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ORIGINAL ARTICLE

Occupational blood and body fluid exposure among emergency medical service providers in the eThekwini metropole of South Africa

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ABSTRACT

Introduction: Emergency Medical Service (EMS) providers in South Africa are among health care workers (HCW) most at risk of contracting infectious diseases due to occupational exposure to blood and body fluids (BBF). While the austere, dynamic, and challenging nature of the prehospital environment appears to be one of the primary drivers to this risk, the growing prevalence of bloodborne infections within the country; particularly Hepatitis B, C and Human Immunodeficiency Virus (HIV), has inevitably compounded the problem. The aim of this study was to investigate the knowledge, practices, and prevalence of BBF exposure among EMS providers in the eThekwini metropole of KwaZulu-Natal, South Africa.

Methodology: This cross-sectional questionnaire-based study was completed by 96 randomly selected EMS providers who worked for the state-run ambulance service and were stationed within the eThekwini metropole.

Results: A total of 41 (42.7%) of the 96 respondents indicated memorable exposure to BBF at some point in their operational career. Exposure appeared to be mostly as a result of needlestick injuries (NSI) (63.4%), followed by BBF exposure into the eyes (19.5%). At the time of exposure, a total of 40 participants (97.6%) were wearing gloves, 22% (n = 9) were wearing facemasks, and 9.8% (n = 4) were wearing eye protection. Less than half of the respondents (46, 47.9%) were aware of existing EMS espoused BBF exposure policies, and 55 (57.3%) knew about post-exposure prophylaxis for HIV. Majority of the respondents (n = 74; 77.1%) indicated that they always recapped needles, and 46.9% (n = 45) dispose of sharps containers when completely full.

Conclusion: The findings suggest that BBF related knowledge and practices among EMS providers working in the eThekwini metropole may be inadequate, and may increase the risk of blood exposure. In order to improve knowledge, immediate provision of EMS-specific BBF exposure training is required.

Introduction

Due to the nature of their jobs, healthcare workers (HCWs) continue to be at increased risk of percutaneous and mucocutaneous exposure to blood and body fluids (BBF) [1]. Among the many bloodborne pathogens that HCWs are occupationally exposed to, the hepatitis B virus (HBV), hepatitis C virus (HCV), and human Immunodeficiency Virus (HIV) appear to be the most common [2]. While hepatitis B and C characteristically target the liver, and HIV the immune system, all three diseases present significant health risks [3]. The risk of BBF exposure may be higher in developing countries such as South Africa, due to the increased burden of bloodborne diseases [1,4–6], however, compliance to universal precautions can still drastically reduce exposures. Universal precautions are a set of guidelines aimed at preventing BBF exposures in HCWs [7].

Emergency medical service (EMS) providers represent a cohort of HCWs who identify as being among the most susceptible to BBF exposure. This is typically a result of the dynamic, uncontrolled, unpredictable and challenging nature of their jobs [8]. These challenges include working in confined spaces, in areas with poor ambient light, and in the back of fast-moving ambulances [9]. These challenges, compounded by the burden of bloodborne diseases, place South African EMS providers at high risk of bloodborne virus infection.

While studies that investigated BBF exposure in EMS providers do exist, with reported exposure rates as high as 60% in the United States of America and 40% in the Republic of Korea [10,11], published data on the subject is generally scant. In fact, other than McDowall and Laher (2019) who examined needlestick injuries (NSI) in EMS providers,

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no other studies were locatable that specifically investigated BBF exposure rates in South African EMS providers. The aim of this study was to investigate the knowledge, practices, and prevalence of BBF exposure among EMS providers in the eThekwini metropole of KwaZulu-Natal, South Africa.

Methods

Sampling

This was a cross-sectional questionnaire-based study that recruited a powered sample of 125 (N = 392, CL 95%, CI 7.25) randomly selected EMS providers who worked for the state-run ambulance service and were stationed within the eThekwini metropole. After all of the 392 operational EMS providers were assigned a unique number, a computer-generated randomisation application was used to identify 125 participant assigned numbers to be used in the study. Non-operational staff members (e.g., control room and administrative staff) were excluded from participating in the study due to the determined unlikeliness of BBF exposure.

Pilot testing

To ensure that the survey questionnaire was contextually appropriate and had the capacity to collect information required for the study, a pilot exercise was undertaken using ten additional EMS providers from the N = 392 who were not part of the initial 125 randomly selected to participate in the study. These ten EMS providers were subsequently excluded from participating in the actual study. The pilot group signed a confidentiality document to ensure that the study and questionnaire were kept secret. There were some suggestions and recommendations that emerged from the pilot test, many of which were accepted and incorporated into the survey that would eventually become the version used in the study. The survey consisted of four sections: Demographic Information, Knowledge, Practices and Exposures.

