Needlestick injuries among health care workers of University of Alexandria hospitals

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الإصابات الوخزيّة بين العاملين في الرعاية الصحية في مستشفيات جامعة الإسكندرية

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الخلاصة: تهدف هذه الدراسة المستعرضة لاستقصاء معدل انتشار وظروف الإصابات بوخز الإبر لدى العاملين في الرعاية الصحية في المستشفيات التعليمية لجامعة الإسكندرية، لتقييم فعالية إجراءات المكافحة الحالية والاحتياطات المعيارية للوقاية. وقد حصل الباحثون على المعطيات من خلال استبيان يُستوفَى ذاتياً دون ذكر الأسماء، استوفاه 645 ممرضة وطبيباً وعاملاً طبياً مساعداً في عام 2007. وتبيَّن أن ما يقرب من ثلثي العاملين (67.9٪) قد عانى من وخزة إبرة على الأقل في الأشهر الاثني عشر السابقة. وقد كانت الإصابات في 8.2٪ من الحالات أثناء العناية بمرضى مرتفعي الخطورة (لديهم سوابق الإصابة بفيروس الإيدز أو بفيروس الالتهاب الكبدي «بي» أو «سي» أو ممَّن يتعاطون المخدرات بالحقن). وتبيَّن من تقييم فعالية إجراءات المكافحة القائمة حالياً أن العوامل الوقائية التي يُعْتَدُّ بها من الإصابة بوخز الإبر هي: استخدام أدوات ظاهرُها السلامة (معدل الأرجحية 0.41)، والالتزام بالدلائل الإرشادية لمكافحة العدوى (معدل الأرجحية 0.42)، والتدريب على سلامة الحقن (معدل الأرجحية 0.14) وكون درجة حرارة الغرفة مُريحة (معدل الأرجحية 0.32)، وتوافر بروتوكول مكتوب للإبلاغ الفوري (معدل الأرجحية 0.37).

ABSTRACT The aims of this cross-sectional study were to investigate the prevalence and circumstances of needlestick injury (NSI) among heath care workers at University of Alexandria teaching hospitals and to assess the effectiveness of the existing control measures and standard precautions. Data were obtained by anonymous, self-reporting questionnaire from 645 nurses, physicians and ancillary staff in 2007. Around two-thirds of workers (67.9%) had suffered at least 1 NSI in the last 12 months. High-risk patients (with history of HIV, hepatitis B virus or , hepatitis C virus infection or injecting drug use) were involved in 8.2% of injuries. On evaluating the effectiveness of existing control measures, significant protective factors against NSI were: using devices with safety features (OR 0.41), adherence to infection control guidelines (OR 0.42), training in injection safety (OR 0.14), comfortable room temperature (OR 0.32) and availability of a written protocol for prompt reporting (OR 0.37).

Blessures par piqûre d'aiguille chez les agents de soins de santé des hôpitaux universitaires d'Alexandrie

RÉSUMÉ Les objectifs de la présente étude transversale étaient d'étudier la prévalence et les circonstances des blessures par piqûre d'aiguille chez les agents de soins de santé des hôpitaux universitaires d'Alexandrie et d'évaluer l'efficacité des mesures de lutte existantes et les précautions standard. Les données ont été obtenues au moyen d'un questionnaire anonyme direct rempli par 645 infirmières, médecins et personnels auxiliaires en 2007. Environ deux-tiers de ces personnels (67,9 %) déclaraient au moins une blessure par piqûre d'aiguille dans les douze derniers mois. Des patients à haut risque (ayant des antécédents de VIH, d'infection par le virus de l'hépatite B ou C ou d'injection de drogues) étaient impliqués dans 8,2 % des blessures. L'évaluation de l'efficacité des mesures de lutte existantes a révélé que les facteurs de protection significatifs contre les blessures par piqûre d'aiguille étaient les suivants : l'utilisation de dispositifs équipés de fonctions de protection (OR 0,41), le respect des directives pour la lutte contre les infections (OR 0,42), la formation en matière de sécurité des injections (OR 0,14), une température ambiante confortable (OR 0,32) et la disponibilité d'un protocole écrit pour une notification rapide (OR 0,37).

