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Cross-sectional survey on occupational needle stick injuries amongst prehospital emergency medical service personnel in Johannesburg

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ABSTRACT

Introduction: Prehospital personnel are exposed to challenging situations that place them at increased risk of sustaining a needle stick injury (NSI). Blood borne infections such as HIV and Hepatitis B or C may be transmitted from a NSI. Sub-Saharan Africa has the largest number of people living with HIV globally. There is no data pertaining to NSI among Emergency Medical Service (EMS) personnel in South Africa. This study aimed to investigate the cumulative incidence, knowledge, attitudes and practices pertaining to NSIs amongst a select group of prehospital personnel in Johannesburg.

Methods: This was a prospective, questionnaire based, cross-sectional survey of personnel employed at three EMS service providers in Johannesburg.

Results: Of the 240 subjects that participated in the study, there was a total of 93 NSIs amongst 63 (26.3%) subjects. Of these, 41 (65.1%) had sustained one previous NSI, 16 (25.4%) had two NSIs, 5 (7.9%) had three NSIs and one (1.6%) had five NSIs. Almost two-thirds ($n = 60$; 64.5%) of NSIs were sustained during intravenous line insertion. Most of the study subjects were male ($n = 145$, 60.4%), between the age of 25–29 years ($n = 67$, 27.9%), had a BLS qualification as the highest level of training ($n = 89$, 37.1%), had > 10 years of EMS experience ($n = 69$; 28.8%) and were up to date with their Hepatitis B vaccination at the time of the study. HIV post exposure prophylaxis (PEP) was initiated in 82 (88.2%) out of the 93 NSI incidents. However, the recommended 28-day course of therapy was only completed in 68 (82.9%) out of the 82 cases where PEP was initiated.

Conclusion: Prehospital personnel are at risk of sustaining a NSI. There is a need to promote awareness with regards to the risks, preventive measures, awareness of PEP protocols and the timely initiation and completion of HIV PEP amongst EMS personnel in Johannesburg.

African relevance

- The rate of needlestick injuries differs among doctors, nurses and prehospital Emergency Medical Services (EMS) providers.
- In low-resourced countries, there has been a high reported rate of occupational needlestick injuries.
- Johannesburg EMS personnel are at high risk of sustaining a needlestick injuries.
- There is a need to promote needlestick injuries awareness amongst this population.

Introduction

Percutaneous injury or needle stick injury (NSI) can be defined as a puncture wound to the skin or mucous membrane with an unsterilized or contaminated instrument or object [1]. Rates of NSI differ among

doctors, nurses and prehospital Emergency Medical Services (EMS) providers [2–4]. The annual incidence of NSIs has been reported as 1.34 per 100 hospital beds and 1.22 per 100 nurses [3]. Twenty percent of EMS providers in California had sustained a NSI over a 12 month period [4].

Shift work, long working hours, unfamiliar environments and uncontrolled working conditions predispose EMS healthcare workers to NSIs [5,6]. Transmission of HIV, Hepatitis B virus (HBV) and Hepatitis C virus (HCV) infections are major concerns after sustaining a NSI. The risk of seroconversion following a NSI is highest for HBV (6%–30%) followed by HCV (0.5%–10%) and is lowest for HIV (0.3%) [7]. Since the seroprevalence of HIV infection in South Africa is among the highest in the world [8,9] with approximately one-fifth of the adult population being infected [9], transmission of HIV after a NSI is a major concern. In general, most post exposure prophylaxis (PEP) protocols predominantly focus on reducing the risks of HIV transmission [10,11].

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There is limited data available on NSIs amongst South African EMS providers [12]. Since EMS personnel in South Africa generally have a broad scope of practice, we hypothesized that the prevalence of NSIs is high. We, therefore, aimed to investigate the cumulative incidence, knowledge, attitudes and practices pertaining to NSIs amongst a select group of prehospital EMS personnel working in Johannesburg.

