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Research Article

**ASSESSMENT OF KNOWLEDGE TOWARDS NEEDLE STICK
INJURIES AMONG HEALTH WORKERS IN SAUDI ARABIA**Abdullah Ali Bin Saqer^{1*}, Ali Mohammad Alshehri¹, Almansouri Mona Fayin S²¹Prince Sattam Bin Abdulaziz University, Al-Kharj, Saudi Arabia, ²Tianjin Medical University, China.**Abstract:**

Background: Most people who work in a health care facility are at risk of sustaining a needle stick injuries. Despite published guidelines and training programs, needle stick injuries have been neglected and remain an ongoing problem.

Objectives: To explore the prevalence and circumstances of needle stick injuries among healthcare Workers in a governmental hospital in Saudi Arabia 2018.

Methods: A cross sectional study was carried out. All health care workers at the general surgery departments were targeted. Inclusion of 49 HCWs only was done. Self-administrated data was collected using a specially designed questionnaire prepared in English form. It included data about socio-demographic characters, exposure to needle stick injuries, factors and circumstances that enhance injuries. The mean percent score for unfavorable circumstances during injection was calculated. Chi square test, Fishers' Exact test and Mann-Whitney U test were used.

Results: 77.6% of HCWs gave injections; with an average of 1.4 ± 0.50 injection per day. 81.6% received training on safe use of needles. 91.8% of HCWs perceived NSIs as dangerous and 95.9% knew the risks. All Saudi HCWs significantly received assisted disposal of needles. 78.3% did not re-sheath syringe, 95.9% use safe boxes, 55.1% separated needle from syringes with gloved hands, 87.8% wearing gloves on dealing with patients. The prevalence of NSIs among HCWs was 28.6 %.

Conclusion: NSIs were prevalent incident. Among HCWs, vaccination coverage for HBV was not complete. Not all HCWs perceived NSIs as dangerous. Some HCWs performed risky practices on injection and handling syringes. The score of unfavorable circumstances during injection was relatively high.

Key words: Needle stick injuries, health care workers, sharp injuries, syringes, safety.

Abbreviations: Needle stick injuries (NSIs), Health care workers (HCWs), hepatitis B virus (HBV), hepatitis C virus (HCV).

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INTRODUCTION:

Workplace safety is a very important aspect of occupational health practice in many countries. Needle stick injury has been recognized as one of the occupational hazards, which results in transmission of blood borne pathogens [1-3]. Most people who work in a health care facility are at risk of sustaining a needle stick injuries. They may especially happen to nursing staff, lab workers, Surgeons and housekeepers [4]. Among health care workers (HCWs), HIV, hepatitis B and C, and cytomegalovirus are recognized occupational health infections of special importance [5, 6].

In most of the developing countries, very few efforts have been undertaken to raise awareness of the health-care workers and hospital managers. Concrete knowledge on the transmission of blood-borne diseases in health-care facilities is very limited. Unsafe practices are very common. Additionally, there is a lack of regulation and policy to protect health workers from exposure [7]. Most of the time, health care workers never receive training in infection control and standard precautions although such trainings and practices are low cost solution to reducing risk of sharp injuries and have a high likelihood of being adopted [8].

Despite published guidelines and training programs, needle stick injuries have been neglected and remain an ongoing problem because the rate of such injuries depends on the medical discipline, which makes it difficult to know exactly how serious the problem is, or how well prevention programs work [9]. The aim of study to explore the prevalence and circumstances of Needle stick Injuries among healthcare workers in governmental hospitals in Saudi Arabia 2018.

SUBJECTS AND METHODS:

This cross-sectional study was carried out during January through February 2018. All health care workers at the general surgery departments of were targeted. The study included 49 HCWs only with a response rate of only 49%. An informed verbal consent was obtained from all participants after explanation of the objectives of the study. Self-administrated data was collected using a specially designed questionnaire prepared in English form. It included data about socio-demographic characters, exposure to needle stick injuries, factors and circumstances that enhance injuries to design effective prevention programs. A pilot study of 15 non-injured cases was carried to refine the questionnaire. Reliability of the questionnaire was determined using Cronbach's alpha (0.879).

The mean percent score for unfavorable circumstances during injection was calculated using the following formula:

$$\text{Mean percent score} = \frac{\sum \text{Selected variables} \times 100}{\text{Maximum possible score}}$$

Statistical Analysis

SPSS package version 17 was used. Frequencies, percentages, proportions, mean and standard deviation were calculated. Chi square test, Fishers' Exact test and Mann-Whitney U test were used accordingly. P-value was considered significant at level less than 0.05 levels.

