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Safe injection procedures, injection practices, and needlestick injuries among health care workers in operating rooms

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ABSTRACT

Background: Of the estimated 384,000 needle-stick injuries occurring in hospitals each year, 23% occur in surgical settings. This study was conducted to assess safe injection procedures, injection practices, and circumstances contributing to needlestick and sharps injures (NSSIs) in operating rooms.
Methods: A descriptive cross sectional approach was adopted. Modified observational checklists based on World Health Organization (WHO) definitions were used in operating rooms (n = 34) and interview questionnaire was administered to HCWs (n = 318) at the Alexandria Main University Hospital.
Results: Safe injection procedures regarding final waste disposal were sufficiently adopted, while measures regarding disposable injection equipment, waste containers, hand hygiene, as well as injection practices were inadequately carried out. Lack of job aid posters that promote safe injection and safe disposal of injection equipment (100%), overflowing of sharps containers and presence of infectious waste outside containers (50%), HCWs not cleaning their hands with soap and water or alcohol-based hand rub (58.1%), and HCWs not wearing gloves during IV cannula insertion (58.1%), were all findings during observations. High prevalence of NSSIs was reported (61.3%), mostly during handling suture needles (50.8%). In addition, 66.2% of the injured HCWs were the original user of the sharp item which was contaminated in 80% of injuries. At time of NSSI, 79% HCWs were wearing gloves. The most common injured sites were left fingers (39.5%), and 55.4% of injuries were superficial. After exposure, 97.9% did not report their exposure. The source patient was not tested for HBV, HCV and HIV infection in more than 70% of injuries and 96.9% of injured HCWs did not receive post exposure prophylaxis.
Conclusion: The study highlighted that inadequately adopted safe injection procedures and insufficient injection practices lead to high prevalence of NSSIs in operating rooms.

1. Introduction

"Needlestick injury (NSI)" is a puncture wound, cut, or scratches inflicted by medical instruments intended for cutting or puncturing (cannulae, lancets, scalpels, etc.) that may be contaminated with a patient's blood or other body fluids. As needles cause more than 70% of sharps related injuries, the term (NSI)s is sometimes used instead or combined with sharp injuries (SIs).[1,2] A "Safe injection" is defined as one that does not harm the recipient, the provider or the community. Thus, the risk of infection of health care workers (HCWs) from contaminated sharps and needlesticks should be considered part of a larger risk-factor group called "Unsafe injections".[3]

Needlestick injury (NSI) is considered the second commonest cause of occupational injury within the National Health Service (NHS).[2] Occupational exposure to bloodborne pathogens from NSIs exposure is a serious problem in healthcare due to the high frequency and severity of the infections that can occur.[4] Centers for Disease Control and Prevention (CDC) estimate that each year 385,000 needlesticks and sharps injuries (NSSIs) are sustained by hospital-based healthcare personnel; an average of 1000 sharps injuries per day.[5]

The World Health Organization (WHO) estimates suggest that 1 in 10 HCWs worldwide sustain a NSI each year.[6] The WHO states that among the 35 million HCWs worldwide, about 3 million receive percutaneous exposures to bloodborne pathogens each year; 2 million of those to hepatitis B virus (HBV), 0.9 million to

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hepatitis C virus (HCV) and 170,000 to human immunodeficiency virus (HIV).[7] The estimated risks of transmission of infection from an infected patient to the HCW following a needle-stick injury are to be: hepatitis B – 3–10% (up to 30%); hepatitis C – 0.8–3%; HIV – 0.3% (mucous membrane exposure risk is 0.1%).[8] Data from Exposure Prevention Information Network (EPINET) system suggest that in an average hospital, workers incur approximately 27 needle-stick injuries/100 beds/year.[9]

An assessment done by the WHO Eastern Mediterranean Regional Office shows an average of 4 NSIs per year per HCW.[10] In Egypt, a study conducted in Gharbiya Governorate, showed that 66.2% of HCWs reported that they experienced at least one SI in their working life.[11] Another study was conducted at the 3 teaching hospitals of Alexandria University, reported that 67.9% of HCWs had at least 1 SI in the previous 12 months.[12]

The operating room continues to rank as one of the highest-risk hospital settings for percutaneous injury.[13] It is considered as the second most common site of sharps injuries after inpatient wards.[2,14] Of the estimated 384,000 needle-stick injuries occurring in hospitals each year, 23% occur in surgical settings.[15]

In developing countries, few efforts have been undertaken to raise awareness about (NSSIs) among HCWs and hospital managers, unsafe practices are common and there is an inadequate post-exposure management.[6] This study was conducted at the Alexandria Main University Hospital (AMUH), to assess procedures adopted in operating rooms for safe injection and sharp use, evaluate injection practices, and identify circumstances and factors contributing to NSSIs as well as post exposure management.

