AN ANALYSIS OF NEEDLE-STICK AND SPLASH EXPOSURES AMONG HEALTH CARE WORKERS AND STUDENTS AT GROOTE SCHUUR HOSPITAL: 2001-2005

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DEDICATION

This thesis is dedicated to my daughter Oreneile, my mother Mohampi, my sisters Basetsana and Koketso, my brothers Tiego and Kagiso, my nieces Bonolo and Didintle, my nephews Papi, Pako and Mooketso. I would like to thank them for the love and support.
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ABSTRACT

Introduction: Blood-borne diseases such as HIV, hepatitis B and C viruses have made health care institutions hazardous places of work. Health care workers (HCWs) and students are at risk of acquiring these infections and associated diseases in the workplace through needle-stick and splash exposures. Globally over the years, preventative measures such as universal precautions, safety devices, Hepatitis B vaccination and post-exposure prophylaxis for HIV have been introduced so as to reduce the transmission of infection from patients to HCWs and students and to prevent the associated diseases.

Groote Schuur hospital (GSH), a tertiary and teaching hospital, has these preventative measures in place. It also has a well-established staff health clinic which records all the reported needle-stick and splash exposures sustained by HCWs working there and the by students training there. The overall aim of the study was to analyse the data of the reported needle-stick and splash exposures among HCWs and students at GSH between 2001 and 2005.

There were a number of specific objectives, including to describe the characteristics of the health care workers and students who reported an exposure to blood- or bodily fluid-contaminated objects, by gender, age and their occupation in the hospital or outside the hospital; to measure the numbers or incidence rate where possible of blood- or bodily-fluid- contaminated needle-stick or splash exposure by time the exposure occurred, occupation, area in the hospital the exposure occurred and type of task, the frequency of re-exposure (> one incident) and how this varied by occupational group; to measure the incidence rates for doctors, medical students and nurses and the rate ratios for doctors and medical students with nurses being the reference category; to determine the HIV seroprevalence (at follow-up or at baseline if no follow-up) among the reported exposure group, and whether this varied by occupation and if any post-exposure HIV seroconversions were documented among exposed HCWs or students; to determine the proportion of adequate hepatitis B antibodies among the reported exposure group, and
whether these vary by occupation; to determine the proportion of blood- or bodily fluidcontaminated objects from unknown source patients and the prevalence of HIV, hepatitis B and hepatitis C infection among the known source patients for these objects; to determine the time PEP was accessed by different occupations and to determine the incidence rate of reported exposures before and after the introduction of needle safety devices among nurses in 2002.

**Methods:** The study was descriptive, with both cross-sectional and longitudinal components. All the reported cases of needle-stick and splash exposures sustained by HCWs (staff employed at GSH, paramedics and Salt River mortuary staff) and students (medical, nursing and radiology) working at GSH between 2001 and 2005 were analysed. The tools used to collect the data were the sharps injury register in the staff health clinic, an inoculation incident form, hospital medical records, the GSH Human Resource Management department database and the GSH Clinicom Information system.

**Results:** A total of 1 119 HCW and students reported 1 293 needle-stick and splash exposures between 2001 and 2005. Registrars and medical students constituted the largest proportions of HCWs and students who reported exposures (17% each) followed by enrolled nurse (12%). There were more needle-stick exposures (77%) than splash exposures (15%.

The majority of the needle-stick and splash exposures occurred in the general wards (29%) followed by operating theatres (23%). The exposures that occurred in other hospitals constituted 12% of the reported exposures with the smallest proportion of exposures occurring in the ambulance (2%) and other areas of the hospital (2%). Drawing blood and performing procedures such as operating, suturing and biopsies were tasks involved in the exposure most frequently reported by exposed health care workers and students (14% each). While half of the exposures (56%) occurred during office hours (between 08h00 and 16h00), a substantial proportion of exposures occurred after hours, with 27% and 25% of the exposures reported by nurses and medical students respectively occurring between 16h00 and 24h00.
Of the exposed HCWs and students, 89% had single exposures, 9% two exposures and 3% more than two exposures. Doctors reported the highest proportion of exposures (38%) followed by nurses (28%), other HCWs and students (18%) and medical students (16%). The average incidence rate of needle-stick and splash exposures sustained by doctors was 16 per 100 persons per five years compared to 5 per 100 person per five years for nurses and 8 per 100 persons per five years for medical students.

Doctors consistently had a three times higher annual incidence rate [IR 3.0; 95% confidence interval (CI) 2.18 - 4.0)] of needle-stick and splash exposures than nurses between 2001 and 2005. Medical students overall had a 50% higher risk (IR 1.01; 95% CI 1.01-2.25) than nurses. However, the annual incidence rate among medical students increased steadily over the years, from being the same as that of nurses (IR 1.0; 95% CI 0.6-1.56) in 2001 to twice that of nurses (IR 2.0; 95% CI 1.37-2.9) in 2005.

A total of 86% of the reported exposures involved HCWs or students who were confirmed HIV negative, with only one of the reported cases being HIV positive at baseline and 14% with unrecorded HIV status. The HIV seroprevalence among the source patient was 24%, with 10% of them having unknown status. A total of 4% were hepatitis B surface antigen positive, with 16% having unknown status. Only 1% were hepatitis C antigen positive, but 16% of them had unknown status.

Exposed health care workers accessed PEP on average 2 hours after the exposure, with nearly half of the (49%) accessing it during office hours. However, only 45% of HCWs and students exposed to bodily-fluid or blood-contaminated objects of HIV positive or HIV status unknown source patients completed their six month follow-up as required by the needle-stick policy. HCWs and students with needle-stick exposure completed the six-month follow-up more frequently than those with splash exposures (p=0.03).
Among the exposure cases there was 65% hepatitis B immunity coverage (serum antibody concentration level >100 IU/l), with 70% of registrars and 72% of medical students respectively having immunity.

The introduction of safety devices in 2002 appeared to reduce the annual incidence rate of needle-stick exposures among nurses from 7 per 100 nurses per year in 2002 to a stable 5 per 100 nurses per year, the same as in 2001 before their introduction. However, the differences from year to year were not statistically significant.

Discussion: When it comes to needle-stick and splash exposures in our study, doctors, nurses and medical students appear to be the high risk groups with the general wards and operating theatres being the high risk areas. While no seroconversion was recorded, the high proportion of non follow-up by exposed staff and students may mask some seroconversions. Of positive note is that there was quick access to PEP.

The noticeable lower than expected hepatitis B immunity coverage highlights the need for more education, training and awareness for HCWs and students with regard to accessing hepatitis B vaccination. Education and training is also required on the importance of attending staff health clinic after a HIV positive exposure and their importance in the surveillance of this programme and compensation purposes.

The increasing incidence rate over the five years among medical students highlights the need for UCT Health Sciences Faculty to review their curriculum on training medical students on safe practices.

There was a reduction of the incidence rate of needle-stick exposures among nurses in 2003 to 2005 after the introduction of safety devices in 2002, to that of 2001, thus keeping the incidence rate stable. More studies are recommended to determine the reasons for inability of further reduction of the incidence rate of needle-stick exposures among the nurses beyond that of 2001.
CHAPTER 1

INTRODUCTION

Health institutions are unique work settings because of the hazards faced by health care workers (HCWs). These include physicians, nurses, laboratory and dental personnel, pre-hospital care providers, housekeeping, laundry and maintenance workers\textsuperscript{1, 2}. Other than the usual occupational hazard categories (physical, mechanical, ergonomic, chemical and psychological) HCWs are also exposed to blood-borne hazards such as human immunodeficiency virus (HIV), hepatitis B and hepatitis C viruses. The more frequent exposure of HCWs to bodily fluid and blood-contaminated splashes and sharp objects such as needles, scalpels, lancets and broken glass \textsuperscript{3} increases their risk of contracting these blood-borne infections in the workplace compared to the general population and workers in other work settings \textsuperscript{2}.

The World Health Organisation (WHO) states that in 2003 there were an estimated two million percutaneous exposures sustained from sharp objects among the world’s 35 million health care workers \textsuperscript{4}. The United States of America (USA) experienced 600 000 to 800 000 such exposures per year among their 8 million health care workers \textsuperscript{2}. The high incidence of needle-stick exposure was also demonstrated in a study carried out at the Calicut Medical College, USA, which reported that 82\% of interns and 56\% of nursing students had at least one incident during their work \textsuperscript{5}. Another study carried out among 642 health care workers at three hospitals in Hanoi showed that 68.8\% to 71\% of them had been injured by sharp objects during work \textsuperscript{4}.

Within health care institutions, HCWs such as surgeons, operating room nurses, intensive care staff including neonatal care staff, obstetricians, interventional radiologists and their assistants and emergency and trauma staff work more frequently with sharp objects than workers who are at low risk such as clerks, administrators and receptionists \textsuperscript{6}, putting the former at higher risk of sustaining needle-stick exposures. The WHO reported in 2005 that of all the health care workers, nurses suffered most needle-stick injuries and other sharp injuries
at an average of 1-4 needle-sticks and other sharp injuries per year. This could be due to the fact that nurses tend to perform high risk tasks related to needle-stick and splash injuries such as drawing blood, administering drugs and suturing.