RESULTS:

There was significant difference between mean age of Saudi (27.7 \pm 5.28 years) and non Saudi HCWs (34.7 \pm 10.41 years) (p=0.010). The majority of HCWs (85.7%) was females (p= 0.628) and 16.3% was paramedical with insignificant difference between Saudi and non Saudi (p= 0.981). The mean working years was 8.8 \pm 8.15 (p=0.021), working hours per day (9.97 \pm 1.84) (p=0.000) and mean number of shifts per week was 3.3 \pm 1.54 (p=0.001) (Table 1).

Most of HCWs (95.9%) received HBV vaccine; meanwhile only 69.4% received booster dose in the past 10 years and 81.6% made periodic check up for HBV, AIDS and HCV. (Table 2)

More than three fourths (77.6%) of HCWs included in the sample gave injections; with an average of 1.4 \pm 0.50 injection per day (p=0.024). More than four fifths (81.6%) received training on safe use of needles. Majority (91.8%) of HCWs perceived NSIs as dangerous and 95.9% knew the risks. (Table 3)

All Saudi HCWs included in the sample (100.0%) significantly received assisted disposal of needles (p=0.029). More than three fourths (78.3%) did not re-sheath syringe, 95.9% use safe boxes, 55.1% separated needle from syringes with gloved hands, 87.8% wearing gloves on dealing with patients (p= 0.208, 0.058, 0.130 and 0.046 respectively). (Table 4)

The mean percent score for unfavorable circumstances during injection was significantly lower among Saudi than non-Saudi (58.8 \pm 8.32, 64.4 \pm 6.53, p= 0.013). (Table 5) The prevalence of NSIs among HCWs was 28.6 % with insignificant difference between Saudi and non-Saudi (p=0.223).

The mean percent perception score for hospital safety measures was insignificantly higher among non-Saudi (65.0 \pm 13.78) than Saudi (52.9 \pm 7.56), (p=0.069). (Table 6)

Nearly one third (30.8%) stated that NSIs were accidents, 53.8% reported it; with 23.1% filled incident report and 53.8% mentioned that sharp box was beside them while injured. (Table 7)

Table 1: General description of the studied HCWs by nationality

	Saudi N=18 (%)	Non-Saudi N=31 (%)	Total N=49 (%)	p-value
Age in years Mean \pm SD	27.7 \pm 5.28	34.7 \pm 10.41	32.1 \pm 9.45	0.010 [^]
Gender				0.628
Males	2 (28.6/11.1)	5 (71.4/16.1)	7 (100.0/14.3)	
Females	16 (38.1/88.9)	26 (61.9/83.9)	42 (100.0/85.7)	
Specialty				0.981 ¥
Medical	3(37.5/16.7)	5 (62.5/16.1)	8(100.0/83.7)	
Paramedical	15 (36.6/83.3)	26 (63.4/83.9)	41 (100.0/16.3)	
Working years Mean \pm SD	5.3 \pm 4.89	10.8 \pm 9.0	8.8 \pm 8.15	0.021 [^]
Working years in KSA Mean \pm SD		9.7 \pm 3.39		
Working hours per day Mean \pm SD	8.2 \pm 0.43	9.97 \pm 1.84	9.3 \pm 1.70	0.000 [^]
Shifts per week Mean \pm SD	4.2 \pm 1.62	2.7 \pm 1.24	3.3 \pm 1.54	0.001 [^]
Marital status				0.757 [*]
Never married	9 (40.9/50.0)	13 (59.1/41.9)	22 (100.0/44.9)	
Ever married	9 (33.3/50.0)	18 (66.7/58.1)	27 (100.0/55.1)	
For non-Saudi, is your family with you?				
No		23 (74.2)		
Yes		8 (25.8)		

^{*}Pearson's Chi-square test, ¥ Fishers' Exact test, [^] Mann-Whitney U test, p- value is significant at < 0.05

Table 2: Immune state of the studied HCWs by nationality

	Saudi N=18 (%)	Non-Saudi N=31 (%)	Total N =49 (%)	p-value
Previous HBV vaccine				0.058 ¥
No	2 (100.0/11.1)	0 (0.0/0.0)	2 (100.0/4.1)	
Yes	16 (34.0/88.9)	31 (66.0/100.0)	47 (100.0/95.9)	
If yes received vaccine within the past 10 years				0.321 ¥
No	2(15.4/12.5)	11 (84.6/35.5)	13(100.0/27.7)	
Yes	14 (41.2/87.5)	20 (58.8/64.5)	34 (100.0/72.3)	
Periodic check up for HBV, AIDS, etc.				0.633 ¥
No	4 (44.4/22.2)	5 (55.6/16.1)	9 (100.0/18.4)	
Yes	14 (35.0/77.8)	26 (65.0/83.9)	40 (100.0/81.6)	