2. Material and methods

A descriptive cross sectional approach was adopted. All operating rooms at AMUH were observed (n = 34). All HCWs (surgeons, anesthetists, nurses, ancillary workers, and housekeepers) who worked in the operating rooms, and agreed to participate were included in the study (n = 318). The fieldwork of the study started in April 2014 throughout November 2014.

2.1. Study tools

2.1.1. Modified observational checklists based on (WHO) definitions[16]

These checklists were used to assess *safe injection procedures* adopted in the operating rooms. Eighteen items were observed as follows: (i) disposable injection equipment: 5 items with a total score of 5; (ii) hand hygiene measures: 4 items with each item was a total score of 4; (iii) waste containers: 6 items with a total score of 6; and (iv) final waste disposal: 3 items with a total score of 3. Each item was given a score of either 0 (the safe measure not applied) or 1 (the safe measure applied). The absolute and percent score were calculated for each measure, then, the total percent score was calculated. Operating rooms were visited during morning shifts.

Moreover, observational checklists were used to assess *injection practices* including: safe preparation of injection, hand hygiene, use of antiseptics for cleaning the patient's skin before the procedure, use of new pair of gloves with each injection, needle recapping, and immediate disposal of sharps and infectious waste. Types of injections in operating rooms included intravenous injections, intravenous infusions, epidural, spinal, caudal anesthesia as well as central venous catheter and arterial line administration. In every operating room, observation of each type of injection was done once. Fifteen items were observed to assess injection administration practice. Each item was given a score of either 0 (the safe practice not done) or 1 (the safe practice done), then, the absolute and percent score were calculated. The study included 62 observations of injection practices.

2.1.2. Self-structured predesigned interview questionnaire[5,16,17]

It was administered to HCWs in the operating rooms to collect information about: (a) Sociodemographic and occupational characteristics; (b) Frequency of accidental exposure to NSSIs during the last 6 months; (c) Characteristics of the last NSSI experienced by the injured HCWs, regarding the type of sharp instrument causing the injury; the source of injury; the timing, the site and depth of injury as well as the use of gloves at time of exposure; and (d) Post-exposure management, regarding first aid measures; reporting; source patient and injured HCW blood testing for HBV, HCV, and HIV, post-exposure prophylaxis (PEP), and follow-up care.

2.1.3. Interview questionnaire with infection control supervisor[16]

The head of infection control unit at AMUH was interviewed using a predesigned questionnaire based on World Health Organization (WHO) definitions,[16] in order to assess the injection and sharps safety policy adopted in the operating rooms. Questions were designed to collect information about the adoption of injection and sharps safety guidelines and healthcare waste disposal guidelines, the availability of training courses to HCWs, and provision of post-exposure prophylactic medications for high risk exposures.

2.2. Statistical analysis of the data

The collected data were coded and typed onto computer files using SPSS software program version 20.0.[18] Descriptive statistics included arithmetic mean (X), standard deviation (SD), frequency and percentages. Analytic measures included Chi-square test, and Monte Carlo test. The level of significance selected for results was 5% ($\alpha = 0.05$).

2.3. Ethical clearance

The study was approved by the Research Ethics Committee at the Alexandria University Faculty of Medicine. Objectives of the study, procedures, types of information to be obtained, and publication were explained to HCWs. An informed consent was obtained from each participant in the study. Collected data were confidentially kept and insured.