Methods

This prospective questionnaire based cross-sectional study was conducted between - 17 January to 25 October 2018. The study population comprised a convenience sample of 240 EMS personnel, employed at one of three EMS service providers in Johannesburg. A total of 300 questionnaires were distributed, yielding a response rate of 80%. Students and other healthcare professionals not employed at any of the three EMS service providers were not eligible to participate in the study. Permission to conduct the study and ethical clearance was obtained from each of the service providers and the University of Witwatersrand Human Research and Ethics Committee (certificate M170512) respectively. Potential study subjects were approached at Continuous Medical Education (CME)/Continuous Professional Development (CPD) events and/or their operation base. Subjects were given an information sheet outlining the study details. Consenting subjects were requested to complete the anonymous questionnaire that was placed in an envelope and handed out to them by the primary investigator. Participant confidentiality and anonymity was maintained throughout the study.

The questionnaire was based on the knowledge, attitudes and practice (KAP) model. It included questions pertaining to gender, age, qualifications, experience and the number of NSIs sustained over the duration of the subjects' career, how the NSI was sustained, HIV and Hepatitis virus testing following a NSI, aspects pertaining to HIV PEP, perceived risk factors for a NSI, awareness of the availability of a NSI policy at the work place, personal practice following a NSI, perceived risk of acquiring Hepatitis virus or HIV infection following a NSI and Hepatitis B virus vaccination status.

Collected data was captured into an electronic data spread sheet for analysis (Microsoft® Excel®). STATA®, version 13, software was used to perform all statistical analyses. Since the data was mostly categorical in nature, results were predominantly described using frequency and percentage tables.

Results

A total sample of 240 subjects participated in the study. There was a total of 93 NSIs amongst 63 (26.3%) subjects. Of these 63 subjects, 41 (65.1%) had sustained only one previous NSI, 16 (25.4%) had two previous NSIs, 5 (7.9%) had three previous NSIs and 1 (1.6%) had five previous NSIs. Therefore, a total of 22 (34.9%) subjects had sustained more than one NSI. All NSIs were sustained over the duration of the subjects' career.

Table 1 describes the cause of each of the 93 NSI incidents that were

Table 1
Aetiology of the ninety-three needle stick injury incidents.

Aetiology of NSI	n (%)
Intravenous line insertion	60 (64.5)
Finger prick for glucose testing	17 (18.2)
Suturing of wounds	5 (5.3)
Arterial blood gas sampling	3 (3.2)
Venous blood gas sampling	2 (2.2)
Contaminated glass at trauma scene	2 (2.2)
Overfilled sharps container	2 (2.2)
Intramuscular injection	1 (1.1)
Surgical cricothyroidotomy	1 (1.1)

Table 2

Description of gender, age, qualification, experience and Hepatitis B virus vaccination status of study subjects.

Variable	Sustained ≥ 1 NSI over duration of career	Did not sustain NSI over duration of career
	n (%)	n (%)
Gender		
Female	69 (38.9)	26 (41.2)
Male	108 (61.0)	37 (58.7)
Age group (years)		
18–24	31 (17.5)	11 (17.4)
25–29	52 (29.4)	15 (23.8)
30–34	38 (21.5)	10 (15.9)
35–39	11 (6.2)	8 (12.7)
40–44	8 (4.5)	8 (12.7)
> 45	8 (4.5)	4 (6.3)
Highest level of qualification		
BLS	76 (42.9)	13 (20.6)
ILS	61 (34.5)	22 (34.9)
ALS	20 (11.3)	14 (22.2)
ECT	6 (3.4)	1 (1.6)
ECP	14 (7.9)	13 (20.6)
Years of experience		
< 1-year	10 (5.6)	1 (1.6)
1–2 years	28 (15.8)	5 (7.9)
3–5 years	53 (29.9)	15 (23.8)
6–10 years	44 (24.9)	15 (23.8)
> 10 years	42 (23.7)	27 (42.9)
Hepatitis B virus vaccination status		
Up to date	115 (65.0)	44 (69.9)
Not up to date	37 (20.9)	15 (23.8)
Not sure	25 (14.1)	4 (6.3)

BLS - basic life support, ILS - intermediate life support, ALS - advanced life support, ECT - emergency care technician, ECP - emergency care practitioner.

sustained by subjects over the duration of their career. There was a total of nine different causes that were reported. Of note, almost two-thirds ($n = 60$; 64.5%) of NSIs were sustained during intravenous line insertion. The frequencies of all causes are summarized in the table.