¥ Fishers' Exact test, p- value is significant at < 0.05

Table 3: Description of some perception's parameters related to NSIs by nationality

	Saudi N (%)	Non-Saudi N (%)	Total N (%)	p-value
Ever administration of injections				0.147¥
No	2(18.2/11.1)	9 (81.8/29.0)	11 (100.0/22.4)	
Yes	16 (42.1/88.9)	22 (57.9/71.0)	38 (100.0/77.6)	
Average injection number per day Mean ±SD	1.2 ±0.40	1.5 ±0.51	1.4 ±0.50	0.024^
Training on safe use of needles				0.815¥
No	3 (33.3/16.7)	6 (66.7/19.4)	9 (100.0/18.4)	
Yes	15 (37.5/83.3)	25 (62.5/80.6)	40 (100.0/81.6)	
Perception of NSIs				0.611¥
Not dangerous	1 (25.0/5.6)	3 (75.0/9.7)	4 (100.0/8.2)	
Dangerous	17 (37.8/94.4)	28 (62.2/90.3)	45 (100.0/91.8)	
Risks of NSIs				0.058¥
Did not know	2 (100.0/11.1)	0 (0.0/0.0)	2 (100.0/4.1)	
Knew	16 (34.0/88.9)	31 (66.0/100.0)	47 (100.0/95.9)	

¥Fishers' Exact test, ^ Mann-Whitney U test, p- value is significant at < 0.05

Table 4: Description of injection practice and syringes' handling by nationality

	Saudi N (%)	Non-Saudi N (%)	Total N (%)	p-value
Assisted disposal of needles				0.029¥
No	0 (0.0/0.0)	7 (100.0/22.6)	7 (100.0/14.3)	
Yes	18 (42.9/100.0)	24 (57.1/77.4)	42 (100.0/85.7)	
After injection				0.208¥
Re-sheath syringe	3 (75.0/18.8)	1 (25.0/3.3)	4 (100.0/8.7)	
Not re-sheath syringe	11 (30.6/68.8)	25 (69.4/83.3)	36 (100.0/78.3)	
Others	2 (33.3/12.5)	4 (66.7/13.3)	6 (100.0/13.0)	
Use of safe boxes				0.058¥
No	2 (100.0/11.1)	0 (0.0/0.0)	2 (100.0/4.1)	
Yes	16 (34.0/88.9)	31 (66.0/100.0)	47 (100.0/95.9)	
Separation of needle from syringe				0.130¥
With bare hands	5 (55.6/27.8)	4 (44.4/12.9)	9 (100.0/18.4)	
With Gloved hands	8 (29.6/44.4)	19 (70.4/61.3)	27 (100.0/55.1)	
Using Forceps	0 (0.0/0.0)	4 (100.0/12.9)	4 (100.0/8.2)	
Never separate	5 (55.6/27.8)	4 (44.4/12.9)	9 (100.0/18.4)	
Wearing gloves on dealing with patient				0.046¥
No	0 (0.0/0.0)	6 (100.0/19.4)	6 (100.0/12.2)	
Yes	18 (41.9/100.0)	25 (58.1/80.6)	43 (100.0/87.8)	
Injection method resulting in most NSIs				0.868¥
Intramuscular	5 (38.5/27.8)	8 (61.5/25.8)	13 (100.0/26.5)	
Intravenous	7(36.8/38.9)	12 (63.2/38.7)	19 (100.0/38.8)	
Subcutaneous	2 (25.0/11.1)	6 975.0/19.4)	8 (100.0/16.3)	
Sutures and other surgical procedures	4 (44.4/22.2)	5 (55.6/16.1)	9 (100.0/18.4)	