Other than these high risk tasks, factors such as inexperience of staff, especially among interns, medical students and nursing students, exhaustion due to increased workload and dealing with difficult, non-compliant patients increase the risk of exposure. Incorrect handling of used needles and other sharp objects have also increased the risk of exposure. According to the Canadian Centre for Occupational Health and Safety, recapping of needles after use can account for 25-30% of all the needle-stick exposures of nursing staff and laboratory staff.

1.1 HUMAN IMMUNODEFICIENCY VIRAL INFECTION (HIV)

Human Immunodeficiency viral infection is one of the most common blood-borne diseases in patient populations that HCWs are at the risk of acquiring through occupational exposure. It affects mostly the economically viable population, namely those between 15 and 49 years of age. This rising epidemic since its discovery in 1983, has had a major impact on most countries' health systems. This is more evident in the poor, developing Sub-Saharan African region where 63.4% (24.5 million) of the world's 38.6 million people living with HIV/AIDS were residing by 2005.

The high prevalence of HIV/AIDS and the high cost of its treatment with antiretrovirals have compounded the problem of lack of access to health care in developing countries. This lack of access to antiretrovirals has resulted in hospitals having an influx of young patients admitted with AIDS-related illnesses requiring complex health care. The increased hospital bed occupancy (half of the beds) by these patients has rendered the health workplace in Sub-Saharan Africa potentially dangerous. This is because HCWs are exposed to HIV positive blood and body fluids more frequently, thus increasing their risk of acquiring the infection. Consten et al. estimated in 1995 that surgeons in tropical Africa were 15 times more at risk of HIV seroconversion than those in developed countries.
The 2002 World Health Report stated that 2.5% of HIV infections among HCWs were a result of occupational exposure. Surgeons tend to be more at risk of needle-stick injuries than other HCWs because their occupation requires them to work more frequently with blood-contaminated needles. Furthermore, a study conducted in a Zambian district hospital reported that each surgeon had an estimated 1.5% risk of acquiring HIV infection through work over 5 years.

There are two different South African HIV prevalences reported for the 15–49 years age group for 2005. The Nelson Mandela Foundation reported that 16.2% and the UNAIDS that 14.3% of people in this age group were living with HIV in South Africa in 2005. It is thus likely that South Africa has the highest HIV prevalence in the world (in which 10.2% of the world's people two years and older are living with HIV/AIDS).

The impact of HIV/AIDS on the health care system was evident in the national survey conducted by the Human Science Research Council (HSRC) in 2002. The survey involved health sectors in four provinces of South Africa, namely Kwazulu Natal, North West, Mpumalanga and Free State. They found that the prevalence of HIV positive patients in primary health care centres, including district hospitals was 25.7% and in public hospitals 46.2%. Although the Western Cape Province was not included in the study, it does give a sense of the impact of HIV/AIDS on the public health sector nationally. A survey carried out at GF Jooste hospital in the Western Cape reported that between 2001 and 2003, 19% of the admissions were for infectious diseases, with 61% of these diseases being HIV-related.

Several studies conducted globally, have estimated the risk HIV transmission by needle-stick exposure to be between 0.1% and 0.3% and 0.09% per splash exposure. A study in Tanzania’s Mbeya Region reported the risk as less than 0.4% risk of transmission per needle-stick exposure. According to the Italian experience, the risk of HIV seroconversion for after a needle-stick with a hollow-bore needle was 0.21% (95% CI 0.03-0.5%).

Although the risk is low, several factors have been associated with increasing the risk of seroconversion. One of them is a repeated incident of exposure, which increase the
cumulative risk of seroconversion. Significant associations between risk of acquiring HIV infection and injury with a large-diameter needles (gauge >18mm), deep injury, visible blood on the device, procedures involving a needle placed in the source patient’s vein or artery, emergency procedures and terminal illness (high viral load and low CD4 count) of the source patient has been reported in several studies.

Other than these risk factors and the physical strain, there is also a mental stress factor among the HCWs. This is caused by the psychological trauma of treating and caring for young people with complex care needs and terminal illness. This is compounded by fear of contracting the disease through occupational exposure to blood, bodily fluids and HIV-positive patients generally. This is evident in a study conducted in Kenya (2002) which reported that 50% of the young doctors interviewed mentioned fear of contamination by HIV as the cause for a lack of motivation and diminished aspiration to practice medicine.

1.2 HEPATITIS B and C VIRAL INFECTIONS

Hepatitis B (HBV) and hepatitis C (HCV) viral infections are other common blood-borne infections that HCWs are at risk of acquiring through occupational exposure. Pruss-Ustun et al. (2000) reported occupational attributable fractions of 37% and 39% for HBV and HCV infections respectively in HCWs. Similarly the 2002 World Health Report stated that occupational exposure was the cause for 40% of both HBV and HCV infections among HCWs.

HBV viral infection is a serious but preventable global public health problem with two billion people infected and 350 million suffering from the chronic infection. It is relatively rare in Western Countries and more prevalent in Asia and Africa with South Africa having two million HBV carriers in 2000. The infection is usually acquired perinatally or in childhood and people can carry the virus for 30 to 50 years without knowing they are affected. It is 50-100 times more infectious per exposure than HIV and unlike HIV which has a short life span, it has been demonstrated that HBV can survive in dried blood at room
temperature on an environmental surface for at least one week. Health care workers have a six to 30% risk of acquiring HBV infection after needle-stick exposure.

Hepatitis C viral infection was identified in 1988. Its transmission is less frequent than HBV, with health care workers having a one to 8% risk of acquiring HCV infection after occupational exposure. The observation that its prevalence in HCWs is usually lower or similar to that of the general population (1-2%) suggests that the transmission in the health care setting has not been a common source of HCV infection. It occurs more commonly amongst post-transfusion patients and intravenous drug users, and is more prevalent in the older population. Presently, there are estimated 170 million people chronically infected with HCV worldwide.

1.3 PRE-EXPOSURE PREVENTION AND POST-EXPOSURE PROPHYLAXIS

It is the legal responsibility of an employer to ensure a healthy and safe environment for employees. Over the years, several universal infection control precautions have been introduced for HCWs to reduce the risk of acquiring blood-borne diseases. These precautions include provision of personal protective equipment such as gloves, masks, goggles, aprons and boots (where necessary, such as labour ward); the introduction of safety devices such as the needle-less system, single-use disposable injections and sharps containers.

A study conducted in Tygerberg hospital, Western Cape, in 2005, reported a significant reduction from 37 to 15 reported needle-stick injuries in the high care units over six months as a result of the introduction of the needle-less system. They further reported that this intervention and the prevention of 22 needle-stick injuries saved costs up to R69 000. The introduction of safety boxes for the disposal of needles has also reduced the incidence of injuries significantly. These devices need to be accompanied by education and training of staff about safety precautions.

Other than the universal precautions, hepatitis B vaccine which has been available since 1992, has been used as pre-exposure prophylaxis for the prevention of hepatitis B infection.
transmission. The South African Occupational Health and Safety Act (OSHA) of 1993 recommends that this vaccine should be provided for HCWs who have a reasonable expectation of being exposed to blood on the job for the prevention of HBV transmission. The hepatitis B vaccine protocol recommends that the health care worker receives three doses of the vaccine, the first dose immediately, the second dose one month later and the third dose after six months. A HCW is considered immune if hepatitis B antibodies levels are >100 IU/l. A HCW with antibodies <100 IU/l is not protected and should these levels persist following the three doses, the HCW should be revaccinated with another three-dose series. Should levels persist <100 IU/l despite receiving six doses, the HCW will be considered to be a non-responder.

There are neither vaccines nor any pre-exposure prophylaxis (PEP) for HIV or HCV. However, there is HIV and HCV post-exposure prophylaxis for a HWC that has sustained a needle-stick exposure to blood- or body fluid-contaminated object or a splash exposure to blood or bodily fluids. HIV PEP is primary prophylaxis in that it prevents the transmission of the infection. HCV PEP is secondary prophylaxis in that it prevents the progression of the infection to chronic infection.

HIV PEP includes Zidovudine (AZT) and Lamivudine (3TC) and Kaletra and its administration depends on the severity of the exposure. AZT and 3TC, also known as dual PEP, are given for exposures that are considered low to medium risk such as superficial needle-stick or splash exposure. Kaletra, a protease inhibitor, is added to the two drugs (thus triple PEP) if the exposure is high risk such as deep penetration or a source patient with very high viral load.

The PEP should be given as soon as possible, preferably within one to two hours after the injury to prevent seroconversion. It cannot be given 96 hours post-exposure since it is no longer effective. A HCW or student who is exposed to blood or bodily fluids of a known HIV-positive source patient is given either dual or triple PEP for 28 days. The blood- or bodily-fluid contaminated objects of unknown source patients are assumed HIV positive, in which case the HCW or student is also given the 28 day supply of PEP.
The problem with HIV PEP is that it can be toxic. It has been reported that nearly 50% of treated HCWs experience side effects such as nausea, malaise, headache, anaemia and anorexia. These can be severe enough to cause the HCW to be booked off sick, thus worsening the already scarce human resource situation in a work-overloaded health facility.