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Received: 23/02/09; accepted: 26/07/09

Introduction

Workplace safety is a very important aspect of occupational health practice. In 1998, the Centers for Disease Control and Prevention (CDC) estimated that approximately 800 000 health care workers (HCWs) in the United States were injured by patient needles and about 2000 of those workers tested positive for hepatitis C virus (HCV) infection, 400 for hepatitis B virus (HBV) and 35 for human immunodeficiency virus (HIV) [1]. The World Health Organization has estimated that in developing regions, 40%–65% of HBV and HCV infections in HCWs are attributable to percutaneous occupational exposure [2].

In Egypt, like many developing countries [3], few efforts have been undertaken to raise awareness about needlestick injury (NSI) among HCWs and hospital managers. Concrete knowledge on the transmission of bloodborne diseases in health care facilities is very limited and unsafe practices are common. Additionally, there is a lack of regulations and policies to protect HCWs from exposure [4]. HCWs rarely receive training in infection control and standard precautions, even though these are low-cost solutions to reducing the risk of sharp injuries and have a high likelihood of being adopted [5].

There are no clear figures from Alexandria about the prevalence of NSIs, the circumstances surrounding them or the barriers to reporting them. Previous research shows that the rate of injections is high in University of Alexandria teaching hospitals and more than 30% of these injections are done with previously used syringes [6]. The prevalence of HBV and HCV in Egypt is high and unsafe injections transmit most of these infections. Hence, the risk of NSIs and associated infections is higher in Egypt compared with other countries [6]. The present study was conducted to investigate the prevalence and context of NSIs and the behaviour associated with the reporting of injuries among HCWs in University of Alexandria teaching hospitals. An assessment of knowledge about risk perceptions and the practice of standard precautions was also conducted. This study will provide essential baseline data for developing and testing low-cost training interventions in standard precautions.

Methods

Study design

A cross-sectional survey was conducted during January to December 2007.

Study population and setting

The study population was HCWs at the 3 University of Alexandria teaching hospitals. All workers who were in direct contact with patients or using equipment on patients and who were likely to be exposed to bloodborne pathogens were included.

Sample size

Health care in the 3 teaching hospitals is provided by 6087 workers (Statistical Administrative Records of University Hospitals, 2007). The total number of HCWs to be selected was estimated using the following equation: $n = (z^2 \times p \times q)/D^2$. Since the actual prevalence of NSI was unknown, the probability of its occurrence was estimated to be equal to that of its nonoccurrence ($p = q = 0.5$) and a value of 0.2 was chosen as the acceptable limit of precision (D). Based on these assumptions, the sample size was estimated to be 913 HCWs. Samples were proportionally allocated across different job categories: nurses, physicians, ancillary staff, etc.

Data collection tool

An anonymous self-administered questionnaire was developed based on the health belief model [7] and distributed to the HCWs at their work place. The purpose, procedure, risks and benefits of the study were explained to the participants and verbal informed consent was obtained. The Ethics Review Committee at Alexandria Faculty of Medicine reviewed and approved the proposal. The survey tool was pre-tested on a random sample of 55 participants to ensure its practicability and validity. The reliability of the questionnaire was assessed using Cronbach alpha (0.81).

The questionnaire was delivered in Arabic and included information on the HCW's sociodemographic data, professional qualifications and total number of years in practice. We enquired about the number of NSIs during the past 12 months and circumstances surrounding the latest injury, e.g. whether a high-risk patient was involved (one with a history of infection with HIV, HBV or HCV or injecting drug use), the ward/unit where it took place, actions being performed, time of shift, etc. We also asked whether the HCW had reported the injury.

The questionnaire assessed the following health belief constructs:

- Knowledge (1 item): "Can injury by needles at the work place transmit hepatitis B, C or HIV?" (yes = 1, no = 0).
- Perceived susceptibility (1 item): "How much risk of acquiring hepatitis B, C and/or HIV is involved in your work setting?" (1 = none to 5 = very high).
- Perceived severity (1 item): "What can happen if a HCW got an NSI?" (1 = infection with bloodborne pathogen, 0 = nothing).
- Practices concerning standard precautions (5 items): completed HBV vaccination (yes = 1, no = 0); wear gloves for procedures with possibility of blood/body fluid exposure (never = 0 to always = 3); wear gown for procedures with possibility of blood/body fluid splash (never = 0 to always = 3); needle recap after use (never = 0 to always = 3); appropriate waste handling (never = 0 to always = 3).