3. Results

3.1. Safe injection procedures in the operating rooms (n = 34 operating rooms)

In the studied operating rooms, *disposable injection equipment* were not reused (100%), and no loose disposable phlebotomy equipment were found (100%). On the other hand, there was loose disposable needles and syringes outside of packaging and not disposed in a waste container (14.7%), and loose intravenous infusion equipment (2.9%). In addition, job aids posters that promote safe administration of injections were not found (100%). Moreover, blunt suture needles, sheathed scalpels, and other engineered sharps safety devices were not found. As regards *hand hygiene* measures, in all operating rooms, there were job aids posters for appropriate hand hygiene, besides, there was running water and povidone-iodine (Betadine) for washing hands as well as alcohol-based hand rub, however, there was no soap for hand wash (Table 1).

Additionally, there were separate *waste containers* for sharps, infectious and non-infectious waste in all operating rooms (100%), also, one or more sharps container "in stock" was available

Table 1
Procedures for safe injection, as observed in the studied operating rooms.

Safe injection procedures	Operating rooms (n = 34)			
	Yes		No	
	No.	%	No.	%
1. Disposable injection equipment				
- Absence of any loose disposable injection equipment outside of packaging or in a waste container including				
• Loose disposable needles and syringes	29	85.3	5	14.7
• Loose disposable phlebotomy equipment	34	100.0	0	0
• Loose disposable intravenous infusion equipment	33	97.1	1	2.9
- Non reuse of disposable injection equipment	34	100.0	0	0
- Presence of job aids posters that promote safe administration of injections	0	0	34	100.0
Absolute score				
Min–Max	2.0–4.0			
Mean ± SD	3.8 ± 0.4			
Percent score				
Min–Max	40.0–80.0			
Mean ± SD	76.4 ± 9.1			
2. Hand hygiene				
- Presence of running water	34	100.0	0	0
- Presence of soap	0	0	34	100.0
- Presence of alcohol-based hand rub	34	100.0	0	0
- Presence of job aids posters that promote appropriate hand hygiene	34	100.0	0	0
Absolute score				
Min–Max	3.0–3.0			
Mean ± SD	3.0 ± 0.0			
Percent score				
Min–Max	75.0–75.0			
Mean ± SD	75.0 ± 0.0			

(100%). On the other hand, some measures were not efficiently carried out, for example, there was overflowing of sharps containers (8.8%), and infectious waste was observed outside an appropriate container (50.0). Besides, job aids posters that promote safe disposal of used injection equipment were not found (100%). Regarding observation of *final waste disposal*, in all studied operating rooms, there were complete closure of all used sharps containers awaiting for final destruction, as well as safe storage of full sharps containers in a locked area or safely away from public access until final destruction. Shredding autoclaving was the method used for final waste disposal in the hospital. The mean total percent score for safe injection procedures adopted in the studied operating rooms was 79.0% ± 4.9% (Table 2).

3.2. Injection practices (n = 62 observations)

Observation of injections entailed IV injection, infusion and insertion of IV cannula (67.7%), spinal (8.1%), epidural (8.1%) and caudal anesthesia (4.8%), as well as central venous catheter (23.1%) and arterial line administration (3.8%). All HCWs were adherent to some safe injection practice such as preparation of injection on a visibly clean dedicated tray, taking disposable syringe from a sterile unopened packet, and immediate disposal of sharps and other infectious waste in appropriate containers. On the other hand, before preparing an injection, only 41% of HCWs cleaned their hands with alcohol based hand rub and 53% cleaned the patient's skin with an antiseptic. Moreover, after the procedure, only 19.4% cleaned their hands with alcohol based hand rub (Table 3). Additionally, among the 48 observations that entailed using a glass ampoule, only 16.6% of HCWs used a clean barrier when breaking the top of glass ampoule to protect their fingers.

As regard needle recapping; the needles were disposed immediately without recapping (90.3%), or recapped with one hand (9.7%). Observations where HCWs were not wearing gloves (58.1%) were during IV cannula insertion. On the other hand, all HCWs who performed the following injection types (spinal, epidural and caudal anesthesia, as well as central venous catheter and arterial line administration) were using sterile gloves during the injection procedure (100%). The total percent score of safe injection practices ranged from 31.2% to 68.7% with a mean of 43.8% ± 9.6% (Table 3).

3.3. Sociodemographic and work characteristics of HCWs in operating rooms (n = 318)

In our study, 68.6% of the interviewed HCWs were males and 31.4% were females. The mean age of HCWs was 35.7 ± 10.6 years and the mean duration of employment was 11.5 ± 11.4 years. Fifty-three percent of HCWs were vaccinated against HBV with 3 doses (Table 4).

