AN INVESTIGATION INTO OCCUPATIONAL BLOOD AND BODY FLUID EXPOSURE AMONG EMERGENCY MEDICAL CARE PROVIDERS WITHIN THE PUBLIC SECTOR EMERGENCY MEDICAL SERVICE IN ETHEKWINI

A dissertation submitted in fulfilment of the requirements for the degree of Master of Health Sciences in Emergency Medical Care in the Faculty of Health Sciences at the Durban University of Technology

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04 August 2020

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PREFACE AND DECLARATION

This study was conducted at the public sector operational ambulance bases in the eThekwini metropole, under the supervision of Dr Kevin Govender and Dr Simpiwe Sobuwa.

This is to certify that this work is entirely my own and not that of any other person, unless explicitly acknowledged (including citation of published and unpublished sources). The work has not previously been submitted in any form to the Durban University of Technology or to any other institution for assessment or for any other purpose.

Name Melvin Chetty

Signed

Date <u>04 August 2020</u>

ETHICAL CLEARANCE

This is to certify that the research studies conducted for the purposes of this dissertation have the approval of the Institutional Research Ethics Committee (IREC) of the Durban University of Technology (DUT) in KwaZulu-Natal.

Institutional Research Ethics Clearance Number: **REC 007/18**

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ABSTRACT

Introduction

Occupational exposure to blood and body fluid (BBF) is an issue of serious concern for health care workers (HCWs) and presents a major risk factor for the transmission of infectious diseases such as the hepatitis B virus (HBV), hepatitis C virus (HCV), and the human immunodeficiency virus (HIV). Emergency medical care (EMC) providers, particularly those working in the developing countries, appear to be at even greater risk due to nature of their prehospital work and the environment in which this work is undertaken.

Purpose

To investigate the knowledge, practices and exposure to BBF among public sector EMC providers in the eThekwini metropole, as part of a process of informing contextually relevant recommendations for the mitigation and management of BBF exposure in the prehospital environment.

Methodology

The study used a mixed methodological approach and was conducted in two phases. During the first phase quantitative data was collected using a questionnaire which was distributed to a randomly selected and representative sample of EMC providers employed by the Emergency Medical Rescue Services (EMRS) in eThekwini. Phase two included the collection of qualitative data through structured interviews which were conducted with the information-rich respondents who had participated in phase one. Through methodological triangulation, the data from Phase one and Phase two were integrated to obtain an in-depth understanding of the knowledge, practices and exposure to BBF among public sector EMC providers in the eThekwini metropole.

Results

A total of 41 (43%) of the 96 participants indicated that they had been exposed to BBF at some point in their careers. The majority (n = 26, 63%) of such BBF exposures was due to needlestick injuries (NSI) with the procedure involved in gaining intravenous (IV) access accounting for most (n = 14, 34%) of the BBF exposures. The main contributing factor in relation to most (n = 25, 61%) of the exposures was combative

patients. There was a significant relationship between the qualifications of the EMS providers and the type of BBF exposure (p = .016). It was found that a higher proportion of intermediate life support (ILS) providers sustained NSI compared to advanced life support (ALS) and basic life support (BLS) providers, whilst a higher percentage of ALS providers sustained BBF exposure to their eyes, while basic life support providers sustained more BBF exposures to broken skin as compared to ALS and ILS providers. Seventy nine percent (n = 76) of the respondents were unable to identify all of the presented risks of their BBF exposure, while 80.2% (n = 77) did not know where their organisation's BBF exposure guideline was kept. There was a significant relationship between the EMC providers' qualification and their knowledge of the risks of BBF exposure (p = .01), with ILS providers identifying more risks associated with BBF exposures compared to ALS and BLS providers. Half of the respondents (n = 48) were unable to identify all the presented examples of universal precautions. The association between qualifications and knowledge of universal precautions was significant (p= .002). Advanced life support and ILS providers demonstrated greater knowledge of BBF exposure compared to BLS providers. Inadequate BBF exposure training and a lack of clear direction regarding BBF exposure protocols were identified as possible reasons for the inadequate knowledge of both the risks of BBF exposure and universal precautions. Most (n = 87, 90.6%) of the respondents indicated that they always used gloves when there was a perceived risk of BBF exposure, while 27.1% (n = 26) and 15.6% (n = 15) indicated that they never used eye protection and facemasks respectively. Possible reasons for the infrequent use of personal protective equipment (PPE) include the unavailability of PPE, and EMC providers not anticipating the BBF exposure. The majority of the respondents (n = 74, 77.1%) indicated that they always recapped needles, 95.8% (n = 92) removed needles from syringes and 46.9% (n = 45) disposed of sharps containers when completely full.

Conclusion

The study found that the EMC providers employed by the EMRS in eThekwini do not possess adequate knowledge of either BBF exposure or universal precautions, which may be one of the contributing factors to the high prevalence of BBF exposures revealed in this study. As the burden of disease continues to grow, urgent intervention is required to mitigate BBF exposure in all HCWs, but particularly in the case of EMC providers who are frontline staff who often have no prior knowledge of the patients they may see before the initial contact. As informed by this study interventions may include the provision of BBF exposure training, the circulation of effective BBF exposure guidelines and the adequate availability of PPE.

DEDICATION

This dissertation is dedicated to my loving wife, Zakia. You have been a pillar of strength through every season of our lives. Words cannot express how much you mean to me. I love you dearly.

To my beautiful children, Shiloh, Talia and Isaiah, you are my greatest accomplishments. Thank you for understanding when I had to study instead of spending time with you.

My mom and dad, Deshni and Morgan Chetty, thank you for your love and support throughout my life. I will forever be grateful.

AKNOWLEDGEMENTS

Firstly, I would like to thank the Lord for His grace in my life, and for giving me the strength and passion required to complete this project.

Secondly, to my supervisors, Dr Kevin Govender and Dr Simpiwe Sobuwa, thank you for your patience, encouragement, guidance and support throughout the duration of this journey.

Thank you to Dr Fikile Nkwanyana for your assistance with the inferential statistics, Mrs Nevlene Manilal for her assistance with the maps, and Ms Alexa Barnby for editing the dissertation.

To all the participants in this study, thank you for your cooperation and willingness to participate in the study.

I would also like to thank the KwaZulu-Natal Emergency Medical Rescue Services and the KwaZulu-Natal Department of Health for granting me permission to conduct this study.

To my family, friends and colleagues, I am grateful for your motivation and support.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ANNEXURES

LIST OF ABBREVIATIONS

BBF:	Blood and body fluid
HCW:	Health care worker
EMC:	Emergency medical care
EMRS:	Emergency Medical Rescue Service
ALS:	Advanced Life Support
ILS	Intermediate Life Support
BLS	Basic Life Support
ECP:	Emergency Care Practitioner
CCA	Critical Care Assistant
EMS:	Emergency medical services
HIV:	Human immunodeficiency virus
HBV:	Hepatitis B virus
HCV:	Hepatitis C virus

LIST OF TERMS

Health care workers (HCWs): Individuals who provide medical care to ill or injured people. They include doctors, nurses and EMC providers (Joseph and Joseph 2016).

Emergency medical service (EMS): A system which is responsible for all aspects of the provision of prehospital emergency care within a specific geographical location (Stein, Wallis and Adetunji 2015).

Emergency medical care (EMC) providers: For the purposes of this study, EMC providers refer to individuals who have been trained to provide emergency medical treatment to patients in the prehospital environment. As such, the term includes Advanced Life Support (ALS), Intermediate Life Support (ILS), and Basic Life Support (BLS) practitioners.

Advanced Life Support (ALS): EMC providers who are trained to provide several advanced procedures including drug-assisted, endotracheal intubation and the administration of many different types of medications, depending on the type of ALS qualification. For the purposes of this study ALS providers refers to those providers who are registered as Paramedics and Emergency Care Practitioners (ECPs) with the Health Professions Council of South Africa (HPCSA).

Intermediate Life Support (ILS): EMC providers who are on the Ambulance Emergency Assistant Register of the HPCSA.

Basic Life Support (BLS): EMC providers who are on the Basic Ambulance Assistant Register of the HPCSA.

Blood and body fluid (BBF) exposure: Contact with BBF through needlestick injuries, BBF in the eyes, BBF in the mouth and/or BBF on non-intact skin (Aigbodion, Motara and Laher 2019).

Bloodborne pathogen: Virus or disease that is carried via blood

CHAPTER 1:

INTRODUCTION

1.1 Background

Blood and body fluid exposure is a global healthcare problem, with over 35 million individuals reportedly at risk every year (Auta *et al*. 2017). Among those who are at risk, approximately three million sustain percutaneous exposures to BBF. According to Rossouw, Van Rooyen and Richter (2014), this problem is more significant in developing countries, where the burden of bloodborne diseases is greater and resources are scarcer. Healthcare workers in the developing countries are at a high risk of being infected by various types of bloodborne pathogens, of which HBV, HCV, and HIV are the most common, and which all present significant health risks (Zaidi, Beshyah and Griffith 2010).

Recent data indicates that HBV and HCV have overtaken HIV, tuberculosis and malaria as the leading cause of death from infectious diseases, with Africa being identified as the region with the second highest prevalence of HBV and third highest prevalence of HCV in the world (World Health Organisation 2017b). Furthermore, South Africa has the highest number of people living with HIV in the world. This implies that South African HCWs are at high risk of infection to bloodborne diseases (Department of Health 2014).

Although medical personnel across the various medical professions are affected, EMC providers may be the group most susceptible to BBF exposure due to the uncontrolled nature of the environment in which they work. The prehospital environment is highly dynamic and is fraught with many challenges. Such challenges include working in confined spaces, in areas with poor ambient light, and in the back of fast moving emergency vehicles (Boal *et al*. 2010). These challenges, coupled with the high prevalence of HIV, HBV and HCV, place South African EMC providers at very high risk of exposure to BBF and infection with bloodborne pathogens.

1.2 Research problem

A high prevalence of BBF exposure among EMC providers has been observed in various countries (Topczewska and Gańczak 2019; Oh and Uhm 2016; Wicker *et al*. 2010). International studies that investigated the knowledge and practices of EMC providers in relation to BBF exposure found that many HCWs did not possess adequate knowledge of how to effectively prevent and manage occupational BBF exposures (Harris and Nicolai 2010; Shaban 2006; Karimi-Sari *et al.* 2017; Leiss, Sousa and Boal 2009). These studies identified a number of unsafe practices which may predispose EMC providers to exposure to BBF and possible infection with bloodborne pathogens. This is disturbing when considering that EMC providers are in the frontlines of such exposure.

There is limited literature available on BBF exposure among EMC providers in South Africa as most studies on the topic have focused primarily on hospital based HCWs. The researcher located one previous South African study related to BBF exposure among EMC providers only. However, this study investigated one route of BBF exposure only. It is a matter of concern that so little is known on the subject within a South African context, as the EMC providers in South Africa may be among those EMC providers who, in light of the burden of disease and the challenging nature of the prehospital environment in the country, are at the highest at risk of infection due to bloodborne pathogens. This highlights the need for reliable local studies to provide an insight into this important, yet under-researched, area.

1.3 Researcher's interest in the study

The researcher qualified as an advanced life support paramedic in 2005 and then completed his bachelor's degree in Emergency Medical Care. He has vast experience in the field of emergency medical care and has worked as a critical care paramedic in both public and private emergency medical service (EMS) settings in South Africa and abroad and, at the time of the study, was involved in emergency care education in South Africa.

Based on his experience as an operational paramedic, the researcher has observed both that medical sharps and other biological contaminants are poorly handled in the prehospital environment in South Africa, and also that universal precautions are not properly upheld. It has also been observed that BBF exposures were quite common but were not effectively managed, which may make these practitioners susceptible to bloodborne virus infections.

1.4 Aims and objectives

1.4.1 Aim of the study

The aim of this study was to investigate the knowledge, practices, and exposure to BBF among EMC providers employed by the EMRS in the eThekwini metropole, in order to make evidence-based recommendations to prevent and effectively manage BBF exposures in the prehospital environment.

1.4.2 Objectives of the study

- To determine the prevalence and factors associated with BBF exposure among EMC providers employed in the eThekwini metropole.
- To determine the knowledge and practices of EMC providers in relation to pre- and post-BBF exposure.
- To identify the important components of an effective pre- and post-BBF exposure protocol.

1.5 Structure of the dissertation

Chapter 1: Introduction

Chapter one of this study presents the background to the research topic. This is done by providing an insight into the reported and global burden of BBF exposure, particularly in the developing countries where the burden of bloodborne diseases is greater and resources are scarcer. The focus of the chapter then narrows even further to prehospital HCWs where the very nature of their jobs often places them at a high risk of BBF exposure. The chapter concludes by presenting the aim and objectives of the study, together with the research problem and the researcher’s interest in the study.

Chapter 2: Literature review

In chapter two the literature on BBF exposure in HCWs is extensively reviewed. The chapter starts by introducing the subject of BBF exposure in HCWs, and then goes on to discuss the burden of bloodborne diseases, particularly in developing countries. The chapter then explores BBF exposure among EMC providers with a specific focus on prevalence rates, knowledge and practices, and highlights the need for EMS-specific BBF exposure guidelines. The chapter ends by outlining the important components of internationally accepted BBF exposure guidelines.

Chapter 3: Research methodology

Chapter three provides an overview of the research process which was followed. The chapter opens by presenting the research design and research methodology used in the study. It then goes on to describe the study setting and the study population. The sampling techniques, data collection processes, and data analysis conducted in both the quantitative and the qualitative phases are then discussed. Finally, the chapter explores the validity, reliability and trustworthiness of the study as well as the ethical considerations which were upheld during the study.

Chapter 4: Results

The results of both the quantitative and qualitative phases are presented separately in this chapter. The chapter starts by describing the results of the quantitative data analysis, including the response rate and the demographics of the study. The chapter then progresses to describing the prevalence of BBF exposures, and factors associated with BBF exposures. The knowledge and practices of the participants in relation to BBF exposures are then described. The chapter concludes by presenting the results of the qualitative data analysis.

Chapter 5: Discussion

In chapter five the results and findings of both the quantitative and the qualitative phases of the study are integrated and discussed in light of what is already known about the subject. The focus of the discussion is on the prevalence of BBF exposure in EMC providers, and the factors associated with such BBF exposures. The chapter then goes on to discuss the knowledge and practices of EMC providers in relation to BBF exposure and closes with a discussion on BBF exposure guidelines.

Chapter 6: Conclusion and recommendations

Chapter six summarises the research findings and presents recommendations to effectively prevent and manage BBF exposures in EMC providers. Finally, the chapter presents recommendations for future research and discusses the limitations of the study.

1.6 Conclusion

This chapter provided a background and introduction to BBF exposure among EMC providers. The research problem, research aim, research objectives, and the structure of the dissertation were presented together with a discussion on the researcher's interest in the study topic. The following chapter contains a review of relevant literature on BBF exposure among HCWs, with specific emphasis on BBF exposure among EMC providers.

CHAPTER 2:

LITERATURE REVIEW

2.1 Introduction

This chapter reviews existing literature on BBF exposure among HCWs, with specific focus on BBF exposure among EMC providers. The purpose of a literature review is to summarise the existing evidence on a specific topic, and to lay a foundation for new studies (Polit and Beck 2018). The chapter presents the search strategy used by the researcher to identify relevant literature, and reviews the literature on the burden of bloodborne diseases, BBF exposure in HCWs, the prevalence of BBF exposure in EMC providers, practices related to BBF exposure, and EMS-specific BBF exposure guidelines.

2.2 Search strategy

Various sources were used to identify relevant literature related to the research topic. This included the SUMMON search feature in the Durban University of Technology's online library, and the use of various online databases. These databases included PubMed, Science Direct, Google, Google Scholar, Ebscohost, and the institutional repositories of various universities, mainly, the Durban University of Technology, University of KwaZulu-Natal, and University of Cape Town. The resources consulted comprised journal articles, government documents and dissertations. While the intention had been to access resources no older than ten years, given the paucity of literature on BBF exposure in EMC providers, resources older than ten years were consulted where necessary. The key words and phrases that were used to carry out the literature search are presented in table 2.1:

Table 2.1: Key search words and phrases

Blood and body fluid exposure
Occupational exposure to blood and body fluid
Occupational injuries in healthcare workers
Blood and body fluid exposure in healthcare workers

Blood and body fluid exposure among healthcare workers in South Africa
Blood and body fluid exposure among paramedics
Blood and body fluid exposure among emergency medical service personnel
Blood and body fluid exposure among emergency medical care providers
Occupational exposure to blood and body fluid among paramedics
Occupational exposure to blood and body fluid among emergency medical service personnel
Blood and body fluid exposure among paramedics in South Africa
Blood and body fluid exposure among emergency medical service providers in South Africa

2.2 The burden of bloodborne disease

Over 70 million people have been infected with HIV since the epidemic began, with approximately 35 million deaths being attributed to the disease (World Health Organisation 2017a). At the end of 2017 there were 36.9 million people living with HIV globally, two thirds of whom were from the African continent (World Health Organisation 2017a), and who accounted for 75% of the global HIV related deaths (Zehri, Bhatti and Qureshi 2013). The Department of Health Strategic Plan South Africa (2014) highlighted that, at the time, South Africa had the largest number of people living with HIV in the world which, according to Statistics South Africa (2017), equated to over 7.06 million people.

The South African National HIV Prevalence, Incidence and Behaviour Survey- 2012 found that the Kwa-Zulu Natal province had the highest prevalence of HIV in the country, while the eThekwini Metropolitan Municipality was the city with the highest HIV prevalence in South Africa with 14.5% of its population infected with the disease. The eThekwini Metropolitan Municipality was closely followed by the Ekurhuleni Metro (14.3%), and Buffalo City Metro with 13.6% (Shisana *et al*. 2014). A South African study found that approximately 60% of all patients admitted to public hospitals in South Africa were HIV positive (Karani, Rangiah and Ross 2011). This finding is in line with evidence from an earlier study which found that 62.5% of all patients admitted to a public hospital in Durban, South Africa were HIV positive (Pillay *et al*. 2001).

The Global Hepatitis Report- 2015 estimated that 325 million people were infected with the HBV or HCV virus globally with the viruses accounting for 1.34 million deaths in 2015 alone. Approximately 1.75 million new HCV infections occur every year, with unsafe healthcare procedures being the leading cause of new infections (World Health Organisation 2017b). The African continent was identified as the region with the second highest prevalence of HBV, and third highest prevalence of HCV in the world (World Health Organisation 2017b).

A study conducted in KwaZulu-Natal, South Africa found that 39% of HCWs who sustained occupational exposures to BBF did not have any immunity against HBV infection, while 56% did not know their HBV immunity status (Khan and Ross 2013). Khan and Ross (2013) also found a high prevalence of active HBV infections among HCWs in two provinces in South Africa and they noted suboptimal protection against HBV infection (Sondlane *et al*. 2016). South Africa lost 113 million disability adjusted life years in 2013 due to HBV and HCV infection (Hecht *et al*. 2018). The high prevalence of HIV, HBV and HCV in South Africa exposes HCWs operating in the country to a high risk of being infected with these bloodborne diseases.

2.3 Blood and body fluid exposure in healthcare workers

Healthcare workers are at significant risk of infection by potentially life-threatening bloodborne pathogens. There are more than 60 different types of bloodborne diseases to which HCWs may be exposed (Auta *et al.* 2017). These include malaria, tuberculosis, gonorrhoea, herpes and typhus (Zaidi *et al.* 2010). However, the three pathogens which are most commonly associated with BBF exposures are HBV, HCV, and HIV. Infection with these pathogens may result in severe illness, disability or even death (Markovic-Denic *et al*. 2015).

Exposures occur when HCWs come into contact with the blood or body fluids of patients. The main routes of exposure are percutaneous injury (e.g. needlestick injuries (NSI) or cuts with a used medical device), mucous membrane exposure (e.g. blood or body fluid splash to the mouth, nose or eyes), and non-intact skin exposure (e.g. contact with blood on skin that is cut or abraded) (Lee *et al*. 2017). After exposure, the risk of infection depends on the type of pathogen; the route of exposure; the immunity status of the HCW; and the amount of virus in the blood or body fluid of the source patient (UK Health and Safety Executive 2019).

The percutaneous route is the most common route of all BBF exposures and represents the greatest risk of infection (UK Health and Safety Executive 2019). The risk of infection is increased if the HCW sustains a deep NSI injury with a hollow-bore needle; if blood was visible on the needle; injury following arterial injection/cannulation; or if the source patient has a high viral load (Webb 2019). The average risk of infection following a NSI is between 6 to 30% for HBV for unvaccinated health care workers, 1.8% for HCV, and 0.23% for HIV (Baggaley 2006; Centers for Disease Control and Prevention 2003).

Of the 35 million HCWs globally, three million are exposed to bloodborne pathogens every year (Lee *et al.* 2017). It is estimated that percutaneous exposures to BBF result in 16000 HCV, 66000 HBV and 1000 HIV infections annually and which cause approximately 1 100 deaths and significant disability among HCWs (Auta *et al*. 2017). More than 90% of all bloodborne virus infections in HCWs occur in the developing world, particularly in Africa. This may be due to inadequate or non-existent BBF exposure reporting/surveillance systems (Zaidi *et al.* 2010).

A systematic literature review was undertaken to determine the prevalence of body fluid exposures among HCWs in 21 African countries. Sixty-five articles with a total of 29 385 participants met the criteria to participate in the study. The study found that the lifetime prevalence rates of BBF exposures varied drastically between the 21 countries (29.1% in Burkino Faso to 89.2% in Morocco). The pooled lifetime prevalence of body fluid exposures across the 21 African countries was 65.7%, while the pooled lifetime prevalence of percutaneous exposure to body fluid was 54.4% (Auta *et al.* 2017).

While medical personnel across the various medical professions are exposed to BBF, EMC providers are probably the group most susceptible to exposure due to the uncontrolled and challenging nature of the prehospital environment. Emergency medical care providers, also known as paramedics, are required to provide lifesaving interventions in stressful and sometimes austere environments. The prehospital environment is highly dynamic and is fraught with many challenges, making paramedicine one of the most dangerous occupations in the world (Thomas, O’Meara and Spelten, 2017).

Emergency medical care providers are required to perform many of the invasive procedures that hospital-based HCWs perform, but in less than optimal conditions, for example, operating in confined spaces and in areas with poor visibility, and performing intricate procedures in the back of fast moving ambulances (Boal *et al*. 2010). These challenges may increase the risk of BBF exposure in EMC providers. However, although EMC providers may be the group of HCWs who run the highest risk of exposure to bloodborne pathogens, the majority of South African studies on occupational BBF exposure have focused primarily on hospital-based personnel. As a result, there is limited literature available on BBF exposure among South African EMC providers.

2.4 Prevalence of blood and body fluid exposures among EMC providers

A recent study undertook a literature review on occupational exposure to bloodborne pathogens among paramedics between 1987 and 2017 (Gańczak and Topczewska 2018). The twelve-month prevalence rates for paramedics exposed to BBF varied significantly between the different countries (Thailand: 63%, Poland between 14 and 78%, USA: 22%). The researchers also reported methodological errors, including selection bias in some of the studies reviewed, and highlighted that the data collection methods varied significantly between the different studies. Similar US prevalence rates were reported by Leiss *et al*. (2006), who investigated occupational exposure to blood using a nationally representative sample of American paramedics. Questionnaires were sent via mail to all registered paramedics in the country. The study found that, of the 2 664 paramedics who took part in the study, over 21% had been exposed to BBF in the preceding 12 months.