Most of the subjects that participated in the study were male ($n = 145$, 60.4%), between the age of 25–29 years ($n = 67$, 27.9%), had a BLS qualification as the highest level of training ($n = 89$, 37.1%), had > 10 years of experience ($n = 69$; 28.8%) and were up to date with their Hepatitis B virus vaccination at the time that the study was conducted. Table 2 describes gender, age, qualification, experience and Hepatitis B virus vaccination status of study subjects.

Table 3 describes HIV and Hepatitis B virus testing of subjects following the 93 NSI incidents. Overall, a higher proportion of subjects had tested for HIV than for Hepatitis B virus. Within 72 h following the NSI, most subjects ($n = 89$; 95.7%) had underwent testing for underlying HIV infection, whereas only 62 (66.7%) had tested for underlying Hepatitis B virus infection. At the 6-week, 4-month and 12-month intervals after the NSI, incrementally fewer subjects had undergone testing.

Initiation, drug regimen utilized, and compliance with HIV PEP is described in Fig. 1. Overall, HIV PEP was initiated in 82 (88.2%) out of the 93 NSI incidents. However, the recommended 28-day regimen was

Table 3
HIV and Hepatitis B virus testing of participants following a needle stick injury.

Recommended testing times	HIV testing n (%)	Hepatitis B virus testing n (%)
Within 72 h of incident	89 (95.7)	62 (66.7)
6 weeks after incident	66 (71.0)	32 (34.4)
4 months after incident	52 (55.9)	19 (20.4)
12 months after incident	37 (39.8)	19 (20.4)