¥Fishers' Exact test, p- value is significant at < 0.05

Table 5: Description of injection circumstances by nationality

	Saudi N= 18 (%)	Non Saudi N=31 (%)	Total N=49 (%)	p-value
Light				0.052¥
Dark	4 (80.0/22.2)	1 (20.0/3.2)	5 (100.0/10.2)	
Dim	2 (40.0/11.1)	3 (60.0/9.7)	5 (100.0/10.2)	
Normal	11 (39.3/61.1)	17 (60.7/54.8)	28 (100.0/57.1)	
Bright	1 (9.1/5.6)	10 (90.9/32.3)	11 (100.0/22.4)	
Noise				0.535*
Silence and Normal voice	10 (33.3/55.6)	20 (66.7/64.5)	30 (100.0/61.2)	
Noise and Very annoying voice	8 (42.1/44.4)	11 (57.9/35.5)	19 (100.0/38.8)	
Hands during injection				0.832¥
Dry	9 (42.9/50.0)	12 (57.1/38.7)	21 (100.0/42.9)	
Moist without gloves	2 (25.0/11.1)	6 (75.0/19.4)	8 (100.0/16.3)	
Moist inside gloves	4 (33.3/22.2)	8 (66.7/25.8)	12 (100.0/24.5)	
With gel, oil or cream	3 (37.5/16.7)	5 (62.5/16.1)	8 (100.0/16.3)	0.395¥
Clarity of vision				
Not clear	4 (50.0/22.2)	4 (50.0/12.9)	8 (100.0/16.3)	
Clear	14 (34.1/77.8)	27 (65.9/87.1)	41 (100.0/83.7)	0.628¥
Ground condition				
Dirty	2 (28.6/11.1)	5 (71.4/16.1)	7 9100.0/14.3)	
Clean	16 (38.1/88.9)	26 (61.9/83.9)	42 (100.0/85.7)	0.254¥
Room temperature				
Cold	4 (66.7/22.2)	2 (33.3/6.5)	6 (100.0/12.2)	
Hot	1 (25.0/5.6)	3 (75.0/9.7)	4 (100.0/8.2)	
Suitable	13 (33.3/72.2)	26 (66.7/83.9)	39 (100.0/79.6)	0.977¥
Patient' cooperation				
Not cooperative	4 (36.4/22.2)	7 (63.6/22.6)	11 (100.0/22.4)	
Cooperative	14 (36.8/77.8)	24 (63.2/77.4)	38 (100.0/77.6)	0.263¥
Time of injection				
Beginning of shift	5 (55.6/27.8)	4 (44.4/12.9)	9 (100.0/18.4)	
End of shift	6 942.9/33.3)	8 957.1/25.8)	14 (100.0/28.6)	
Did not remember	7 (26.9/38.9)	19 (73.1/61.3)	26 (100.0/53.1)	0.098¥
Error of refraction in HCWs				
No	13 (31.7/72.2)	28 (68.3/90.3)	41 (100.0/83.7)	
Yes	5 (62.5/27.8)	3 (37.5/9.7)	8 (100.0/16.3)	0.013^
Mean percent score for unfavourable circumstances during injection				
Mean ± SD	58.8 ±8.32	64.4 ±6.53	62.4 ±7.65	

*Pearson's Chi-square test, ¥Fishers' Exact test, ^ students' t test, value is significant at < 0.05

Table 6: Perception of some parameters of hospital safety by injured HCWs

	N=13 (%)
Completeness of incident report should done	
New NSIs	1 (7.7)
Used NSIs	10 (76.9)
Both	2 (15.4)
Complete vaccination schedule against HBV	
No	3 (23.1)
Yes	10 (76.9)
Training on NSIs	
No	3 (23.1)
Yes	10 (76.9)
Reading a copy of hospital safety policy on ethical disposal of clinical waste:	
No	3 (23.1)
Yes	10 (76.9)
Mean percent perception score for hospital safety measures Mean \pm SD	
Total	58.5 \pm 12.14
Saudi	52.9 \pm 7.56
Non Saudi	65.0 \pm 13.78
P-value	0.069 [^]

[^] Mann –Whitney U test, p is significant at <0.05 level

Table 7: Description of actually occurred NSIs

	N =13 (%)
NSIs occurred due to	
Poor disposal	1 (7.7)
Accident	4 (30.8)
Cannot remember	6 (46.2)
Others	2 (15.4)
Reporting	
No	6 (53.8)
Yes	7 (53.8)
Filling incident report	
No	10 (76.9)
Yes	3 (23.1)
Presence of sharp box	
No	6 (46.2)
Yes	7 (53.8)

DISCUSSION:

Because little is known about the prevalence and circumstances of needle stick injuries among health care workers in governmental hospitals since it has been estimated that most of these injuries go unreported, this study contributed to the understanding of the risks of exposure to such injuries among health care workers in hospital settings. Such information will contribute significantly to an understanding not only the risk for such injuries but the development of effective intervention strategies. Nearly one third (28.6%) of participant HCWs had sustained at least one needle stick injury in the last 12 months preceding the study. In the developing countries, on average 2 million NSIs are projected yearly, this is probably a low estimate, because of the lack of surveillance systems and underreporting of injuries [10].