3.4. Frequency of accidental exposure to NSSIs in the last six months, as experienced by HCWs

In the current study, 61.3% of the interviewed HCWs experienced accidental NSSIs during the last 6 months. Among those who experienced NSSIs (n = 195), 24.6% had $\geqslant$5 NSSIs. The percentage of HCWs who experienced $\geqslant$5 NSSIs was mostly among the surgical staff (50%) followed by nursing staff, anesthesia staff, and other HCWs including housekeeper staff, sterilization staff, and technicians (20.8%, 14.6% and 14.6% respectively). The difference was statistically significant (X^2 = 8.5, MCp = 0.03).

3.5. Characteristics of the last NSSI experienced by the injured HCWs (n = 195)

In 64.6% of NSSIs, the source patient was identifiable but not tested for HBV, HCV and HIV. Additionally, 66.2% of the injured HCWs were the original user of the sharp item. The sharp item was contaminated in 80% of injuries. Suture needles were involved in the majority of injuries (52.3%) followed by disposable needles, scalpels and glass ampoule (16.4%, 12.8% and 7.2% respectively). Moreover, 68.2% of NSSIs occurred during use of the device, 17.4% before use, and 14.3% after use of device. NSSIs that occurred after use of device were either during putting sharps into disposal

Table 2
Waste management measures as observed in the studied operating rooms.

Waste management measures	Operating rooms (n = 34)			
	Yes		No	
	No.	%	No.	%
1. Waste containers				
- Presence of separate waste containers for sharps, infectious and non-infectious waste	34	100.0	0	0
- Infectious waste[a] is always present inside an appropriate container	17	50.0	17	50.0
- Absence of overflowing or pierced sharps containers	31	91.2	3	8.8
- Absence of used sharps in an open container[b]	34	100.0	0	0
- Presence of one or more sharps container "in stock"	34	100.0	0	0
- Presence of job aids posters that promote safe disposal of used injection equipment	0	0	34	100.0
Absolute score				
Min–Max	3.0–5.0			
Mean ± SD	4.4 ± 0.6			
Percent score				
Min–Max	50.0–83.3			
Mean ± SD	±10.1			
2. Final waste disposal				
- Complete closure of all sharps containers awaiting for final destruction	34	100.0	0	0
- Safe storage of full sharps containers	34	100.0	0	0
- Absence of any used sharps on floors	34	100.0	0	0
Absolute score				
Min–Max	3.0–3.0			
Mean ± SD	3.0 ± 0.0			
Percent score				
Min–Max	100.0–100.0			
Mean ± SD	100.0 ± 0.0			
Total absolute score				
Min–Max	11.0–15.0			
Mean ± SD	14.2 ± 0.8			
Total percent score				
Min–Max	61.1–83.3			
Mean ± SD	79.0 ± 4.9			

[a] Infectious waste should be placed in a container that is specific for non-sharps infectious waste example bloody swabs or dressings.
[b] A standard safety box that does not have the top cardboard flaps folded over and inserted into the top of the box is an open container. Any other container with a wide opening at the top (wide enough to insert fingers and touch used sharps) also is an open container.

Table 3
Safe injection practices in all observed injections performed in the studied operating rooms.