Another US-based study investigated the lifetime prevalence of BBF among EMC providers. The study found that, of the 311 EMC providers who participated in the study, 60% reported occupational exposures to BBF (Harris and Nicolai 2010). This is in contrast to the results of a Korean study, which found that, of the 907 EMC providers who participated in the study, over 40% had been exposed to BBF (Oh and Uhm 2016).

A German-based study, which investigated the lifetime prevalence of NSI in paramedics, found that 30% of the 377 participants had been exposed to NSI (Wicker *et al*. 2010). Similar lifetime prevalence rates were reported by a South African study which investigated NSI among EMC providers. The study found that 63 (26.3%) of the 240 participants had sustained NSI at some point in their careers (McDowall and Laher 2019). Apart from this study, the researcher was not able to identify any other research studies related to BBF exposure among EMC providers in South Africa.

The methodologies used in the studies on BBF exposure among EMC providers varied widely, making it difficult to draw direct comparisons between the exposure rates. Some studies focused only on NSI, and others looked at all routes of exposure. Some investigated lifetime exposures, while others looked at 12-month exposure rates. However, very little is known about BBF exposure rates among South African paramedics.

2.5 Knowledge of blood and body fluid exposure and universal precautions

Knowledge of the risks associated with exposure to bloodborne pathogens, prevention strategies and the effective management of BBF exposures are fundamental in preventing bloodborne virus infection among HCWs. Several studies have evaluated the knowledge of HCWs on BBF exposure and found that many of the HCWs did not possess the required knowledge of the risks involved, prevention strategies and the management of BBF exposures (Harris and Nicolai 2010; Nkoko *et al.* 2014; Shaban 2006; Siddique *et al*. 2008).

One study found that, while most HCWs understood that HBV and HCV could be transmitted by NSI, only 6% of the 300 participants were aware that HIV could be transmitted by NSI (Siddique *et al*. 2008). However, the fact that this study was conducted over a decade ago may explain the lack of awareness on the part of HCWs regarding the risk of HIV transmission through NSI. A South African study which assessed the knowledge, attitudes and practices of HCWs in relation to BBF exposure revealed that 38.6% of the 74 participants indicated that needles should be recapped before disposal (Nkoko *et al.* 2014). The study also found a significant relationship between inadequate knowledge of BBF and BBF exposure.

An American study reported that 78.8% of EMC providers who participated in the study were unable to identify the following three examples of universal precautions, namely, use of gloves, use of eye protection and facemasks, and placement of needle and sharps in sharps containers. The study also revealed that ALS providers were over seven times more likely to possess accurate knowledge of universal precautions compared to BLS providers (Harris and Nicolai 2010). Similar results were reported by an Australian study which found that 17.2% only of the 1 258 EMC providers were able to identify the correct system of infection control, while over 50% did not identify hand washing as a primary infection control strategy (Shaban 2006). The latter finding concurs with the finding of Karimi-Sari *et al.* (2017) who investigated the knowledge, attitudes and practices of Iranian Health Sciences students in relation to HBV and HCV infection. The study found that medical students scored higher than paramedicine students in the knowledge component of the study.

It would, therefore, appear that many EMC providers and other HCWs do not possess the required knowledge on BBF exposure, thereby rendering themselves susceptible to exposure. This, highlights the need for training institutions and employers to place more emphasis on equipping students and employees with the necessary knowledge and skills to prevent and effectively manage occupational BBF exposures.

2.6 Practices related to blood and body fluid exposure

2.6.1 The use of personal protective equipment

Personal protective equipment in the healthcare environment refers to equipment that protects HCWs from health or safety hazards (UK Health and Safety Executive 2019). This includes the use of eye protection, facemasks, gowns and gloves to prevent occupational exposure to BBF. However, while the use of PPE is of critical importance to the safety of HCWs, an Ethiopian study found that 12% of HCWs only indicated that they always complied with standard precautions (Haile, Engeda, and Abdo 2017. The study highlighted that HCWs were more likely to comply with standard precautions if they had received training on infection prevention; they had a high perception of the risks involved; they always had PPE available and they received management support. High levels of noncompliance were also reported by a Nigerian study which found that only 22% of the participants always complied with standard precautions

(Arinze-Onyia *et al.* 2018). The study also found that low perception of risk to hazards was the most common factor which contributed to the noncompliance with PPE use.

A study conducted in Virginia, United States of America (USA) found that most paramedics used their PPE inconsistently (Harris and Nicolai 2010). This finding is in line with another American study which found that the majority of mucosal exposures (66%) occurred when paramedics were not wearing their PPE (Leiss *et al*. 2009). From the researcher's own experience as an operational paramedic, PPE is not adequately utilised in the prehospital setting in South Africa. However, there is limited literature on the compliance with PPE use among EMC providers in South Africa.

2.6.2 Universal precautions

Universal precautions are a set of guidelines aimed at preventing BBF exposure among HCWs (Broussard and Kahwaji 2020). They include the provision and use of PPE; the provision and use of sharps containers in which to dispose of needles and other sharps; the evaluation of employees' adherence to safety practices by employers; and the development of policies and procedures to prevent exposure to BBF (Centers for Disease Control and Prevention 2010).

A literature review on compliance with universal precautions among HCWs found that a large number of HCWs were not fully compliant with universal precautions (Al-Mahdali 2015). A South African study conducted in KwaZulu-Natal found that, while HCWs were compliant with certain aspects of universal precautions, there was not always full compliance with universal precautions (Massinga *et al.* 2012). The reasons for noncompliance include a lack of resources, insufficient knowledge of universal precautions, and the attitudes of HCWs to the use of universal precautions. This finding is in contrast to the findings of a recent study in Saudi Arabia which reported a high compliance with universal precautions among HCWs (Banaser *et al.* 2019). The study highlighted the lack of PPE and training as a barrier to compliance with universal precautions.

Leiss *et al*. (2009) found that 32.1% of NSI among paramedics occurred during sharps disposal; 16.1% during the cleaning of the emergency vehicle due to the inappropriate disposal of medical sharps; and 19.8% during sudden movement of the emergency vehicle. A Korean study reported that 22.6% of the participants admitted to recapping needles and 10.9% to needle manipulation (Oh and Uhm 2016). Similar findings were reported by Harris and Nicolai (2008), who found that 40% of EMC providers admitted to recapping needles, and 79% to inappropriate sharps disposal practices. However, there is limited literature available on the adherence to universal precautions by EMC providers in South Africa.

2.6.3 Reporting of exposures

The reporting of occupational BBF exposures has been recognised by the Centers for Disease Control and Infection (2010) as a critical link in the prevention of infection by bloodborne pathogens. Reporting ensures effective, early, post-exposure management; financial compensation for affected workers; and improved strategies aimed at preventing BBF exposures (Centers for Disease Control and Infection 2010).

A recent study which investigated BBF exposure among intern doctors in South Africa found that the majority of BBF exposures were reported, with 1.1% of the 182 exposures only not being reported (Aigbodion, Motara and Laher 2019). However, contrasting results were seen in another South African study which found that 82% of 291 exposures among HCWs were not reported (Mbah 2014). These results concur with those of an American study which found that 51% of paramedics had not reported BBF exposure incidents (Boal *et al.* 2008). High rates of under-reporting were also reported by a Korean study which found that only 19% of occupational exposures to BBF among paramedics were reported (Oh and Uhm 2016).

The main reasons for not reporting BBF exposures include the fear of being reprimanded; the complexity of the reporting process; and thinking that the exposure is not significant (Boal *et al.* 2008; Oh and Uhm 2016). There is limited literature available on the reporting of BBF exposure by South African EMC providers. The available information was extracted for mention in this section.

2.7 The need for EMS-specific BBF exposure guidelines in South Africa

The National Health Act 61 of 2003 (Republic of South Africa 2003) and Occupational Health and Safety Act 85 of 1993 (Republic of South Africa 1993) mandate the implementation of policies to protect HCWs from being infected with communicable diseases. Mahomed, Jinabhai, Taylor and Yancey (2007) evaluated the preparedness of emergency medical services for occupationally acquired communicable diseases in the prehospital environment in South Africa. The study found that South Africa did not have an EMS-specific communicable disease and infection control policy and that only Kwazulu-Natal (KZN), Eastern Cape, and Gauteng had EMS-specific standard operating procedures (SOPs). Mahomed *et al*. (2007) also noted that the SOPs in KZN was had last been updated in 1999.

While each EMS service in South Africa probably utilises some form of BBF guideline/protocol, it is unclear whether these guidelines include the important components of an effective BBF protocol. The following section outlines the components of internationally accepted BBF guidelines.

2.8 EMS-specific blood and body fluid exposure guidelines

The chain of infection transmission, as depicted in figure 2.1, comprises six links (South Western Ambulance Service NHS Foundation Trust 2016). Effective BBF exposure guidelines will ensure that at least one link in the chain of infection is broken in order to prevent infection with bloodborne pathogens. An explanation of each of the six links of infection transmission is provided below.

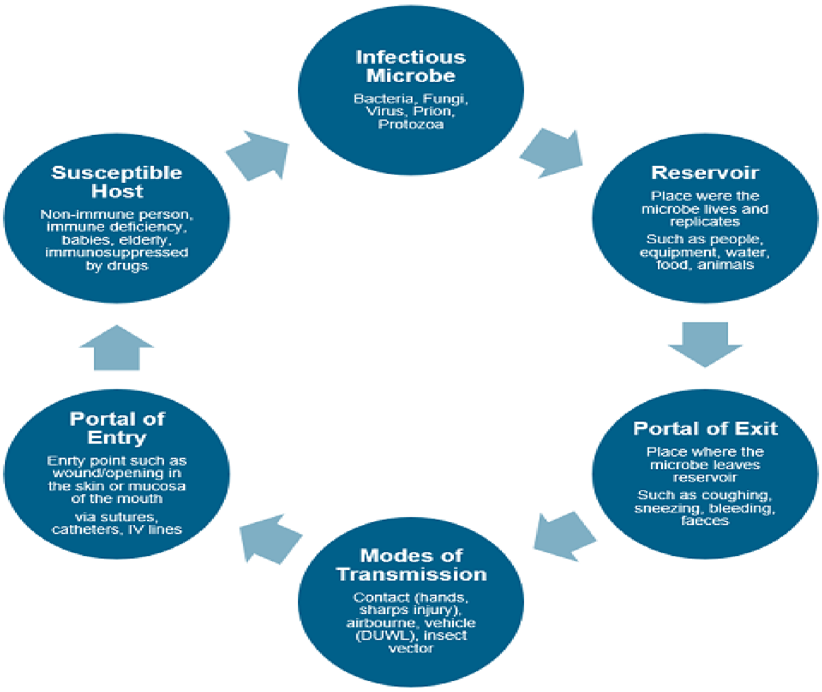


Figure 2.1: Chain of Infection

Infectious microbes: These are microorganisms that cause disease and include viruses, bacteria and parasites. Paramedics treat patients daily who are possibly infected with various pathogens including HIV, HBV, and HCV.

Reservoir: This is the place where an infectious agent lives. It could be a person, animal, and emergency vehicles, among other places. As highlighted earlier, South Africa has been identified as the country with the most HIV infections in the world, and high rates of HBV and HCV infections. This places HCWs who work in the country at a high risk of exposure.

Portal of exit: This is the route by which the infectious agent leaves the reservoir. This route includes blood or other body fluids from the patient's mouth or nose, respiratory tract, mucous membranes, and skin. For example, a patient may vomit on an EMC provider.

Mode of transmission: This is the means by which the infectious agent is transmitted from the reservoir to the host. It includes airborne; direct contact including blood on broken skin, percutaneous exposure (skin is penetrated by a used needle or sharp device); indirect contact, and droplet contact transmission.

Portal of entry: This is the route by which the infectious agent enters the susceptible host. As indicated earlier, this could be from BBF into the eyes, BBF on broken skin, or through NSI.

Susceptible host: This is a person who lacks adequate resistance to an infectious agent, for example, an EMC provider who is not immunised against an infectious agent such as the HBV. Such a provider is at high risk for HBV infection as he/she lacks immunity against the virus.

Breaking one of these links will ensure that the infection transmission process is halted. The next section describes the strategies aimed at breaking the links of infection transmission.

2.8.1 Personal protective equipment

The primary means by which EMC providers may prevent bloodborne virus infection is to prevent an exposure from happening in the first place. Adequate use of PPE will ensure that most portals of entry are covered, thereby reducing the risk of infection transmission. There are various types of PPE that EMC providers may use, including gloves, eye protection, facemasks, aprons, and protective suits, the use of which will be determined by the risks involved (South Western Ambulance Service NHS Foundation Trust 2016). Figure 2.2 illustrates a risk assessment approach to selecting PPE (South Western Ambulance Service NHS Foundation Trust 2016).

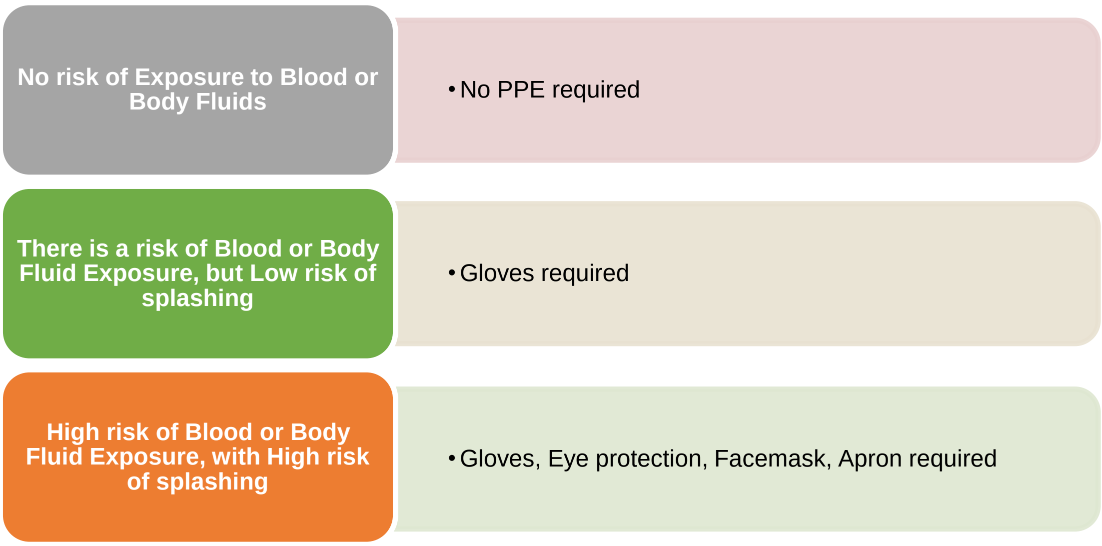


Figure 2.2: Risk assessment approach for selecting PPE

Gloves should be worn whenever there is a risk of contact with blood or body fluid, mucous membranes and non-intact skin, and when handling medical sharps or contaminated equipment. Gloves should be donned immediately before patient contact and removed immediately after patient contact. Gloves must be appropriately sized as gloves which are incorrectly fitted may be prone to tearing. Gloves should be changed when treating different patients and between different procedures on the same patient as there is a risk of cross infection. The use of double gloves is recommended in situations where there is a high risk of tearing. Gloves should be appropriately disposed of and should be followed by effective hand washing. Glove washing and the transcribing of notes on gloves may break down the integrity of the gloves and should not be done (South Western Ambulance Service NHS Foundation Trust, 2016; Saskatoon Health Region Prehospital Emergency Medical Services 2017).

Eye protection should be worn whenever there is a risk of the eyes being exposed to BBF. This includes treating patients who are bleeding; high risk procedures such as endotracheal intubation, suctioning, bag-valve mask ventilation; and when cleaning BBF spills. Prescription glasses and sunglasses may not provide adequate protection from BBF, and specifically designed side shields eye protection should be utilised to provide adequate eye protection. Emergency care providers should be discouraged from touching their eyes during patient care as this may result in an exposure. Eye protection should be carefully removed after use to prevent self-exposure and should be washed and disinfected after use. This should be followed by effective had washing (Saskatoon Health Region Prehospital Emergency Medical Services 2017).

Facemasks offer protection against BBF exposure to the face and mouth and should be used whenever there is a risk of BBF splashing. High risk procedures include endotracheal intubation, suctioning, and any other procedures which may cause the aerosolization of BBF. Facemasks must be disposed of after use (South Western Ambulance Service NHS Foundation Trust 2016).

Disposable plastic aprons are not recommended for routine use in the prehospital setting but should be utilised when there is extensive BBF splashing, and in situations where there is an increased risk of the EMC providers' uniforms being contaminated with BBF. Aprons should be disposed of after use, and must be followed by effective hand washing. A complete spare uniform set should be available in case of uniform contamination (South Western Ambulance Service NHS Foundation Trust 2016: 40).

Personal protective equipment must be donned in the following order: apron, mask, eye protection, and gloves; and should be removed in the following order to prevent cross-contamination: gloves, apron, eye protection, and facemask. This should be followed by effective handwashing (South Western Ambulance Service NHS Foundation Trust 2016).

2.8.2 Hand hygiene

Handwashing has been identified as the most effective procedure in breaking the chain of infection transmission (South Western Ambulance Service NHS Foundation Trust 2016). Effective handwashing prevents both the spread of potentially deadly germs to patients and the colonisation of germs on the hands of EMC providers. The use of soap and water and alcohol-based hand sanitisers have been identified as effective agents to ensure clean hands.

The use of hand sanitisers to disinfect hands may be applicable in most clinical situations where there is limited access to hand washing stations. However, emergency care providers should wash their hands with soap and water whenever their hands are visibly soiled, and as frequently as possible (Centers for Disease Control and Infection 2020).

Handwashing should be carried out in the following situations (as adapted from The Centers for Disease Control and Infection (2020):

- Before and after patient contact.
- During the wearing of PPE and after PPE is removed.
- Before and after the touching and cleaning of equipment and the emergency vehicle.
- After contact with BBF contaminated surfaces.
- Before performing any aseptic procedures.
- Whenever hands are soiled.
- When working on a different body site on the same patient, and when working on a different patient (For example, multiple patients at a motor vehicle collision scene).

2.8.3 Pre-exposure prophylaxis

As indicated earlier, HIV, HBV, and HCV have been identified as bloodborne pathogens which pose a significant health risk to HCWs. The HBV is the pathogen which is the most easily transmittable and, yet, it is the most preventable (Khan and Ross 2013). The introduction of the HBV vaccine in 1991 resulted in HBV infections dropping from 17 000 in 1983 to just 800 in 1995. The vaccine has been identified as the most effective strategy with which to eliminate HBV transmission among HCWs (Prüss-Ustün, Rapiti and Hutin, 2005). According to the Hepatitis B Foundation (2019), all healthcare personnel are required to receive three initial doses of the HBV vaccination, and these should be followed up with booster vaccinations as required.

A blood test should be done to confirm a positive HBV surface antibody, which indicates immunity to the HBV (Hepatitis B Foundation 2019).

2.8.4 Management of sharps

A sharps injury is an injury caused by any sharp device, including needles, with penetration through the skin (percutaneous) on any part of the body (South Western Ambulance Service NHS Foundation Trust 2016). As described earlier, percutaneous exposure to BBF has serious implications, including infection with HIV, HBV and HCV, among many others. It is of critical importance that EMC providers handle needles and other sharp devices safely to prevent exposure to sharps injuries and infection. Strategies for the safe handling of sharps, as adapted from the South Western Ambulance Service NHS Foundation Trust (2016), include the following:

- Sharps should never be passed between practitioners.
- Sharps must be disposed of directly into sharps containers.
- Sharps containers should never be more than three quarters full.
- Sharps must not be recapped.
- Needles must not be manipulated but should be disposed of together with the syringe as a single unit.
- EMC providers must be extra vigilant when using needles in emergency situations.
- EMC providers must ask for assistance when using needles on uncooperative patients.
- Sharps must not be left lying around or pushed into the bunk.
- Sharps must never be carried in pockets.
- Needleless systems and safety engineered needle devices should be used.

2.8.5 Cleaning and disinfection

The cleaning and disinfection of emergency vehicles and equipment is critical in reducing the risk of cross-infection between health care workers and patients. It is the responsibility of EMC providers to ensure that their emergency vehicle and equipment are cleaned and disinfected at all times. El-Mokhtar and Hetta (2018) swabbed 25 ambulances in order to investigate the bacterial contamination of ambulances. Of the

400 swab samples taken, 286 potentially pathogenic bacteria were identified. Naguran (2008) conducted an earlier study in KwaZulu-Natal to investigate the prevalence of fungi and bacteria in ambulances. The study identified 13 different microorganisms present on ambulance surfaces, the majority (10) of which were potentially pathogenic.

Cleaning and disinfection are two distinctly separate processes and should not be regarded as a single procedure. Cleaning involves the physical removal dirt and/or blood using detergents and other cleaning agents while disinfection involves the removal of microorganisms, for example from ambulance surfaces, using effective disinfection agents (Saskatoon Health Region Prehospital Emergency Medical Services 2017). If a surface is disinfected before it is cleaned, the surface may not be adequately disinfected, as the microorganisms may be shielded by the impurities on the surface. Thus, a surface must be cleaned adequately and then disinfected using effective disinfection agents. The Metropolitan Chicago Health Council (2012) recommends the use of the following disinfection agents:

- External surfaces of equipment such as stethoscopes and pulse oximeters: Alcohol 70 to 95%.
- External surfaces and blood spills: Standard bleach 1:10.
- External surfaces of equipment, floors, walls and other furnishings: Hydrogen Peroxide (0.5%).