Data collection

Post randomisation, selected EMS providers were categorised according to their respective ambulance bases and shifts, as this proved to be location and time when questionnaires were meant to be distributed and collected. Dates for data collection were determined through consultations with the EMS service administrators. Data collection took place at shift change (07:00 or 19:00) on the pre-selected dates to avoid disrupting EMS operations or missing staff who were required to complete and return questionnaires.

On the days when questionnaires were distributed, the first author was present at each ambulance base and personally invited each randomly selected EMS provider to participate in the study. Those who agreed to participate in the study had to sign a consent document, and were provided with a letter of information and the questionnaire. They were also informed that should they not want to participate in the study, a blank unfiled questionnaire should be returned.

Data analysis

Microsoft Excel® 2016 was used to undertake descriptive statistics; including frequency distributions and cross tabulations. The Pearson chi-square test and Fisher's exact test were used to calculate inferential statistics using the Stata® version 15 software, to determine whether significant relationships existed between established variables at a 0.05 significance level.

Ethics Approval

Ethics approval to conduct the study was granted by the Durban University of Technology's Institutional Research Ethics Committee (REC 007/18), and permission to conduct the study was granted by the EMS service.

Table 1
BBF exposure by demographics

Demographic variables		Exposed to BBF (n)	%	Not exposed to BBF (n)	(%)
Years of experience	1 to 2	1	100.0	0	0.0
	3 to 5	1	33.3	2	66.7
	6 to 10	5	50.0	5	50.0
	More than 10	34	41.5	48	58.5
	ALS	2	66.7	1	33.3
Qualification	ILS	25	44.6	31	55.4
	BLS	14	37.8	23	62.1
Age	20 to 35	5	45.4	6	54.6
	36 to 45	13	34.2	25	65.8
	46 and over	23	48.9	24	51.1
Sex	Male	35	45.4	42	54.6
	Female	6	31.6	13	68.4

Results

Exposure

Ninety-six of the 125 participants returned completed questionnaires, resulting in a response rate of 77%. Forty-one of the 96 participants (42.7%) were exposed to BBF at some point in their career. Advanced life support providers (ALS) accounted for the highest percentage of BBF exposures, followed by intermediate life support (ILS) providers. Table 1 provides a breakdown of the BBF exposures according to the selected demographic variables.

Needlestick injuries accounted for majority (n = 26, 63.4%) of the BBF exposures, and occurred during the process of intravenous (IV) cannulation, disposal of sharps, and finger pricking with blood lancets. The procedures responsible for most (n = 4, 50%) of the BBF exposures to the eyes were bleeding control, and loading of patients into the ambulance. Bleeding control was also the procedure responsible for majority (n = 5, 71.4%) of the BBF on broken skin exposures. Table 2 provides a description of the procedures being done per route of exposure.

Knowledge

Less than half of the respondents (n = 46, 47.9%) indicated that they were aware of their organisation's BBF exposure policy, while 80.2% (n = 77) did not know where they could access the policy. When participants were given the opportunity to identify potential infections that they could contract as a result BBF exposure, only 20.8% (n = 20) identified all three of the presented risks of exposure (HIV, HBV, HCV). While majority of the respondents (n = 87, 90.6%) were aware that there was pre-exposure prophylaxis for HBV, 42.7% (n = 41) were not aware that post-exposure prophylaxis existed for HIV. Only half of the respondents (n = 48) were able to identify all four presented components of universal precautions; namely, use of gloves, use of protective eyewear, use of facemasks, and disposal of sharps in puncture resistant containers. Table 3 describes the identification of the components of universal precautions by demographics. The relationship between qualification and identification of the components of universal precautions was found to be significant (p= 0.002), with ALS and ILS providers identifying more of the presented components of universal precautions compared to the basic life support (BLS) providers.