Safe injection practices	Injection observed (n = 62)			
	Done		Not done	
	No.	%	No.	%
Preparation of injection procedure				
- Preparation of injection on a visibly clean, dedicated table or tray	62	100.0	0	0.0
- Washing hands before preparing an injection with soap and running water	0	0.0	62	100.0
- Cleaning hands before preparing an injection by using alcohol-based hand rub	26	41.9	36	58.1
- Using a new pair of gloves	26	41.9	36	58.1
- Taking disposable syringe from a sterile unopened packet	62	100.0	0	0.0
Injection administration				
- Using a clean barrier to protect fingers when breaking the top of glass ampoule (n = 48)	8	16.6	40	83.3
- Cleaning the patient's skin before the injection with an antiseptic	33	53.2	29	46.8
- Avoiding palpation of the venipuncture site after skin preparation with an antiseptic (n = 19)	8	42.1	11	57.9
- Appropriate securing the patient and the intended puncture site	62	100.0	0	0.0
- Cleaning the rubber stopper on the glass bottle top with an alcohol pad before inserting the spike	0	0.0	62	100.0
- Termination of the procedure and applying pressure to prevent hematoma expansion (n = 10)	10	100.0	0	0.0
Waste management activities				
- Avoiding recapping of used needle with two hands	62	100.0	0	0.0
- Cleaning the work area with disinfectant after the procedure if there is BBF contamination (n = 2)	2	100.0	0	0.0
- Cleaning hands by washing with soap and clean water or using alcohol-based hand rub after the procedure	12	19.4	50	80.6
- Immediate disposal of sharps and infectious waste in an appropriate container	62	100.0	0	0.0
Total absolute score				
Min–Max	5.0–11.0			
Mean ± SD	7.0 ± 1.5			
Total percent score				
Min–Max	31.2–68.7			
Mean ± SD	43.8 ± 9.6			

Table 4
Distribution of the studied HCWs according to their sociodemographic and occupational characteristics.

Sociodemographic and occupational characteristics	HCWs (n = 318)	
	No.	%
Gender		
- Male	218	68.6
- Female	100	31.4
Age (Years)		
- Min–Max	20.0–65.0	
- Mean ± SD	35.7 ± 10.6	
- 20–<30 years	141	44.3
- 30–<40 years	75	23.6
- 40–<50 years	51	16.0
- 50–<60 years	44	13.8
- 60–<70 years	7	2.2
Level of education		
- Read and write	10	3.1
- Basic education	20	6.3
- Diploma at Institute of Nursing	77	24.2
- MBBCh	101	31.8
- Master	56	17.6
- MD	54	17.0
Profession		
- Surgical staff	170	53.5
- Anesthesia staff	41	12.9
- Nursing staff	73	23.0
- Other HCWs (Technicians, housekeepers and sterilization staff)	34	10.7
Duration of employment (years)		
- Min–Max	0.50–47.00	
- Mean ± SD	11.5 ± 11.4	
- 6 m–<10 years	184	57.9
- 10–<20 years	54	17.0
- 20–<30 years	40	12.6
- 30–<40 years	36	11.3
- 40–<50 years	4	1.3
Hepatitis B vaccination		
- Vaccinated with ⩾3 doses	169	53.1
- Not vaccinated or incomplete doses	149	46.9

Table 5
Characteristics of the last NSSI experienced by the injured HCWs.

Characteristics of the last NSSI	Injured HCWs (n = 195)	
	No.	%
Source patient was identifiable		
- No	13	6.7
- Yes and tested	56	28.7
- Yes but not tested	126	64.6
Injured HCW was the original user of the sharp item		
- No	66	33.8
- Yes	129	66.2
Sharp item was contaminated		
- Contaminated	156	80.0
- Uncontaminated	39	20.0
Sharp item that caused the injury		
- Suture needle	102	52.3
- Disposable syringe	32	16.4
- Scalpel	25	12.8
- Ampule	14	7.2
- I.V. catheter	7	3.6
- Electrocautery	5	2.6
- Scissors	3	1.5
- Others (Towel clip, prolene suture, spinal/epidural needle, drain, transfusion set)	7	3.5
Timing of injury		
- Before use of item	34	17.4
- During use of item	133	68.2
- After use of item	28	14.3
Site of the injury		
- Rt hand Palm	5	2.6
- Rt hand Dorsum	4	2.1
- Rt Thumb	26	13.3
- Rt Fingers	34	17.4
- Lt hand Palm	12	6.2
- Lt hand Dorsum	5	2.6
- Lt Thumb	28	14.4
- Lt Fingers	77	39.5
- Rt Front lower leg	1	0.5
- Rt foot	3	1.5
Depth of the injury		
- Superficial (little or no bleeding)	108	55.4
- Moderate (skin punctured, some bleeding)	70	35.9
- Deep (deep stick/cut, or profuse bleeding)	17	8.7
Gloves used at time of the injury		
- Single pair gloves	91	46.7
- Double pair gloves	63	32.3
- No gloves	37	19.0
- N/A[a]	4	2.1
Hand predominance of injured HCW		
- Right handed	188	96.4
- Left handed	7	3.6
Source of the injury		
- Suturing	99	50.8
- Improper handling of instruments	34	17.4
- IV injection or cannulation	14	7.2
- Improper disposal of sharp waste	17	8.7
- Opening of ampoule or disposable syringe before use	14	7.2
- Recapping a needle	11	5.6
- Electrocautery	5	2.6
- Bad lighting in emergency operating rooms	1	0.5

[a] The injury was not in the hands.

container (28.5%), needle recapping (21.4%), device left on floor (10.7%) or near disposal container (10.7%), or item protruding from opening or side of disposal container or trash bag (7.1%) (Table 5).