- Perceived benefits of standard precautions (1 item): "Do you believe that standard precautions practices protect against bloodborne infections?" (strongly disagree = 0, strongly agree = 4)]
- Perceived barriers to practise of standard precautions (2 items): unavailability of protective equipment (yes = 1, no = 0); lack of training in standard precautions (yes = 1, no = 0)
- Cue to action (1 item): "Are you exposed to factors (e.g. mass media campaign, advice from others, pamphlet, illness of a friend/workmate, newspaper/magazine article) that prompts action to be taken?" (yes = 1, no = 0)
- Perceived self-efficiency (1 item): "Are you confident in your ability to successfully practice safe standard precautions at your workplace?" (not confident = 0, completely confident = 2).

An infection transmission knowledge score was calculated and a standard precautions practice score was calculated as a percentage of the maximum possible score.

High-risk injured workers (n = 187) was identified by 12 statements addressing factors increasing the possibility of infection transmission (no = 0, yes = 1), then a total score was computed. Those workers who had total score above the median were considered to have had a high-risk injury.

Statistical analysis

Data were entered in *Epi-Info*, version 6.04 and analysis was performed using *SPSS*, version 13.0. Data were analysed using the case–control approach. Means and standard deviation (SD) were computed for continuous variables and proportions for categorical variables. Odds ratio (OR) and the corresponding 95% confidence interval (CI) were computed.

Multiple linear regression analysis was performed to assess the relationship between the standard precautions practice score and the infection transmission knowledge score, the standard precautions knowledge score, perceived risk of infection at workplace, perceived severity of disease due to NSI at the workplace, age, work experience and qualifications. Those variables that were significant at $P < 0.05$ were selected for the multivariate model. The assumptions model fitness was assessed using residual plots. Alpha was set at the 5% level.

Results

Distribution of job categories

Of the 913 HCWs selected, 645 (70.6%) completed the questionnaires: 371 nurses, 56 senior staff physicians, 55 trainee physicians (residents/attending surgeons/interns), 88 technicians/bloodbank staff and 75 support staff (housekeepers, laundry, maintenance workers and porters). Nurses had the highest response rate (92.5%), followed by staff physicians (83.6%), trainee physicians (74.3%), technicians/bloodbank staff (57.5%) and support staff (34.4%). Male HCWs accounted for 31.9% of the sample. The age of the participating HCWs ranged from 17 years to 60 years, with a mean age of 30.8 (SD 8.6) years.

Prevalence of NSI

More than two-thirds of HCWs (438, 67.9%) had sustained at least 1 NSI in the previous 12 months. Of these workers, 33.0% suffered 1 injury, 18.0% 2 injuries, 12.0% 3 injuries and 5.0% more than 3 NSIs. Table 1 shows that HCWs aged 40+ years and those with 5+ years of work experience were significantly less likely to be injured (OR 0.32, 0.28

Table 1 Personal characteristics of health care workers ever experiencing needlestick injury (NSI) in the last 12 months and those not exposed to such injury in teaching hospitals in Alexandria

Characteristic	NSI (n = 438)		No NSI (n = 207)		OR	95% CI
	No.	%	No.	%		
Age (years)						
> 20	142	32.4	53	25.6	1	
20–< 30	138	31.5	46	22.2	0.74	0.39–1.84
30–< 40	112	25.6	50	24.2	0.96	0.45–2.74
40–< 50	36	8.2	34	16.4	0.32	0.02–0.59
50–60	10	2.3	24	11.6	0.28	0.01–0.51
Sex						
Male	143	32.6	63	30.2	1	
Female	295	67.4	144	69.6	1.8	0.64–2.70
Work experience (years)						
< 1	219	50.0	67	32.4	1	
1–< 5	162	37.0	86	41.5	0.76	0.37–1.85
5+	57	13.0	54	26.1	0.34	0.01–0.73

OR = odds ratio; CI = confidence interval.

and 0.34 respectively). However, sex had no effect on the occurrence of NSI (OR 1.8; 95% CI: 0.64–2.7).