The treatment of HCV involves treating the HCW with interferon. This drug is effective only in the presence of infection, especially in early infection. It is recommended that the HCW be followed-up four to six monthly after an exposure to HCV-positive blood in order to detect early infection and refer for appropriate treatment to prevent chronic infection of the liver.

Several studies have been done on cost-analysis for PEP, and it has been shown that preventing the exposure is more cost-saving than offering PEP, thus strongly supporting the case for prevention.

It is important to note that, despite the pre-exposure vaccination and post-exposure prophylaxis being available to HCWs, underreporting remains a large problem. It has been estimated that the number of the reported injuries are only a fraction of the actual number of injuries. Falgas et al. (2007) reported that of the 73 needle-stick and splash exposure that occurred over five years, none were reported by physicians. They assumed that this could be related to the physicians' unwillingness to reveal the incident due to the belief that they can handle the issue themselves.

Elmiyeh et al. (2004) reported that of 279 interviewed health care workers working in The Lister Hospital in England, 80% of them were aware of having sustained a needle-stick exposure, but that only 51% of them reported it. This figure was supported by a study conducted by Makary et al. (2007), also reporting that only 51% of the 578 surgeons in training who sustained needle-stick exposures reported them, with lack of time being the most common reason given.
1.4 MOTIVATION FOR THE STUDY

Groote Schuur Hospital is one of the three tertiary hospitals in the Western Cape Province. It employs approximately 3 550 health care workers per annum, excluding contract workers, paramedics and mortuary staff. It also accommodates contract workers for outsourced services such as cleaning, linen bank and those who perform renovations in the hospital. It provides teaching to the University of Cape Town’s (UCT) fourth to sixth year medical students. It has 26 general wards, operation theatres, a casualty unit (emergency unit and trauma unit), out-patients departments, laboratory and an A-floor which houses the support departments such as linen bank, waste management and kitchen. The maternity unit consists of a labour ward, its own operating theatre, antenatal clinic and six wards. The hospital has 938 beds and admits an average of 70 HIV positive patients per month. The average length of stay in the hospital for patients is six days.

There is a well-established Occupational Health clinic, known as the Staff Health Clinic. It has a dedicated medical doctor, occupation health nurse, an enrolled nurse and a clerk. This clinic offers primary health care and occupational health and safety services to HCWs. It provides HIV post-exposure prophylaxis, namely Lamivudine (AZT), Stavudine (3TC) and Kaletra, to staff employed by the hospital and students training in the hospital who sustain needle-stick and splash exposures in the hospital or at other hospitals (see glossary). Although the paramedics and Salt River mortuary staff members are not GSH employees, the clinic has an agreement with the Provincial health department to provide them with prophylaxis. The staff health clinic also provides pre-exposure hepatitis B vaccine and its booster to the same groups.

Needle-safety devices were introduced throughout the hospital in February, 2002. Although they were meant to reduce the incidence of blood exposures among staff members, especially nurses, no target was set in the form of an indicator for their effectiveness. From the information provided by the Assistant Director of Nursing Division, the devices consist of the needle-free intravenous infusion sets, the safety ported and unported intravenous access
catheters, safety syringes for intramuscular injections and safety lancets for capillary sampling (see Appendix 1).

Since the implementation of the percutaneous blood or bodily fluid exposure policy and recording of exposures in the 1980s (exact year not known owing to frequent staff changes), the recorded data have not been analysed. There has also not been an analysis of the effect of the introduction of the needle safety devices on the incidence of needle-stick exposures among HCWs in the hospital.

1.5 OBJECTIVES OF THE STUDY

1. To describe the characteristics of the health care workers and students who reported an exposure to blood- or bodily fluid-contaminated objects, by gender, age and their occupation in the hospital or outside the hospital.
2. To measure the numbers or incidence rate where possible, of blood- or bodily-fluid-contaminated needle-stick or splash exposure by time the exposure occurred, occupation, area in the hospital the exposure occurred and type of task.
3. To measure the frequency of re-exposure (> one incident) and how this varied by occupational group.
4. To measure the incidence rates for doctors, medical students and nurses.
5. To measure the rate ratios for doctors and medical students with nurses being the reference category.
6. To determine the HIV seroprevalence (at follow-up or at baseline if no follow-up) among the reported exposure group, and whether this varied by occupation.
7. To determine if any post-exposure HIV seroconversions were documented among exposed HCWs or students
8. To determine the proportion of adequate hepatitis B antibodies among the reported exposure group, and whether these vary by occupation.
9. To determine the proportion of blood- or bodily fluid-contaminated objects from unknown source patients and the prevalence of HIV, hepatitis B and hepatitis C infection among the known source patients for these objects.
10. To determine the time PEP was accessed by different occupations.

11. To determine the incidence rate of reported exposures before and after the introduction of needle safety devices among nurses in 2002.
CHAPTER 2

METHODS

2.1 DEFINITIONS

Health care worker: An employee, namely, doctor, nurse, physiotherapist, radiographer, laboratory technician, general assistant, porter, security officer or student working at Groote Schuur Hospital, including the paramedics and the Salt River mortuary staff.

Staff health clinic: An Occupational Health clinic at Groote Schuur Hospital

Student: A person enrolled with a learning institution for medicine, nursing, physiotherapy, radiography. The nursing students are enrolled with Cape Town University of Technology (CPUT), the physiotherapy, radiology and medicine students are enrolled with University of Cape Town.

Medical student: Fourth, fifth and sixth medical students receiving their clinical training at Groote Schuur Hospital and its designated satellite health institutions such as New Somerset Hospital, Red Cross Hospital, Mowbray Maternity Hospital, Victoria Hospital, community health centres and midwife obstetric units. Their procedure duties include drawing of blood, putting up intravenous lines, suturing and delivering babies.

Casualty: This covers the Trauma Unit which deals with trauma cases such as motor vehicle accidents and the Emergency Unit that deals with medical and gynaecological emergencies.

Needle-stick exposure: Physical damage of the skin by a sharp object such as needles, scalpels, lancets or broken glass contaminated with blood and/or bodily fluids of source patients. Injury and exposure will be used interchangeably.
Splash exposure: Blood and/or bodily fluids of source patients coming into contact with broken skin and mucous areas, such as mouth, eyes or inside the nose of health care workers.

Pre-exposure prophylaxis: A hepatitis B vaccine given to a worker before he/she sustains an exposure to prevent them from acquiring hepatitis B infection when they are exposed. According to its protocol, three doses are given initially, and a booster after five years.

Post-exposure prophylaxis: HIV ante-retroviral medication given to a health care worker after sustaining a percutaneous or splash exposure to prevent HIV transmission.

Enrolled Nursing Auxiliary (ENA) and Enrolled Nurse (EN): A nurse who has completed one or two years of training. Their job description includes providing nursing care to patients such as cleaning the patient, wound dressing, checking vitals signs such as finger prick blood sugar level and haemoglobin. They are not allowed to administer intravenous, intramuscular or subcutaneous drugs, take blood specimens or flush intravenous lines.

Professional/ Registered Nurse (RN): A nurse who has completed a 4-year degree/diploma in nursing, but generally has less than 3 years of experience and service. His/her job description includes administering intravenous, intramuscular or subcutaneous drugs to patients, taking blood where necessary and flushing intravenous lines.

Senior Professional Nurse (SPN): A nurse who has completed a 4-year degree/diploma in nursing, with or without a post basic diploma of training in a specific field, for example, Intensive care, Orthopaedics or Operating theatre. They have at least three to five years of experience and service. Their job description is similar to that of the professional nurse but assumes a supervisory or shift leadership role.

Chief Professional Nurse (CPN): The nurse has the same basic qualifications and job description as the PN and SPN, but generally has one or two post basic qualifications as well. They have more than five years of experience and service. They may be managers in their
wards or areas of work. Their job description as managers includes administrative, management and clinical duties.

**Intern**: A newly-qualified doctor undergoing his/her first year of training post-graduation. Their procedure duties are the same as those for medical students, although medical students tend to do more of the above-mentioned procedure duties so as to acquire skills.

**Medical officer (MO)**: A doctor who has completed his/her internship and senior house officer post. Some of them are waiting to be accepted for their preferred specialty. Their procedure duties are similar to those for interns, but with more a senior role.

**Senior house officer (SHO)**: A doctor who has just completed his/her internship. Their procedure duties are similar to those of a medical officer.

**Registrar**: A doctor specializing in a particular medical field. Their duties might include operating and performing more complex procedures like bronchoscopy. Other than training, the registrars supervise the intern, SHO and MO.

**Consultant**: A qualified specialist. Their role is to train the registrar. Their job description may involve operating and performing invasive procedures.

**WCI 304**: A first medical report that the staff health clinic doctor completes at the initial reporting by a HCW or student of a needle-stick or splash exposure to HIV positive or unknown HIV status blood or bodily fluid at work. The report is submitted to the Compensation Commissioner (CC) for compensation of the HCW or student when they have HIV, HBV or HCV seroconversion.

**WCI 305E**: A final medical report completed by the staff health clinic doctor six months after the first medical report and submitted to CC for compensation of the HCW or student when they have HIV, HBV or HCV seroconversion.
Compensation Commissioner: A division in the Department of Labour in South Africa responsible for compensating HCWs or students who have a proven work-related injury or disease.