At time of NSSI, 46.7% HCWs were wearing single pair gloves, and 32.3% were wearing double pair gloves. In our study, the most common injured sites were left fingers (39.5%) followed by right fingers, left thumb and right thumb (17.4%, 14.4% and 13.3% respectively). Additionally, 55.4% of NSSIs were superficial with little or no bleeding, while 35.9% involved moderate skin penetration with some bleeding. Moreover, 50.8% of injuries were during handling suture needles; 17.4% during improper handling and transferring of surgical instruments, and 8.7% during improper disposal of sharps (Table 5).

3.6. Post-exposure management following the last NSSI experienced by exposed HCWs

After exposure to a NSSI, 43.6% of injured HCWs applied first aid measures as washing the affected area, and applying disinfectant. Moreover, 97.9% of HCWs did not report their exposure to the infection control or occupational health unit. Reasons for not reporting, as stated by the HCWs, were mostly due to absence of reporting system (51.2%), lack of knowledge about the reporting procedure (35.5%), no time to report (10.8%), or it is not important to report (1.7%). In the majority of NSSIs, source patient was not tested for HBV, HCV and HIV infection (72.3%, 71.3% and 89.2% respectively). Furthermore, the percentage of injured HCWs who were tested for HBV, HCV and HIV were 35.4%, 37.4% and 20.5% respectively. In addition, 96.9% of injured HCWs did not receive PEP. Besides, the injured HCWs who were tested for HBV, HCV and HIV and performed a follow up tests were 27.5%, 27.4% and 27.5% respectively (Table 6).

Table 6
Post-exposure management following the last NSSI exposure experienced by the exposed HCWs in the last 6 months (n = 195).

Post-exposure management	Done		Not done	
	No.	%	No.	%
First aid measures				
- Washing the affected area, allowing bleeding, using a disinfectant	85	43.6	110	56.4
Reporting exposure				
- Immediately following the exposure to infection control or occupational health unit	4	2.05	191	97.9
Source patient testing following NSSIs				
- HBV	54	27.7	141	72.3
- HCV	56	28.7	139	71.3
- HIV	21	10.8	174	89.2
Exposed HCWs testing				
- HBV	69	35.4	126	64.6
- HCV	73	37.4	122	62.6
- HIV	40	20.5	155	79.5
Administration of PEP				
- HBIG, HBV vaccine, PEP medication HCV	6	3.07	189	96.9
Follow-up care				
- HBV (n = 69)	19	27.5	50	72.5
- HCV (n = 73)	20	27.4	53	72.6
- HIV (n = 40)	11	27.5	29	72.5

3.7. Injection and sharps safety management policy adopted in the operating rooms

As reported by the head of infection control unit during the interview, there was available injection safety policy and guidelines applied in the operating rooms at the Hospital, as well as health care waste disposal policy and guidelines. For all injection procedures performed, there was an appropriate number of disposable syringes, needles and intravenous infusions sets, as well as in stock. There was no stock-outs in the last 6 months of disposable injection equipment, equipment for intravenous infusions or puncture-resistant sharps containers. Moreover, there is a designated staff that dispose healthcare waste who have received training in waste management by the infection control staff. In addition, there is post-exposure management for both the source patient and the exposed HCW, as well as prophylactic medication for high-risk exposures. A test for HBV, HCV and HIV performed for the exposed HCWs at time of exposure, moreover follow-up tests performed at 3 and 6 months after exposure.