Circumstances of NSI

Nurses had the highest risk of suffering NSI (62.3%) compared with the other occupational categories such as physicians (11.0%) and support staff (14.2%) (Table 2). Disposable syringes accounted for the highest proportion of injuries (38.4%) and most NSI (36.5%) occurred in the wards (Table 2). Over one-third of injuries (36.0%) occurred during recapping a needle. A high percentage of NSIs (28.3%) also occurred during disposal of the used device. High-risk patients (those with a history of infection with HIV, HBV or HCV or injection drug use) were involved in 8.2% of injuries. The majority of injuries (73.1%) occurred at end of the shift. Most HCWs (77.4%) reported feeling mentally distressed after their injury.

Risk of infection after NSI

The 187 staff members who were judged to have suffered a high-risk injury were compared with the total sample (Table 3). Factors that increased a HCW's chance of suffering a high-risk injury were: exposure to a source patient who had evidence of bloodborne infection (OR 12.4, $P = 0.003$); when the procedure involved inserting a needle directly in a patient's vein or artery (OR 9.07, $P = 0.013$); deep injury (OR 6.60, $P < 0.001$); and not wearing personal protective equipment (OR 5.20, $P = 0.001$) (Table 3). Nearly one-fifth of the staff surveyed (18.9%) were either unprotected or unaware of their HBV serological status; 83 HCWs (12.9%) had not completed HBV vaccination and this factor was also associated with a high-risk injury (OR 6.35, $P < 0.001$); Other factors—device nature; duration of potential contact; body part injured; time interval between injury and wound cleansing; availability and use of prophylactic medication; and follow-up testing of the exposed workers—did

Table 2 Circumstances of most recent needlestick injury among health care workers (HCW) in teaching hospitals in Alexandria

Circumstance	No. (n = 438)	%
Occupational group		
Nurse	273	62.3
Support staff	62	14.2
Staff physician	48	11.0
Trainee physician	47	10.7
Technician, blood bank staff	8	1.8
Device involved		
Syringe needle (pre-filled, disposable)	168	38.4
Suture needle	102	23.3
Winged, butterfly needle	59	13.5
Intravenous catheter stylet	34	7.8
Lancet (for skin prick)	33	7.5
Blood collection (needle holder or vacuum tube)	26	5.9
Hypodermic needle attached to disposable syringe	15	3.4
Location of occurrence (medical specialty area)		
Inpatient ward	160	36.5
Intensive care unit	69	15.8
Dialysis unit	55	12.6
Operating room	46	10.5
Emergency room	39	8.9
Outpatient department	28	6.4
Delivery room	23	5.3
Laboratory	18	4.1
Activity and timing of accident		
Recapping or disassembly of needle	158	36.1
Inappropriate disposal of used device (container too full, wrong type)	124	28.3
After use and before disposal	49	11.2
Before use of the device	46	10.5
During use of the device	38	8.7
During disposal (appropriate)	23	5.3
Work practice		
Recapping by hand	148	33.8
Collision with another HCW or sharp	75	17.1
Unsafe collection and disposal of sharps waste	72	16.4
Patient moved and jarred device	42	9.6
Handling/passing equipment to another HCW	40	9.1
Transferring body fluids between containers	38	8.7
Manual tissue retraction	23	5.3
Involvement of high-risk patient[a]		
No	211	48.2
Yes	36	8.2
Unsure/not specified	191	43.6
Timing of injury		
End of shift	320	73.1
Beginning of shift	118	26.9
Health status of HCW after injury		
Mental distress	339	77.4
Chronic illness	52	11.9
Normal	47	10.7

[a]*High-risk patient (history of infection with HIV, hepatitis B virus or hepatitis B virus or injecting drug user).*

Table 3 **Factors increasing the possibility of suffering a high-risk needlestick injury (NSI) among health care workers (HCW) in teaching hospitals in Alexandria**