2.8.6 Post-exposure management of exposure to blood and body fluid

It is essential that the main emphasis is preventing the occurrence of BBF exposures. However, should an exposure occur, it must be effectively managed. Figure 2.3 outlines the steps that should be taken should an exposure to BBF occur:

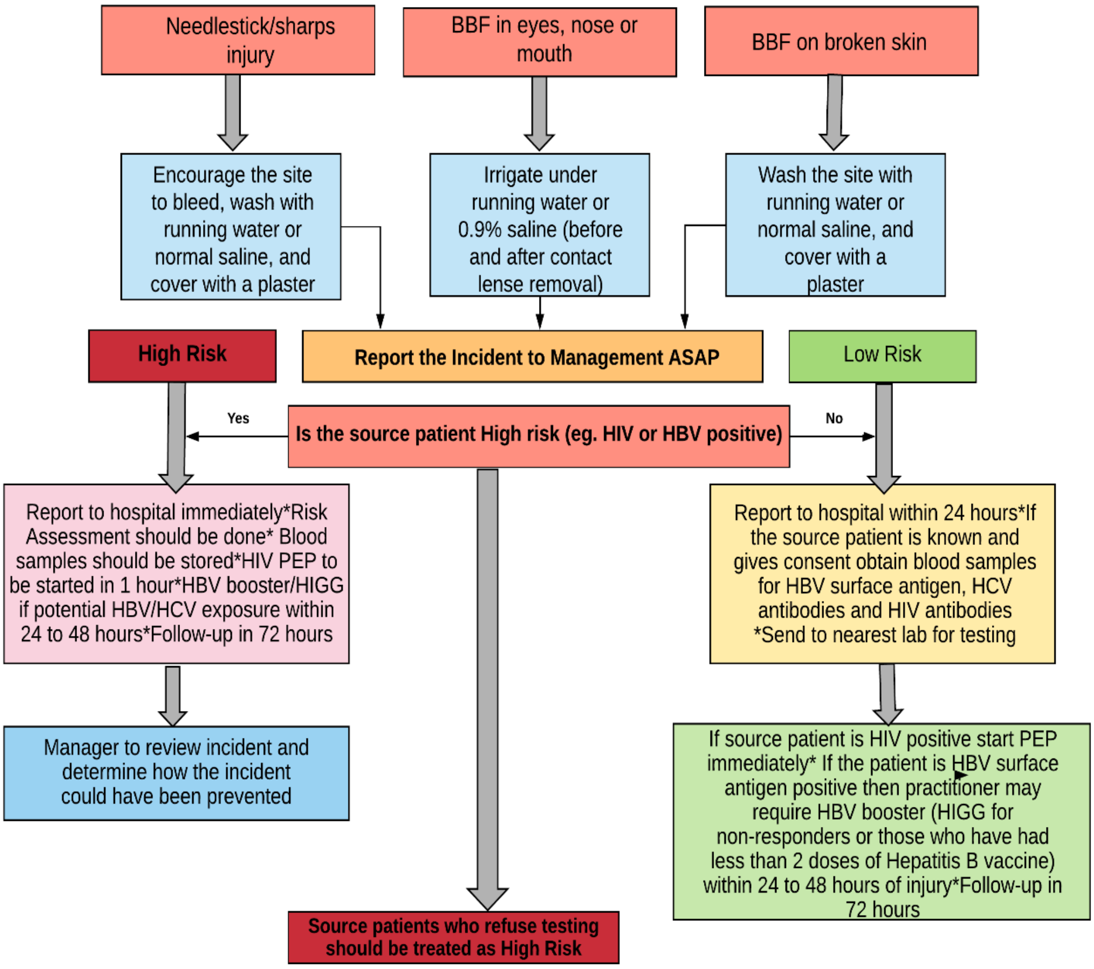


Figure 2.3: Post-exposure management of exposure to blood and body fluid: (Adapted from South Western Ambulance Service NHS Foundation Trust 2016: 54)

2.9 Conclusion

This chapter reviewed relevant literature on BBF exposure among HCWs, with a particular emphasis on EMC providers. While all EMC providers may be at high risk of exposure and possible infection by bloodborne pathogens due to the challenges associated with the prehospital environment, EMC providers in South Africa are, in all likelihood, at an increased risk of infection due to the burden of disease in the country. It was evident from the literature reviewed that many EMC providers do not possess the required knowledge on BBF exposure and universal precautions and also that many perform unsafe practices, which may render them susceptible to exposure and possible infection. It is critical that all EMC providers have access to effective guidelines to prevent BBF exposure. While there is a myriad of studies on BBF exposure in the workplace, there is a clear paucity in the available literature on the occupational exposure to BBF among EMC providers. This paucity appears to be particularly prevalent in resource-constrained health systems such as South Africa.

CHAPTER 3:

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter presents an overview of the research process that was undertaken during the study by describing the way in which the requisite data was collected, validated and analysed. The chapter also discusses the research design and the research methodology used in the study, with special emphasis on the study setting, population, sampling techniques, data collection, data analysis, validity and reliability as well as the ethical considerations upheld in the study.

3.2 Research design

A research paradigm may be defined as the philosophical disposition in respect of the way in which the researcher views the world, which guides the researcher's ideas and actions (Creswell 2014). The pragmatic paradigm does not ascribe to the traditional postpositive and constructivist approaches but, instead, allows the research problem/question to inform the design and methods of the study in question (Polit and Beck 2018). Pragmatism underpins mixed methods research, which supports the use of multiple methods of obtaining the requisite data instead of relying on a single method of inquiry.

This study used a descriptive, explanatory, sequential, mixed methods design, with the data being collected in phases (Polit and Beck 2018). In the study, the quantitative data was collected first and was followed by the collection of qualitative data. This design was used to allow for the qualitative data to provide greater insights into the data collected in the quantitative phase. The quantitative and qualitative data was analysed separately although the results were interpreted together.

The STROBE (Strengthening the Reporting of Observational studies in Epidemiology) guideline (Annexure M) was used to guide the reporting in this study. According to Cuschieri (2019) the STROBE guideline was developed to ensure the high-quality presentation of studies by ensuring that researchers clearly explicate "what was planned, what was done, what was found, and what was concluded". In addition, it also serves to ensure that the strengths and weaknesses of the study are clearly documented.

3.3 Study setting

eThekwini is the largest city in the KwaZulu-Natal province and the third largest city in South Africa. The land area of the eThekwini metropole is 2, 555 square kilometres with an estimated population of 3.6 million people (eThekwini Municipality 2017). This means that eThekwini is the city with the largest population in KwaZulu-Natal, which equates to an estimated 1, 409 people per square kilometre.

The Emergency Medical Rescue Services (EMRS) is responsible for the emergency medical care of a large majority of the population of eThekwini. A 2010 report found that 25.8% only of the eThekwini population had access to medical insurance (KwaZulu-Natal Department of Health 2012). The KwaZulu-Natal Department of Health (2019) Annual Performance Plan revealed that the EMRS in eThekwini transported a total of 123 100 patients in the 2017/18 period, which represents approximately 27% of the total patients (457 656) transported in the KwaZulu-Natal province.

The study was conducted at all the operational public sector ambulance bases in the eThekwini metropole, excluding planned patient transport services. The public sector ambulance service in eThekwini consists of the following eleven ambulance bases, namely, Phoenix, Tongaat, KwaMashu, Wentworth, Durban Central, Mpumalanga, Illovo, Mariannhill, Clermont, Umlazi, and Chatsworth. Figure 3.1 depicts the positions of the public sector ambulance bases on a map of the eThekwini metropole.

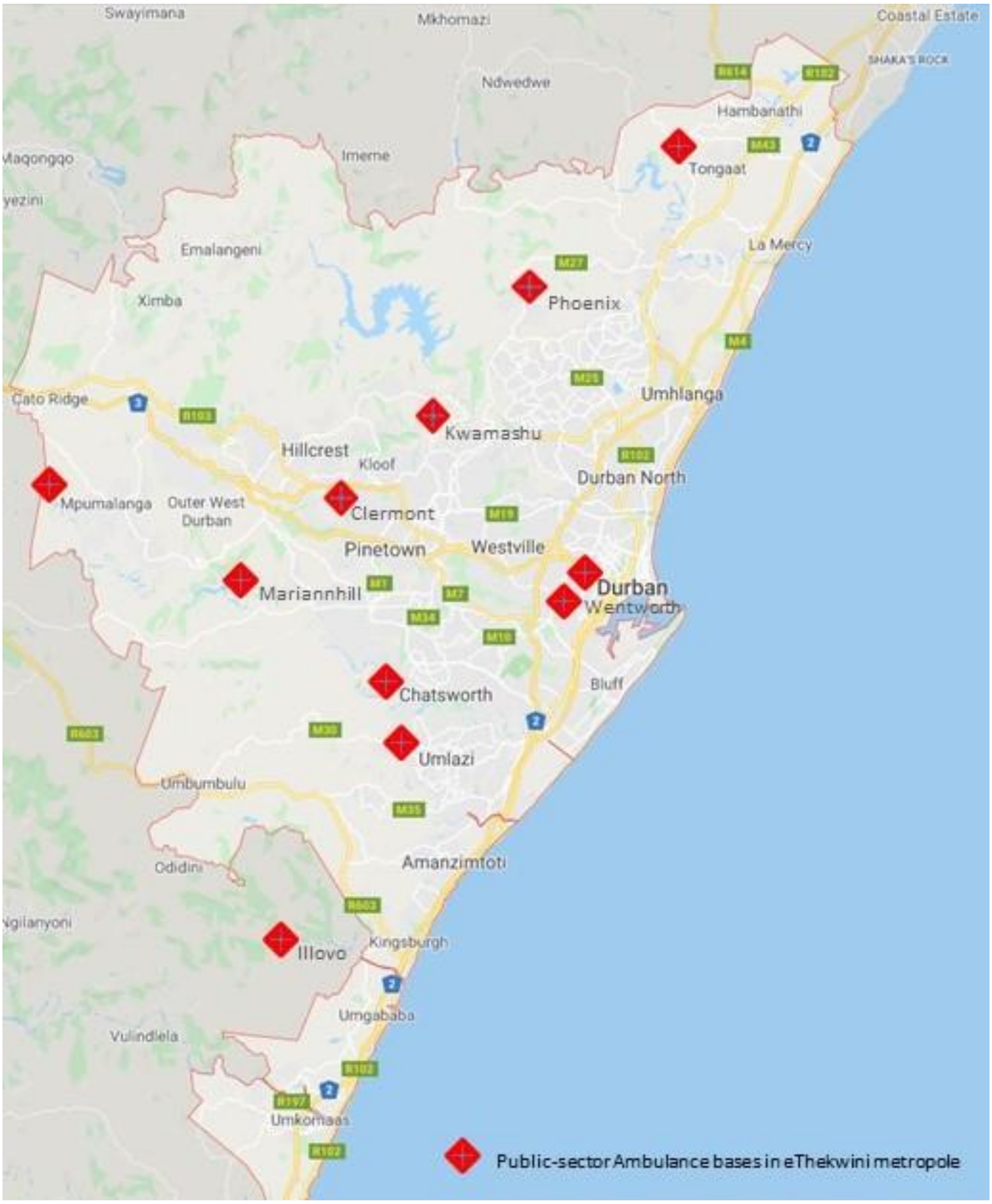


Figure 3.1: Map of public sector ambulance bases in the eThekwini metropole

(Adapted from Google maps https://www.google.com/maps/place/Durban+Metro)

3.4 Phase one: Quantitative phase

Phase one of the study involved the collection of quantitative data from operational EMC providers employed by EMRS in eThekwini. The data collection instrument was an anonymous survey questionnaire which investigated the knowledge, practices, and exposure of EMC providers to BBF.

3.4.1 Study population

The target population in a study refers to the entire group of individuals whom the researcher would like to investigate (Brink, Van der Walt and Van Rensburg 2012: 131). The target population for this study comprised operational EMC providers working for the EMRS in the eThekwini metropole. This included all operational BLS, ILS and ALS practitioners who were in the employ of EMRS during the study period. Basic life support providers are able to provide basic interventions such as bleeding control and performing CPR, while ILS providers are able to perform all of the interventions that BLS providers may provide in addition to other intermediate level skills such as the insertion of intravenous (IV) lines and the administration of certain medications. Advanced life support providers, on the other hand, are able to perform several advanced procedures including drug-assisted endotracheal intubation and the administration of many different types of medications, depending on the type of ALS qualification (KwaZulu-Natal Department of Health 2020). There are three different types of ALS qualifications in South Africa, namely, the Critical Care Assistant, National Diploma/Diploma in EMC, and ECP. The holders of the CCA and National Diploma/ Diploma in EMC are registered as paramedics with the Health Professions Council of South Africa (HPCSA), and have a lesser scope of practice than ECPs – ECP being the highest qualification of ALS providers in South Africa (Sobuwa and Christopher 2019). Practitioners employed by the EMRS were selected to participate in the study because they are responsible for the prehospital emergency medical care and transportation of a large majority of the public sector patients in eThekwini. These practitioners are at significant risk of acquiring bloodborne diseases from occupational exposure due to the high prevalence of HIV and other bloodborne diseases among patients who utilise the public healthcare system in eThekwini (Karani *et al*. 2011; Hecht *et al*. 2018).

3.4.2 Sampling

Sampling in the research context refers to a process involving the selection of a portion of the target population to represent the population (Polit and Beck 2018). There were 392 operational EMC providers employed by the EMRS in eThekwini who were on active duty during the study period. Table 3.1 provides a breakdown of the qualification levels of the EMC providers employed by the EMRS in eThekwini.

Table 3.1: Breakdown of Qualification Level

Qualification	Total
BLS	201
ILS	172
ALS (Includes Emergency Care Practitioners, National Diploma EMC, and Critical Care Assistant)	19
	392

There are different ways in which to calculate a sample size in quantitative studies. For the purposes of this study the sample size was calculated using the online software Creative Research Systems (2018). The software, using a 7.25 margin of error, at a 95% confidence level, established that a sample of 125 EMC providers would be required for the study. As indicated by other studies, this margin of uncertainty is acceptable (Govender 2015; Yeung, Okamoto *et al* 2011).

The study utilised probability sampling in the form of simple random sampling to select participants from the study population. The use of the simple random sampling technique meant that that each individual, operational EMC provider working for the EMRS in the eThekwini metropole had an equal chance of being selected to participate in the study. As discussed by Polit and Beck (2018) this technique reduces the probability of the sample being atypical of the actual population. In order to undertake this sampling method, all 392 of the operational EMC providers working for the EMRS in the eThekwini metropole were assigned a unique number. A computer-generated randomisation application was used to randomly identify 125 of the 392 numbers. The EMC providers assigned to those randomly selected numbers identified were recruited into the sample.

3.4.3 Inclusion criteria:

- All operational EMC providers who were employed by the EMRS in the eThekwini metropole during the study period.
- Such operational EMC providers who were available for selection at their respective ambulance bases during the data collection period.

3.4.4 Exclusion criteria:

- Non-operational staff members
- Planned Patient Transport personnel

3.4.5 Permission to conduct the study

Following approval from the Durban University of Technology (DUT) Institutional Research Ethics Committee (IREC) (Annexure A), permission to conduct the research study was sought from the KwaZulu-Natal Department of Health's Provincial Health Research Committee. An application was submitted online on the National Heath Research Database for approval. The documents that were submitted included the research proposal, Institutional Research Ethics approval, and a letter of support from the EMRS in eThekwini (Annexure B). Approval to conduct the study was granted by the KwaZulu-Natal Department of Health's Provincial Health Research Committee. (Annexure C)

3.4.6 Pilot test of the research instrument

A pilot test of the quantitative data collection tool (questionnaire) was conducted on ten EMC providers from within the target population prior to the data collection. The aim of this pilot study was to ensure the adequacy of the questionnaire in terms of meeting the objectives of the study; to identify and address any problems which may exist; and to refine the data collection instrument (Brink *et al*. 2012). The pilot test group signed a document of confidentiality (Annexure J) to ensure that the details of the study and the questionnaire were kept confidential. The pilot test group were excluded from selection to participate in the actual study.

There were no problems regarding the manner in which the data collection tool was administered. It took between ten to fifteen minutes for all the participants to complete the questionnaire. The following required clarification during the pilot test. A few of the participants did not understand the meaning of the phrase safety engineered devices. Accordingly, the word engineered was removed and replaced with the phrase safe needle devices to make it easier for the participants to understand the relevant questions. Some of the participants did not know the meaning of prophylaxis and thus a description was added in brackets next to the word prophylaxis to make it easier to understand.

3.4.7 Data collection

The public sector ambulance service in eThekwini operates on a 24-hour basis and is structured around a total of four shifts. The EMC providers who were selected to participate in the study were categorised according to their respective ambulance bases and shifts. Data collection dates were chosen for each of the selected participants through consultations with the EMRS administration clerks. The data was collected at shift change (07:00, 19:00) on the pre-selected dates. On the data collection dates, the researcher presented himself to the officer in charge at each ambulance base before the data was collected at the shift changes. The officer in charge introduced the researcher to the participants. The researcher then presented the details of the study to the participants and personally invited the randomly selected practitioners to participate in the study. Those who agreed to participate in the study were requested to fill in the questionnaire (Annexure K), which consisted of the following four sections: Demographic information, Knowledge, Practices and Exposures. The questionnaire comprised predominantly closed-ended questions pertaining to the research objectives.

An information letter (Annexure D/E) was provided and the participants were required to sign a consent form before being allowed to participate in the study (Annexure H/I). The personal information of the participants was not recorded on the questionnaires. Each consent form and questionnaire were allocated a unique number both to ensure the participants' anonymity and to enable the researcher to identify participants should they wish to withdraw from the study at a later stage. The data collection process presented certain challenges as the researcher had to drive to each of the ambulances bases multiple times. This was frustrating at times as the researcher sometimes travelled long distances only to discover that some of the participants who had been randomly selected were not at work.

3.4.8 Quantitative data analysis

The data which had been collected was entered on Microsoft Excel 2016 for analysis (Microsoft Corporation, Redmond, WA). Descriptive statistics, including frequency distributions, cross tabulations and a variety of tables and graphs were used to describe the data. The Pearson chi-square test and Fisher’s exact test were used to calculate inferential statistics, to determine whether significant relationships existed between the sets of categorical data at a 0.05 significance level. The chi-square test was performed only when at least 80% of the cells presented a frequency of five or greater, and no cell had a frequency smaller than one. If these criteria were not met, the Fisher’s exact test was performed. Inferential statistics were calculated using the Stata version 15 software (StataCorp 2017).

3.4.9 Validity and reliability

Instrument validity is used to determine whether a data collection instrument actually measures what it is required to measure (Brink *et al*. 2012). The validity of the quantitative data collection instrument (structured questionnaire) was ensured by conducting a detailed literature review prior to the development of the structured questionnaire. The literature review informed the development of the structured questionnaire by ensuring that all important aspects surrounding the research objectives were included in the questionnaire.

The content validity of the data collection instrument was evaluated by the research supervisors who are regarded as experts in the area of research and emergency medical care. In addition, a pilot test was undertaken to evaluate the content validity of the questionnaire. The participants from the pilot test provided feedback on the layout of the questionnaire; the time it took to complete the questionnaire; and the complexity and ambiguity of the questions. The information obtained from the pilot test was used to refine the data collection instrument.

Reliability in quantitative research refers to the degree to which a data collection instrument is able to yield consistent results when used repeatedly (Brink *et al*. 2012).

A pilot test of the structured questionnaire was undertaken prior to the actual data collection to ensure the reliability of the questionnaire. This allowed the researcher to evaluate the consistency of the data collection instrument.

3.5 Phase two: Qualitative Phase

Phase two of the study comprised interviews with selected participants from the quantitative phase to enable the researcher to obtain a deeper understanding of the information collected in the quantitative data collection phase.

3.5.1 Study population

The emergency medical care providers who had participated in phase one of the study has been asked on the Phase one consent form to indicate whether they would be interested in participating in Phase two of the study. Those participants who had indicated in Phase one that they had been exposed to BBF and who had indicated their interest in participating in Phase two of the study, formed the target population for Phase two of the study. These participants were deemed to be information-rich and considered as being able to provide a substantive, emic account of BBF exposure among EMC providers.

3.5.2 Sampling

While the quantitative phase had utilised simple random sampling to select a sample, the qualitative phase involved the purposeful selection of participants from the quantitative phase in order to allow a deeper understanding of the quantitative data. As discussed by Polit and Beck (2018), this type of sampling is used to identify participants who would be able to provide a greater insight into the phenomenon of interest.

A total of ten participants who met the criteria and who had indicated their interest in participating in Phase two of the study were purposefully selected from the target population. These participants were contacted telephonically and invited to participate in Phase two of the study. While ten participants formed the initial qualitative data sample, this process was guided by the principle of data saturation which, according to Creswell (2014), denotes the point at which the qualitative data collection is either terminated due to the non-emergence of new themes, or extended should further exploration be required.

3.5.3 Inclusion criteria:

- Participants from Phase one of the study who had indicated that they had sustained BBF exposures and who had indicated their interest in participating in Phase two of the study.

3.5.4 Exclusion criteria:

- Participants who had not sustained BBF exposures.
- Participants from Phase one who had sustained BBF exposures but who did not want to participate in Phase two of the study.

3.5.5 Qualitative data collection

The qualitative data was collected by means of telephonic interviews. The participants who had indicated their interest in participating in Phase two of the study were contacted via telephone as indicated per the contact details that they had provided on the consent form, and interview appointments were scheduled. The participants were sent an information letter via WhatsApp messenger detailing the research process (Annexure F/G). The initial plan was to send the information letter to the participants via email. However, some of the participants had advised that they did not have access to emails.

The interview questions were formulated once the quantitative data had been analysed to allow the researcher to obtain more in-depth qualitative information and to gain a deeper understanding of the information obtained in Phase one of the study (Annexure L). The telephonic interviews were audio recorded and transcribed verbatim for the purposes of analysis. Phase two of the study proceeded smoothly for the most part although two of the participants interviews had to be rescheduled because the participants were unable to participate on the dates for which their initial interviews had been scheduled.

3.5.6 Qualitative data analysis

Thematic analysis was used to analyse the qualitative data. The thematic analysis process was conducted as outlined by Braun and Clarke (2006). After the recorded audio data had been transcribed, it was read and reread by the researcher and the researcher reflected on the general meaning of the information. This provided an opportunity for the researcher to gain a feeling for what the participants were saying, and to identify initial topics and ideas in the data.

Once the researcher was familiar with the data, the data was coded, which as explained by Polit and Beck (2018) involves the development of a method to classify and index the data. This allows for the accessing of segments of data without having to reread the entire data set. Figure 3.2 illustrates the data coding process.

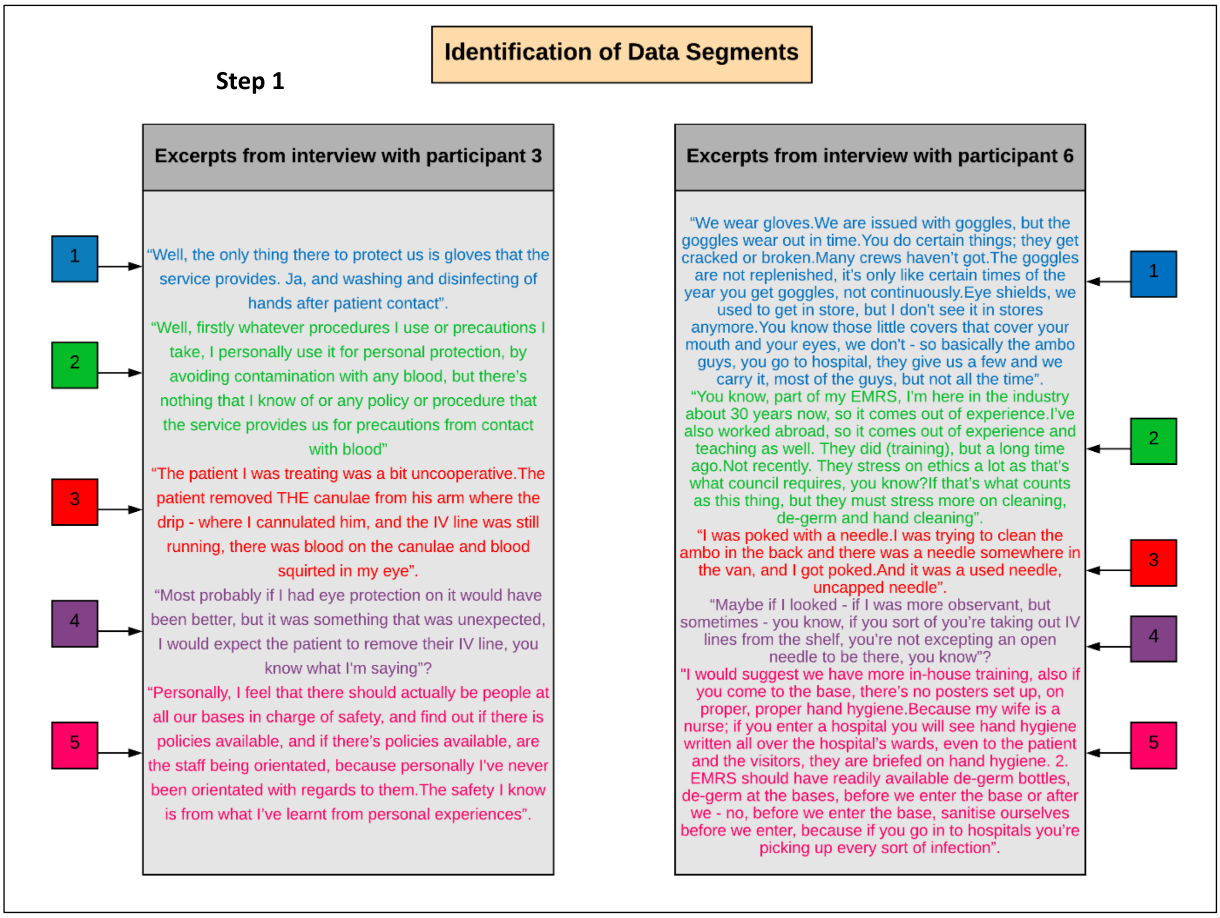


Figure 3.2: Identification of data segments

The data extracts were then categorised according to initial themes that were identified. This is illustrated in figure 3.3. The next step was to review the themes. This included the combining, splitting, and refining of certain themes so that they were coherent and meaningful. The themes were refined further and initial names were allocated to the themes. Potential subthemes were also identified. This step in the qualitative data analysis process was the most challenging as the names of the themes had to be succinct and catchy and also represent the essence of the themes. The names allocated to the themes were changed multiple times during this process. Lastly, the findings of the qualitative data analysis were interpreted and presented.