4. Discussion

Regarding ***safe injection procedures*** *adopted in the operating rooms*, certain safe injection procedures were adopted in accordance with WHO and CDC regulations,[7,19,20] especially the final waste disposal. On the contrary, in a study conducted in Gharbiya Governorate, sharps were improperly disposed in waste storage areas, which were also not secure enough to prevent the access of lay persons. In addition, the percentage of used sharps observed lying around outside the health-care facilities was 44.4% in outpatient clinics and 14.3% in hospitals.[11]

Regarding ***injection practice***, all HCWs in the present study, were adherent to some safe injection practices. This result coincides with the results of Aboul-Ftouh study.[21] On the other hand, a study conducted in Pakistan, found that 74.8% of HCWs administered injections with used syringes.[22]

The current study showed that 41.9% of HCWs cleaned their hands with alcohol based hand rub before preparing an injection, 53% cleaned the patient's skin before the injection with an antiseptic, and protective gloves were used in 41.9% of observed injections. Similar findings was reported by Ain-Shams study, (44.2%, 30.9%, and 20.4% respectively).[21]

In 90.3% of observations in the present study, needles were disposed immediately without recapping. All HCWs immediately disposed sharps in appropriate containers. This result contradicts the result of Ismail, who reported needle recapping with two hands before disposal (71.4%).[11] In addition, a study conducted in India (2012), showed that 56.1% of medical personnel recapped needles with two hands, 38.5% recapped needles with one hand, and only 5.2% avoided needles recapping.[9] Moreover, Ain-shams study reported that only 43.2% of HCWs practiced proper needle disposal.[21]

In the present study, 53.1% of HCWs were vaccinated against HBV with 3 doses. Similarly, Mbaisi study found low vaccination coverage among HCWs (42%).[23] On the contrary, Gholami, showed that 76.4% of HCWs received complete doses of hepatitis B.[24]

In the present study, about two thirds of the interviewed HCWs experienced an accidental NSSI during the last 6 months; 24.6% of the exposed HCWs had $\geqslant$5 injuries. Likewise, Hanafi et al. reported that 67.9% of HCWs had at least one needlestick in the previous 12 months with 5% experienced more than 3 injuries.[12] Similar high prevalence was reported by Kerr (73.2%).[25] On the other hand, lower prevalence of NSSI was reported in Kenya (19%),[23] and in a study conducted by Yousafzai et al. (26.7%).[22] In the current study, the high prevalence of exposure could be attributed to the high workload in the operating rooms, long working hours, inexperience, as well as lack of training regarding safe work practice.

Moreover, our study found that the highest percentage of HCWs who experienced $\geqslant$5 SIs was among the surgical staff followed by nursing staff. This result was consistent with the results of a study conducted at Frankfurt am Main University Hospital, where the highest percentage of HCWs who experienced NSSIs was among physicians (39.1%) followed by nursing personnel (33.9).[1] On the other hand, Gholami found that nurses reported the highest frequency of NSSIs.[24]

In the current study, suture needles were the commonest cause of injuries, followed by disposable needles, scalpels and glass ampoule. Similarly, Jagger found that 72.7% of SIs was associated with suture needles (43.4%), followed by scalpel blades (17.1%), and disposable syringes (12.1%).[26] Additionally, Bakaeen et al., found that suture needles and sharp instruments accounted for 50% and 34% of operating rooms injuries, respectively.[27] In US, the National Surveillance System for Healthcare Workers (NaSH) found that disposable needles were involved in 55% of all reported

percutaneous injuries, followed by suture needles (21%).[28] Besides, a study in India (2010), found that the commonest source of injury was disposable needles (41.5%), followed by IV cannula (9%), and suture needles (7%).[29]

NSSIs in the present study were mostly during handling suture needles; improper handling and transferring of surgical instruments, and improper disposal of sharps. These findings coincides with the findings reported by Jagger, who found that 54% of injuries occurred during the act of suturing.[26] Furthermore, the NaSH surveillance system in US, found that 36% of sharps injuries occurred during the handling of suture needles.[28]

In the current study, about two thirds of injured HCWs were the original users of the sharp item. Similarly, in Chakravarthy study, more than 50% of the times, the original user was exposed.[29] Another study showed that surgeons were most often the original users (81.9%); while, nurses and surgical technicians were most often injured by devices originally used by others (77.2% and 85.1% of injuries, respectively).[26] In the present study, the sharp item was contaminated in most of NSSIs (80%), this was similar to the results of Chakravarthy study (85%).[29]

In the current study, at time of NSSIs, about one third of HCWs were wearing double pair gloves, and 19% did not wear gloves. On the other hand, a study in UK, reported that doctors were not wearing gloves in 10% of exposure, and double gloves were worn only by 15% of senior doctors.[30] Moreover, in a study conducted in Kenya, double gloves were worn by 9% of the HCWs.[23] This difference might be due to different research settings; our study was carried in the operating rooms, while the other studies were carried out at different hospital departments.