Practices

Only three (7.3%) of the 41 participants who were exposed to BBF indicated that they were wearing all three of the presented types of personal protective equipment (PPE) when the exposure occurred, namely,

Table 2
Procedures being done per route of exposure

Route of exposure		Frequency (n)	Percentage (%)
Needlestick injury	Administering an injection	2	7.7
	Cleaning the ambulance	1	3.8
	Disposing of sharps	5	19.3
	Extricating the patient	1	3.8
	Finger pricking with blood lancet	4	15.4
	Obtaining Intravenous access	13	50.0
Total		26	100.0
BBF in eyes	Cleaning the ambulance	1	12.5
	During endotracheal intubation	1	12.5
	Finger pricking with blood lancet	1	12.5
	Loading patient into the ambulance	2	25.0
	Obtaining Intravenous access	1	12.5
	Stopping bleeding	2	25.0
Total		8	100.0
BBF on broken skin	Finger pricking with blood lancet	1	14.3
	Loading patient into the ambulance	1	14.3
	Stopping bleeding	5	71.4
Total		7	100.0

Table 3
Identification of the presented components of universal precautions

		Identified 1 UP		Identified 2 UP		Identified 3 UP		Identified 4 UP		
Demographic variables		(n)	%	(n)	%	(n)	%	(n)	%	Fisher's exact test
Years of experience	1 to 2	0	0.0	0	0.0	0	0.0	1	100.0	P= 0.92
	3 to 5	0	0.0	1	33.3	1	33.3	1	33.3	
	6 to 10	0	0.0	3	30.0	2	20.0	5	50.0	
	More than 10	6	17.3	14	17.1	21	25.6	41	50.0	
	ALS	0	0.0	0	0.0	1	33.3	2	66.7	P= 0.002
Qualification	ILS	3	5.3	7	12.5	9	16.1	37	66.1	
	BLS	3	8.1	11	29.7	14	37.8	9	24.3	
Age	20 to 35	1	9.1	2	18.1	4	36.4	4	36.4	P= 0.58
	36 to 45	3	7.9	8	21.1	11	28.9	16	42.1	
	46 and over	2	4.3	8	17.0	9	19.1	28	59.6	
Gender	Male	5	6.5	15	19.5	16	20.8	41	53.2	P= 0.30
	Female	1	5.3	3	15.8	8	42.1	7	36.8	

UP- Universal Precautions

Table 4
PPE used for each route of BBF exposure

Route of exposure	PPE used	Frequency (n)	Percentage (%)
Needlestick injury	Gloves	18	69.2
	Gloves and facemask	5	19.2
	Gloves and eye protection	1	3.9
	Gloves, eye protection, and facemask	1	3.9
	Facemask	1	3.9
Total		26	100.0
BBF in eyes	Gloves	7	87.5
	Gloves and facemask	0	0.0
	Gloves and eye protection	0	0.0
	Gloves, eye protection, and facemask	1	12.5
	Facemask	0	0.0
Total		8	100.0
BBF on broken skin	Gloves	6	85.7
	Gloves and facemask	0	0.0
	Gloves and eye protection	0	0.0
	Gloves, eye protection, and facemask	1	14.3
	Facemask	0	0.0
Total		7	100.0

PPE- Personal protective equipment

gloves, eye protection, and facemasks. Only one of the seven respondents (12.5%) who sustained BBF exposure to the eyes was wearing eye protection when the exposure occurred. The PPE used for each route of BBF exposure is presented in Table 4.

Table 5 describes practices related to the handling of needles and other sharps. Majority of the respondents (n = 74, 77.1%) indicated that they always recap needles, while 65.6% (n = 63) dispose of needles on the scene by recapping and taking the needles to the emergency vehicle for disposal. The majority of the respondents (n = 88, 91.7%) remove needles from syringes with their gloved hands, and almost half of the respondents (n = 45, 46.9%) dispose of sharps containers when it is completely full.

Table 5
Handling of needles and other sharps

		Frequency (n)	Percentage %
Recapping needles	Always	74	77.1
	Most of the time	8	8.3
	Sometimes	7	7.3
	Never	7	7.3
Disposal of needles on scene	Carry sharps container	33	34.4
	Recap and carry to ambulance	63	65.6
Removal of needles from syringes	Bare hands	1	1.0
	Forceps	3	3.1
	Gloved hands	88	91.7
	Never	4	4.2
Disposal of sharps containers	Completely full	45	46.9.
	Half full	6	6.2
	Three quarters full	45	46.9
Total		96	100.0

Discussion

Many of the EMS providers (42.7%) sustained an occupational exposure to BBF at some point in their career. While these findings are consistent with those reported by Oh and Uhm [11] who found very similar (40%) BBF exposure rates in Korean EMS providers, Harris and Nicolai [10] documented an even higher percentage (66%) of BBF exposure among American EMS providers. This indicates that higher percentages of BBF exposures are very possible, particularly when unsafe BBF practices and inadequate knowledge of universal precautions are left unmitigated.

In line with the findings of international studies [12,13], majority (63.4%) of the BBF exposures found in this study were attributable to NSI. Comparatively, another South African- based study, reported a significantly lower percentage of NSI (26.3%) [14]. The percutaneous route of BBF exposure poses the greatest risk of infection to bloodborne pathogens [15]. Given the high prevalence of HIV, HBV and HCV in South Africa, EMS providers are at risk of contracting these diseases following a NSI exposure.