2.2. ABBREVIATIONS AND ACROMYMS

AIDS: Autoimmune-deficiency syndrome
CC: Compensation Commissioner
CPN: Chief Professional Nurse
ENA: Enrolled Nursing Assistant
FBC: Full blood count
GA: General assistant
GSH: Groote Schuur Hospital
HBV: Hepatitis B virus
HCV: Hepatitis C virus
HCW: Health care worker
HIV: Human immunodeficiency virus
MO: Medical Officer
MOU: Midwife obstetric unit
NaSH: National Surveillance for Health Care Workers
PEP: Post-exposure prophylaxis
OSHA: Occupational health and safety Act of 1993
RN: Registered Nurse
SHO: Senior House Officer
SPN: Senior Professional Nurse
UCT: University of Cape Town
UNAIDS: Joint United Nations Programme on HIV/AIDS
WHO: World Health Organisation
2.3 STUDY POPULATION

All GSH health care workers employed between 2001 and 2005 (± 3 550 at any given time), fourth, fifth and sixth year UCT medical students (± 500 at any given time between 2001 and 2005), unknown number of nursing students, radiology students, support staff, paramedics and Salt River mortuary staff at risk between 2001 and 2005.

2.4 STUDY SAMPLE

The sample consisted of all HCWs and students who reported their needle-stick and/or splash exposure between 2001 and 2005. It included recurrent exposures of some of the individuals. For most of the analyses the sum total of exposures was the relevant sample. The sample also included hospital’s Occupational Health clinic and administration staff who were interviewed about the operational issues in the hospital.

2.5 STUDY DESIGN

There were two components.

1. A descriptive cross-sectional component described:
   - The characteristics of the exposed health care workers and student by age, gender and occupation.
   - The proportion of blood-contaminated objects from unknown source patients and the prevalence of HIV, hepatitis B and hepatitis C infection among the known source patients for these objects.
   - The frequency of re-exposure (more than one incident) and how this varied by occupational group.
   - The HIV seroprevalence at follow-up or at baseline if no follow-up among exposed HCWs and students.
   - The proportion of adequate hepatitis B antibodies and HIV seroprevalence among the reported exposure group, and whether this varied by occupational group.
• The time PEP was accessed by the different occupations.

2. A retrospective cohort component aimed:
• To measure the numbers or incidence rate where possible, of percutaneous exposure or splash exposures by time the exposure occurred, occupation, work area in the hospital the exposure occurred and type of task.
• To determine the risk ratio of percutaneous exposure among doctors and medical students, with the nurses being the reference group.
• To determine if any post-exposure HIV seroconversions were documented among the exposed HWCs and students.
• To determine the incidence rates of reported exposures among nurses before and after the introduction of needle safety devices in 2002.

2.6 ETHICAL CONSIDERATIONS

The study was approved by the Ethics Review Committee of the UCT Health Sciences Faculty and the hospital management (see Appendices 2 and 3).

Confidentiality was ensured by the author being the only one collecting the data, including collecting information on HIV prevalence, from all the data sets. Anonymity in the research data set was ensured while accessing clinical records of HCWs and students, by encoding the health care worker’s or student’s name on the questionnaire. Furthermore, guided by the data collecting sheet, the required information was loaded directly from the data sets onto Excel spreadsheet at the hospital thus avoiding removal of any records from the establishment.

This study should benefit both management and the employees, in that the high risk areas requiring improvement on safety would be identified, and those with fewer injuries would be commended. The hospital management will be able to determine if the implemented safety devices are effective or not. The hospital’s occupational health clinic staff will be able to identify areas which need improvement for their efficient management of needle-stick and splash exposures among the health care workers. The UCT Health Sciences faculty will
benefit by an appreciation of any strengths and weaknesses of the curriculum with regards to teaching medical students on safety practices in the workplace.

Since both the employees and the hospital management have the right to information, the results of the study will be relayed to them on completion of the study. This will be done by presenting the results to the hospital’s health and safety committee, other management employee channels and the UCT Health Sciences Faculty. The study will also be published so as to assist other institutions in their approach to needle-stick and splash exposures in health care settings.

2.7 DATA COLLECTION

The collection of data was guided by the databases available in the hospital and determined by the management of health care workers who sustained a needle-stick and/or splash exposure. It is thus important to describe the management process first thereby to assist understanding of the data collection process.

2.7.1 Management of health care worker with percutaneous injury at GSH
(see Figure 1)

When the health care worker or any student (medical, nursing, radiography, etc.) sustains a percutaneous or splash exposure during working hours, they inform their immediate supervisor, wash the area and milk the blood, if accessible, under a running tap. Thereafter, the blood of the source patient is taken with consent. The HCW or student is then sent to the staff health clinic with the patient’s blood specimen. There, he/she fills in an inoculation reporting form (Appendix 4), receives pre-test counseling, has his/her blood taken and depending on the severity of the injury, receives either dual or triple PEP (see Chapter 1).

The HCW or student’s and the source patient’s blood are sent to the hospital-linked Virology laboratory urgently to be tested for HIV and hepatitis B viruses. With regards to hepatitis B, the HCW or student’s blood is tested for hepatitis B antibodies level, while the source
patient’s blood is tested for hepatitis B antigens. The hepatitis C test is requested for the source patient only and is requested for the HCW or student only if the source patient’s blood test is hepatitis C positive. Every effort is made to ensure that the blood results of the source patient are known within 24 hours.

To ensure confidentiality, the laboratory technician gives the results telephonically to the staff health clinic Occupational Health Nurse or doctor, who in turn informs the HCW or student immediately. Should the source patient’s blood result be HIV positive, the HCW or student is given PEP for 28 days as stated above. For situations where the HCW or student is exposed to blood-contaminated or bodily-fluid contaminated sharp object of an unknown source, he/she is also given PEP for 28 days. A source patient who declines to be tested is treated as an unknown source. PEP is discontinued immediately if the source patient is HIV negative.

The hospital management has made provision for ongoing care of health care workers and students after hours (from 16h00 to 08h00 the following morning) and during weekends when the staff health clinic is closed. This is done by equipping operating theatres and labour ward, which have been identified as high risk areas in the hospital owing to the high incidence of exposure, with a three-day course of dual PEP for after hours and during weekends exposures. The equipping of these areas with PEP allows a HCW or student immediate access to PEP should he/she sustain an exposure after hours and during weekends. The exposed HCW or student is then sent to GSH Trauma unit for further management such as counseling and drawing of blood.

A HCW or medical student who sustains the exposure after hours in any area of the hospital, other than the two mentioned, or outside the hospital where PEP is not available (such as the ambulance in transit and Salt River mortuary) goes to the GSH Trauma unit for PEP access and further management. They are all then advised at trauma unit to report to the staff health clinic during working hours for blood results and further management should it be warranted.

Record keeping is important for surveillance of the programme and proper management of HCWs and students. This record keeping is done by the Occupational Health nurse at the
staff health clinic who files the completed inoculation form and enters the incident in a Sharps Injury register. The information entered is the folder number of the HCW or student, the type of exposure (mucous or percutaneous), the HCW’s occupation, gender, time of occurrence, area where the exposure occurred, task performed when the exposure occurred, type of exposure, the HIV blood results of the HCW or student, their levels of hepatitis B antibodies, the time the PEP was given after the injury, the results of the source patient (HIV, hepatitis B and C) and whether the HCW or student reported for their post HIV exposure follow-up. The progress of the HCW or student on PEP is recorded in his/her folder, including any side-effects of the PEP.

The staff health clinic doctor completes and files the first medical report (WC1 304) and the final medical report (WC1 305E) for HCW or student who has been exposed to blood or bodily fluids of a source patient who is HIV positive or with unknown HIV status. The WC1 304 is completed at the initial reporting of exposure and the WC1 305E is completed six months after the initial reporting. The completion of these medical records is to ensure compensation should the HCW or student has HIV, HBV or HCV seroconversion during the six-month follow-up.

Furthermore, as part of hospital’s patient management, the HCW or student’s name, folder number, date of birth, gender and date of consultation are entered into the hospital’s information system called Clinicom.
Figure 1. Flow Chart on the management of needle-stick and/or splash exposure for health care workers and students at Groote Schuur Hospital

HCW or student has percutaneous or splash exposure

- Informs the unit manager

During office hours
- Report to staff health clinic

- PEP given immediately, then report to trauma unit

After hours
- PEP available

No

- Report to trauma unit given PEP (three day supply)

Yes

- HCW/student’s and patient’s blood sent off for HIV, hepatitis B and FBC

- Report to staff health clinic during office hours

AT STAFF HEALTH CLINIC
In incident form completed, HCW/student counselled

IF SEEN AT TRAUMA UNIT

No

- Send off patient’s blood for HIV, hepatitis B and hepatitis C

Yes

- Get patient’s and HCW/student’s HIV, hepatitis B and FBC results.