In our study, 96.4% of HCWs were right handed and most common injured sites were left fingers, followed by right fingers, left and right thumb. Moreover, most injuries were superficial, followed by moderate and deep injuries. Similarly, in a study conducted in UK, 86% of HCWs were right handed; 65% of exposures were in the non-dominant left hand, 25% in left index finger and 15% in left thumb.[30] In addition, Mbaisi, found that 67.8% of the SIs were superficial, 30% were moderate, while 1.7% involved deep penetration.[23]

In the present study, regarding ***post exposure management***, 97.9% of HCWs did not report their exposure. This contradicts the results of another study, where 94% of HCWs reported immediately within an hour.[23] The reasons for not reporting, as stated by the HCWs in the current study, were mostly due to absence of reporting system, lack of knowledge about reporting procedure, no time to report, or it is not important to report. Similarly, a high prevalence of non-reporting (74.7%) was found in Hanafi et al. study; reasons for not reporting were lack of knowledge of appropriate procedures after injury (22.6%); belief that their HBV vaccination status was sufficient (20.5%); belief they were at low risk of infection (19.9%); time constraints (16.5%); use of self-care (14.7%); and fear of punitive response by employer (5.8%).[12] Additionally, Kerr found that 51.7% of injured surgeons did not report their injuries, the reasons for not reporting as they stated; 39.3% thought the patient to be of low risk, 22.5% were not concerned, 30.0% had no time and only 1.1% thought that with double-gloving and a solid needle the risk for blood-borne transmission of viruses was low. Ten percent of surgeons did not state a reason.[25]

The present study revealed that following a NSSI, the majority of source patients were not tested for HBV, HCV and HIV infection. On the contrary, Himmelreich, found that the index patients for 86.5% of NSSIs underwent serum testing for HBV, HCV, and HIV.[1] Moreover, Mbaisi found that the source patient was identified and tested for HIV infection in 91.5% of cases.[23] In addition, our study showed that less than on third of injured HCWs were tested and performed follow up tests for HBV, HCV and HIV. On the contrary, Malka et al., in Romania, found that all HCWs who reported an exposure were tested at the day of the event and were followed at least once during the first year and after 12 months.[31]

In our study, 96.9% of injured HCWs did not receive PEP. On the contrary, another study reported that PEP was not administered in only 5% of cases.[31] additionally, Himmelreich et al., found that, almost all employees with anti-HBs, of less than 100 IU/L at time of exposure, received HBV booster immunization within 48 h of their NSSIs.[1]

Findings of the current research contradict what was reported during the interview with the head of Infection Control Unit at AMUH regarding the existence of adequate safety policies for the use of needles and sharps, and availability of post-exposure management including blood testing for the exposed HCWs at time of exposure and follow-up tests.

5. Conclusion

The study highlighted that in operating rooms at AMUH, some procedures for safe injection were inadequately adopted, and injection practices were insufficiently carried out. Moreover, a relatively high prevalence of NSSIs (61.3%) was reported, where injuries were mostly during handling suture needles. Post exposure management was entirely substandard. The study clearly shows how multi-part system of safe sharps use breaks down in certain areas, particularly education, monitoring, and reporting. It is recommended to implement all procedures for safe injection, provide HCWs' training programs about safe injection practice, and Hepatitis B vaccination with complete doses to all HCWs. Furthermore, it is recommended to perform a routine screening for HBV, HCV, and HIV antibodies every 6 months for all HCWs with or without history of NSSIs; those with positive results should be further subjected to PCR testing. Finally, it is recommended to develop a specific operating room sharps policy that is under institutional sharps policy, since the operating room has special needs and special recommendations for safety.

Conflict of interest

Authors declare that there is no conflict of interest.

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