Transmission factor	Total sample (n = 645)	High-risk NSI		Low-risk NSI		OR	95% CI	*P*-value
		No.	%	No.	%			
Exposure to patient with evidence of bloodborne infection	36	30	83.3	6	16.7	12.4	4.6–23.8	0.003
Procedure involving needle placed directly in vein or artery	130	90	69.2	40	30.8	9.07	2.5–18.8	0.013
Immune status of HCW (hepatitis B unvaccinated)	83	81	97.6	2	2.4	6.35	2.7–9.5	< 0.001
Depth of injury (deep)	133	120	90.2	13	9.8	6.60	1.2–13.7	< 0.001
No personal protective equipment worn by HCW [a]	152	130	85.5	22	14.5	5.20	1.6–15.1	< 0.001
Body part injured (vascular)	102	20	19.6	82	80.4	0.62	0.1–1.8	0.309
Device was visibly contaminated with patient's blood	318	95	29.9	223	70.1	1.77	0.3–3.4	0.053
No follow-up testing for exposed HCW	119	49	41.2	70	58.8	1.72	0.5–3.2	0.254
Device was large-gauge hollow-bore needle	236	104	44.1	132	55.9	1.59	0.9–2.9	0.305
Unavailability or non-use of prophylactic medication[b]	118	45	38.1	73	61.9	1.53	0.7–4.8	0.396
Time interval between injury and wound cleansing (> 30 min)	201	70	34.8	131	65.2	1.39	0.2–3.7	0.326
Long duration of potential contact	101	53	52.5	48	47.5	1.30	0.7–6.5	0.137

[a] *Gloves, mask, eye protection, face shield, gowns.*
[b] *Antiretroviral therapy, immunoglobulin and vaccination for hepatitis B.*
OR = odds ratio; CI = confidence interval.

not significantly affect the chance of having a high-risk injury.

Rate of nonreporting of NSI

A total of 327 respondents (74.7%) did not report the injury to the employee health service. Physicians were less likely to report an NSI than other health care professionals; for example, 87.5% of staff physicians did not report the NSI compared with 70.3% of nurses and 79.0% of support staff. Reasons for not reporting the injury 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%) (Figure 1).

Effectiveness of existing control measures

Table 4 shows that the factors that decreased the frequency of NSIs were: access to devices with safety features (OR 0.41, 95% CI: 0.21–0.73); adherence to infection control guidelines (OR 0.42, 95% CI: 0.26–0.71); having had training in injection safety and appropriate work practices (OR 0.14, 95% CI: 0.03–0.40); a comfortable room temperature (OR 0.32, 95% CI: 0.06–0.67); and available written protocol for prompt reporting (OR 0.37, 95% CI: 0.02–0.57). Factors that did not significantly affect the risk of NSIs were: access to personal protective equipment; location of the disposal containers; rigidity and design of disposal boxes; having full immunization against HBV; practising double gloving; having organized shift schedules; having sufficient staff numbers, characteristics of the work environment; or having periodic inservice health monitoring.

Standard precautions practices and its predictors

The percentage knowledge score of HCWs about the risks associated with NSIs ranged from 30% to 82%, with a mean score of 58.7%. The standard precautions practice score for the HCWs ranged from 27% to 78%, with a mean score of 46.3%. In the multiple linear regression model, the only significant predictors of the standard precautions practice score were knowledge of infection transmission following an NSI (adjusted β = 0.18, 95% CI: 0.06–0.29) and work experience of the HCW (adjusted β = 0.06, 95% CI: 0.02–0.09). The final model explained 9.3% of the variation in the safety precautions practice

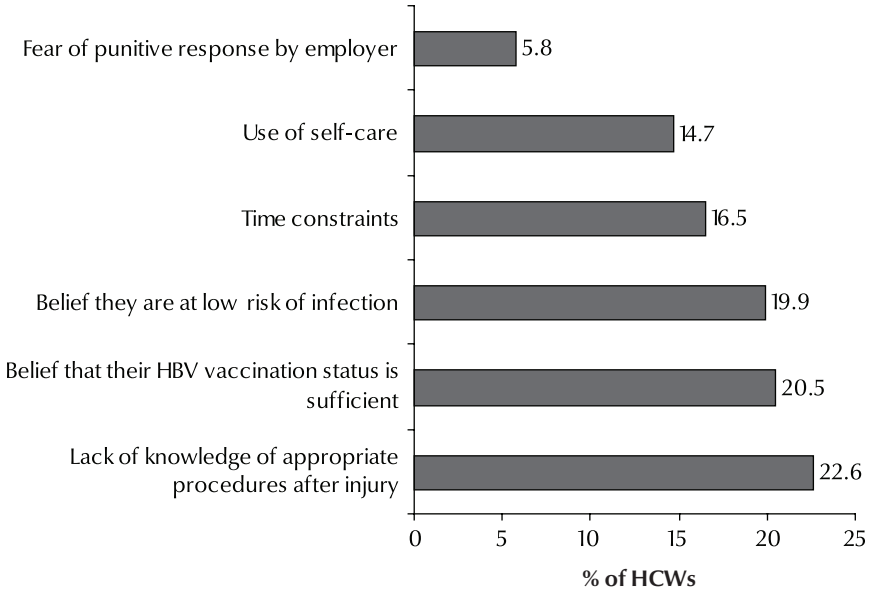

Figure 1 Possible reasons for nonreporting among health care workers (HCWs) experiencing needlestick injury in teaching hospitals in Alexandria (*n* = 327)