Compared to Leiss et al. [16] who found that disposing of needles and blood lancets were the procedures responsible for most (32.1%) of the NSI, obtaining intravenous access was the procedure which accounted for the majority (50%) of the NSI in this study. This is consistent with the findings of McDowall and Laher who reported that 64.5% of NSI occurred during IV cannulation [14]. It is important that EMS providers regard IV cannulation as a high-risk procedure for BBF exposure, and maintain a high level of awareness when performing the procedure.

Many of the EMS providers in this study demonstrated incomplete knowledge of the risks of BBF exposure and universal precautions. This is in line with the findings of international studies which also reported a lack of knowledge of the risks of BBF exposure and universal precautions in EMS providers [10,17]. Knowledge of the risks of BBF exposure and the effective implementation of universal precautions is fundamental to the prevention of BBF exposures. Insufficient knowledge of the risks of BBF exposure and strategies to prevent such exposures may result in unsafe practices, and in turn lead to BBF exposure. This is a plausible reason for the high prevalence of BBF exposures observed in our study, and highlights the need for effective training aimed at awareness and prevention of BBF exposures in EMS providers.

This study revealed a strong relationship ($p = 0.002$) between level of training and universal precautions, and found that ALS and ILS providers demonstrated a more complete knowledge of universal precautions compared to BLS providers. Complaints regarding the suboptimal quality of BLS training programmes have been reported previously [18], which may be a possible reason for the lack of knowledge of BLS providers regarding universal precautions. The link between BLS training programmes and knowledge of universal precautions was however not investigated in this study.

The noncompliance or incomplete compliance with PPE among EMS providers has been documented previously [10,16,19]. This is consistent with the results of this study which found that many of the respondents were not fully compliant with the use of PPE when they sustained the BBF exposure. The study revealed that, while 97.6% of the respondents had been wearing gloves when they were exposed to BBF, over 80% had not been wearing facemasks, and 90% had not been wearing protective eyewear. Although the factors influencing noncompliance with PPE was not quantified in this study, possible reasons for noncompliance, as indicated by other studies include the unavailability of PPE, the use of PPE was annoying, and not having time to use PPE [11,16,19].

The majority of the respondents in this study (77.1%) indicated that they always recapped needles and disposed of needles on scene by recapping and carrying the recapped needle to the ambulance (65.6%). These findings are consistent with those reported by Topczewska and Gańczak [20] who documented that over half of EMS providers indicated that they recapped needles. In contrast, significantly lower rates of needle recapping (14%) was reported by Harris and Nicolai [10]. Our study also revealed that over 90% of the participants removed needles from syringes with gloved hands and that almost half (46.9%) of them disposed of sharps containers when completely full. These unsafe needle practices may predispose EMS providers to exposure and possible infection with bloodborne pathogens.

Many of the EMS providers in this study did not possess adequate knowledge on the risks of BBF exposure and universal precautions, and undertake unsafe needle and PPE practices, which may be related to the high prevalence of BBF exposure in the study. Interventions to reduce BBF exposures in EMS providers should include the provision of effective BBF exposure guidelines, improved compliance with universal precautions, and adequate BBF exposure training.

A limitation of this study is the potential bias of self-reported data, as it cannot be known for certain that respondents have reported accurately on the way they feel or behave. Another limitation is that it only investigated BBF exposures among EMS providers employed by one EMS service in one city in South Africa. Accordingly, the study findings may not be representative of the entire EMS provider population in South Africa. However, in view of the paucity of literature on BBF exposure among EMS providers in South Africa, the findings of this study do open the door for larger regional or national studies to be undertaken on the topic. In light of the fact that the participants were asked to provide details on their past BBF exposure incidents, another limitation may be said to be the possibility of recall bias.

Conclusion

Emergency medical service providers are at high risk of exposure to BBF. The high prevalence of BBF exposures among EMS providers in eThekwini may be related to the lack of knowledge of BBF exposure

and universal precautions, infrequent use of PPE, and unsafe needle practices. Strategies aimed at reducing BBF exposure in EMS providers may include the provision of EMS-specific BBF exposure training, the distribution of effective BBF exposure guidelines, and compliance with universal precautions.

Dissemination of results

The results of the study were distributed to the EMS service which participated in the study.

Author's contribution

Authors contributed as follows 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: MC contributed 50%; KG 25%; and SS 25%. 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 declared no conflicts of interest.

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