Prevalence of needle stick injuries among Malaysian health care workers in the two teaching hospitals were reported to be 31.6% and 52.9% respectively [11]. Data from injection safety surveys conducted by the WHO and others show on average: four NSIs per worker per year in the African, Eastern Mediterranean, and Asian populations [10]. In Vietnam, 38% of physicians and 66% of nurses reported sustaining a sharp stick injury in the previous nine months [12].

In South Africa, 91% of junior doctors reported sustaining a needle stick injury in the previous 12 months, and 55% of these injuries came from source patients who were HIV-positive [13].

The present study provided descriptive epidemiological evidence of how such injuries occur including under what circumstances incident occurred; with fairly good score for unfavorable circumstances associated with injections. The picture that emerges reflects a continuum of risk opportunities throughout the life cycle of the device use involving interactions among patients, workers, devices and the environment. Overall, the epidemiological patterns of reported NSI were consistent with other authors' reviews [14- 16]. Physicians mostly do not provide injections as nurses do and hence their risk of injury exposure is lower. Certain working conditions increase the risk of needle stick injury. Those were staff reductions where health care workers assume additional duties or are rushed; difficult patient care situations; and working at night with reduced lighting [17]. Of the blood borne pathogens, HBV is preventable. Nearly all hospitals in Saudi Arabia have made the provision of HBV vaccination a requirement of employment at a health care facility. Majority (95.9%) of staff surveyed reported to receive previous HBV vaccine.

Actually only 81.6% were doing periodic check up for HCV and AIDS. This means that still health care facilities surveyed have allowed even a small proportion of staff to remain a risk to themselves or to their patient population. Understanding the scope of the problem requires recognizing the underreported problem. About 53.8% of the studied health care workers with a history of needle stick injuries did not report the injury to an employee health service. The underreporting of needle stick injuries is also a serious problem in other researches, thus 40– 80% of all injuries go unreported [19]. Barriers to reporting should be appropriately identified and eliminated in order to ensure appropriate care and treatment of health workers to prevent infection as a result of exposure. The current work revealed that the knowledge score for hospital safety measures was relatively low. A satisfactory adherence of HCWs to infection control guidelines was a protective factor to prevent NSIs. Noncompliance to a safe work practice is determined by a range of factors including lack of knowledge, interference with work skills, risk perception, conflict of interest, not wanting to offend patients, lack of equipment, and time, uncomfortable personal protective equipment, inconvenience, work stress, and perceiving a weak organizational commitment to safety climate [20]. Standard Precautions represents a system of barrier precautions to be used by all personnel for contact with blood, all body fluids, secretions, excretions, non intact skin, and mucous membranes. It applies to all patients receiving care in hospitals, regardless of their diagnosis or presumed infection status. These precautions are the "standard of care." Standard Precautions focuses on reducing the risk of transmission of microorganisms. This system embodies the concepts of Standard Precautions (Blood and Body Fluid Precautions designed to reduce the risk of transmission of blood borne pathogens) and Body Substances Isolation (designed to reduce the risk of transmission of pathogens from moist body substances) [21].

CONCLUSION:

NSIs were prevalent incident. Not all HCWs received HBV vaccination. Not all HCWs perceived NSIs as dangerous. Some HCWs performed risky practices on injection and handling syringes. The score of unfavorable circumstances during injection was relatively high.

RECOMMENDATION:

Emphasis on vaccination for all HCWs with HBV vaccine and importance of periodic check up for HBV, HCV and AIDS. Improving injection and

syringe handling circumstances are mandatory. Obligations and rules together with legalizations must be planned for continuous training of HCWs about use of sharp boxes, injection safety and hospital safety policy to decrease prevalence of NSIs.

STUDY LIMITATIONS:

Inclusion of small sample size due low response rate was a major limitation that occurred with this study. Inclusion of HCWs in other departments of hospital may be in favorable. Motivation and assurance of HCWs will be needed to participate in similar future studies to get the full picture about NSIs.