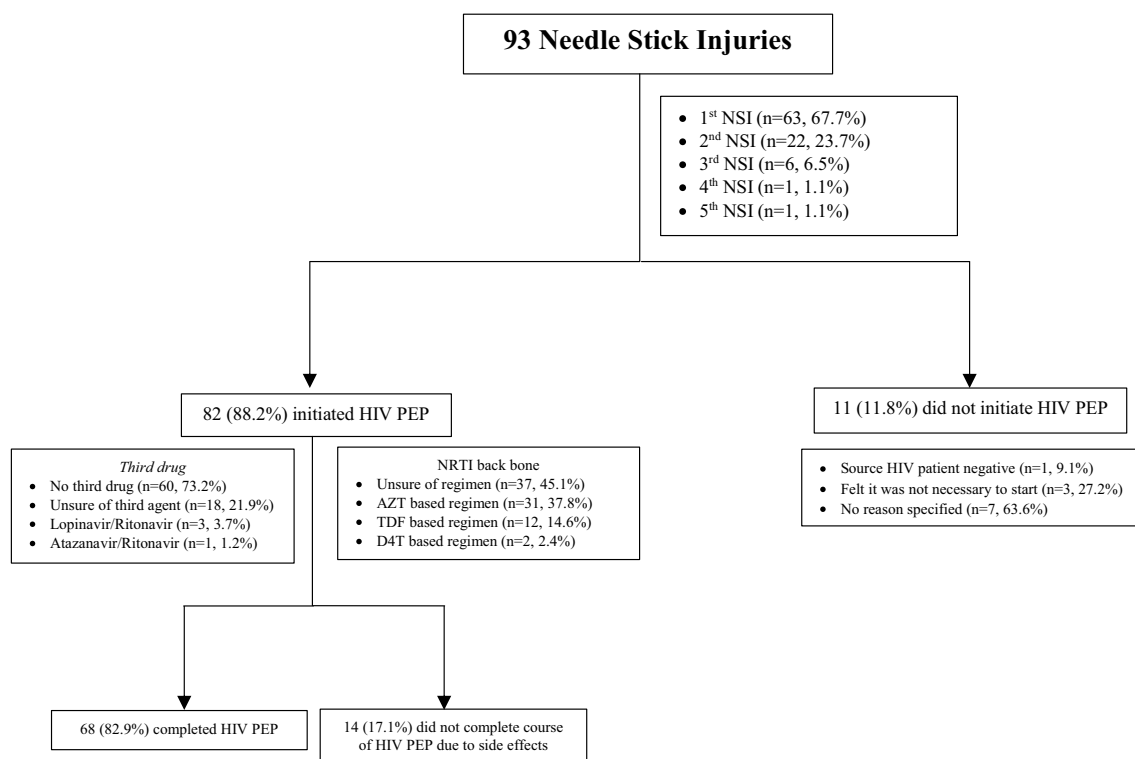


Fig. 1. Initiation, compliance and selection of antiretroviral therapy amongst study subjects that had experienced a needle stick injury. NSI-needle stick injury; PEP-post-exposure prophylaxis; NRTI-nucleoside/nucleotide reverse transcriptase inhibitors.

only completed in 68 (82.9%) incidents. Among the 63 subjects that had experienced only one NSI, the majority initiated ($n = 55$; 87.3%) and had completed ($n = 47$; 85.5%) the 28-day PEP regimen. Whereas, amongst the 22 subjects that had experienced a second NSI, 19 (85.7%) initiated PEP and 15 (78.9%) completed the regimen. All the 6 subjects that had experienced a third NSI had initiated PEP, however, only 4 (66.7%) completed the regimen. The one participant that had experienced a fourth and fifth NSI had initiated and completed the recommended regimen of PEP after both NSI episodes.

Of the 82 incidents where PEP was initiated, subjects were not aware of the constituents of the prescribed antiretroviral regimen in 37 (45.1%) cases. Of the remaining 45 (54.9%) cases, an AZT (Zidovudine) based regimen was prescribed in 31 (68.9%) cases whereas TDF (Tenofovir) and D4T (Stavudine) based regimens were prescribed in 12 (26.7%) and 2 (4.4%) cases respectively. Twenty-three (51.1%) subjects reported that they were not prescribed a third agent, whereas 18 (19.4%) were unsure if a third agent was prescribed.

Of the remaining 4 (8.9%) subjects, 3 (6.7%) had used Lopinavir/Ritonavir and 1 (2.2%) had used Atazanavir/Ritonavir as the third antiretroviral agent.

Table 4 summarises the responses of subjects regarding personnel/staff members and various scenarios that were perceived as high risk for sustaining a NSI. About 40% ($n = 98$) of subjects believed that inexperienced staff were at high risk of sustaining a NSI while less than 10% of subjects reported that doctors, nurses, all EMS personnel (except ILS personnel) and managers were at high risk of sustaining a NSI. Regarding high risk scenarios; exhaustion, managing an intoxicated patient, managing a psychiatric patient and personal inexperience were perceived by approximately two-thirds of subjects as high-risk scenarios for sustaining a NSI.

Most subjects ($n = 219$; 91.3%) reported that their company/organisation had a policy or standard operating procedure in place following a NSI. Three (1.3%) subjects reported that this was not available, whereas 18 (7.5%) subjects were unsure if this was available. Most subjects also reported that they were aware of what to do following a

Table 4

Personnel and scenarios that were perceived as high risk for sustaining a needle stick injury.