- Patient HIV positive or HIV status unknown

- Patient HIV negative

Give 28 day supply of PEP then follow-up HCW / student with HIV and FBC tests at two weeks, four weeks, six weeks, three months and six months

PEP: post exposure prophylaxis  HCW: Health care worker  HIV: Human immunodeficiency virus
FBC: Full blood count
2.7.2 COLLECTION OF DATA

Five databases were used to collect the data:
1. The Sharps Injury register;
2. The inoculation incident form;
3. The hospital medical records;
4. Groote Schuur Hospital’s Human Resource Management department database;
5. Groote Schuur Hospital’s Clinicom information system

The staff in the staff health clinic was interviewed regarding the management of HCWs and students reporting needle-stick and splash exposures at the staff health clinic. The hospital’s Assistant Director in the Nursing Division provided information on the different safety devices available in the hospital.

A data capture form was designed for data collection (Appendix 5). It included occupation, gender and age of the exposed health care worker, type of exposure, time of occurrence of the exposure, type of task done when the exposure occurred, the time the PEP was given, age of the patient, HIV status, hepatitis B and hepatitis C status of the source patient, the hepatitis B vaccination and HIV status of the HCW and whether the HCW reported for the results after the exposure (see Appendix 5).

To ensure confidentiality, the author personally collected all the data on the exposures reported by HCWs and students between 2001 and 2005 from the same databases. The Sharps Injury register obtained from the staff health clinic was the first tool to be used. It contained the name of the health care worker, their hospital folder number, the area where the injury occurred, the health care worker’s HIV and hepatitis B results, the source patient’s folder number, HIV, hepatitis B and hepatitis C results. It also stated if the health care worker attended the staff health clinic or only reported the exposure telephonically and if the source patient was unknown.
To ensure anonymity, the health care worker’s name was coded by using the first two letters of their surname, the first letter of their first name, the last digit of the year of exposure and a digit for the month of the exposure preceded by zero (for example, “ma103” meant “Lerato Maiphethho had the exposure in March 2001”). The validity of the folder numbers and the coding system was verified by randomly selecting 20 folders numbers from those that I had already been entered into the research dataset, entering them into the Clinicom system, and then checking them against the name of the health care worker and the date of consultation. All the 20 folder numbers were correct.

The hospital folder numbers were used to obtain the information from the inoculation form and the medical records. The inoculation form kept in the staff health clinic contained the outstanding information not available in the sharps register namely the gender and age of the health care worker, the time the exposure occurred, the type of exposure, the task performed when the exposure occurred, the time the post-exposure prophylaxis was given.

Medical records of the health care worker were sought where the inoculation form was not available at the clinic and where the time post-exposure prophylaxis was not recorded in the inoculation form. A list of folder numbers of all required medical records was compiled and handed to the staff members working in the medical records department to retrieve the records. As is the hospital’s policy that medical records should not leave its premises, information required was loaded directly from the records into an Excel spreadsheet at the medical records department.

Information on the total number of GSH employees in each year was obtained from the Human Resources Management department at GSH and the information on the annual number of medical students from 2001 and 2005 was obtained from the UCT Health Sciences Faculty’s undergraduate office. These were used as denominators for calculating the incidence rates.
2.8 DATA ANALYSIS

The data were analysed using Stata 8 software package and with the assistance of a qualified statistician. The analysis included:

1. A univariate analysis to describe:
   - The high risk groups by age, gender, area of work in the hospital, occupation, time of occurrence and type of task.
   - The prevalence of hepatitis B vaccination and HIV seroprevalence among the reported exposure group.
   - The incidence of needle-stick and/or splash exposures among nurses, doctors and medical students.
   - The proportions of blood- or bodily-fluid contaminated objects from unknown source patients and HIV positive source patients
   - The proportion of HCWs who attended the staff health clinic post HIV positive exposure. A chi-squared two-sample test of proportions, the Stata command "prtest", was used to test the difference in clinic attendance between health care workers with needle-stick and those with splash exposure.

2. The immediate form of incidence rate (iri) command in Stata 8 was used to compare the risk ratios of doctors and medical students, with the nurses as the reference category.

3. The 95% Confidence Interval, Stata 8 command cii, was used to test whether there was any significant difference in the incidence rate of percutaneous exposures before and after the introduction of safety devices among nurses in 2002.

2.8 PILOT

The data capture form was piloted on 01 February 2007. Twenty folder numbers were selected randomly such that each number had an equal opportunity of being selected. The random selection was done by generating twenty numbers ranging from one to 1,293 on to the computer. The numbers selected were: 14, 44, 32, 76, 1, 1010, 1088, 33, 777, 809, 434, 911, 455, 202, 299, 12, 987, 355, 677 and 285. The folder numbers that corresponded to
those twenty numbers were thus used in the pilot study. The piloting showed that for all the 20 folders, information was missing for some of the categories, such as type of task, time the injury occurred and hepatitis B serum antibodies concentration of HCW and student. The age of the HCW and student was added.
CHAPTER 3

RESULTS

Figure 2 shows how the sample was selected from the population of HCWs and students. The total number of HCWs employed and students training in the hospital between 2001 and 2005 is not known because of some leaving the establishment and replaced by others over the years. The replacement of HCWs with others has led to a non-cumulative number of approximately 3 550 HCWs per year. The total number of HCWs and students exposed to needle-stick and splash exposure over the five years is also not known because, for reasons unknown, others elected not to report the needle-stick or splash exposure.

There were 1 119 HCWs and students who reported 1 293 needle-stick and splash exposure over the five years. Of the 1 293 cases of exposure 1 113 were HIV negative at baseline and follow-up, 179 had unknown HIV status at baseline and follow-up and only one was known HIV positive at baseline.

Of the 1 293 cases of exposure, 847 were exposed to HIV negative blood or bodily fluids and 441 were exposed to blood or bodily fluids of HIV positive source patient or source patient with unknown HIV status. Of the 441, 143 did not attend the staff health for follow-up, 76 attended the clinic up to three months, 197 completed their six-month follow-up and 25 had no recording of follow-up attendance.
Figure 2: Flow diagram of HIV status and follow-up of reported HCWs and student between 2001 and 2005

Total number\(^1\) of HCWs\(^2\) and students employed at GSH (2001-2005)
\(N = \text{unknown}\)

All HCWs and students who had needle-stick or splash exposures annually
\(N = \text{unknown}\)

HCWs and students who did not report exposure between 2001 and 2005
\(N = \text{unknown}\)

HCWs and students who reported exposure between 2001 and 2005
\(N = 1,119\)

Number of exposures reported by 1,119 HCWs and students between 2001 and 2005
\(N = 1,293\)

Number of exposures HIV\(^3\) negative at baseline and follow-up
\(N = 1,113\)

Number of exposures HIV positive at baseline
\(N = 1\)

Number of exposures with unknown HIV status at baseline and follow-up
\(N = 179\)

HCWs and students exposed to HIV negative blood or bodily fluids
\(N = 847\)

HCWs and student exposed to unknown HIV or HIV positive blood or bodily fluids, required to attend staff health clinic for six months
\(N = 441\)

Unrecorded attendance
\(N = 25\)

No attendance after exposure
\(N = 143\)

Attended up to three-month follow-up
\(N = 76\)

Completed six-month follow-up
\(N = 197\)

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\(^1\) An average of 3,550 health care workers and 500 medical students working in the establishment annually with unknown number of paramedics and Salt River mortuary staff

\(^2\) Health care workers

\(^3\) Human Immunodeficiency virus
There was a total of 1,119 health care workers and students who reported 1,293 needle-stick or splash exposures between 2001 and 2005.

Table 1 shows that of the 1,119 health care workers and students, females constituted almost two-thirds, with 4% having missing data for gender. The average age of male HCWs was 31 years (IQR: 21 years, 64 years) and of females was 32 years (IQR: 19 years, 58 years).

Of the doctors, registrars constituted the highest proportion (17%) of 1,119 HCWs and students who reported exposures, followed by interns (9%) and consultants and medical officers/SHOs with lowest percentage (4% and 5%, respectively). Of the nurses, enrolled nurses and chief professional nurses constituted the highest proportion (12% and 10%, respectively) of the 1,119 HCWs and students, followed by registered nurses (5%) and senior professional nurses making up one percent.