score (Table 5). Residual analysis using the assumptions of normality, linearity and constant variance revealed that the model fitted well.

Discussion

We found that more than two-thirds (67.9%) of HCWs questioned had sustained at least 1 NSI in the 12 months preceding the study. Lower prevalences of NSIs were reported among HCWs in 2 Malaysian teaching hospitals (31.6% and 52.9% respectively) [8]. In Vietnam, 38% of physicians and 66% of nurses reported sustaining a sharpstick injury in the previous 9 months [9]. In South Africa, 91% of junior doctors reported sustaining an NSI in the previous 12 months, and 55% of these injuries came from source patients who were HIV-positive [10].

Our study provides descriptive epidemiological evidence of how such injuries occur, including under what circumstances, with what devices and during what types of procedures. The picture that emerges reflects a number of different risk opportunities involving interactions among patients, workers, devices and the environment.

Overall, the pattern of reported NSIs was consistent with other authors' reviews [11–13]. Physicians mostly do not provide injections and hence their risk of injury exposure is lower than nurses. Housekeepers clean and collect waste without protective equipment and hence are at high risk of injury exposure. Concerning device-specific NSIs, syringe needles were associated with 38.4% of all NSIs experienced by the studied HCWs. This finding is consistent with data presented by Ippolito et al. 1997 [14], in which hollow-bore needles accounted for 38.5% of percutaneous injuries. Better prevention strategies need to be developed in our hospitals, for example, providing safer needle devices to all HCWs [15] or ensuring sharps containers are placed at appropriate spots [16].

Surprisingly, more NSIs occurred at locations such as patient rooms where there was less intense activity than in more intense areas such as the emergency room. This may be because better qualified staff work in the emergency rooms, because HCWs are more cautious in high intensive units where highly invasive procedures are performed or because HCWs in the less intensive units may have responsibilities for more patients, which may cause staff to rush injections [17].

In contrast to the present work, 38% of percutaneous injuries among HCWs in Taiwan occurred during the injection, when a needle being manipulated in a patient became accidentally dislodged [18], whereas in our study recapping or disassembly of needles was the most common activity causing injury (36.0%). Even though recapping has been banned by the United States Occupational Safety and Health Administration, it continues to be an identified cause of injury [19].

Certain working conditions have been shown to increase the risk of NSIs, including reductions in staffing levels, HCWs who assume additional duties or who are rushed, difficult patient care situations and working at night with reduced lighting [20]. However, we found that factors such as having organized shift schedules and having sufficient staff numbers had no significant effect on the occurrence of NSIs.

High-risk patients (those with a history of HIV, HBV or HCV infection or injecting drug use) were involved in

Table 4 Effectiveness of existing measures to prevent needlestick injury (NSI) among health care workers in teaching hospitals in Alexandria