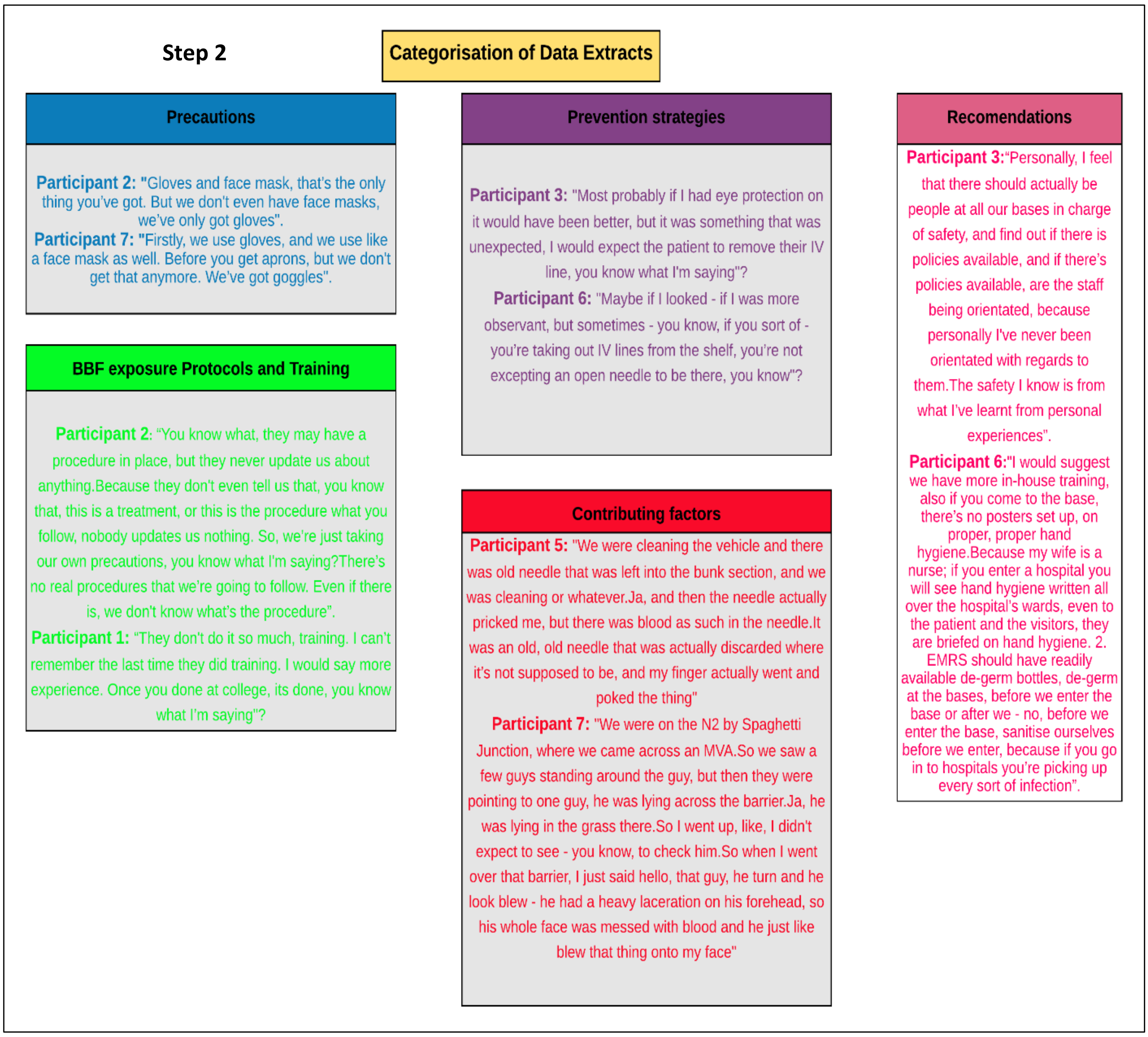


Figure 3.3: Categorisation of data extracts

3.5.7 Trustworthiness of the study

The trustworthiness of the study was ensured by applying Lincoln and Guba's (1985) criteria of trustworthiness in qualitative research, namely, credibility, transferability, dependability and confirmability and as described by Polit and Beck (2018).

3.5.7.1 Credibility

According to Polit and Beck (2018), credibility in qualitative research refers to the confidence in the truth value of both the data and the data analysis. The following techniques were used to ensure the credibility of the study:

- Reflexive journaling was carried out throughout the qualitative phase. This allowed the researcher to reflect on his thoughts about previous experience, the responses of the participants, and how he may be affecting the research process. This helped to reduce researcher bias.
- Purposive random sampling was used to identify participants who had been exposed to BBF. These participants were deemed to be able to provide a substantive, emic account of BBF exposure among EMC providers.
- Data saturation was used to determine an adequate sample size, with the data collection being terminated once no new themes were identified in the data.
- The audio data was recorded and transcribed verbatim.
- Member checking was carried out with four of the eight participants with these four participants being asked to validate whether the transcribed data had been captured and interpreted correctly.

3.5.7.2 Transferability

Transferability in the research context refers to the degree to which the research findings may be applied to other settings (Polit and Beck 2018). The transferability of this study was ensured by providing dense descriptions of the entire research process, including the research setting, sampling, participants, data collection, and data analysis.

3.5.7.3 Dependability and confirmability

- Careful documentation of the entire research process was carried out to ensure that the readers would have a comprehensive picture of how the research process had been carried out to determine whether it would be possible for the study to be replicated in a similar setting with similar participants.
- Four of the eight participants were asked to verify whether the transcribed data and interpretations were accurate. This ensured that the interpretations of the data did not stem from the researcher's imagination but, instead, that they represented the participants' voices.
- An audit trail was made available by the researcher through reflexive journaling, field notes, and the availability of the original interview transcripts.

3.6 Integration of quantitative and qualitative data

The integration of quantitative and qualitative data is presented in the discussion section of the study. The quantitative findings are presented first, followed by the reporting of the qualitative findings. The qualitative results are used to provide a deeper understanding of the quantitative findings (Creswell 2014).

3.7 Ethical considerations

Ethical approval to conduct the study was granted by the Institutional Research Ethics Committee (IREC) of the Durban University of Technology (IREC 007/18) (Annexure A). Gatekeeper permission to conduct the study at EMRS ambulance bases was granted by the KwaZulu-Natal Department of Health's Provincial Health Research Committee (Annexure C) with support from the operations manager of the EMRS (Annexure B).

Strict confidentiality was maintained for the duration of the entire research study. This was done by ensuring that the personal information of the participants was not recorded on either the quantitative questionnaire or the qualitative interview transcripts. Codes were used instead of recording the personal information of the participants. During the research process all the captured data was kept on a password protected computer, which only the researcher could access. The original questionnaires, audio files and qualitative interview transcripts were locked in a safe to which only the researcher had access. These materials will be kept for a period of 5 years after the completion of the study, after which they will be destroyed.

The participants were provided with a letter of information in both English and IsiZulu (Annexure D/E) indicating all the details of the research study. In addition, they were required to sign a consent letter (Annexure H) during Phase one of the study prior to their completing the structured questionnaire. Those who were interested in participating in Phase two of the study indicated their interest in doing so on the consent form. The participants were informed before the telephonic interviews in Phase two that they were being audio recorded for transcription purposes. They were provided with a letter of information which was sent to them via WhatsApp messenger as some of the participants did not have access to email, while all had access to WhatsApp messenger (Annexure F/G).

As indicated on the letter of information, all participants had the right to withdraw from the study at any stage of the research process. The participants were not exposed to any harm or risks. The use of random sampling in Phase one of the study ensured that all of the EMC providers employed by the public sector ambulance service had an equal chance of being selected to participate in the study. The respondents were not coerced into participating in the study in any way and did so of their own free will. The participants did not receive any form of remuneration from the researcher.

The participants in the pilot test group were required to sign a letter of confidentiality to ensure that the details of the research remained confidential (Annexure J).

3.8 Conclusion

This chapter presented the research design, study population, sampling methods and data collection used for both the quantitative and qualitative phases of the research. The validity, reliability, and trustworthiness of the study were also discussed together with the ethical considerations that were taken into account in the study. The following chapter presents the results of both the quantitative and qualitative phases of the study.

CHAPTER 4:

RESULTS

4.1 Introduction

This chapter presents the findings from both phases of the study. The findings from phase one, which includes the information from the self-administered questionnaire, are presented as a descriptive narrative supported by inferential statistics, while the findings from phase two are presented in the form of two themes that emerged from the analysis of the transcribed interviews.

4.2 Phase one results (Quantitative)

4.2.1 Response rate

Of the 125 participants recruited to take part in the study, 96 completed and returned the self-administered questionnaire, thus resulting in a response rate of 77%. Not one of the respondents were excluded from the study due to incomplete questionnaires.

4.2.2 Demographics of the respondents

Table 4.1 depicts the demographics of the respondents. There were more than four times the number of males than females in the study, while the majority of the respondents were over the age of 46 years. Most of the respondents were ILS qualified with 3.1% only being ALS qualified. Finally, the majority (85.4%) of the participants had more than ten years' experience in the emergency medical care field.

Table 4.1: Demographics of the respondents

		Frequency (n)	Percentage (%)
Gender	Male	77	80.2
	Female	19	19.8
Age	20 to 35	11	11.5
	36 to 45	38	39.6
	46 and over	47	48.9
Qualification	ALS	3	3.1
	ILS	56	58.3
	BLS	37	38.6
Years of experience	1 to 2	1	1.1
	3 to 5	3	3.1
	6 to 10	10	10.4
	More than 10	82	85.4
Total		96	100.0

4.2.3 Blood and body fluid exposures

As illustrated in figure. 4.1, 43% of the respondents had been exposed to blood and/or body fluid at some point in their career.

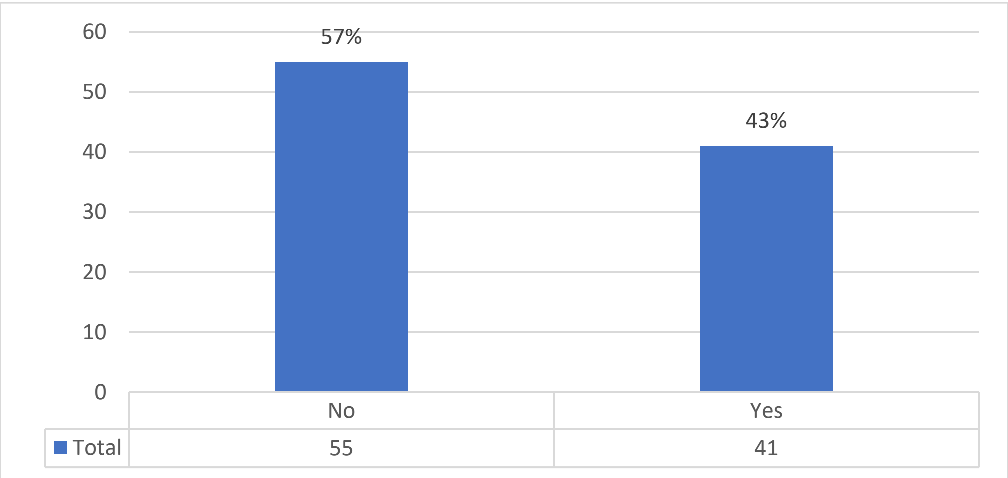


Figure 4.1: BBF exposures

Table 4.2 presents a breakdown of the BBF exposures according to the various demographic variables. As indicated in the table, a higher proportion of males had been exposed to BBF compared to females, while advanced life support providers accounted for the highest percentage of BBF exposures, followed by the ILS providers. A chi square test for independence was conducted to investigate the relationship between age and gender, and BBF exposure, and a Fisher's exact test was performed to examine the association between years of experience and qualification, and exposure to BBF fluid. No significant relationships were found between these variables.

Table 4.2: BBF exposure by demographics

		Exposed to BBF		Not exposed to BBF		
Demographic variables		**(n)**	**%**	**(n)**	**(%)**	**Fisher's exact**
Years of experience	1 to 2	1	100.0	0	0.0	*P= .73*
	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	
Qualification	ALS	2	66.7	1	33.3	*P= .55*
	ILS	25	44.6	31	55.4	
	BLS	14	37.8	23	62.1	
Age						**Chi square**
	20 to 35	5	45.4	6	54.6	*P= .39*
	36 to 45	13	34.2	25	65.8	
	46 and over	23	48.9	24	51.1	
Gender	Male	35	45.4	42	54.6	*P= .27*
	Female	6	31.6	13	68.4	

The study found that needlestick injuries accounted for the majority of BBF exposures, followed by splashes of BBF into the respondents' eyes and exposure following instances when the skin had been broken prior to the BBF exposure. The skin could have been broken from a contusion, abrasion or laceration. The types of BBF exposure are depicted in figure 4.2.

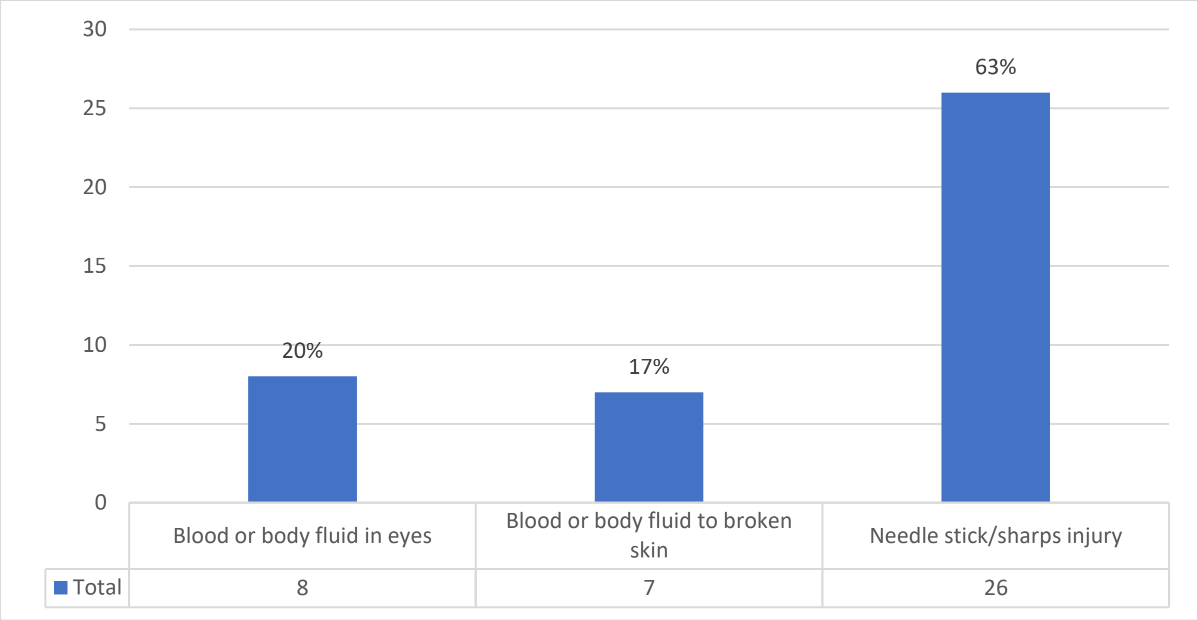


Figure 4.2: Type of BBF exposure

As indicated in table 4.3, a Fisher's exact test of was performed to examine the relationship between qualification and type of BBF exposure. The relationship between these two variables was found to be significant (p = .016). A higher proportion of ILS providers sustained NSI, a higher percentage of ALS providers sustained BBF exposure to their eyes, and a higher proportion of BLS providers sustained BBF exposure to broken skin compared to ALS and ILS providers.

Table 4.3: Type of BBF exposure by qualification

	Needlestick injuries		BBF in eyes		BBF on broken skin		
Qualification	**(n)**	**%**	**(n)**	**%**	**(n)**	**%**	**Fisher's exact**
ALS	1	50.0	1	50.0	0	0.0	
ILS	19	76.0	5	20.0	1	4.0	*P= .016*
BLS	6	42.9	2	14.2	6	42.9	

As indicated in figure 4.3, the majority (98%) of the respondents indicated that they had been wearing gloves when the BBF exposure had occurred, 22% only had been wearing facemasks, and 10% had been wearing eye protection when the exposure occurred.

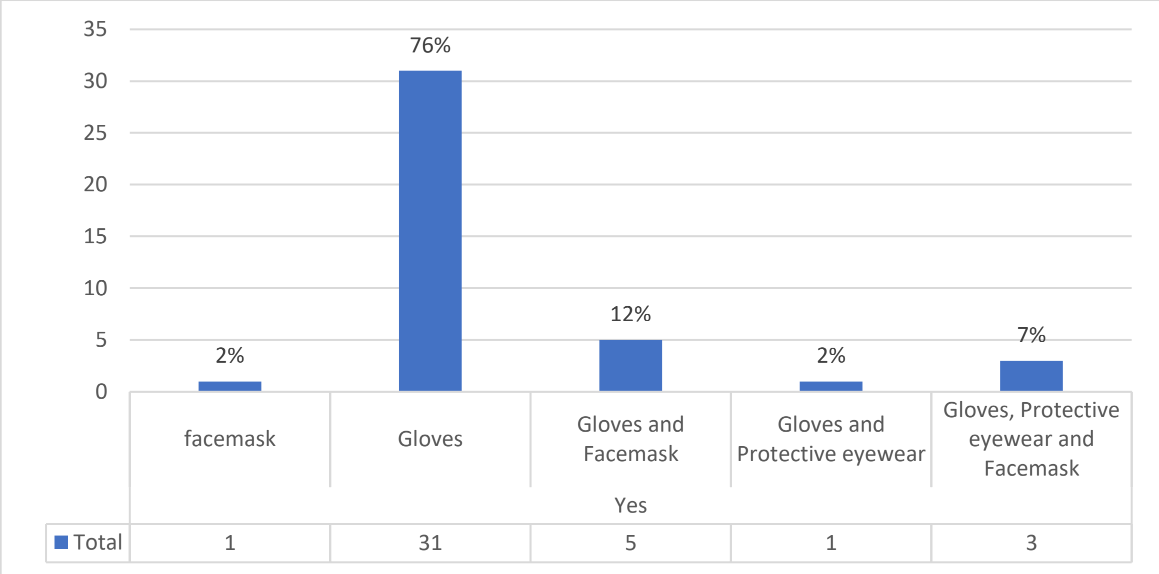


Figure 4.3: PPE used when the BBF exposure occurred

Figure 4.4 provides a breakdown of the procedures which were being carried out when the BBF exposures occurred. Most of the BBF exposures had occurred when the respondents were obtaining intravenous (IV) access (34%), while other procedures ranking high on the list included stopping bleeding (17%), finger pricking with a blood lancet (15%), and sharps disposal (12%).

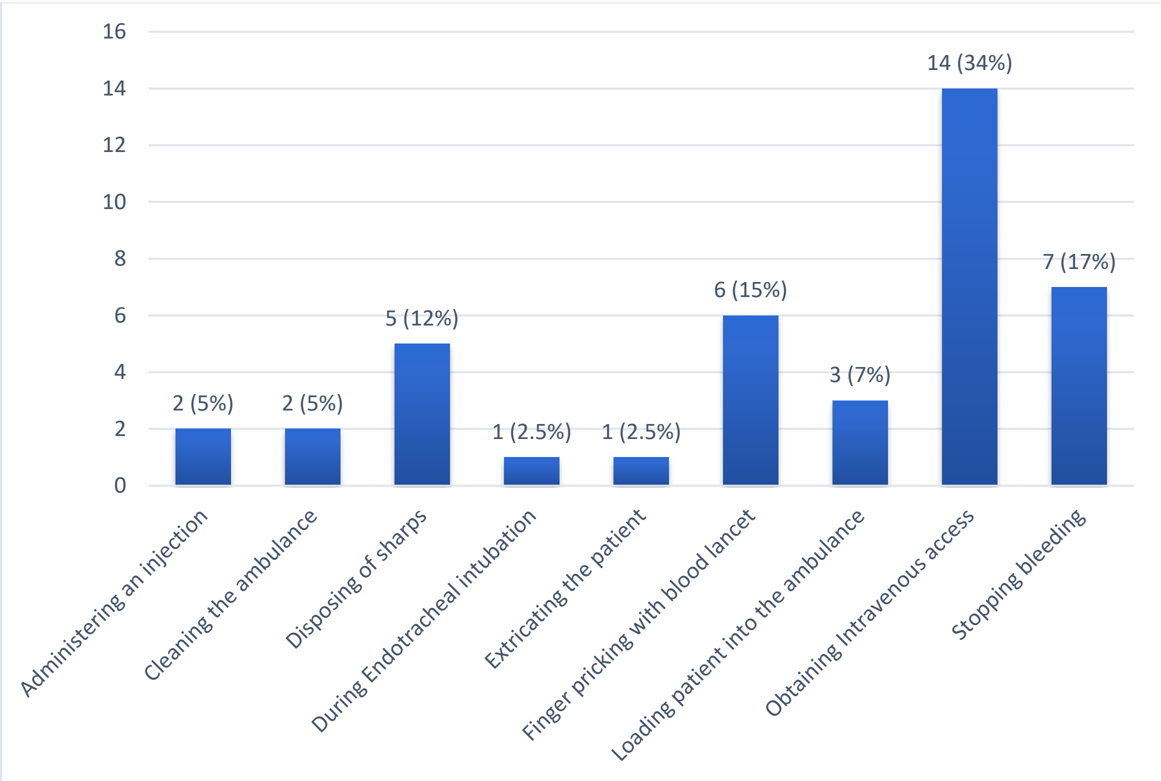


Figure 4.4: Procedures being done when the BBF exposure occurred

As demonstrated in Table 4.4, most of the respondents (96.1%) had been wearing gloves when they sustained NSI, one respondent only had been wearing eye protection when they sustained BBF exposure to the eyes, while all seven who were exposed to BBF on broken skin had been wearing gloves when the exposure occurred. There was no significant relationship found between route of exposure and PPE use (p= .68).