General assistants constituted an equal proportion as medical officers/SHOs (5%). This was more than consultants (4%), nursing students (3%), paramedics (3%) and laboratory technicians (2%), radiographers (2%), radiology students (1%) and senior professional nurses (1%) who all made a small proportion of exposed HCWs and students.
### Table 1: Characteristics of exposed health care workers and students by gender, age and occupation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>N=1119</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>339 (30%)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>736 (66%)</td>
</tr>
<tr>
<td></td>
<td>Missing</td>
<td>44 (4%)</td>
</tr>
<tr>
<td><strong>Age in years (average)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>31 (21-64)*</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>32 (19-58)*</td>
</tr>
<tr>
<td><strong>Occupation</strong></td>
<td>Registrar</td>
<td>191 (17%)</td>
</tr>
<tr>
<td></td>
<td>MS</td>
<td>189 (17%)</td>
</tr>
<tr>
<td></td>
<td>EN</td>
<td>131 (12%)</td>
</tr>
<tr>
<td></td>
<td>CPN</td>
<td>112 (10%)</td>
</tr>
<tr>
<td></td>
<td>Intern</td>
<td>99 (9%)</td>
</tr>
<tr>
<td></td>
<td>RN</td>
<td>61 (6%)</td>
</tr>
<tr>
<td></td>
<td>MO/SHO</td>
<td>59 (5%)</td>
</tr>
<tr>
<td></td>
<td>GA</td>
<td>50 (5%)</td>
</tr>
<tr>
<td></td>
<td>Miscellaneous</td>
<td>48 (4%)</td>
</tr>
<tr>
<td></td>
<td>Consultant</td>
<td>46 (4%)</td>
</tr>
<tr>
<td></td>
<td>NS</td>
<td>34 (3%)</td>
</tr>
<tr>
<td></td>
<td>Paramedics</td>
<td>31 (3%)</td>
</tr>
<tr>
<td></td>
<td>LT</td>
<td>23 (2%)</td>
</tr>
<tr>
<td></td>
<td>Radiographer</td>
<td>19 (2%)</td>
</tr>
<tr>
<td></td>
<td>SPN</td>
<td>9 (1%)</td>
</tr>
<tr>
<td></td>
<td>RS</td>
<td>8 (1%)</td>
</tr>
<tr>
<td></td>
<td>Missing</td>
<td>12 (1%)</td>
</tr>
</tbody>
</table>

MS=Medical student  EN=Enrolled nurse  SPN= Senior professional nurse  
CPN= Chief professional nurse  MO= Medical officer  SHO= Senior house officer  
GA= General assistant  NS= Nursing student  LT= Laboratory technologist  RN= Registered nurse  
RS=Radiography student  Other= porters, physiotherapists, security officers, visitor in the hospital, 
police officer in Salt River mortuary  
*median (Inter Quartile Range)*
Looking at the type of exposure reported by different occupations, Table 2 shows that over the five years all occupations reported a higher proportion of needle-stick exposures (77%) than splash exposures (15%). However, radiology students reported only needle-stick exposures.

Although the laboratory technicians and paramedics were amongst occupations with the lowest numbers reported, they each had the second highest proportion of reported splash exposures (25%). This was second to medical students who had the highest proportion of splash exposures (28%).

Table 2: Type of exposure reported by occupation

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Needle-stick</th>
<th>Splash</th>
<th>Missing</th>
<th>Total exposures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registrar</td>
<td>177 (72%)</td>
<td>28 (11%)</td>
<td>41 (17%)</td>
<td>246 (19%)</td>
</tr>
<tr>
<td>MS</td>
<td>143 (70%)</td>
<td>58 (28%)</td>
<td>3 (2%)</td>
<td>204 (16%)</td>
</tr>
<tr>
<td>EN</td>
<td>129 (87%)</td>
<td>12 (8%)</td>
<td>8 (5%)</td>
<td>149 (12%)</td>
</tr>
<tr>
<td>CPN</td>
<td>118 (87%)</td>
<td>13 (10%)</td>
<td>4 (3%)</td>
<td>135 (10%)</td>
</tr>
<tr>
<td>Intern</td>
<td>79 (69%)</td>
<td>25 (22%)</td>
<td>10 (9%)</td>
<td>114 (9%)</td>
</tr>
<tr>
<td>RN</td>
<td>57 (83%)</td>
<td>9 (13%)</td>
<td>3 (4%)</td>
<td>69 (5%)</td>
</tr>
<tr>
<td>Consultant</td>
<td>44 (70%)</td>
<td>9 (14%)</td>
<td>10 (16%)</td>
<td>63 (5%)</td>
</tr>
<tr>
<td>GA</td>
<td>45 (87%)</td>
<td>2 (4%)</td>
<td>5 (10%)</td>
<td>52 (4%)</td>
</tr>
<tr>
<td>MO/SHO</td>
<td>47 (75%)</td>
<td>8 (13%)</td>
<td>8 (13%)</td>
<td>63 (5%)</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>49 (92%)</td>
<td>4 (8%)</td>
<td>0 (0%)</td>
<td>53 (5%)</td>
</tr>
<tr>
<td>NS</td>
<td>31 (84%)</td>
<td>5 (14%)</td>
<td>1 (3%)</td>
<td>37 (3%)</td>
</tr>
<tr>
<td>Paramedics</td>
<td>21 (66%)</td>
<td>8 (25%)</td>
<td>3 (9%)</td>
<td>32 (3%)</td>
</tr>
<tr>
<td>LT</td>
<td>15 (63%)</td>
<td>6 (25%)</td>
<td>3 (13%)</td>
<td>24 (2%)</td>
</tr>
<tr>
<td>Radiographer</td>
<td>16 (76%)</td>
<td>5 (24%)</td>
<td>0 (0%)</td>
<td>21 (2%)</td>
</tr>
<tr>
<td>SPN</td>
<td>9 (81%)</td>
<td>2 (18%)</td>
<td>0 (0%)</td>
<td>11 (1%)</td>
</tr>
<tr>
<td>RS</td>
<td>8 (100%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>8 (1%)</td>
</tr>
<tr>
<td>Missing</td>
<td>2 (17%)</td>
<td>2 (17%)</td>
<td>8 (67%)</td>
<td>12 (1%)</td>
</tr>
</tbody>
</table>

MS=Medical student EN=Enrolled nurse SPN=senior professional nurse CPN=Chief professional nurse MO=Medical officer SHO=senior house officer GA=General assistant NS=Nursing student LT=Laboratory technologist RN=Registered Nurse RS=Radiography student

Other=porters, physiotherapists, security officers, visitor in the hospital, police officers at Salt River mortuary
Most of the exposures occurred in the general wards (29%) and operating theatres (23%) with the third highest exposures reported (12%) having occurred in other areas outside the hospital such as other hospitals, Salt River mortuary and medical school (Table 3). Of the 1 293 exposures reported, 10% were from Casualty.

The lowest proportion of reported exposures (2%) occurred in ambulances in transit and labour ward with a third of these exposures being splash exposures.

All the areas had more needle-stick than splash exposures, with 91% of the exposures recorded from out patients department being needle-stick. Data was missing for the type of exposure that occurred in operating theatres for 15% of the cases.

Although not shown on the table, 44% of the registrars’ exposures occurred in the operating theatres, with 44% of the enrolled nurses’ exposures occurring in the general wards and 43% of the medical students’ exposures occurring in other health facilities outside GSH.

Looking at the column percentages, 32% of the reported needle-stick exposures occurred in the general wards with the least needle-stick exposures occurring in ambulances (2%). Splash exposures occurred more frequently in operating theatres (31%) with the least splash exposures occurring in other areas in the hospital (1%).
Table 3: Type of exposure reported by area

<table>
<thead>
<tr>
<th>Area the exposure occurred</th>
<th>Type of exposure reported by HCW or student</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Needle-stick N=990 (77%)</td>
</tr>
<tr>
<td>General ward</td>
<td>316 (85%)</td>
</tr>
<tr>
<td>Operating theatre</td>
<td>192 (65%)</td>
</tr>
<tr>
<td>Other areas outside hospital¹</td>
<td>115 (77%)</td>
</tr>
<tr>
<td>Casualty</td>
<td>91 (72%)</td>
</tr>
<tr>
<td>Intensive care unit</td>
<td>87 (85%)</td>
</tr>
<tr>
<td>Out patients department</td>
<td>73 (91%)</td>
</tr>
<tr>
<td>Laboratory and Radiology</td>
<td>58 (81%)</td>
</tr>
<tr>
<td>Labour ward</td>
<td>19 (68%)</td>
</tr>
<tr>
<td>Other areas in hospital²</td>
<td>23 (85%)</td>
</tr>
<tr>
<td>Ambulance</td>
<td>16 (62%)</td>
</tr>
<tr>
<td>Missing</td>
<td>0 (0%)</td>
</tr>
</tbody>
</table>

¹ Other health facilities such as Mowbray Maternity hospital, New Somerset hospital, Red Cross hospital, Community Health centre, GF Jooste hospital, Midwife Obstetric units and Conradie Hospital; Salt River mortuary; medical school; magistrate court; Transkei.

² E-floor; AZ floor; Old Main building; linen bank; specimen depot; elevator; Central Sterilizing Department.
Table 4 lists the tasks performed when the exposures occurred. A total of 14% of the exposures reported occurred while drawing blood and when performing procedures such as caesarian section, operating, suturing, performing biopsies and autopsy. Altogether 12% of the exposures occurred while assisting with procedures.

Cleaning procedures which were performed by general assistants such as collecting refuse bags, cleaning instruments, mopping floors, closing sharps container, cleaning resuscitation trolley and checking suture tray constituted the fourth highest proportion of reported exposures (9%). This was higher than procedures performed by nurses such as administering drugs or ward procedures.

There was a low percentage of exposure, 4% and 8%, caused by recapping and discarding needles, respectively.

Only 2% of the exposures occurred while delivering babies in labour ward with 70% of them being splash exposures. The information on the task performed when the exposure occurred was missing for 10% of the reported exposures.