Control measure	NSI (*n* = 438)		No NSI (*n* = 207)		OR	95% CI
	No.	%	No.	%		
Access to safety engineered devices (sheathed or retract after use)	61	13.9	71	34.3	0.41	0.21–0.73
Access to personal protective equipment	143	32.6	86	41.5	0.82	0.43–1.04
Awareness of standard precautions guidelines	283	64.6	139	67.1	0.90	0.46–1.53
Satisfactory adherence with infection control guidelines	127	29.0	123	59.4	0.42	0.26–0.71
Training in injection safety and appropriate work practices	35	8.0	56	27.0	0.14	0.03–0.40
Full immunization against hepatitis B	132	30.1	68	32.9	0.83	0.49–2.74
Double gloving practice	28	6.4	28	13.5	0.43	0.05–1.52
Having organized shift schedule	126	28.7	66	31.9	0.84	0.38–1.74
Having sufficient staff numbers	259	59.1	133	64.3	0.74	0.36–2.03
Periodic inservice health monitoring	30	6.8	19	9.2	0.68	0.38–1.05
Available written protocol for prompt reporting of NSI	42	9.6	80	38.6	0.37	0.02–0.57
Features of disposal containers						
Location (in close proximity to work area)	124	28.3	62	30.0	0.92	0.45–1.52
Design (rigid impermeable plastic box)	255	58.2	102	49.3	0.75	0.38–1.94
Design (open top box)	279	63.7	143	69.0	0.93	0.12–2.93
Work environment characteristics						
Lighting (bright)	307	70.1	156	75.4	0.83	0.53–2.54
Noise (silence)	134	30.6	124	59.9	0.34	0.02–0.71
Number of people at the bedside (only 1)	192	43.8	97	46.9	0.91	0.48–2.96
Condition of hands (dry)	279	63.7	150	72.5	0.74	0.18–0.19
Visibility (good)	306	69.9	145	70.0	0.95	0.63–2.83
Floor condition (clean)	195	44.5	98	47.3	0.78	0.26–1.95
Room temperature (comfortable)	177	40.4	150	72.5	0.32	0.06–0.67

OR = odds ratio, CI = confidence interval.

8.2% of injuries. HIV, HBV and HCV are highly transmissible pathogens and this finding is a concern in view of the high rate of NSIs with hollow-bore needles, which are effective in delivering large amounts of blood and body fluids [21]. Of these bloodborne pathogens, HBV is preventable. Teaching hospitals in Alexandria have not made HBV vaccination a requirement of employment. Many staff surveyed (18.9%) were either unprotected or unaware of their serological status. This means that the health care facilities surveyed have allowed a proportion of staff to remain at risk to themselves or to patients. A vaccination programme for clinical and nonclinical staff has been recommended by the CDC since 1983 [22].

Fortunately, not all NSIs result in exposure to an infectious disease, and of those that do, the majority do not result in transmission of infection. Nevertheless, prospective studies of HCWs exposed to HCV through an NSI or other percutaneous injury have found that the incidence of anti-HCV seroconversion averages 1.8% (range 0%–7%) per injury [23]. Data combined from more than 20 prospective studies worldwide of HCWs exposed to HIV infected blood through percutaneous injury revealed an average transmission rate of 0.3% per injury [24]. HCWs' risk of infection in the present study depended on several factors, such as the procedure involving a needle placed directly in a patient's vein or artery, exposure to a patient who had evidence of bloodborne infection, immune status of the HCW, the severity of the NSI and the availability personal protective equipment.

Understanding the scope of the problem requires the scale of underreporting to be recognized. It is believed that only 1 out of 4 NSIs is reported in Alexandria teaching hospitals and this was confirmed by the present study in which 74.7% of HCWs did not report the NSI to an employee health service. Other studies have found that

Table 5 Predictors of standard precautions practice score for needlestick injury (NSI) among health care workers in teaching hospitals in Alexandria

Variable	Univariate model				Multivariate model[a]			
	β	*F*-value	*P*-value	R^2	Adjusted *β*	95% CI of *β*	*F*-value	*P*-value
Knowledge score	0.22	14.39	0.000	0.06	0.18	0.06–0.29	3.05	0.003
Perceived susceptibility of acquiring infection at workplace	0.02	0.02	0.885	0.00	–	–	–	–
Perceived severity of disease after NSI	0.35	11.83	0.001	0.05	–	–	–	–
Age	0.05	16.29	0.000	0.07	–	–	–	–
Years of work experience	0.07	16.84	0.000	0.07	0.06	0.02–0.09	3.39	0.001
Occupational group		4.00	0.008	0.04	–	–	–	–
Nurse	1.75	2.33	0.021	–	–	–	–	–
Staff physician	0.57	0.70	0.486	–	–	–	–	–
Trainee physician	0.62	0.89	0.375	–	–	–	–	–
Support staff	0.98	3.14	0.002	–	–	–	–	–

[a]*Adjusted* $R^2 = 0.093$, F-*value* = *13.37,* $P < 0.001$.
OR = odd ratio; CI = confidence interval.