REFERENCES:

- Do, A.N., Ciesielski, C.A., Metler, R.P., Hammett, T.A., Li, J., Fleming, P.L., Occupational. acquired human immunodeficiency virus (HIV) infection: National case surveillance data during 20 years of the HIV epidemic in the United States. *Infection Control Hospital Epidemiology*, 2003; 24: 86-96.
- CDC NIOSH, What every worker should know: How to protect yourself from needle stick injuries. Publication No. 2000-213.
- Puro, V., De Carli, G., Petrosillo, N., Ippolito, G., Risk of exposure to blood borne infection for Italian healthcare workers, by job cat. 2001; 22(4):206-10.
- Park K: Hospital Waste Management. Park's Textbook of Preventive and Social Medicine. 18th ed. India: Banarsidas Bhanot; 2007:596
- Kane A, Lloyd J, Zaffran M, Simonsen L, Kane M. Transmission of hepatitis B, hepatitis C and human immunodeficiency viruses through unsafe injections in the developing world: model-based regional estimates. *Bull World Health Organ*. 1999;77(10):801-7.
- Prüss-Üstün A, Rapiti E, Hutin Y. Sharps injuries: global burden of disease from sharps injuries to health-care workers. *World Health Organization, Geneva. (WHO Environmental Burden of Disease Series No. 3) 2003.*
- Talaat M, Kandeel A, El-Shoubary W, Bodenschatz C, Khairy I, Oun S, Mahoney FJ. Occupational exposure to needlestick injuries and hepatitis B vaccination coverage among health care workers in Egypt. *American Journal of Infection Control* 2003; 31(8): 469-74.
- Ismail NA, Aboul Ftouh AM, El Shoubary WH. Safe injection practice among health care workers, Gharbiya, Egypt. *J Egypt Public Health Assoc*. 2005; 80(5-6):563-83.
- Luthi JC, Dubois-Arber F, Iten A, Maziero A, Colombo C, Jost J, Francioli P. The occurrence of percutaneous injuries to health-care workers: a cross sectional survey in seven Swiss hospitals. *Journal Suisse de Médecine*, 1998; 128(14):536-43.
- Simonsen L, Kane A, Lloyd J, Zaffran M, Kane M. Unsafe injections in the developing world and transmission of blood borne pathogens: a review. *Bull World Health Organ*. 1999; 77(10):789-800.
- Ng YW, Hassim IN. Needlestick injury among medical personnel in Accident and Emergency Department of two teaching hospitals. *Med J Malaysia*. 2007; 62(1):9-12.
- Ministry of Health, Department of Therapy, Vietnam. Report on the implementation of the APW of a pilot survey on unsafe injection practice in Vietnam, Hanoi 2003, p. 30.
- Mingoli A, Sapienza P, Sgarzini G, Modini C. Surgeons' risk awareness and behavioral methods of protection against blood borne pathogen transmission during surgery. *Ann Surg* 1999; 230:737-8.
- Trim JC, Elliott TS. A review of sharps injuries and preventative strategies. *J. Hosp. Infect.* 2003; 53 (4): 237-42.
- Lee JM, Botteman MF, Xanthakos N, Nicklasson L. Needlestick injuries in the United States. Epidemiologic, economic, and quality of life issues. *AAOHN J*. 2005; 53 (3):117-33.
- Lewis FR, Short LJ, Howard RJ, Jacobs AJ, Roche NE. Epidemiology of injuries by needles and other sharp instruments. Minimizing sharp injuries in gynecologic and obstetric operations. *Surg. Clin. North Am*. 1995; 75 (6):1105-21.
- WHO. Sharp injuries, Health care worker safety. Protection of the human environment. Environmental burden of disease. Series No.11 Geneva, 2005, Annex 2.
- Center for Disease Control and Prevention. Immunization of health-care workers: recommendations of the Advisory Committee on Immunization Practices (ACIP) and the Hospital Infections Control Practices Advisory Committee (HICPAC). *Morbidity and Mortality Weekly Report*. 1997; 46(RR-18):23.
- Abu-Gad HA, Al-Turki KA. Some epidemiological aspects of needle stick injuries among the hospital health care workers: Eastern province, Saudi Arabia. *European Journal of Epidemiology* 2001; 17: 401-7.
- Centers for Disease Control and Prevention. National Institute for Occupational Safety and Health (NIOSH) NIOSH Alert: Preventing Needle stick Injuries in Health Care Settings, 1999. Publication No. 2000-108.

21. Center for Disease Control. Perspective in disease prevention and health promotion update. Standard precautions for prevention of transmission of HIV, HBV and other blood-borne pathogens in health care settings. MMWR, 1988; 37:24.