Description	n (%)
Personnel at high risk of sustaining a needle stick injury	
Inexperienced staff members	98 (40.8)
Students	82 (34.2)
ILS	37 (15.4)
Males	33 (13.8)
Females	30 (12.5)
Experienced staff members	27 (11.3)
Nurses	26 (10.8)
ECP	22 (9.2)
ALS	22 (9.2)
ECT	15 (6.3)
BLS	13 (5.4)
Doctors	10 (4.2)
Management	6 (2.5)
Scenarios associated with a high risk of sustaining a needle stick injury	
Exhaustion	163 (67.9)
Managing an intoxicated patient	160 (66.7)
Managing a psychiatric patient	158 (65.8)
Personal inexperience	152 (63.3)
Stress	119 (49.6)
Rotational shift work	39 (16.3)

ILS - intermediate life support, ECP - emergency care practitioner, ALS - advanced life support, ECT - emergency care technician, BLS - basic life support.

NSI ($n = 224$; 93.3%). Following a NSI, the majority of subjects indicated that they would a) report the incident to their manager ($n = 237$; 98.7%), b) determine the source patient's HIV and Hepatitis virus infection status ($n = 210$; 87.5%), c) undergo a Hepatitis B and C virus screening test immediately ($n = 200$; 83.3%) and d) undergo a HIV screening test immediately ($n = 214$; 89.2%).

Approximately half the number of subjects ($n = 125$; 52.1%) reported that the risk of acquiring Hepatitis B or C virus infection

following a NSI was higher, whereas about a third reported that the risk of acquiring HIV ($n = 83$, 34.6%) was higher and 32 (13.3%) were unsure. Despite the perceived risk, only 159 (66.3%) subjects were up to date with their Hepatitis B virus vaccinations at the time that the study was conducted. Fifty-two (21.6%) were not up to date and 29 (12.1%) were unsure of vaccination status.

Discussion

From initiation of their career until the date of data collection, more than a quarter of respondents (26.3%) had experienced at least one NSI. Comparatively, a study conducted in California, USA that enrolled 2664 subjects reported that 20% of EMS providers were exposed to a NSI within a 12 month period [4]. Another smaller study conducted by Alhazmi et al. in West Virginia (USA), noted a NSI incidence of 18.21% amongst 248 EMS personnel [13]. Higher incidences of NSIs amongst health care workers have been reported in Iran and Nigeria [14,15]. Since the likelihood of sustaining a NSI is higher with a longer duration of exposure, a likely reason for the higher incidence of NSIs in this study is that participants reported on the total number of NSIs over the span of their career. In comparison, most of the other studies reported on the incidence of NSIs over a 12-month period.

In a questionnaire-based study in Pakistan amongst healthcare workers who reported a NSI, 73% had reported more than one NSI [16]. Comparatively, approximately a third (34.9%) of NSI victims in this study had reported more than one NSI. Targeting modifiable risk factors such as poor working environments, long working hours, shift work, understaffing, lack of a sharps container, recapping of used needles, mental stress and physical stress [5,6,17,18] as well as non-modifiable risk factors such as increased patient load and a sense of urgency within the workplace [6] may reduce the risk of NSIs in EMS workers.

In contrast to international findings, where hypodermic injections (intramuscular, subcutaneous and/or intra-dermal injections) were reported as the most common cause of NSIs [2,17], almost two-thirds (64.5%) of NSIs in this study were sustained during intravenous line insertion. Compared to other countries, intravenous line insertion and various other procedures are frequently performed by EMS personnel in South Africa [19].

There were no significant differences between age groups with regards to the cumulative incidence of NSIs in this study. In contrast, other studies noted a higher incidence of NSIs among older EMS personnel and females [4,13]. There are no obvious reasons that may have accounted for the lack of difference noted in our study. In keeping with findings of other studies [4,13], our study also showed that EMS personnel with greater experience were more likely to have sustained a NSI. Although this may seem surprising, our findings can be attributed to the fact that a longer career would provide more opportunity for sustaining a NSI. Unfortunately, our study did not evaluate the number of NSIs sustained in the last year of service.