40%–80% of all NSIs go unreported [25]. The present study identified common reasons for nonreporting of NSIs that warrant attention. In the absence of access to postexposure prophylaxis, there is little perceived benefit to reporting occupational exposure, especially when reporting can result in punishment, blame or even job loss. In addition, health workers commonly perceived the risk of the exposure to be low. Barriers to reporting should be appropriately identified and eliminated in order to ensure appropriate counselling and treatment of health workers after exposure. Antiretroviral therapy administered within 24 to 36 hours after exposure has been associated with an 81% reduction in HIV infection. Although no postexposure prophylaxis is available for HCV, testing can identify HCV infection at an early stage, during which treatment is highly effective in preventing chronic infection. Furthermore, reporting of NSIs may be required to establish the causal relationship of the exposure and subsequent complications (e.g. chronic infection or inability to practise medicine). Although legal requirements vary, failure to report an occupational exposure may lead to the denial of subsequent claims [26].

HCWs in the present study were not educated in occupational bloodborne hazards, as indicated by the low score on infection transmission knowledge. Accurate information about the risk of bloodborne transmission from occupational exposure to needlesticks is necessary and should include information about the most effective measures to control exposure and infection.

This study assessed the effectiveness of existing control measures for prevention of NSI. The survey revealed that the use of preventive measures in our facilities was inadequate. Although an increasing number and variety of needle devices with safety features are now available, only 10% of workers knew about needle-less safety devices. Needle-less or protected needle intravenous systems have been shown to decrease the incidence of NSIs by 62%–88% [27].

"Standard precautions" is 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 [28]. In the present survey, the mean score of standard precautions practice was 46.3%. The rate of use of standard precautions in teaching hospitals in developed countries is considerably higher than in our hospitals [29,30]. Knowledge of infection transmission following NSI and work experience played an important role in prediction of standard precautions practice at university hospitals in Alexandria.

Some limitations of the present study should be noted. Because all information was self-reported, misclassification is possible, although the anonymous nature of the survey would be expected to facilitate accurate reporting. Also, this work lacked data on outcomes, including results of serological testing for HIV or HBV or HCV infection among HCWs who sought care for their injuries. Although NSIs are the most common type of exposure, other percutaneous and splash exposures represented additional hazards to HCWs and our work did not collect data on these exposures.

As with any emerging public health problem, there are several important research areas in which our knowledge about NSIs and their prevention can be improved. Studies are recommended to determine the adverse outcomes

(infectious, psychological and financial) of these injuries. An ongoing review of current medical devices and options and safety features of devices is necessary. Evaluation studies to provide improved information on what does and does not work will similarly continue to improve the effectiveness of comprehensive safety programmes.

Conclusion

While the science base on NSIs continues to grow, research indicates that such injuries are an important and continuing cause of exposure to serious and sometimes fatal infections among HCWs. Greater collaborative efforts are needed to prevent NSIs and their consequences. Such efforts are best accomplished through a comprehensive programme that addresses institutional, behavioural and device-related factors that contribute to the occurrence of NSIs. Critical to this effort is the elimination of needle use where safe and effective alternatives are available and the continuing development, evaluation and use of needle devices with safety features. All such approaches must include serious initial and ongoing training efforts. Accurately tracking NSIs is critical. Establishment of surveillance that could be used to identify potential risk factors associated with NSIs, such as high-risk occupations, settings or procedures, and detects the emergence of new problems. Surveillance systems could be used also to track whether interventions put into place significantly help reduce injuries.

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WHO guidelines on drawing blood: best practices in phlebotomy

Phlebotomy poses risks for patients and health workers. The above-mentioned recent guidelines were produced to improve the quality of blood specimens and the safety of phlebotomy for health workers and patients, by promoting best practices in phlebotomy. In April 2008, the WHO Injection Safety programme – part of the Department of Essential Health Technologies (EHT) at WHO Headquarters in Geneva – convened a consultation on best practices for phlebotomy and blood collection. Th resulting document, *WHO guidelines on drawing blood: best practices in phlebotomy,* provides guidance on the steps recommended for safe phlebotomy, and reiterates the accepted principles for drawing and collecting blood. The guidelines are based on a literature review that focused on identifying systematic literature reviews and evidence relating specifically to phlebotomy practices in developing countries. Draft guidelines and evidence were reviewed by an expert panel, who reached consensus on the recommendations.

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