Table 4.4: PPE used for each route of BBF exposure

Route of exposure	PPE used	Frequency (n)	Percentage (%)	Fisher's exact
Needlestick injury	Gloves	18	69.2	*P= .68*
	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	

As depicted in table 4.5, the three procedures which accounted for the majority of the NSI related exposures included obtaining IV access (50%), disposing of sharps (19.3%), and finger pricking with blood lancets (15.4%). Other procedures which had resulted in NSI included the administration of injections, cleaning the ambulance and patient extrication. In instances of BBF exposure to the eyes, the majority of the exposures had taken place during bleeding control (25%) and while loading the patient into the ambulance (25%). Other such procedures included finger pricking with blood lancets, endotracheal intubation, and obtaining IV access. Bleeding control was the procedure that was responsible for the majority (71.4%) of the BBF on broken skin exposures, while other such procedures included finger pricking with blood lancets, and the loading of patients into the ambulance.

Table 4.5: Procedures being done per route of exposure

Route of exposure		Frequency (n)	Percentage (%)
Needlestick injury	Administering an injection	2	7.7
	Gloves and facemask	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

As illustrated in figure 4.5, most of the exposures took place either on scene or in a stationary ambulance.

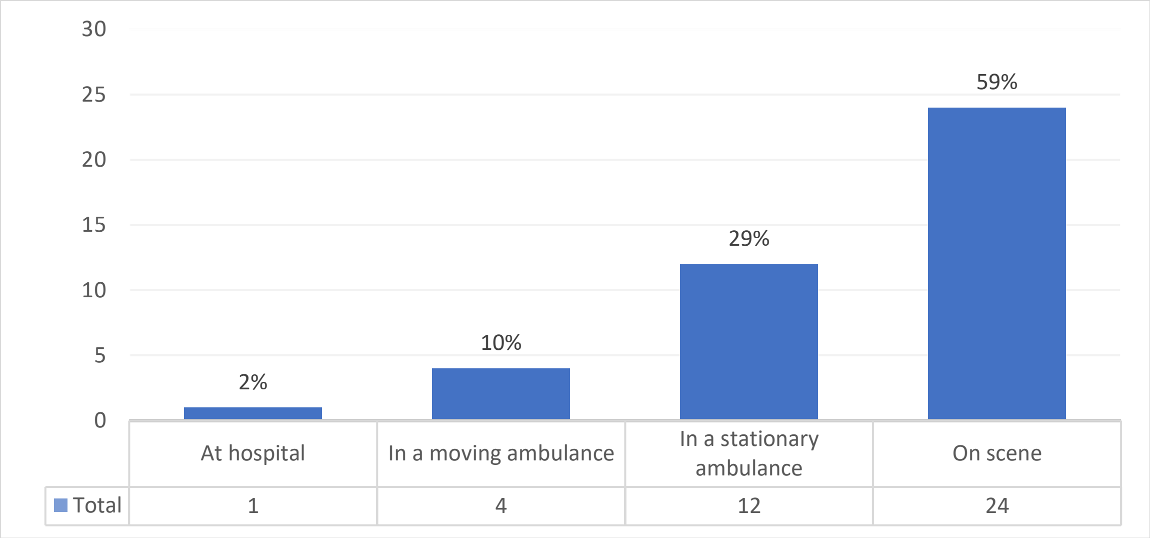


Figure 4.5: Where the BBF exposures took place

When asked what factors had contributed to the BBF exposures, combative patients emerged as the contributing factor for most of the exposures (see figure 4.6).

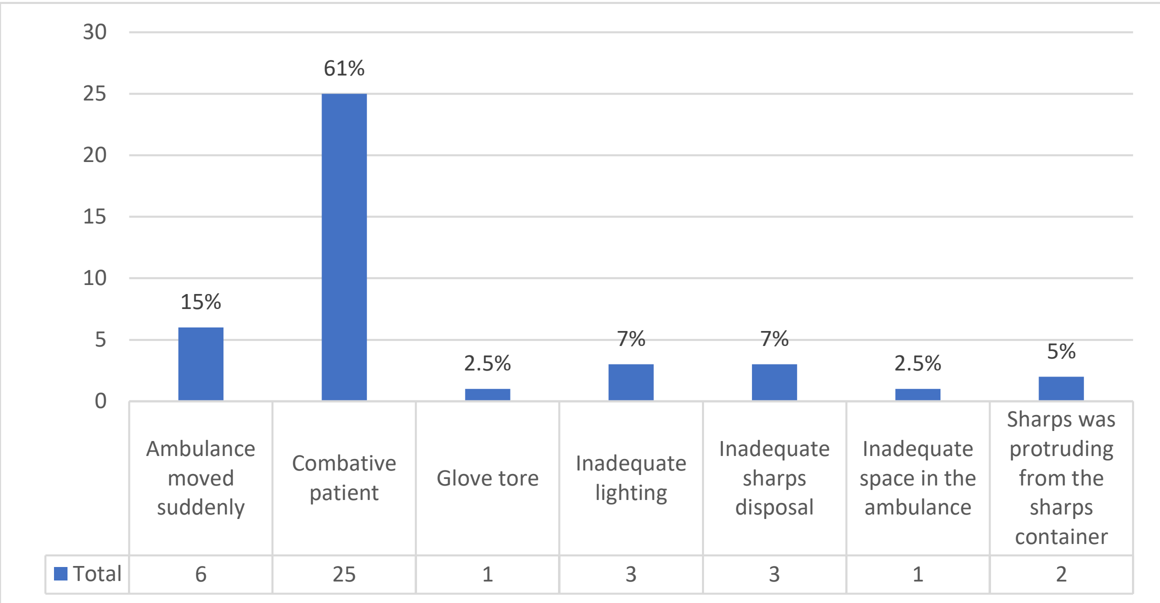


Figure 4.6: Factors which contributed to BBF exposures

As illustrated in figure 4.7, the majority of the respondents (83%) indicated that they had reported the BBF exposure to management.

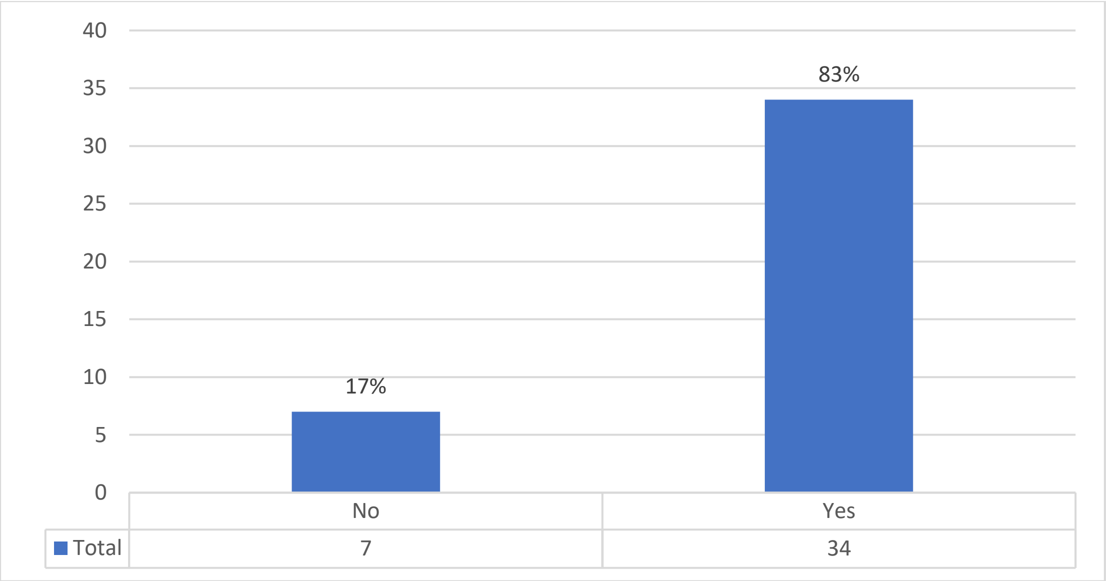


Figure 4.7: Participant responses to Q (30): Did you report the exposure?

All seven of the respondents who had not reported the exposure indicated that their reason for not reporting the exposure had been that they had not thought that the exposure was serious (see figure 4.8).

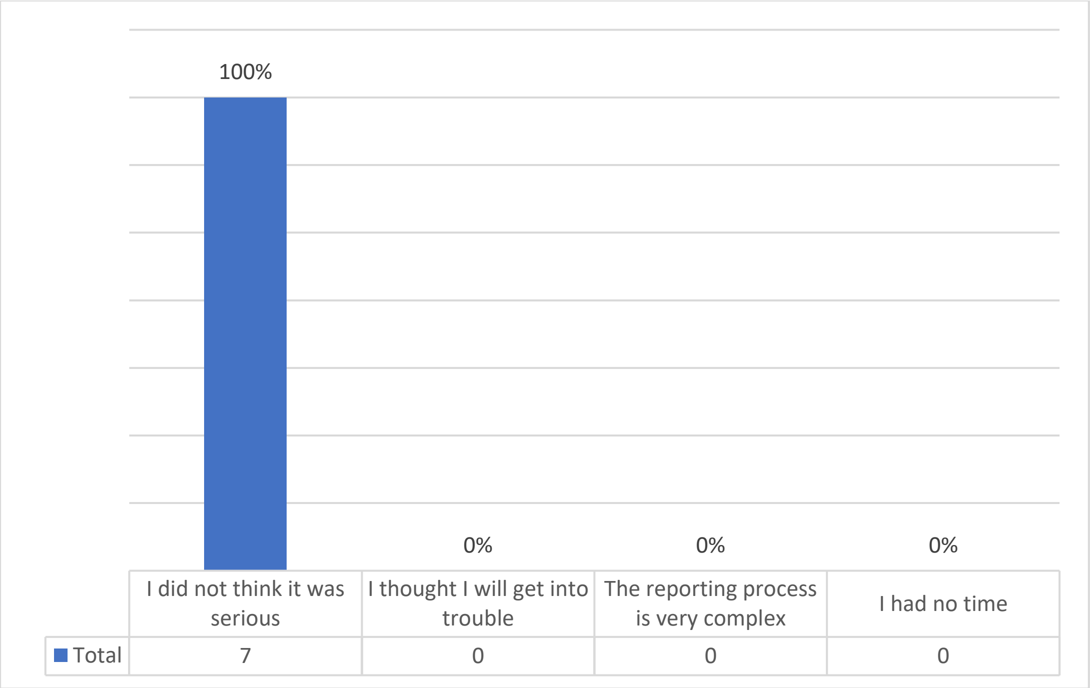


Figure 4.8: Participant responses to Q (31): Why did you not report the exposure?

4.2.4 Knowledge of BBF exposure and universal precautions

As indicated in figure 4.9, 21% of the respondents identified all three of the presented risks of BBF exposure (HIV, HBV, HCV), while 43% only identified one risk.

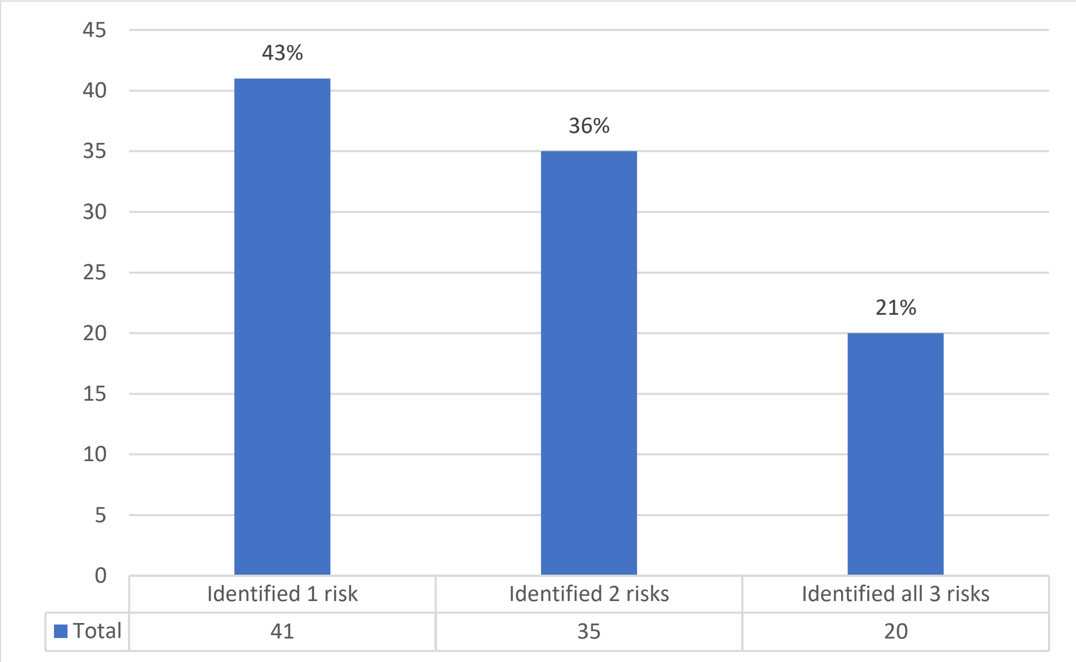


Figure 4.9: Knowledge of the risks of BBF exposure

As detailed in table 4.6, a similar percentage of respondents in the six to 10-year experience and the more than 10-year experience groups identified the three presented risks of exposure to BBF (20% and 19.5% respectively). A Fisher's exact test was conducted to examine the association between years of experience, age and qualification, and identification of the risks of BBF exposure. The association between qualification and knowledge of the risks of BBF exposure was found to be significant ($p = .01$), while ILS providers identified more risks associated with BBF exposures compared to ALS and BLS providers. A chi-square test of independence was performed to investigate the relationship between gender and knowledge of the risks of BBF exposure. The relationship between these variables was found to significant ($p = .03$). In addition, there was a higher proportion of males who identified more of the risks of BBF compared to females. Of the 20 participants who identified all three of the presented risks of BBF exposure, 95% were males.

Table 4.6: Identification of the presented risks of BBF exposure

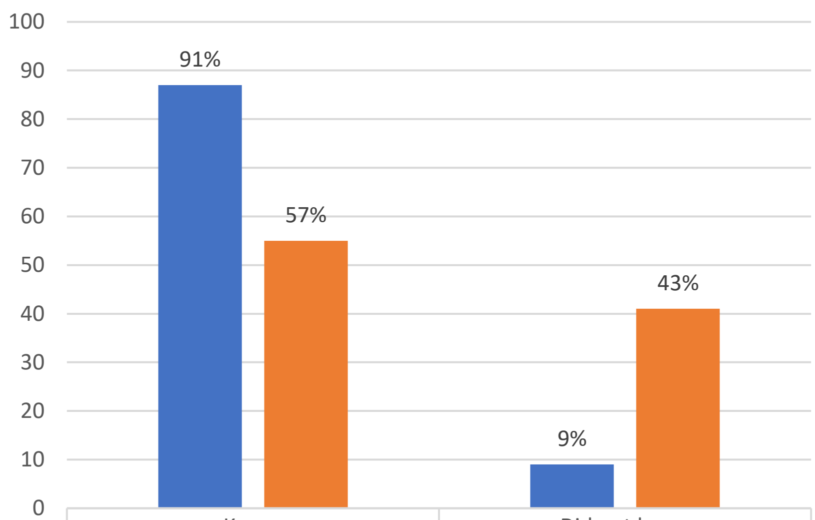
Demographic variables		Identified 1 risk (n)	Identified 1 risk %	Identified 2 risks (n)	Identified 2 risks %	Identified 3 risks (n)	Identified 3 risks %	Fisher's exact
Years of experience	1 to 2	0	0.0	0	0	1	100.0	*P= .49*
	3 to 5	1	33.3	1	33.3	1	33.3	
	6 to 10	6	60.0	2	20.0	2	20.0	
	More than 10	34	41.5	32	39.0	16	19.5	
Qualification	ALS	0	0.0	3	100.0	0	0.0	*P= .01*
	ILS	19	33.9	21	37.5	16	28.6	
	BLS	22	59.5	11	29.7	4	10.8	
Age	20 to 35	6	54.5	4	36.4	1	9.1	*P= .35*
	36 to 45	18	47.4	15	39.5	5	13.1	
	46 and over	17	36.2	16	34.0	14	29.8	
Gender	Male	28	36.4	30	38.9	19	24.7	**Chi square*** *P= .03*
	Female	13	68.4	5	26.3	1	5.3	

Less than half of the respondents indicated that they were aware of their company's BBF exposure policy, while over 80% did not know where they could access the policy. These findings are presented in table 4.7.

Table 4.7: Knowledge of organisation's BBF exposure policy

		Frequency (n)	Percentage (%)
Are you aware of your company's BBF exposure policy?	Yes	46	47.9
	No	28	29.2
	Partially Aware	22	22.9
Do you know where your company's BBF exposure policy is kept?	Yes	19	19.8
	No	77	80.2

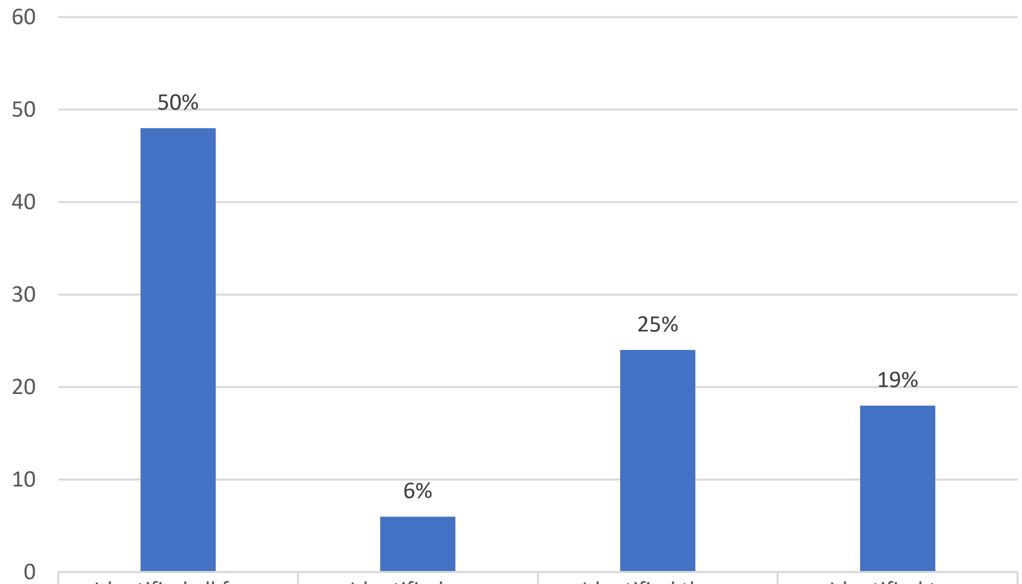
As indicated in figure 4.10, the majority of the respondents (90.6%) were aware that there was pre-exposure prophylaxis for HBV, while 42.7% were not aware that there was post-exposure prophylaxis for HIV.



	Knew	Did not know
Pre-exposure prophylaxis for HBV	87	9
Post-exposure prophylaxis for HIV	55	41

Figure 4.10: Knowledge of pre and post BBF exposure prophylaxis

As illustrated in figure 4.11, half of the respondents only were able to identify the following four examples of universal precautions, namely, use of gloves, use of protective eyewear, use of facemasks, and disposal of sharps in puncture resistant containers.



	Identified all four universal precautions	Identified one universal precaution	Identified three universal precautions	Identified two universal precautions
Total	48	6	24	18

Figure 4.11: Knowledge of universal precautions

Table 4.8: Identification of the presented examples of universal precautions

Demographic variables		Identified 1 UP (n)	Identified 1 UP %	Identified 2 UP (n)	Identified 2 UP %	Identified 3 UP (n)	Identified 3 UP %	Identified 4 UP (n)	Identified 4 UP %	Fisher's exact
Years of experience	1 to 2	0	0.0	0	0.0	0	0.0	1	100.0	*P= .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	
Qualification	ALS	0	0.0	0	0.0	1	33.3	2	66.7	*P= .002*
	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= .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= .30*
	Female	1	5.3	3	15.8	8	42.1	7	36.8	

As described in table 4.8, 66.7% of the ALS providers, 66.1% of the ILS providers, and 24.3% of the BLS providers identified all of the presented examples of universal precautions. A Fisher’s exact test was performed to examine the association between the various demographic variables, and the identification of the presented examples of universal precautions. The association between qualification and identification of the risks of universal precautions was found to be significant (p= .002), with ALS and ILS providers identifying more of the presented examples of universal precautions compared to the BLS providers. As indicated in figure 4.12, the majority of the respondents (98%) indicated that they would report BBF exposures immediately after the exposure.

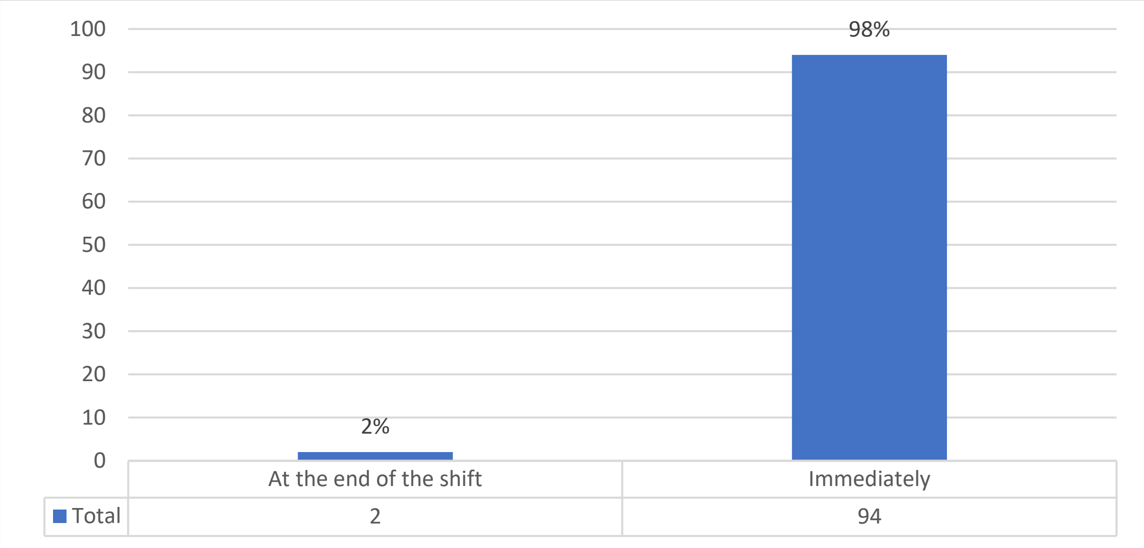


Figure 4.12: When should an exposure be reported?

4.2.5 Practices related to blood and body fluid exposure

Table 4.9 presents the use of PPE among the respondents in situations where there is a perceived risk of BBF exposure.

