prophylaxis and the type of chemoprophylaxis used.

is approximately 0.3% (95% confidence interval CI = 0.2-0.5%) (Bell, 1997; Marcus, 1988; CDC, 1993) and after a mucous membrane exposure is 0.09% (95% CI = 0.006-0.5%) . Blood is the main body fluid that causes most of the occupational HIV infection in HCW. Therefore, preventing blood exposure is the primary means of preventing occupationally acquired HIV infection and appropriate postexposure chemoprophylaxis is also an important element of workplace safety. Moreover, we must have the information on the epidemiological data of HIV exposure, type of exposure, possible causes of exposure, etc in order to assess how to reduce the rate of HIV transmission in HCW.

This report describes the 200 incidents from the Thai Red Cross Society which imposes a system of self-reporting of the accidents in order to benefit from the insurance coverage of work-related HIV infection. The incidence increased gradually from 1991 when the self-reporting policy was implemented. It reached the peak in 1994, then declined and reached plateau from 1995 to 1997 (Fig 1). The highest incidence in 1994 corresponds with the peak incidence of HIV infection in the country in 1994-1995 (Thai CDC, 1998). The decline after 1994 may also indicate a better workplace safety measure.

Nurses are more prone to get HIV exposure than the other groups of HCW since they are the group of HCW who perform many procedures with the patients such as IV access, injection, venepuncture. This reflects the preponderance of the accidents in the working age females, *ie*, 20-40 years old (Table 1). The less likelihood of older HCW to get the accidents may be explained by the fact that they are more experienced or they are responsible more for administrative work than the direct nursing care.

According to the workplace, everyone would think that emergency room, delivery room, operative room and intensive care unit would be the more dangerous zones since there are more blood-exposure procedures being performed. However, the evidence showed the contrary. The highest incidence was in the medical wards (Table 2). The reasons may be that there are more procedures done in medical wards and there are more HIV-infected patients admitted there. In addition, most procedures are being performed in the normal working hours, thus, the highest risk working period is 8.00-16.00 hours (Table 3).

Of the 158 incidences of needle-stick injury, left hand was twice more likely to be stuck than the right hand (Table 5). This is well expected because the right hand is usually the dominant hand, therefore, there is more chance for the other non-dominant hand to be stuck especially the left thumb and the left index finger. When the types of procedure resulting in injury were analyzed, venepuncture, intravenous access, injection and waste collection were the leading high-risk procedures (Fig 2). This confirms the other observations that more accidents occurred to the nurses in the medical wards since these procedures are frequently performed by nurses in the medical wards. Two-thirds of the reasons of the injury was carelessness during procedure, inappropriate disposal and lack of protective barriers from spills of body fluid (Fig 3). Therefore, the guidelines for prevention of nosocomial HIV infection in HCW should include the ways to prevent these possible causes.

The use of postexposure chemoprophylaxis became apparent only after 1992 and reached the peak in 1996 (Fig 4). This probably reflects the uncertainty of the efficacy of the chemoprophylaxis until the publication of the retrospective case-control study in 1997 which showed that zidovudine (ZDV) could reduce the HIV infection by 81% (95% confidence interval CI = 43%-94%) (Cardo *et al*, 1997). However, our study indicated that only 78% of the high-risk exposures that postexposure chemo-

prophylaxis was recommended and only 69% of those recommended actually took the medicines. This probably reflects the concern for the side effects of the drugs. Zidovudine was the first antiretroviral agent being used in chemoprophylaxis, followed by double nucleosides (ZDV plus Lamivudine) in 1995 and triple regimen (ZDV, Lamivudine and Indinavir) in 1997 (Fig 4). The changing pattern of postexposure antiretroviral use follows the recommendations given by Centers for Disease Control and Prevention, US Department of Health and Human Services (CDC, 1990, 1996, 1998).

Although our follow-up rate was only 55% at 6 months, none was seroconverted. In addition, after more than 7 years of instituting this insurance program with over 200 exposed individuals, none claimed for compensation. Therefore, it can be concluded that nosocomial HIV transmission among healthcare workers is very low.

Our study is the first large-scale, long-term prospective study of the risk of HIV transmission among Asian health care workers. Our results demonstrate that nursing personnel working during the regular working hours in the medical wards are at the highest risk of accidental exposure to HIV-infected blood and body fluids. The non-dominant hand is at higher risk than the dominant hand and most of the accidents are caused by human error and carelessness. Therefore, to institute an effective policy to prevent occupational HIV infection among HCW, the following points should be emphasized :

1. More nursing personnel should be allocated to the medical wards during the regular working hours since more risky procedures are being done.

2. Education and training should be targeted to nursing personnel between 21-40 years old.

3. Repeated training on certain risky procedures is warranted such as venepuncture, intravenous access, infection and waste collection.

4. Attention should be given more to left thumb and left index finger where needle-stick injury occurs most.

5. Training and strict follow-up of the universal precaution guidelines should be emphasized such as the ready availability and the proper use of the protective devices eg gloves, goggles, gowns, etc, proper disposal of sharp objects, no recapping of needles, etc (CDC, 1989; De Vries and Cossart, 1994; Henderson *et al*, 1990).

6. Carefulness and alertness during any procedures are pivotal for any prevention and one should be aware that carelessness is also able to injure others besides self.

7. Post-exposure counseling is essential. Clinicians who can provide post-exposure care should be available around the clock as well as the antiretroviral agents recommended for post-exposure prophylaxis.

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