Looking at the column percentages, most needle-stick exposures occurred while drawing blood (17%) and most splash exposures occurred while assisting with procedures (27%).
Table 4: Task performed when the exposure occurred

<table>
<thead>
<tr>
<th>Task</th>
<th>Type of exposure reported by HCW or student</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Needle-stick N=990 (77%)</td>
</tr>
<tr>
<td>Performing procedures&lt;sup&gt;1&lt;/sup&gt;</td>
<td>135 (75%)</td>
</tr>
<tr>
<td>Drawing blood</td>
<td>170 (94%)</td>
</tr>
<tr>
<td>Assisting with procedures&lt;sup&gt;2&lt;/sup&gt;</td>
<td>104 (67%)</td>
</tr>
<tr>
<td>Cleaning procedures&lt;sup&gt;3&lt;/sup&gt;</td>
<td>114 (97%)</td>
</tr>
<tr>
<td>Administering drugs&lt;sup&gt;4&lt;/sup&gt;</td>
<td>103 (95%)</td>
</tr>
<tr>
<td>Discarding needle</td>
<td>98 (98%)</td>
</tr>
<tr>
<td>Other&lt;sup&gt;5&lt;/sup&gt;</td>
<td>71 (75%)</td>
</tr>
<tr>
<td>IV line procedures&lt;sup&gt;6&lt;/sup&gt;</td>
<td>55 (85%)</td>
</tr>
<tr>
<td>Ward procedures&lt;sup&gt;7&lt;/sup&gt;</td>
<td>53 (87%)</td>
</tr>
<tr>
<td>Recapping needle</td>
<td>54 (96%)</td>
</tr>
<tr>
<td>Lab procedures</td>
<td>20 (87%)</td>
</tr>
<tr>
<td>Delivering&lt;sup&gt;8&lt;/sup&gt;</td>
<td>7 (30%)</td>
</tr>
<tr>
<td>Missing</td>
<td>6 (5%)</td>
</tr>
</tbody>
</table>

<sup>1</sup> Caesarian section, operating, suturing, draining abscess, biopsy, autopsy, ascitic tap

<sup>2</sup> Shaving patient, drawing blood, putting up intravenous line, assisting in theatre, transferring patient, dressing wound

<sup>3</sup> Collecting refuse bags, cleaning instruments, mopping the floor, closing sharps container, checking suture tray, cleaning resuscitation trolley,

<sup>4</sup> Administering anaesthetic, intravenous, intramuscular etc

<sup>5</sup> Closing corpse, opening tube, ward round, transferring patient from bed to trolley, hugging colleague after drawing blood, patient coughing during resuscitation, bitten by patient, detached blood transfusion unit, burst urine bag, blood-soaked swab onto a health care container, knocked the sharps container.

<sup>6</sup> Putting up intravenous line and flushing intravenous line

<sup>7</sup> Checking patient’s haemoglobin and visidex, turning patient, bathing patient, wound dressing, clearing the bed.

<sup>8</sup> Delivery of babies in labour ward
Table 5 (a) shows that overall there were more needle-stick exposures (77%) than splash exposures (15%). Slightly more than half of the exposures (56%) occurred between 08h00-16h00, with 87% being needle-stick exposures. A total of 21% of all the exposures occurred between 16h01 and 24h00 and 11% between 24h01 and 07h59. The information for time of exposure was missing for 12% of the cases.

Looking at the column percentages, nearly two-thirds of needle-stick exposures (64%) and less than a half of splash exposures (46%) occurred between 08h00 and 16h00. A third of the splash exposure and 22% of the needle-stick exposures occurred between 16h01 and 24h00. An equal proportion of needle-stick and splash exposures (12%) occurred between 24h01 and 07h59.

Table 5 (a): Types of exposure by time of occurrence

<table>
<thead>
<tr>
<th>Time the exposure occurred</th>
<th>Needle-stick</th>
<th>Splash</th>
<th>Missing</th>
<th>Total exposures</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=990 (77%)</td>
<td>N=196 (15%)</td>
<td>N=107 (8%)</td>
<td>N=1293 (100%)</td>
<td></td>
</tr>
<tr>
<td>08h00-16h00</td>
<td>634 (64%)</td>
<td>90 (46%)</td>
<td>1 (1%)</td>
<td>725 (56%)</td>
</tr>
<tr>
<td>16h01-24h00</td>
<td>214 (22%)</td>
<td>62 (32%)</td>
<td>1 (1%)</td>
<td>277 (21%)</td>
</tr>
<tr>
<td>24h01-07h59</td>
<td>118 (12%)</td>
<td>24 (12%)</td>
<td>0 (0%)</td>
<td>142 (11%)</td>
</tr>
<tr>
<td>Missing</td>
<td>24 (2%)</td>
<td>20 (10%)</td>
<td>105 (98%)</td>
<td>149 (12%)</td>
</tr>
</tbody>
</table>
All HCWs and medical students reported more of half of exposures between 08h00-16h00 [Table 5(b)]. There were 54% of nurses that had the exposures during this time almost the same proportion as doctors (53%). A quarter of the exposures occurred between 16h00 and 24h00 among nurses and medical students.

All HCWs and students reported less exposure between 24h01 and 07h59 with the least being among medical students and other HCWs (9%).

Information on the time of exposure was missing for 19% of the doctors.

**Table 5 (b): Time of exposure by occupation**

<table>
<thead>
<tr>
<th>Time the exposure occurred</th>
<th>Occupation of exposed HCW or student (column percentages)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nurses N=368 (29%)</td>
</tr>
<tr>
<td>08h00-16h00</td>
<td>198 (54%)</td>
</tr>
<tr>
<td>16h00-24h00</td>
<td>101 (27%)</td>
</tr>
<tr>
<td>24h01-07h59</td>
<td>50 (14%)</td>
</tr>
<tr>
<td>Missing</td>
<td>19 (5%)</td>
</tr>
</tbody>
</table>
Table 6 shows that 89% of 1 119 HCWs and students reported only one needle-stick or splash exposure. There were 9% who reported two exposures while only 3% reporting more than two exposures. Only one of the 189 medical students had more than two exposures. Of the 31 HCWs who had more than two exposures, one consultant and one registrar had five and ten incidents respectively.

Looking at the column percentages, registrars constituted more than a third (12/31) of HCWs and students who reported more than two exposures.
### Table 6: The number of exposures reported per HCW or student by occupation

<table>
<thead>
<tr>
<th>Occupation</th>
<th>1 (N=992 (89%))</th>
<th>2 (N=96 (9%))</th>
<th>&gt; 2 (N=31 (3%))</th>
<th>N=1119 (100%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registrar</td>
<td>157 (82%)</td>
<td>22 (12%)</td>
<td>12 (6%)</td>
<td>191 (17%)</td>
</tr>
<tr>
<td>MS</td>
<td>177 (94%)</td>
<td>11 (6%)</td>
<td>1 (1%)</td>
<td>189 (17%)</td>
</tr>
<tr>
<td>EN</td>
<td>118 (90%)</td>
<td>10 (8%)</td>
<td>3 (2%)</td>
<td>131 (12%)</td>
</tr>
<tr>
<td>CPN</td>
<td>94 (84%)</td>
<td>14 (13%)</td>
<td>4 (3%)</td>
<td>112 (10%)</td>
</tr>
<tr>
<td>Intern</td>
<td>85 (86%)</td>
<td>13 (13%)</td>
<td>1 (1%)</td>
<td>99 (9%)</td>
</tr>
<tr>
<td>RN</td>
<td>53 (87%)</td>
<td>5 (8%)</td>
<td>3 (5%)</td>
<td>61 (5%)</td>
</tr>
<tr>
<td>MO / SHO</td>
<td>54 (92%)</td>
<td>5 (9%)</td>
<td>0 (0%)</td>
<td>59 (5%)</td>
</tr>
<tr>
<td>GA</td>
<td>49 (98%)</td>
<td>1 (2%)</td>
<td>0 (0%)</td>
<td>50 (4%)</td>
</tr>
<tr>
<td>Other</td>
<td>42 (88%)</td>
<td>4 (8%)</td>
<td>2 (4%)</td>
<td>48 (4%)</td>
</tr>
<tr>
<td>Consultant</td>
<td>37 (80%)</td>
<td>6 (13%)</td>
<td>3 (7%)</td>
<td>46 (4%)</td>
</tr>
<tr>
<td>NS</td>
<td>32 (94%)</td>
<td>1 (3%)</td>
<td>1 (3%)</td>
<td>34 (3%)</td>
</tr>
<tr>
<td>Paramedics</td>
<td>30 (97%)</td>
<td>1 (3%)</td>
<td>0 (0%)</td>
<td>31 (3%)</td>
</tr>
<tr>
<td>LT</td>
<td>22 (96%)</td>
<td>1 (4%)</td>
<td>0 (0%)</td>
<td>23 (2%)</td>
</tr>
<tr>
<td>Radiographer</td>
<td>17 (89%)</td>
<td>2 (11%)</td>
<td>0 (0%)</td>
<td>19 (2%)</td>
</tr>
<tr>
<td>SPN</td>
<td>8 (89%)</td>
<td>0 (0%)</td>
<td>1 (11%)</td>
<td>9 (1%)</td>
</tr>
<tr>
<td>RS</td>
<td>8 (100%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>8 (1%)</td>
</tr>
<tr>
<td>Missing</td>
<td>9 (100%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>9 (1%)</td>
</tr>
</tbody>
</table>

MS = Medical student  EN = Enrolled nurse  SPN = Senior professional nurse  
CPN = Chief professional nurse  MO = Medical officer  SHO = Senior house officer  
GA = General assistant  NS = Nursing student  LT = Laboratory technologist  RN = Registered nurse  
RS = Radiography student  Other = porters, physiotherapists, security officers, visitor in the hospital,  
police officers at Salt River mortuary
Tables 7 summarises exposure numbers and proportions among doctors, nurses, medical students and other health care workers and students.