Table 4.9: Use of PPE when there is a perceived risk of BBF exposure

PPE use		Frequency (n)	Percentage (%)
Gloves	Always	87	90.6
	Most of the time	5	5.2
	Sometimes	4	4.2
	Never	0	0.0
Protective eyewear	Always	21	21.9
	Most of the time	10	10.4
	Sometimes	39	40.6
	Never	26	27.1
Facemasks	Always	25	26.0
	Most of the time	16	16.7
	Sometimes	40	41.7
	Never	15	15.6
Total		96	100.0

While the majority (90.6%) of the respondents indicated that they always used gloves in situations where there is a perceived risk of BBF exposure, only 21.9% used eye protection, and 26.0% used facemasks in such situations. An analysis of the results also indicated that 27.1%, and 15.6% of the respondents respectively indicated that they never used eye protection and facemasks respectively when there is a perceived risk of BBF exposure.

Table 4.10 illustrates that the majority of the respondents (77.1%) had admitted that they always recap needles, while 65.6% indicated that they dispose of needles on the scene by recapping and taking the needles to the emergency vehicle for disposal. The majority of the respondents (91.7%) indicated that they remove the needles from syringes with their gloved hands and almost half of the respondents (46.9%) indicated that they dispose of sharps containers when it is completely full.

Table 4.10: 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

As indicated in figure 4.13, 14% of the respondents indicated that they had not received a HBV vaccination.

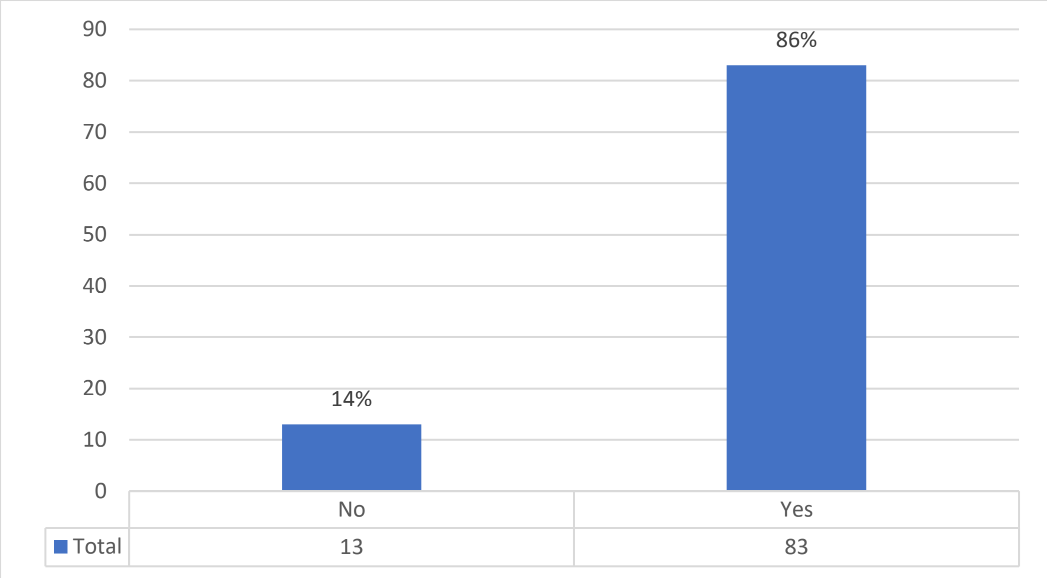


Figure 4.13: Received the HBV vaccination

4.3 Phase two results (Qualitative)

The aim of Phase two of the study was to specifically address the first and second research objectives. This included identifying those factors which influenced the knowledge and practices of EMC providers regarding BBF exposures, factors associated with BBF exposures, and identifying strategies to prevent BBF exposures among EMC providers in South Africa.

As discussed in the previous chapter, the participants recruited into phase two of the study comprised the phase one participants who had been exposed to BBF, and who had indicated their interest in participating in Phase two of the study. Ten participants who met the inclusion criteria and who were identified as being information-rich and capable of providing a substantive, emic account of BBF exposure among EMC providers were purposefully selected and invited to participate in telephonic interviews on mutually agreed upon dates. After six interviews had been conducted, it was evident that the participants had all experienced such similar challenges and experiences that repetition of information was occurring – a characteristic of data saturation. Two more interviews were conducted to verify the data saturation, thus bringing the total number of interviews conducted to eight. The recorded interviews were transcribed verbatim and analysed using thematic analysis. As indicated in table 4.11, the data was coded and then classified into themes and sub-themes.

Table 4.11: Themes and sub-themes

Themes	Sub-themes
• Challenges and barriers for adherence to BBF polices and guidelines	• BBF exposure protocols • BBF exposure training • PPE
• Factors likely to prevent or mitigate BBF exposures	• Compliance with PPE use • Appropriate sharps disposal

4.3.1 Challenges and barriers for adherence to BBF polices and guidelines

When asked questions about the prevention and management of BBF exposures, the participants in phase two of the study expressed some concerns regarding the support they received from their organisation. They cited challenges related to accessing their organisation's BBF protocol/guideline; challenges related to PPE, and the BBF training they received.

4.3.1.1 Blood and body fluid exposure protocols

Many of the participants indicated that they were not familiar with their company's BBF protocol/guideline while some were not aware whether such a protocol/guideline even existed. It was evident from the quotations below that the participants had no clear direction regarding the policy or procedure to follow in order to prevent and manage BBF exposures. Without access to effective BBF guidelines, EMC providers may be at an increased risk of BBF exposure.

> *"Well, firstly, whatever procedures I use or precautions I take, I personally use it for personal protection, by avoiding contamination with any blood, but there's nothing that I know of or any policy or procedure that the service provides use for precautions from contact with blood"* [Participant 3].

> *"Personally, I feel that there should actually be people at all our bases in charge of safety, and find out if there is policies available, and if there's policies available, are the staff being orientated, because personally I've never been orientated with regards to them" [*Participant 3].

"You know what, they may have a procedure in place, but they never update us about anything. Because they don't even tell us that, you know that, this is a treatment, or this is the procedure what you follow, nobody updates us nothing. So, we're just taking our own precautions, you know what I'm saying? There's no real procedures that we're going to follow. Even if there is, we don't know what's the procedure" [Participant 2].

"I think it's set out by, I think the World Health Organisation, could be, like, precautions. Sometimes you go to the hospital, you get some informative thing saying this is what you should use" [Participant 4].

"I think the staff should be given more education on how to react, or they should have a protocol in place, to say, if you have a blood splash, you have to do A, B, C and D, you have to do all this here. But, now, they don't have any procedure in place" [Participant 7].

4.3.1.2 Blood and body fluid exposure training

Effective BBF exposure prevention and management training is of critical importance to prevent BBF exposure, particularly for EMC providers who are at the frontlines of such exposures. Some of the participants expressed concern over the lack of adequate BBF exposure training they received from their organisation. It is evident that the participants feel that their organisation does not provide adequate BBF exposure training. The following excerpts highlighted their frustration.

"They did training, but a long time ago. Not recently. They stress on ethics a lot as that's what council requires, you know? If that's what counts as this thing, but they must stress more on cleaning, de-germ and hand cleaning" [Participant 6].

“I can’t remember the last time they did training. I would say more experience. Once you done at college, its done, you know what I’m saying? So, we, as humans, you drop your guard, because you feel you experienced, this is your game, you confident what you’re doing, but sometimes we fall short” [Participant 1].

"Basically there’s no orientation, there’s no updates on that, it’s just a once off thing that when you join the service and then it’s left up on the individuals, but there should be ongoing lectures, going on to this needlestick injury, training, like a refresh or an update, which they don't do. So, they actually need to on a continuous basis” [Participant 5].

"I would suggest we have more in-house training, also if you come to the base, there’s no posters set up, on proper, proper hand hygiene. Because my wife is a nurse; if you enter a hospital you will see hand hygiene written all over the hospital wards, even to the patient and the visitors, they are briefed on hand hygiene” [Participant 6].

"…more information put in place and maybe have talks and everything, which service don't give at the moment. It could help people; you know what I mean? That’s my personal point of view" [Participant 4].

4.3.1.3 Personal protective equipment

Some of the participants raised concerns over the provision and availability of PPE, particularly protective eyewear and aprons. It is evident from their quotations that the participants feel that their organisation can do more with regards to provision and availability of PPE. Their quotations are presented below:

“Well, the only thing there to protect us is gloves that the service provides, and washing and disinfecting of hands after patient contact” [Participant 3].

"Here there's no aprons here, right. And then the face masks and the glasses. Glasses, you know they give you glasses, the plastic glasses, the ones you use for cutting grass? The same glasses. They gave me one so it must last you like 10 years. That thing got broken long time, man. They give you one, must last 10 years. At least it should be freely available" [Participant 2].

"Firstly, we use gloves, and we use like a face mask as well. Before you get aprons, but we don't get that anymore" [Participant 7].

One participant, in particular, expressed his frustration over the lack of protective eyewear and disinfectant solutions.

"We wear gloves. We are issued with goggles, but the goggles wear out in time. You do certain things, they get cracked or broken. Many crews haven't got. The goggles are not replenished, it's only like certain times of the year you get goggles, not continuously. Eye shields, we used to get in store, but I don't see it in stores anymore. You know those little covers that cover your mouth and your eyes, we don't. So, basically the ambo guys, you go to hospital, they give us a few and we carry it, most of the guys, but not all the time" [Participant 6].

"But, also, degerm that the hospitals have got readily available outside the casualty, outside every ward, we haven't got it at base number 1. We have to get from hospitals to carry it in ambulances. So, it would be beneficial if they provide in stores, like how they do bandages, just go to stores and we can replenish it. But we have to pinch these things off hospitals" [Participant 6].

4.3.2 Factors that were likely to prevent or mitigate BBF exposures

The participants were provided with the opportunity to reflect on their BBF exposure incidents, and to suggest measures which may have prevented them from sustaining such exposures. The majority of the participants identified compliance with PPE use, particularly eye protection, and appropriate sharps disposal. Inadequate compliance with PPE makes EMC providers vulnerable to BBF exposures, as exposures can occur without warning. Some of the participants' comments are presented below:

> *"The patient I was treating was a bit uncooperative. The patient removed the canulae from his arm where the drip - where I cannulated him, and the IV line was still running, there was blood on the canulae and blood squirted in my eye"* [Participant 3].
>
> *"Most probably if I had eye protection on it would have been better, but it was something that was unexpected, I wouldn't expect the patient to remove their IV line, you know what I'm saying?"* [Participant 3].
> *"We were on the N2 by Spaghetti Junction, where we came across an MVA. So we saw a few guys standing around the guy, but then they were pointing to one guy, he was lying across the barrier. He was lying in the grass there. So I went up, like, I didn't expect to see - you know, to check him. So, when I went over that barrier, I just said hello, that guy, he turned and he look blew – he had a heavy laceration on his forehead so his whole face was covered with blood and he just like blew that thing into my face"* [Participant 7].
>
> *"Maybe if I had responded with the goggles it should be better if I just put it on"* [Participant 7].
>
> *"We were cleaning the vehicle and there was old needle that was left into the bunk section. We was cleaning or whatever and then the needle actually pricked me, but there wasn't blood as such in the needle. It was an old, old needle that was actually discarded where it's not supposed to be, and my finger actually went and poked the thing"* [Participant 5].
>
> *"It's negligence on certain crews that maybe left the needle there, they actually should have taken the needle straight away into the sharps container bottle, that's it"* [Participant 5].

4.4 Conclusion

This chapter presented the results of the study in accordance with the research objectives. Phase one provided the quantitative results, and phase two presented the qualitative results. The quantitative findings revealed that NSI accounted for the majority of the BBF exposures, which were sustained by a higher proportion of ILS providers compared to ALS and BLS providers. It emerged that many of the respondents had not been complying with the use of eye protection and facemasks when they were exposed to BBF. Most of the BBF exposures happened on scene with IV access being the procedure that accounted for the majority of such exposures. Combative patients were found to be the main contributing factor to most of the BBF exposures.

It appeared that many of the respondents lacked knowledge about both the risks associated with BBF exposures and the precautions which should be taken to prevent such exposures. The ILS providers demonstrated greater knowledge about the risks of BBF exposure compared to the ALS and BLS providers, while the ALS and ILS providers demonstrated greater knowledge of the universal precautions compared to BLS providers. Less than half of the respondents indicated that they were aware of their organisation's BBF exposure policy. In addition, a large percentage did not even know that there was postexposure prophylaxis for HIV. The quantitative findings also revealed that many of the respondents infrequently wore eye protection and facemasks in situations where there was a risk of BBF exposure, while many attested to unsafe needle practices, including needle recapping, needle manipulation, and improper sharps disposal.

The findings from the qualitative phase revealed that the challenges related to adherence to BBF exposure policies included a lack of clear direction in respect of BBF exposure protocols and guidelines, the unavailability of PPE, and a lack of BBF exposure training. In addition, the findings from this phase also highlighted the factors that could have prevented the BBF exposures. Such factors included compliance with PPE, and proper sharps disposal.

The following chapter presents a discussion of the results of the study.

CHAPTER 5:

DISCUSSION

5.1 Introduction

This chapter discusses the results which were presented in the previous chapter. The quantitative and qualitative results are discussed together in order to provide a more in-depth understanding of BBF among EMC providers than may otherwise have been the case. The results are discussed within the context of other relevant national and international studies on the research topic.

The aim of this chapter was to address the research objectives which were outlined in chapter one of the study, namely, to determine the prevalence and factors associated with BBF exposure among EMC providers employed in the eThekwini metropole, and to determine the knowledge and practices of EMC providers in relation to both pre- and post-BBF exposure. Research objective three, namely, to identify the important components of an effective pre- and post-BBF exposure protocol, was covered in chapter two. In addition, BBF exposure guidelines are also discussed in this chapter.

5.2 Response rate

As indicated earlier, the participants were randomly selected from a list of operational EMC providers employed by the public sector ambulance service in the eThekwini metropole. The response rate of the study was 77%. The primary reason for non-participation in phase one of the study was the participants' absence from work during the data collection period. This research study demonstrated a similar response rate to those of another study conducted in South Africa and also a study conducted in Poland (76.3% and 80% respectively) (Garus-Pakowska, Górajski and Szatko 2017; McDowall and Laher 2019), but a higher response rate compared to a previous American study (55%) (Leiss *et al*. 2006) which investigated BBF exposure among EMC providers. A possible reason for this higher response rate is the fact that the researcher personally distributed the questionnaires to the participants at their respective ambulance bases and then collected them, as opposed to distributing the questionnaires via the postal mail services, as was the case in the American study.

5.3 Socio-demographic characteristics

The EMS profession has long been regarded as a male dominated occupation (Gonsoulin and Palmer 1998). This assertion is consistent with the results of this study which found a much higher proportion of male participants (80.2%) compared to female participants (19.8%). This is in line with previous studies on BBF among EMC providers which documented that over 80% of the respondents were males (Mathews *et al*. 2008; Naylor *et al.* 2018). The majority of the participants (48.9%) in this study were over the age of 46 years and held an ILS qualification (58.3%). However, this is in contrast with the results of a South African study which investigated NSI among EMC providers and which found that most of the participants were between the ages of 25 and 29 years, and held a BLS qualification (McDowall and Laher 2019). McDowall and Laher (2019) also found that the majority of the participants in their study had over 10 years' experience in the EMC field, which is consistent with the findings of this study.

An interesting finding in this study was that three (3.1%) of the 96 participants only were ALS qualified. At the time of the study there were 195 ALS providers registered with the HPCSA and residing in KwaZulu-Natal (HPCSA 2020). However, the number of ALS providers working in KwaZulu-Natal but registered as residing in the province may be lower as it is possible that some of ALS providers who are registered with the HPCSA as residing in KwaZulu-Natal may actually be working out of South Africa. According to the KwaZulu-Natal Department of Health (2020), at the time of the study there were 92 ALS providers employed by the public sector ambulance service in the KwaZulu-Natal province with these 92 ALS providers being responsible for the critical care of a large majority of the 11.4 million people who utilise the public health system in KwaZulu-Natal (Statistics South Africa 2018), which equates to one ALS provider per 123 913 people. This is grossly inadequate when compared to the international norm of one ALS provider per 10 000 people (Finlayson 2017). At the time of this study, there were 19 operational ALS providers only, on active duty in EMRS in the eThekwini metropole, which may explain the small number of ALS providers in the sample. These 19 practitioners are responsible for providing advanced prehospital care to the majority of the public sector patients in eThekwini. It is interesting to note that previous studies have reported the skill shortage of ALS providers in South Africa (Govender *et al*. 2012; Binks 2011).

5.4 Blood and body fluid exposures

As indicated earlier, exposure to BBF places EMC providers at a risk of being infected with many life-threatening bloodborne pathogens. Compared to their counterparts elsewhere in the world EMC providers in South Africa may be at a higher risk of infection with HIV, HBV and HCV due to the burden of disease in the country (Statistics South Africa 2017; Hecht *et al*. 2018). The results of this study revealed that 42.7% of the EMC providers had sustained an occupational exposure to BBF. These findings are in accordance with the results reported by Oh and Uhm (2016) who found that 40% of EMC providers had been exposed to BBF at some point in their careers, while Harris and Nicolai (2010) documented an even higher percentage (66%) of BBF exposure among EMC providers. The reasons for the high prevalence of BBF exposure in the studies cited above include both unsafe practices and an incomplete knowledge of universal precautions among the EMC providers. This statement is consistent with the findings of this study. It was not possible to draw any direct comparisons with any previous South African studies due to the lack of literature on BBF exposures among EMC providers in South Africa. The only other South African study related to the subject had investigated NSI among EMS personnel.

With regards to the type of BBF exposure, the majority of the exposures found in the study were attributable to NSI. This finding is in line with other studies which also found that NSI constituted the majority of the BBF exposures (Naylor *et al.* 2018; Oh and Uhm 2016). However, contrasting results have also emerged from earlier studies, which reported lower rates of NSI among EMC providers (Harris and Nicolai 2010; Leiss *et al.* 2006). When compared to another South African study, this study revealed a significantly higher percentage of NSI among the participants in this study (63% vs 26.3%) (McDowall and Laher 2019). As indicated in chapter 2, the percutaneous route of BBF exposure poses the greatest risk of infection to bloodborne pathogens. The high prevalence of NSI found in this study was probably related to the participants inadequate knowledge of universal precautions as well as their unsafe needle practices. Adequate training on strategies aimed at the prevention of BBF exposures may be the key to reducing NSI among EMC providers in South Africa.

This study also revealed that obtaining intravenous access was the procedure which accounted for the majority of the BBF exposures. In a similar vein, a South African study reported that 64.5% of NSI occurred during intravenous cannulation (McDowall and Laher 2019). However, this is contrary to the findings of an American study which found that disposing of needles and blood lancets accounted for the majority (32.1%) of the NSI (Leiss *et al*. 2009). It is interesting to note that the only two South African based studies on the subject revealed that obtaining IV access was the procedure which resulted in the majority of the NSI injuries.

This may be attributed to the large number of unjustified prophylactic intravenous cannulations being undertaken in EMC practice in South Africa (Bester and Sobuwa 2014). However, this is not unique to South African EMS system as a Swiss study reported that over 40% of the IV lines inserted in the prehospital environment had not been used (Gonvers *et al.* 2020).

Most of the BBF exposures cited in this study had occurred on scene. Unlike other healthcare professionals who work in a controlled environment, paramedics are required to use their skills and perform several procedures in uncontrolled and sometimes adverse conditions. This includes working in low light situations and areas with limited space such as the back of a moving ambulance. Hence, paramedicine is regarded as one of the most dangerous occupations in the world (Thomas *et al*. 2017). It is, therefore, essential that EMC providers are given adequate training on strategies and techniques to mitigate BBF exposures in the prehospital environment, and not have to rely on generic BBF prevention training courses. Training should include the provision and awareness of EMS-specific guidelines to prevent BBF exposure.

The majority (61%) of the respondents indicated that combative patients were the primary factor contributing to BBF exposures. For exposures that occurred on scene, combative patients were the contributing factor that ranked over four times more than any of the other factors. This finding is in line with the results of a study conducted by Leiss *et al*. (2009) who reported that a high percentage of nonintact skin exposures occurred as a result of combative or noncooperative patients. There are various reasons for patients being combative, for example, alcohol and drug intoxication, and conditions such as traumatic brain injuries, hypoglycaemia and hypoxia, to name but a few. Managing these types of patients may be very challenging in the prehospital setting, particularly when performing intricate interventions in enclosed spaces such as ambulances. The challenges associated with managing agitated or combative patients has been identified as a problem in the prehospital environment. One strategy to manage these types of patients is the use of chemical restraints to subdue patients prior to performing invasive procedures (Melamed *et al.* 2007). However, a limitation of this method is the fact that, at the time of this study, only ALS providers had access to these types of medications. Furthermore, using chemical restraints requires needle use for intravenous access or intramuscular injection which further increases the risk of NSI in the case of a combative patient. At the time of this study there was a paucity of literature on effective strategies to manage combative or noncooperative patients in the prehospital environment.

The noncompliance or incomplete compliance with PPE among EMC providers during BBF exposure incidents has been documented previously (Leiss *et al*. 2009; Nicolai and Harris 2010; Alhazmi, Parker and Wen 2020). This is consistent with the results of this study which found that the majority of the respondents had not been not fully compliant with PPE when the BBF exposure incidents had taken place. The study revealed that, while 98% 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. Some of the participants from phase two of the study specifically mentioned the non-provision of eye protection by their organisation, while some suggested that their BBF exposure incident may have been prevented if they had been wearing eye protection when the incident occurred. Although the reasons for the noncompliance with PPE was not quantified in this study, possible reasons may be the unavailability of PPE, and the respondents not anticipating the BBF exposure.

The study revealed that 83% of the respondents who had been exposed to BBF had reported the exposure. This percentage is higher compared to other studies which found that 19.5% and 49% respectively of the participants had reported the BFF (Oh and Uhm 2016; Boal *et al.* 2008). The respondents in this study indicated that they had downplayed the exposure as being non-serious and, hence, the non-reporting. The non-reporting of BBF exposure may be related to the lack of knowledge of BBF exposures among emergency care personnel and which is discussed in the next section.

5.5 Knowledge of BBF exposures and universal precautions

Knowledge of the risks of BBF exposure and the effective implementation of universal precautions is fundamental to the prevention of BBF exposures. This study revealed that many of the EMC providers demonstrated an incomplete knowledge of the risks of BBF exposure and universal precautions. These findings are consistent with those earlier studies (Harris and Nicolai 2010; Garus-Pakowska *et al.* 2017). This study found that 79% of the respondents were unable to identify all of the presented risks of BBF exposure. This concurs with the findings of a Polish study which reported a suboptimal knowledge on the part of paramedics regarding the awareness of the risks of bloodborne pathogens (Garus-Pakowska *et al.* 2017). The lack of BBF exposure training indicated by the participants in phase two of this study may explain their incomplete knowledge of the risks of BBF exposure.