Since the HIV seroprevalence in South Africa is known to be high [9,20], it is concerning that 4.3% of study subjects did not undergo testing for HIV within the first 72 h following a NSI. Even more concerning, is the fact that incrementally fewer individuals underwent testing at the recommended 6-week (71.0%) and 4-month (55.9%) follow-up intervals. Possible reasons for this may be due to a lack of awareness of local protocols, negative HIV status of the source patient or that the subjects had forgotten to perform repeat testing.

Several South African studies have shown that amongst the general population, basic knowledge regarding HIV infection is fairly good, however, knowledge regarding the prevalence of HIV infection and personal risk is lacking [21].

In this study, substantially fewer NSI victims had been tested for Hepatitis virus serology as compared to HIV serology. Lack of awareness coupled with the fact that most guidelines predominantly focus on

HIV PEP as opposed to Hepatitis virus [10,11] are plausible reasons. Another potential reason for the low rates of Hepatitis virus testing in this study could be that some of the study subjects were aware of their immunity status and may have not deemed it necessary to undergo testing. This, however is concerning as the prevalence of Hepatitis B virus in South Africa is relatively high (1–10%) and Hepatitis B virus is known to be more readily transmitted than HIV [7,22].

Approximately half the number of participants ($n = 125$; 52.1%) reported that the risk of acquiring Hepatitis virus infection following a NSI was higher, whereas about a third reported that the risk of acquiring HIV ($n = 83$, 34.6%) was higher. The erroneously higher perceived risk of HIV transmission in this study may be as a result of greater media coverage and emphasis on HIV due to its high prevalence in the region.

The recommended 28-day regimen of HIV PEP was only completed by 82.9% of NSI victims in this study with the adverse effect profile being reported as the commonest reason for non-compliance. Similarly, other international studies have also reported adverse effects of HIV PEP medication as the chief reason for poor compliance and failure to complete the recommended duration of prophylaxis. This may be mitigated by administering newer drug regimens which have been associated with more tolerable adverse effects (e.g. Raltegravir) [23]. Due to cost constraints, these newer drug regimens have only recently been made available in public sector facilities locally (personal communication with local department of health personnel).

Subjects in this study perceived that inexperienced staff ($n = 40.8\%$) and students ($n = 34.2\%$) were at highest risk for NSIs. These findings are in keeping with other international studies [4]. Other perceived risk factors such as exhaustion, managing an intoxicated patient, managing a psychiatric patient and personal inexperience have also been reported in other studies [4,6,24].

The fact that almost 10% of study subjects reported that there was either no NSI policy or they were not aware of a NSI policy at their workplace is concerning. This finding suggests that educational programs regarding NSIs aimed at EMS personnel may be suboptimal. The development and implementation of frequent practical based educational programs to identify and correct suboptimal practices among healthcare providers has been strongly recommended [6,17]. Furthermore, the use of safety engineered needle devices have also been shown to reduce the risk of NSIs among healthcare providers [17].

This is a regional study which comprised of 240 subjects among a population of almost 70,000 EMS personnel across South Africa. Hence, our findings may not be representative of the practices and perceptions of EMS personnel in general. Also, since this was a questionnaire-based study, findings were based on data that was self-reported by study subjects. Hence, recall bias may limit our findings. Furthermore, as convenience sampling was used there is an inherent risk of selection bias. In addition, due to the blind nature of data collection, questions posed were open to individual interpretation. This may have also led to bias.

Conclusion

Prehospital personnel are at high risk of sustaining a NSI. There is a need to promote awareness in the prehospital environment. Risks, safe practices, preventive measures, awareness of protocols and the timely initiation and completion of HIV PEP must be emphasized.

Dissemination of results

Results have not been disseminated yet. The results will be shared with all participants following publication. We are planning to present the findings at local events.

Author contribution

Authors contributed as follow to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: JM 60% and AL 40%. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

Declaration of competing interest

The authors declare no conflict of interest.

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