The study revealed a significant relationship ($p = .01$) between qualification and knowledge of the risks of BBF exposure with ILS providers demonstrating a greater knowledge of the risks of BBF exposure compared to ALS and BLS providers, despite the fact that ALS providers possess a higher level of training in the EMC field. This finding, while unexpected, echoes the results of a previous study by Garus-Pakowska *et al*. (2017) which reported that paramedics with a lower level of education possessed more knowledge of the risks of bloodborne pathogens compared to those with a higher level of education. Garus-Pakowska *et al.* (2017) found that those with a higher qualification were often young people with little experience in the EMC field, while those with a lower qualification often had greater experience in the field. The reason for this finding in this study is unknown as there was no significant association ($p= .49$) between experience and knowledge of the risks of BBF exposure. However, caution needs to be exercised in relation to this finding as only three ALS providers participated in the study. It would, thus, be more appropriate to suggest that persons with a higher qualification (ILS) possessed more knowledge than lower qualified personnel (BLS).

Half of the respondents in this study were unable to identify all of the presented examples of universal precautions. This is consistent with the findings of Harris and Nicolai (2010) who found that over 70% of EMC providers were unable to successfully identify all of the presented examples of universal precautions. The participants in phase two indicated their dissatisfaction with the level of BBF training they had received and this may account for this finding. The study revealed a strong relationship ($p = .002$) between level of training and universal precautions, and also found that ALS and ILS providers demonstrated a more complete knowledge of universal precautions compared to BLS providers. This may indicate that the Basic Ambulance Assistant course may not have placed adequate emphasis on both universal precautions and the prevention of BBF exposures. This lack of emphasis may be related to the short duration (4 to 5 weeks) of the programme. In addition, complaints regarding the suboptimal quality of BLS training programmes have been documented previously (Vincent-Lambert, Bezuidenhout and van Vuuren 2014).

The data from phase two of this study suggested that the respondents were not satisfied with the BBF exposure training they received from their organisation. This corroborated the findings from the quantitative phase which had identified a gap in the knowledge of many (79% and 50% respectively) of the study participants regarding the risks and prevention of BBF exposures. Garus-Pakowska *et al.* (2017) reported that the number of BBF exposure training courses being provided in Poland was insufficient at the time of their study. These findings are in line with the findings of this study which indicated that the BBF exposure prevention and management training being provided by the public sector ambulance service in eThekwini at the time of this study was suboptimal and required urgent intervention. It is concerning that many EMC providers lack fundamental knowledge of the prevention and management of BBF exposures as knowledge informs practice and, if practices are unsafe, this may lead to exposure and possible infection with bloodborne diseases.

5.6 Practices related to blood and body fluid exposure

This study revealed that many of the respondents were not fully compliant with the use of PPE. These findings are consistent with the findings of other studies which also reported low rates of compliance with PPE among EMC providers (Topczewska and Gańcza 2019; Oh and Uhm 2016; Wicker *et al.* 2010). While the vast majority of the respondents in this study indicated that they always wore gloves in daily practice, of particular concern was the high percentage (27.1%) of EMC providers in the study who attested to never wearing eye protection. These findings are consistent with those reported by Oh and Uhm (2016) who found that, while over 68% of EMC providers were compliant with the use of gloves, 1.7% only had indicated that they commonly used eye protectors. Oh and Uhm (2016) investigated the noncompliance with PPE use and found that common reasons for not wearing PPE included PPE was not required, the use of PPE was annoying, and an inadequate supply of PPE. The inadequate supply of PPE among EMC providers was also reported by Alhazmi, Parker and Wen (2020). This study did not specifically investigate the reasons for the noncompliance with the use of PPE although, as indicated earlier, the qualitative data from phase two of the study suggested that both the non-provision of PPE and EMC providers not anticipating the exposure may be two possible reasons.

The majority of the respondents in this study indicated that that they always recapped needles (77.1%) and disposed of needles on scene by recapping and carrying the recapped needle to the ambulance (65.6%). These findings are similar to those reported by Topczewska and Gańczak (2019) who documented that over half of EMC providers indicated that they recapped needles, although significantly lower rates of needle recapping (14%) were reported by Harris and Nicolai (2010). This study also revealed that over 90% of the participants manipulated needles (removal of needles from syringes) with gloved hands and that almost half of them disposed of sharps containers only when completely full. The recommended practice is that needles must not be removed from syringes and must, instead, be disposed of as a single unit, and that sharps containers must be disposed of when three quarters full (South Western Ambulance Service NHS Foundation Trust, 2016). Some of the participants from phase two specifically highlighted improper sharps disposal as a possible cause for BBF exposure. These unsafe needle practices may predispose EMC providers to exposure and possible infection with bloodborne pathogens and highlight the need for both effective EMS-specific guidelines and adequate BBF exposure training.

5.7 Blood and body fluid exposure guidelines

Chapter two presented the important components of internationally accepted BBF exposure guidelines, namely, adequate PPE, effective hand hygiene, pre-exposure prophylaxis, safe handling of medical sharps, effective cleaning and disinfection, and post-exposure prophylaxis. It is unclear whether the BBF exposure protocol/SOP of the public sector ambulance service in KZN incorporates all of the important components of an effective BBF exposure guideline, as attempts of obtaining a copy of the EMS-specific protocol/SOP were unsuccessful. A previous South African study reported that almost 10% of the respondents were unaware of their organisation's NSI policy (McDowall and Laher 2019). The results of this study were even more concerning as the study revealed that over 40% of the respondents were unaware of their organisation's BBF exposure policy, while over 80% did not know where the policy was kept. The data from phase two of the study provided further insight into this finding as some of the participants specifically highlighted the lack of clear direction from their organisation regarding BBF exposure policies as a plausible reason for their lack of knowledge of BBF policies and/or protocols.

5.8 Conclusion

This chapter presented a discussion of the results of the study. As revealed by the results, it was clear that a knowledge gap regarding the risks and prevention of BBF exposures exists among EMC providers employed by EMRS in eThekwini. The incomplete knowledge on the part of many of the EMC providers who participated in this study on BBF exposures may explain both the unsafe practices and the high prevalence of BBF exposure among the study participants. The next chapter presents a summary of the study results. It also discusses the limitations and conclusions of the study and provides recommendations to prevent BBF exposures among EMC providers.

CHAPTER 6:

SUMMARY, RECOMMENDATIONS, LIMITATIONS AND CONCLUSION

6.1 Introduction

This study was one of only two identified studies related to BBF exposure among EMC providers in South Africa and, at the time it took place, the study was the only South African based study which had investigated all routes of BBF exposure among this cohort of HCWs. Thus, the study contributed by expanding the paltry and existing body of knowledge on BBF exposure among EMC providers in South Africa.

The researcher identified three specific objectives in relation to attaining the research aim of investigating the knowledge, practices, and exposure to BBF among EMC providers employed by the EMRS in the eThekwini metropole in order to make evidence-based recommendations to prevent and effectively manage BBF exposures in the prehospital environment. Accordingly, the researcher set out to realise these objectives. This chapter presents a summary of the study findings; it offers recommendations to prevent BBF exposure among EMC providers; it discusses the limitations of the study; and presents the conclusions of the study.

6.2 Summary

6.2.1 Blood and body fluid exposures

The first research objective was to determine the prevalence and factors associated with BBF exposure among EMC providers employed in the eThekwini metropole. The study revealed that a large percentage (43%) of the practitioners who participated in this study had been exposed to BBF while carrying out their daily duties. Once exposed such practitioners carry the risk of being infected with HIV, HBV, and HCV, among various other potentially dangerous bloodborne pathogens. The study found that NSI accounted for the majority of the BBF exposures. Among the factors that contributed to the exposures, it emerged that combative patients were responsible for the majority of the exposures. Another important finding of this study was that a large proportion of the EMC providers who sustained BBF exposures had not been fully compliant with the use of PPE when the exposure incident had taken place. The qualitative data from phase two of the study indicated that noncompliance with the use of PPE may be related to the inadequate provision of PPE by the organisation in question. This is an issue of particular concern as EMC providers are in the frontline of BBF exposures and, without the correct PPE, they are vulnerable to exposure and possible infection with bloodborne pathogens.

This study also revealed that obtaining intravenous access and bleeding control were the procedures which accounted for most of the BBF exposures. This is vital information as evidence-based recommendations to prevent BBF exposures may focus on these and other high-risk procedures.

6.2.2 Knowledge and practices of EMC providers relating to BBF exposure

The second research objective was to determine the knowledge and practices of EMC providers in relation to pre- and post-BBF exposure. A significant finding of this study was that the knowledge of the respondents regarding the risks of BBF exposures and universal precautions was suboptimal. 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 possible reason for the high prevalence of BBF exposures in this group of EMC providers. The qualitative findings suggested that possible reasons for the inadequate knowledge base of these practitioners regarding BBF exposures may be both the lack of clear direction regarding BBF exposure policies as well as infrequent and inadequate BBF exposure training programmes.

Another important finding was that many of the participants were performing unsafe practices which may render them susceptible to BBF exposure and possible infection with bloodborne pathogens. These unsafe practices included improper disposal of needles and other sharp devices, needle recapping, and manipulation of needles. The lack of awareness of the risks of BBF exposures may be a possible reason for such unsafe practices. Again, this lack of awareness may, possibly, be linked to the lack clear BBF exposure guidelines and also inadequate training on both the risks of BBF exposure and universal precautions.

6.2.3 Blood and body fluid exposure policies

The third research objective was to identify the important components of an effective pre- and post-BBF exposure protocol. As presented in chapter two, the important components of a BBF exposure protocol should include guidelines on the use of PPE, effective hand hygiene, pre-exposure prophylaxis, the safe management of sharps, effective cleaning and disinfection, and postexposure prophylaxis. However, the study revealed that a large proportion of the participants (47.9%) were not aware of their organisation's BBF exposure policy. In addition, it was unclear whether the BBF exposure protocol/SOP in the public sector ambulance service in the eThekwini metropole included all of the important components of an effective BBF exposure guideline.

6.3 Recommendations

The results of this study suggested that strategies aimed at the prevention of BBF exposures in the prehospital environment require a multipronged approach which requires the commitment of all stakeholders to ensure that effective strategies are properly implemented. Based on the evidence from this study, the following recommendations may help to prevent BBF exposures among EMC providers:

6.3.1 Training and EMS-specific BBF exposure protocols

Exposure to BBF may have significant consequences for both the health and wellbeing of EMC providers. It was evident in this study that many of the EMC providers who participated in the study lacked the fundamental knowledge required to prevent BBF exposures. In addition, the study also found that a large percentage of the participants were not aware of their organisation's BBF exposure protocol or SOP. Accordingly, this study recommends that effective training aimed at awareness, prevention and management of BBF exposures be provided regularly by organisations and that updated EMS-specific prevention and management BBF exposure protocols/SOPSs be circulated to all EMC providers. It is also important that registers be kept to monitor participation in BBF exposure training programmes and to serve as an acknowledgement of the receipt and understanding of the BBF exposure protocols/SOPSs.

6.3.2 Provision of PPE

The adequate provision of PPE is of paramount importance. Organisations must ensure an adequate supply of PPE, and that PPE is always readily available to EMC providers when the need arises. However, the responsibility cannot rest solely on the organisation, and EMC providers must ensure that they are in possession of and use the required PPE at all times.

6.3.3 Pre-exposure prophylaxis

While the majority of the respondents indicated that they had received the HBV vaccination, 13.5% indicated that they had not received a HBV vaccination. This is concerning in view of the fact that that HBV is one of the most easily transmittable bloodborne pathogens but also the most easily preventable. Those practitioners who have not received the HBV vaccination are at significant risk of infection with the HBV. It is, therefore, vital that organisations place significant emphasis on HBV immunisations and that they make sure that adequate records are kept to ensure that all EMC providers are up to date with their HBV vaccinations.

6.3.4 Compliance with use of PPE and universal precautions

The noncompliance with the use of PPE and universal precautions was clearly documented in this study. While the lack of BBF exposure training and the inadequate provision of PPE have been identified as possible contributors to noncompliance with PPE, EMC providers must also take responsibility for their own health and wellbeing and they should ensure that they do not take shortcuts with regards to the use of PPE and universal precautions. The following strategies are recommended:

6.3.4.1 EMC providers must maintain a high degree of suspicion when dealing with BBF, and practitioners should respond to all patients wearing, at the least, their gloves and eye protection. Additional PPE may be required for high risk situations and, thus, a risk assessment approach to the use of PPE, as indicated in chapter two, should be utilised.

6.3.4.2 Practitioners must maintain extreme caution when treating patients on scene, when treating combative patients; and when obtaining intravenous access as these situations were identified as high-risk for BBF exposure in this study. Emergency medical care providers should not recap needles unless they have no other option to render a needle safe. In this case, they should use the one-handed technique to recap needles. Needles must also not be carried from scene to be disposed of in the ambulance and EMC providers should, instead, carry a small sharps container in their jump bags so that they are able to dispose of needles and other sharp devices directly into a sharp's containers, thereby reducing the risk of NSI.

Needles and other sharp devices must not be left lying around in the ambulance or inserted into the bunk of the ambulance but should, instead, be disposed of immediately in sharps containers.

6.3.4.3 Needles must not be removed from syringes or manipulated in any way. Instead, the syringe and the needle must be disposed of as a single unit in sharps containers.

6.3.4.4 Sharps containers must not be disposed of when completely full due to the risk of sustaining NSI from needles and other sharp devices protruding from the sharps container. Sharps containers must, instead, be disposed of when they are three quarters full.

6.3.5 Recommendations for future research

This research study provided new evidence on BBF exposure among EMC providers in South Africa and paved the way for further research to be conducted on this topic. Future research could focus on exploring the BBF exposure protocols/SOPs that various EMS organisations in South Africa have in place and ensuring that these protocols/SOPs include the important components of an effective BBF exposure guideline. As previous studies investigated BBF exposure among EMC providers in urban areas only, it is, therefore, recommended that further research be conducted in rural areas in South Africa. Another opportunity for future research is to carry out tests to confirm the immunity against HBV among EMC providers in South Africa.

6.4 Limitations of the study

The first limitation of this study is that it did not investigate BBF exposures among EMC providers employed in the private sector. Only EMC providers employed by the national public sector EMRS were included in the study. In addition, the study also did not include EMC providers employed by public sector ambulance services from other provinces in South Africa but was, instead, limited to EMC providers employed in the eThekwini metropole. Accordingly, the study findings may not be representative of the entire EMC provider population in South Africa. However, in view of the paucity of literature on BBF exposure among EMC 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. However, so saying, a BBF exposure incident is a critical and quite frightening experience and is not, therefore, something that EMC providers are likely to easily forget.

6.5 Conclusion

The burden of bloodborne disease in South Africa is greater than in the developed world, and there is no indication of this changing in the foreseeable future. If anything, this burden is likely to increase. As a result of the unpredictable and fast-paced nature of the prehospital environment and the high prevalence of HBV, HCV and HIV, paramedics from South Africa are among the highest at risk of bloodborne virus infection.

It emerged that the knowledge of the EMC providers employed by the public sector ambulance service in eThekwini regarding the risks of BBF exposures and universal precautions is suboptimal, while their practices relating to the management of needles and other sharps may be construed as grossly unsafe and as deviating from recognised and safe practice. This inadequate knowledge and unsafe practices on the part of the EMC providers may very well be linked to the high prevalence of BBF exposures observed in the study, although this explicit link is yet to be demonstrated. As revealed by the study findings, the factors that are likely to contribute to mitigating

BBF exposure and possible infection with life-threatening bloodborne pathogens include the adequate provision and use of PPE; effective and accessible guidelines that are contextually relevant and appropriate so as to promote consistent adherence, and finally, but definitely not least, training on BBF exposure and universal precautions.

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Annexure A: Letter of approval from the Durban University of Technology's Institutional Research Ethics Committee

DUT
DURBAN UNIVERSITY OF TECHNOLOGY

Institutional Research Ethics Committee
Research and Postgraduate Support Directorate
2nd Floor, Berwyn Court
Gate 1, Steve Biko Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2375
Email: lavishad@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

8 May 2018

IREC Reference Number: **REC 186/17**

Mr M Chetty
3 Wigham Gardens
Westham
Phoenix
KwaZulu-Natal
4068

Dear Mr Chetty

Occupational exposure to blood and body fluids among emergency care providers

The Institutional Research Ethics Committee acknowledges receipt of your final data collection tool for review.

We are pleased to inform you that the data collection tool has been approved. Kindly ensure that participants used for the pilot study are not part of the main study.

In addition, the IREC acknowledges receipt of your gatekeeper permission letter.

Please note that FULL APPROVAL is granted to your research proposal. You may proceed with data collection.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC Standard Operating Procedures (SOP's).

Please note that any deviations from the approved proposal require the approval of the IREC as outlined in the IREC SOP's.

Yours Sincerely,

Professor J K Adam
Chairperson: IREC

DUT DURBAN UNIVERSITY OF TECHNOLOGY
2018 -05- 08
INSTITUTIONAL RESEARCH ETHICS COMMITTEE
P O BOX 1334 DURBAN 4000 SOUTH AFRICA

Annexure B: Letter of approval from the KwaZulu-Natal Emergency Medical Rescue Services

health
Department:
Health
PROVINCE OF **KWAZULU-NATAL**

DIRECTORATE:

51 Dudley Street, Jacobs
Private Bag X01, Dalbridge, 4014
Tel 031-4803650 Fax 031 4803635 Email: linda.reddy@kznhealth.gov.za
www.kznhealth.gov.za

EMERGENCY MEDICAL SERVICES
eThekwini District

Reference:EMS 3/3/R

26 April 2018

Attention : Mr. Melvin Chetty

PERMISSION TO UNDERTAKE RESEARCH STUDY AT EMRS AMBULANCE BASES

Permission is hereby granted for the request to undertake research at the KZN EMS Ethekwini bases. Kindly ensure that the confidentiality clause is maintained at all times. Please indicate when you would commence so that the relevant managers can be informed accordingly.

Kind Regards

Mr. Rajen Naidoo
District Manager : EMS eThekwini
Emergency Medical Services – EMS

Fighting Disease, Fighting Poverty, Giving Hope

Annexure C: Letter of approval from the KwaZulu-Natal Department of Health Research and Ethics Committee

health
Department:
Health
PROVINCE OF KWAZULU-NATAL

DIRECTORATE:

Physical Address: 330 Langalibalele Street, Pietermaritzburg
Postal Address: Private Bag X9051
Tel: 033 395 2805/ 3189/ 3123 Fax: 033 394 3782
Email: [illegible]
www.kznhealth.gov.za

Health Research & Knowledge Management

HRKM Ref: 273/18
NHRD Ref: KZ_201807_016

Dear Mr M. Chetty
Durban University of Technology

Approval of research

1. The research proposal titled **'Occupational exposure to blood and body fluids (BBFs) among emergency care providers'** was reviewed by the KwaZulu-Natal Department of Health.

   The proposal is hereby **approved** for research to be undertaken at EMRS bases.

2. You are requested to take note of the following:
   a. Make the necessary arrangement with the identified facility before commencing with your research project.
   b. Provide an interim progress report and final report (electronic and hard copies) when your research is complete.

3. Your final report must be posted to **HEALTH RESEARCH AND KNOWLEDGE MANAGEMENT, 10-102, PRIVATE BAG X9051, PIETERMARITZBURG, 3200** and e-mail an electronic copy to hrkm@kznhealth.gov.za

For any additional information please contact Mr X. Xaba on 033-395 2805.

Yours Sincerely

Dr E Lutge
Chairperson, Health Research Committee
Date: 06/08/18

Fighting Disease, Fighting Poverty, Giving Hope

Annexure D: Letter of information: Phase one – English

Letter of Information

Dear Participant,

Thank you for taking the time to read this letter and for considering participating in this research study.

Title of the research study:
Occupational exposure to blood and body fluids among emergency medical care providers.

Principal investigator/s/researcher:
Full names and surname : Melvin Chetty (melvinchetty1@gmail.com)
Qualifications : BTech in Emergency Medical Care (DUT)
: N.Dip: Emergency Medical Care and Rescue (DUT)

Co-investigator/s/supervisor/s:

1. Full names and surname : Dr Kevin P Govender
Qualifications : PhD EM (Med) (UCT)
: MTech EMC (DUT)

2. Full names and surname : Mr Simpiwe Sobuwa
Qualifications : MSc (Med) EM (UCT)

Brief introduction and purpose of the study:
Healthcare workers are at a significant risk of acquiring bloodborne diseases such as Hepatitis B, Hepatitis C, and Human Immunodeficiency Virus (HIV) through occupational exposure to contamination by blood and body fluids. While occupational exposure to blood and body fluids is a global problem, the healthcare professionals from the underdeveloped countries may be among those who are the most affected due to the lack of resources and the burden of bloodborne diseases in these countries. South Africa is facing a very serious HIV epidemic which places healthcare workers who operate in the country at a high risk of infection. Although medical personnel across the various medical professions are affected, emergency care providers may be the group most susceptible to exposure due to the uncontrolled nature of the environment in which they work.

The literature on occupational blood and body fluid exposure has focused primarily on hospital-based healthcare professionals and there is limited information on blood and body fluid exposure among emergency care providers, particularly in the South African context. This proposed research study will investigate the knowledge and practices of emergency care providers in relation to blood and body fluid exposure with the aim of making recommendations to reduce blood and body fluid exposures among emergency care providers in South Africa.

Outline of the procedures:
You are kindly requested to complete a once-off questionnaire which will take approximately fifteen (15) minutes. The questionnaire consists of a series of questions on the demographics, knowledge, practices and exposure of emergency care personnel in relation to occupational blood and body fluid exposure. It is anticipated that the results of this study will contribute to the development of recommendations to prevent blood and body fluid exposures among emergency care providers in South Africa. The study

population will comprise all operational emergency care providers employed by EMRS in the eThekwini metropole.

Risks or discomforts to the participant:
This research study is a questionnaire-based study and will not pose any risks or discomfort of any kind to the participants. The questionnaires will be anonymous and no names will appear on the questionnaire.

Benefits:
You will be contributing to the formulation of recommendations aimed at preventing occupational exposure to blood and body fluids among emergency care providers. The benefits for the researchers may include their obtaining a qualification, and the publication of the study in peer reviewed and academic journals.

Withdrawal from the study:
You are free to withdraw from the research study at any given time during the course of the study.

Remuneration:
You will not receive any form of remuneration for your participation in this research study.

Costs of the study:
You will not be expected to cover any costs related to the research study.

Confidentiality:
Strict confidentiality will be maintained for the entire duration of the research study. Your personal details will be reported on and all your responses will remain anonymous.

Persons to contact in the event of any problems or queries:
You may contact the researcher, Mr. Melvin Chetty (0724664817), the study supervisors (0313735203) or the Institutional Research Ethics Administrator on 031 373 2375. Complaints may be reported to the Director: Research and Postgraduate Support, Prof S Moyo on 031 373 2577 or moyos@dut.ac.za.

Yours sincerely,

Mr M Chetty
Principal researcher

Annexure E: Letter of information: Phase one – IsiZulu

INCWADI YOLWAZI (ISIGABA SOKUQALA)

Umhlanganyeli othandekayo,

Siyabonga ngokuthatha isikhathi sokufunda lencwadi nokucabangela ukuhlanganyela kulolu cwaningo.

Isihloko socwaningo:
Ukuchayeka/ukuvezeka kwegazi kanye namanzi omzimba emsebenzi bahlinzeki bezimo eziphuthumayo.

Umphenyi oyinhloko/ ɨumcwaningi:

Amagama aphelele nesibongo	: Melvin Chetty (melvinchetty1@gmail.com)
Iziqu	: BTech in Emergency Medical Care (DUT)
	: N.Dip: Emergency Medical Care and Rescue (DUT)

Abacwaningi / abaphathi:

1. Amagama aphelele nesibongo : Dr Kevin P Govender
Iziqu : PhD EM (Med) (UCT)
: MTech EMC (DUT)

2. Amagama aphelele nesibongo : Mr Simpiwe Sobuwa
Iziqu : MSc (Med) EM (UCT)

Isingeniso esifushane nenhloso yocwaningo:
Abasebenzi bezempilo basengozini enkulu yokuthola izifo ezithwalwa igazi ezifana ne-Hepatitis B, i-Hepatitis C, ne-Human Immunodeficiency Virus (i-HIV) ngokutholakala kwegazi emzimbeni nasemanzini omzimba. Kusenjalo, ukuchayeka kwegazi kanye namanzi omzimba emsebenzini kuyinkinga yomhlaba jikelele, abahlinzeki bezempilo abavela emazweni angakathuthuki bangase babe phakathi kwalabo abathinteka kakhulu ngenxa yokungabi namandla nezinsiza zokulwa nezifo ezithwalwa igazi. INingizimu Afrika inesifo esiyingozi kakhulu seHIV esenza abasebenzi bezempilo abasebenza kulelizwe babesengozini enkulu yokutheleleka. Nakuba abasebenzi bezokwelapha–kuyo yonke i imikhakha bechaphazeleka, abahlinzeka ngezimo eziphuthumayo bangase babe yiqembu elivame kakhulu ukuchayeka ngenxa yesimo esingalawuliwe sendawo abasebenza kuyo.

Izincwadi eziphathelene nokuchayeka kwegazi namanzi omzimba emsebenzini zigxile kakhulu kubasebenzi basesibhedlela, kube nolwazi oluncane ngalokhu kubasebenzi bezimo eziphuthumayo, ikakhulukazi esimweni saseNingizimu Afrika. Lolu cwaningo oluhlongozwayo luzophenya ngolwazi kanye nemikhuba yabasebenzi bezimo eziphuthumayo mayelana nokuchayeka kwegazi kanye namanzi omzimba, ngenhloso yokuthuthukisa uhlaka lokuqaliswa komhlahlandlela wokuchayeka kwegazi namanzi omzimba kubasebenzi.

Uhlaka lwenqubo:
Ucelwa ukuba ugcwalise uhlu lwemibuzo oluzothatha imizuzu engaba yishumi nanhlanu (15). Lemibuzo iqukethe uchungechunge lwemibuzo ephathelene nolwazi, imikhuba, nokuchaphazeleka kwabasebenzi bezimo eziphuthumayo ngokuphathelene nokuchayeka kwegazi namanzi omzimba emsebenzini. Imiphumela yalolu cwaningo izothuthukisa izincomo zokuvimbela ukuchayeka kwegazi kanye namanzi omzimba kwabahlinzeki bezimo eziphuthumayo eNingizimu Afrika. Lolucwaningo luzobandakanya bonke abahlinzeki kwezimo eziphuthumayo abaqashwe yi-EMRS eMetropolis eThekwini.

Izingozi noma ukuphazamiseka kumhlanganyeli:
Lolu cwaningo luyisifundo esisekelwe emibhalweni yemibuzo futhi ngeke lubeke noma yiziphi izingozi noma ukungathandeki kumuntu ohlanganyele kunoma yiluphi uhlobo. Imibuzo ngeke idalulwe. Awekho amagama azovela ohlwini lwemibuzo.

Izinzuzo:
Uzofaka isandla ekusungulweni kwezincomo zokuvimbela ukuchayeka kwegazi kanye namanzi omzimba kubasebenzi bezimo eziphuthumayo. Izinzuzo zabacwaningi zingase zibandakanye ukuthola iziqu, nokushicilelwa kokucwaninga ekubuyekezeni kontanga kanye namaphephandaba ezifundo.

Ukuhoxiswa ekufundeni:
Ungase uhoxise isifundo socwaningo nganoma isiphi isikhathi ngesikhathi socwaningo.

Imali:
Ngeke uthole naluphi uhlobo lomholo wokubamba iqhaza kwakho kulolu cwaningo.

Izindleko zesifundo:
Ngeke kulindelwe ukhokhe noma yiziphi izindleko ezibhekiswe ekufundeni ucwaningo.

Okuyimfihlo:
Imfihlo eqinile izogcinwa njalo ngaso sonke isikhathi socwaningo. Ayikho eminye imininingwane yakho ezodalulwa kuzo zonke izimpendulo zakho.

Abantu ongaxhumana nabo kunoma yiziphi izinkinga noma imibuzo:
Ungathintana nomcwaningi, Mr Melvin Chetty (0724664817) noma abaqondisi bokufunda (0313735203) noma uMqondisi wezokuHlola we-Institutional ku-031 373 2375. Izikhalazo zingabikwa kuMqondisi: Research and Postgraduate Support, uProf S Moyo ngo-031 373 2577 noma moyos@dut.ac.za.

Ozithobayo,

Mr M Chetty
Umcwaningi oyinhloko

Annexure F: Letter of information: Phase two – English

LETTER OF INFORMATION (PHASE TWO)

Dear Participant

Title of the research study:

Occupational exposure to blood and body fluids among emergency medical care providers.

Principal investigator/s/researcher:

Full names and surname : Melvin Chetty (melvinchetty1@gmail.com)

Qualifications : BTech in Emergency Medical Care (DUT)

: N.Dip: Emergency Medical Care and Rescue (DUT)

Co-investigator/s/supervisor/s:

1. Full names and surname : Dr Kevin P Govender

Qualifications : PhD EM (Med) (UCT)

: MTech EMC (DUT)

2. Full names and surname : Dr Simpiwe Sobuwa

PhD EM (Med) (UCT)

Qualifications : MSc (Med) EM (UCT)

Thank you once again for your participation in Phase one of my study. The survey you completed was devised to obtains information in order to gain insight into blood and body fluid exposure among South Africa emergency care providers. However, this method limited the depth of the data obtained.

The aim of Phase two of the study is to obtain a more in-depth understanding of blood and body fluid exposure among emergency care practitioners. Based on the information that you provided in the questionnaire, you have been identified as a participant who may be able to provide important information/perspectives on the subject under investigation. Thank you for indicating your interest and providing your consent to participate in Phase two of the study.

The procedure: You will be contacted via telephone on the telephone number you provided to determine a mutually suitable time at which to conduct the interview. I will then telephone you, at my cost, and interview you. This will take up no more than 30 minutes of your time. The interview will be audio recorded to allow for data transcription. The questions will be similar to those in the questionnaire, but there will be an opportunity to discuss any aspects that you consider important.

Risks or discomforts to the participant:

This phase of the research study is an interview-based study and will not pose any risks or discomfort of any kind to the participants. The interviews will be totally confidential, and no personal information of the participants will be recorded in the interview transcripts.

Benefits:

You will be contributing to the formulation of recommendations aimed at preventing occupational exposure to blood and body fluids among emergency care providers. The benefits for the researchers may include their obtaining a qualification, and the publication of the study in peer reviewed and academic journals.

Withdrawal from the study:

You are free to withdraw from the research study at any given time during the course of the research study.

Remuneration:

You will not receive any form of remuneration for your participation in this research study.

Costs of the study:

You will not be expected to cover any costs related to the research study.

Confidentiality:

Strict confidentiality will be maintained for the entire duration of the research study. Your personal details will be reported on and all your responses will remain anonymous.

Persons to contact in the event of any problems or queries:

You may contact the researcher, Mr. Melvin Chetty (0724664817), the study supervisors (0313735203) or the Institutional Research Ethics Administrator on 031 373 2375. Complaints may be reported to the Director: Research and Postgraduate Support, Prof S Moyo on 031 373 2577 or moyos@dut.ac.za.

Yours sincerely,

Mr. M Chetty
Principal researcher

Annexure G: Letter of information: Phase two – IsiZulu

ISINGENISO B: INSTITUTIONAL RESEARCH ETHICS COMMITTEE (IREC) - INCWADI YOLWAZI (ISIGABA TWO)

Umhlanganyeli othandekayo,

Siyabonga ngokuthatha isikhathi sokufunda lencwadi nokucabangela ukuhlanganyela kulolu cwaningo

Isihloko socwaningo:
Ukuchayeka kwegazi kanye namanzi omzimba kwabahlinzeki bezimo eziphuthumayo.

Umphenyi oyinhloko/ umcwaningi:

Amagama aphelele nesibongo	: Melvin Chetty (melvinchetty1@gmail.com)
Iziqu	: BTech in Emergency Medical Care (DUT)
	: N.Dip: Emergency Medical Care and Rescue (DUT)

Abacwaningi / abaphathi:

1. Amagama aphelele nesibongo	: Dr Kevin P Govender
Iziqu	: PhD EM (Med) (UCT)
	: MTech EMC (DUT)
2. Amagama aphelele nesibong	: Mr Simpiwe Sobuwa
Iziqu	: PhD EM (Med) (UCT)
	: MSc (Med) EM (UCT)

Siyabonga ngempendulo yakho kwiSigaba Sokuqala sokufunda kwami. Ucwaningo lwakho olugcwalisile liqukethe izimpendulo ngenhloso yokuthola ukuqondangokuchayeka kwegazi kanye namanzi omzimba Phakathi kwabasebenzi bezimo eziphuthumayo baseNingizimu Afrika. Noma kunjalo, kunciphile ukujula kweminininingwane oqokelelwe.

Isigaba sesibili sihlose ukuhlinzeka ukuqonda okujulile ngokuchayeka kwegazi kanye namanzi omzimba kubasebenzi bezimo eziphuthumayo.

Ngokusekelwe kolwazi olunikezile encwadini yemibuzo yakho, ukhonjwe njengomhlanganyeli okwazi ukunikeza imininingwane ebalulekile / imibono kulokhu okucutshungulwayo. Manje ngibhala ukukucela ukuthi uhlanganyele eSigaba sesibili sesifundo sami.

Inqubo: Uma uzimisele ukuhlanganyela, ngicela ungithumelele I-imeyli / i-SMS eyamukelayo ngendlela yempendulo enesihloko esithi-Ngiyakwamukela. Ngizobe sengixhumane nawe ukuze nginqume isikhathi esifanele sokuxoxisana. Ngizokushayela ucingo, ngezindleko zami, ukuze sixoxe. Kuzothatha imizuzu engaphezu kwengu-30 yesikhathi sakho. Lemibuzo izofana naleyo ye-questionnaire, kodwa kuyoba khona nethuba lokuxoxa nganoma yiziphi izici ozibheka njengezibalulekile.

Izingozi noma ukuphazamiseka kumhlanganyeli:
Lolu cwaningo luyisifundo esisekelwe emibhalweni yemibuzo futhi ngeke lubeke noma yiziphi izingozi noma ukungathandeki kumuntu ohlanganyele kunoma yiluphi uhlobo. Imibuzo ngeke idalulwe. Awekho amagama azovela ohlwini lwemibuzo.

Izinzuzo:
Uzofaka isandla ekusungulweni kwezincomo zokuvimbela ukuchayeka kwegazi kanye namanzi omzimba kubasebenzi bezimo eziphuthumayo. Izinzuzo zabacwaningi zingase zibandakanye ukuthola iziqu, nokushicilelwa kokucwaninga ekubuyekezeni kontanga kanye namaphephandaba ezifundo.

Ukuhoxiswa ekufundeni:
Ungase uhoxise isifundo socwaningo nganoma isiphi isikhathi ngesikhathi socwaningo.

Imali:
Ngeke uthole naluphi uhlobo lomholo wokubamba iqhaza kwakho kulolu cwaningo.

Izindleko zesifundo:
Ngeke kulindelwe ukhokhe noma yiziphi izindleko ezibhekiswe ekufundeni ucwaningo.

Ukuyimfihlo:
Imfihlo eqinile izogcinwa njalo ngaso sonke isikhathi socwaningo. Ayikho eminye imininingwane yakho ezodalulwa kuzo zonke izimpendulo zakho.
.

Abantu ongaxhumana nabo kunoma yiziphi izinkinga noma imibuzo:
Ungathintana nomcwaningi, Mr Melvin Chetty (0724664817) noma abaqondisi bokufunda (0313735203) noma uMqondisi wezokuHlola we-Institutional ku-031 373 2375. Izikhalazo zingabikwa kuMqondisi: Research and Postgraduate Support, uProf S Moyo ngo-031 373 2577 noma moyos@dut.ac.za.

Ozithobayo,

Mr M Chetty
Umcwaningi oyinhloko

Annexure H: Consent letter – English

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Mr. Melvin Chetty, about the nature, process, benefits and risks involved in this study – Research Ethics Clearance Number: _________________.
- I have also received, read and understood the above written information (Participant Letter of Information) about the study.
- I am aware that the results of the study, including personal details in relation to my gender, age, date of birth and initials will be anonymously processed in a study report.
- In view of the requirements pertaining to research, I agree that the data collected during this study may be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and my participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) I declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research and which may relate to my participation will be made available to me.

*Please indicate if you would like to participate in PHASE TWO (telephonic interview) of the research study by ticking the applicable box below. The interview will be conducted on a date and time that is convenient for you. By ticking yes, you are giving your consent to participate in Phase two of the study.

Yes	No

Telephone number______________ Email Address___________________

__________________ ___________ ___________ _________________

Full Name of Participant **Date** **Time** **Signature**

I, Mr. Melvin Chetty, herewith confirm that the above participant has been fully informed about the nature, process and risks of the proposed research study.

__________________ ___________ ____________________

Full Name of Researcher **Date** **Signature**

__________________ ___________ ____________________

Full Name of Witness **Date** **Signature**

Annexure I: Consent Letter – IsiZulu

Isitatimende Sesivumelwane Sokubamba iqhaza Esifundweni Sokucwaninga:

- Ngifakazela ukuthi ngitshelwe umcwaningi, uMnu. Melvin Chetty mayelana nemvelo, ukuziphatha, izinzuzo kanye nezingozi zalolu cwaningo - Inombolo Yokukhishwa Kwezimiso Zokucwaninga: ________________
- Ngiyitholile, ngayifunda futhi ngayiqonda imininingwane ebhaliwe ngenhla (I-Letter Participant of Information) mayelana nocwaningo.
- Ngiyazi ukuthi imiphumela yocwaningo, nemininingwane efaka ubulili bami, ubudala, usuku lokuzalwa kanye namagama ami azogcinwa eyimfihlo ngombiko walolucwaningo.
- Ngenxa yezidingo zocwaningo, ngiyavuma ukuthi imininingwane eqoqwe ngesikhathi salolucwaningo ingacubungulwa ohlelweni lwekhompyutha ngumcwaningi.
- Ngingakwazi, nganoma yisiphi isikhathi, ngaphandle kokubandlulula, ngihoxise imvume yami futhi ngihlanganyele esifundweni.
- Nginethuba elanele lokubuza imibuzo futhi (ngokuzithandela kwami) ngizinikezele ukuthi ngilungele ukuhlanganyela kulolucwaningo.
- Ngiyaqonda ukuthi Imiphumela emisha ebandakanya ukuzinikela kwami kulolucwaningo ngizoyithola.

* Sicela ubonise ukuthi ungathanda yini ukubamba iqhaza ku-PHASE TWO (ingxoxo ngocingo) yocwaningo ngokufaka uphawu lwebhokisi elifanele ngezansi. Lengxoxo izoqhutshwa ngosuku nesikhathi esilungele.

Yes	No

Inombolo yocingo ______________ Ikheli le-imeyili ____________________

________________ ________ ________ ______________

Igama eligcwele lomhlanganyeli **Usuku** **Isikhathi** **Isiginesha**

Mina, uMnu. Melvin Chetty, ngalokhu ngiqinisekisa ukuthi lo mhlanganyeli okhulunywe ngenhla uthola ulwazi ngokugcwele ngesimo, ukuziphatha kanye nezingozi zocwaningo oluhlongozwayo.

________________ ________ ________________

Igama eliphelele lomcwaningi **Usuku** **Isiginesha**

________________ ________ ________________

Igama eliphelele loFakazi **Usuku** **Isiginesha**

Annexure J: Letter of confidentiality – Pilot test

LETTER OF CONFIDENTIALITY

Dear participant,

Thank you for agreeing to participate in the pilot test which is aimed at facilitating a review and evaluation of the research study questionnaire. It is important that the contents of the questionnaire are not discussed outside of the pilot test group. I, therefore, request your co-operation in signing this letter of confidentiality.

Title of the Research Study:
Occupational exposure to blood and body fluids among emergency medical care providers.

Principal Investigator/Researcher:
Full names and surname : Melvin Chetty

Co-Investigator/s/Supervisor/s:

1. Full names and surname : Dr Kevin P. Govender

2. Full names and surname : Mr Simpiwe Sobuwa

Participation in this pilot study is entirely voluntary, and you are free to withdraw from the study at any time. Although you will not receive any form of remuneration for participating in the study, we value your input and assure you that all the information provided will remain anonymous at all times.

Yours faithfully,

Melvin Chetty
Principal researcher

By affixing your signature below, you confirm that you agree to the following:

- I shall not discuss the content of this research study/questionnaire with anyone other than the researcher, supervisor, co-supervisor and statistical advisor.

____________________________ ______________ ______________

Name and Surname *(Pilot test Member)* Date Signature

Annexure K: Self-administered questionnaire

This questionnaire consists of questions related to occupational exposure to blood and body fluids. The results of the study will be used to make recommendations aimed at preventing occupational exposure to blood and body fluids among emergency care providers in South Africa. Thank you for taking the time to complete this important survey.

Strict confidentiality will be maintained. Completion of this questionnaire implies consent.

INSTRUCTIONS:

Please answer all questions. Please tick the most applicable box and write your answer/explanation where required.

SECTION A: DEMOGRAPHIC INFORMATION

1. Gender	Male	Female

2. Age	20-35	36-45	46 and over

3. Qualification	BLS	ILS	ALS

4. Number of years' experience	1-2 years	3-5 years	6-10 years	More than 10 years

SECTION B: KNOWLEDGE

5. What are the risks of exposure to blood or body fluids? *You may tick more than one box.*	HIV	Cancer	Hepatitis B	Hepatitis C

6. Are you aware of you company's policy on blood and body fluid exposure?	Yes	No	Partially

7. Do you know where your company's policy on occupational exposure to blood and body fluid is kept?	Yes	No

If yes, please explain where your company's policy on occupational exposure to blood and body fluids can be found:

………………………...

……..

8. For which of these pathogens is there a pre-exposure prophylaxis (prevention) vaccination available?	HIV	Hepatitis B	Hepatitis C

9. For which of these pathogens is a post-exposure prophylaxis (prevention) available? *You may tick more than one box.*	HIV	Hepatitis B	Hepatitis C

10. What are universal precautions? *You may tick more than one answer.*	Use of gloves	Taking a patient's blood pressure	Disposal of sharps in puncture resistant containers	Using a facemask	Using protective eyewear

11. Within what period should exposure to blood or body fluids be reported?	At the end of the shift	At the end of the cycle	Immediately	When you are not busy

<u>SECTION C:</u> PRACTICES

12. How often do you use gloves when there is a risk of exposure to blood or body fluids?	Always	Most of the time	Sometimes	Never

13. How often do you use protective eyewear when there is a risk of exposure to blood or body fluids?	Always	Most of the time	Sometimes	Never

14. How often do you use face masks when there is a risk of exposure to blood or body fluids?	Always	Most of the time	Sometimes	Never

15. How often do you recap needles?	Always	Most of the time	Sometimes	Never

16. How do you dispose of needles/sharps on scene?	Recap and carry to the ambulance	Carry a sharps container with you to scene	Push the needles/sharps into the bunk of the ambulance	Keep in your pocket and dispose of later

Other (Please explain): ……………………………………………………………………………….

……..

17. How do you remove needles from syringes?	Bare hands	Gloved hands	Forceps	Never

18. When do you dispose of sharps containers?	Half full	Three quarters full	Completely full

19. Have you been vaccinated against Hepatitis B virus infection?	Yes	No

20. Have you received a Hepatitis B booster vaccination within the last 5 years?	Yes	No

21. Do you use safe needle devices?	Yes	No

22. With which safe needle devices does your company provide you?	Blood lancets	IV cannulas	Injection needles

SECTION D: EXPOSURES

23. Have you ever been exposed to blood and/or body fluids?	Yes	No

24. If yes, what type of exposure?	Needle stick/sharps injury	Blood or body fluid in eyes	Blood or body fluid in mouth	Blood or body fluid on broken skin

25. How many years ago did you sustain the exposure?	1 to 2 years	2 to 5 years	5 to 10 years	More than 10 years

26. What PPE were you using when the exposure occurred? *You may tick more than one answer.*	Gloves	Protective eyewear	Facemask	None

27. What were you doing when the exposure occurred?	Obtaining IV access	Administering an injection	Stopping bleeding	Finger pricking with blood lancet	Disposing of sharps

Other (please explain) ……………………………………………………………………………

……………………………………………………………………………………………………

28. Where did the exposure occur?	In a moving ambulance	In a stationary ambulance	On scene	At hospital

29. What were the main factors that contributed to the exposure?	Ambulance moved suddenly	Inadequate lighting	Combative patient	Sharps protruding from the sharps container

Other (please explain) ……………………………………………………………………………

……………………………………………………………………………………………………

30. Did you report the exposure to management?	Yes	No

If yes, to whom did you report the incident: …………………………………………………

…………………………………………………………………………………………………….

31. If you did not report the exposure, what was your reason for not reporting it?	I did not think it was serious	I thought I would get into trouble	The reporting process is very complex	I did not have the time

Other (please explain) ………………………………………………………………………………
……

Annexure L: Interview schedule

Objective 1: To determine the factors associated with BBF exposure among EMC providers employed in the eThekwini metropole.

Objective 2: To determine the knowledge and practices of EMC providers in relation to pre-and post BBF exposure

Interview Questions

1. Regarding your exposure to BBF incident, please briefly describe how the incident occurred?

2. With hindsight, what do you think may have prevented the exposure from taking place?

3. Tell me about precautions taken on a daily basis that may protect you against or limit the extent of your exposure to BBF.

4. Is the above something that you have decided yourself or is it a result of a policy, standard, operational guideline or training you have received, just as some examples? So, in other words, what informed your decision to take such precautions?

5. How would you normally respond to, say; a splash of blood into your eye?

6. What happens after the splash, what procedure would you follow?

7. Do you have any suggestions or recommendations to improve your company’s pre- and post BBF systems that are in place?

Annexure M: Strobe checklist

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	108
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	108
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	1
Objectives	3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	4	Present key elements of study design early in the paper	24
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	25
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	27
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	N/A
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	30
Bias	9	Describe any efforts to address potential sources of bias	37
Study size	10	Explain how the study size was arrived at	28
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	27
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	31
		(*b*) Describe any methods used to examine subgroups and interactions	NA
		(*c*) Explain how missing data were addressed	NA
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	NA
		(*e*) Describe any sensitivity analyses	NA
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	28
		(b) Give reasons for non-participation at each stage	61
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	40
		(b) Indicate number of participants with missing data for each variable of interest	NA
Outcome data	15*	Report numbers of outcome events or summary measures	NA
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	28
		(*b*) Report category boundaries when continuous variables were categorized	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	70
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	75
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	61
Generalisability	21	Discuss the generalisability (external validity) of the study results	75
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	NA

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.