Nurses made up 28% of reported cases of exposure with 38% being doctors and 16% medical students. The other 16% constituted all the other occupations, namely radiographers, radiography students, nursing students, porters, general assistants, physiotherapists, security officers, police officers at Salt River mortuary and visitor at GSH.

Table 7: Exposed HCWs and students grouped by occupation (2001-2005)

<table>
<thead>
<tr>
<th>Occupation of exposed health care workers</th>
<th>N=1293 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurses¹</td>
<td>368 (28%)</td>
</tr>
<tr>
<td>Doctors²</td>
<td>486 (38%)</td>
</tr>
<tr>
<td>Other³</td>
<td>235 (18%)</td>
</tr>
<tr>
<td>Medical student⁴</td>
<td>204 (16%)</td>
</tr>
</tbody>
</table>

¹ enrolled nurse, registered nurse, chief professional nurse and senior professional nurse
² consultant, registrar, medical officer, senior house officer and intern
³ radiographer, radiography student, security officer, paramedics, general assistants, porters, visitor, laboratory technicians and unrecorded
⁴ fourth, fifth and sixth year UCT medical students
Table 8(a) shows that the annual average incidence rate over five years for needle-stick and splash exposures was 16 per 100 persons per year among doctors compared to 5 per 100 person per years among nurses and 8 per 100 persons per year among medical students. The highest annual incidence rate amongst doctors and nurses occurred in 2002 (23 per 100 person per year and 7 per 100 persons per year, respectively). Although the highest incidence rate among medical students was in 2005 (10 per 100 person per year), it is not much different from the 9 per 100 persons per year recorded in 2002. The incidence rates for the other occupations could not be determined since denominators for them could not be obtained.

Table 8(a): The annual incidence rate for reported needle-stick or splash exposure among the reported doctors, nurses and medical students (n= 1 293)

<table>
<thead>
<tr>
<th>Occupation of exposed health care workers</th>
<th>Incidence rate (per 100 persons) for percutaneous exposure among health care workers exposed per year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2001</td>
</tr>
<tr>
<td>Doctors</td>
<td>102*/644** = 16</td>
</tr>
<tr>
<td>Nurses</td>
<td>77/1436=5</td>
</tr>
<tr>
<td>Medical students</td>
<td>27/507*** =5</td>
</tr>
</tbody>
</table>

*number of exposed cases reported in that year
** number of employees in that occupation on the establishment
*** number of fourth, fifth and sixth year medical students enrolled with UCT in the year
Overall, doctors had three times greater rate of reporting a needle-stick or splash exposure than nurses (95% CI 2.19- 4.09), this remained constant over the five years [Table 8(b)]. Medical students had a 50% greater rate than nurses (95% CI 1.01-2.25) and in contrast to doctors, experienced a steady rise in relative risk over the five years. In 2001 they had a similar rate to that of nurses, but thus increased steadily so that by 2005 they had twice the rate of nurses (see Figure 2).

Table 8(b): Incidence rate ratios for doctors and medical students relative to nurses

<table>
<thead>
<tr>
<th>Year</th>
<th>Doctors</th>
<th>Medical students</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>3.0 (2.18 - 4.0)</td>
<td>1.0 (0.6 -1.56)</td>
</tr>
<tr>
<td>2002</td>
<td>3.5 (2.7 - 4.6)</td>
<td>1.3 (0.89 - 1.9)</td>
</tr>
<tr>
<td>2003</td>
<td>2.4 (1.69 - 3.37)</td>
<td>1.49 (0.97- 2.25)</td>
</tr>
<tr>
<td>2004</td>
<td>3.0 (2.13 - 4.0)</td>
<td>1.8 (1.2 -2.65)</td>
</tr>
<tr>
<td>2005</td>
<td>3.0 (2.2 - 4.4)</td>
<td>2.0 (1.37 - 2.9)</td>
</tr>
<tr>
<td>Overall average</td>
<td>3.0 (2.19 - 4.09)</td>
<td>1.5 (1.01- 2.25)</td>
</tr>
</tbody>
</table>

Figure 3: Histogram showing the steady increase in the risk among the medical students compared to nurses 2001-2005
There were no recorded HIV seroconversions amongst the exposed health care workers (Table 9). Only one (0.1%) was known to be HIV positive before the exposure occurred and 86% were HIV negative at baseline or at follow-up testing. Of concern however, is that the baseline and follow-up HIV status was unknown among 14% of the reported cases of exposure. There were 179 cases with unknown status, with one-third of these being registrars. Of these unknown cases, 10% and 12 % being medical students and consultants, respectively.

Table 9: HIV seroprevalence among exposed HCWs and students (2001-2005)

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Negative N=1113 (86%)</th>
<th>Positive N=1 (0.1%)</th>
<th>Missing N=179 (14%)</th>
<th>Total exposures N=1293 (100%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registrar</td>
<td>190 (17%)</td>
<td>0 (0%)</td>
<td>56 (31%)</td>
<td>246 (19%)</td>
</tr>
<tr>
<td>MS</td>
<td>186 (17%)</td>
<td>0 (0%)</td>
<td>18 (10%)</td>
<td>204 (16%)</td>
</tr>
<tr>
<td>EN</td>
<td>136 (12%)</td>
<td>0 (0%)</td>
<td>13 (7%)</td>
<td>149 (12%)</td>
</tr>
<tr>
<td>CPN</td>
<td>125(11%)</td>
<td>0 (0%)</td>
<td>10 (6%)</td>
<td>135 (10%)</td>
</tr>
<tr>
<td>Intern</td>
<td>106 (10%)</td>
<td>0 (0%)</td>
<td>8 (4%)</td>
<td>114 (9%)</td>
</tr>
<tr>
<td>RN</td>
<td>55 (5%)</td>
<td>0 (0%)</td>
<td>14 (8%)</td>
<td>69 (5%)</td>
</tr>
<tr>
<td>Consultant</td>
<td>42 (4%)</td>
<td>0 (0%)</td>
<td>21 (12%)</td>
<td>63 (5%)</td>
</tr>
<tr>
<td>MO/SHO</td>
<td>55 (5%)</td>
<td>0 (0%)</td>
<td>8 (4%)</td>
<td>63 (5%)</td>
</tr>
<tr>
<td>Other</td>
<td>48 (4%)</td>
<td>1 (2%)</td>
<td>4 (2%)</td>
<td>53 (4%)</td>
</tr>
<tr>
<td>GA</td>
<td>48 (4%)</td>
<td>0 (0%)</td>
<td>4 (2%)</td>
<td>52 (4%)</td>
</tr>
<tr>
<td>NS</td>
<td>34 (3%)</td>
<td>0 (0%)</td>
<td>3 (2%)</td>
<td>37 (3%)</td>
</tr>
<tr>
<td>Paramedics</td>
<td>29 (3%)</td>
<td>0 (0%)</td>
<td>3 (2%)</td>
<td>32 (2%)</td>
</tr>
<tr>
<td>LT</td>
<td>22 (2%)</td>
<td>0 (0%)</td>
<td>2 (2%)</td>
<td>24 (2%)</td>
</tr>
<tr>
<td>Radiographer</td>
<td>17 (2%)</td>
<td>0 (0%)</td>
<td>4 (2%)</td>
<td>21 (2%)</td>
</tr>
<tr>
<td>SPN</td>
<td>10 (1%)</td>
<td>0 (0%)</td>
<td>1 (1%)</td>
<td>11 (1%)</td>
</tr>
<tr>
<td>RS</td>
<td>7 (1%)</td>
<td>0 (0%)</td>
<td>1 (1%)</td>
<td>8 (1%)</td>
</tr>
<tr>
<td>Missing</td>
<td>3 (0.2%)</td>
<td>0 (0%)</td>
<td>9 (5%)</td>
<td>12 (1%)</td>
</tr>
</tbody>
</table>

MS=Medical student  EN=Enrolled nurse  SPN= Senior professional nurse  
CPN= Chief professional nurse  MO= Medical officer  SHO= Senior house officer  
GA= General assistant  NS= Nursing student  LT= Laboratory technologist  
RN= Registered nurse  RS=Radiography student  Other= porters, physiotherapists, security officers, visitor in the hospital, police officers in Salt River mortuary
Table 10 shows that there were 441 reported exposures to blood- or bodily-fluid contaminated objects of HIV positive source patients and unknown source patients. Of these, 32% of the exposed staff did not attend the staff health clinic at all (as required by the PEP protocol). Only 45% of the exposed HCWs and students that were exposed to HIV positive or unknown source patients completed their required six-month follow-up. There were 17% who attended the clinic for up to three months and records could not be found for another 6% of them.

Almost half of the registrars who had HIV positive exposure did not attend the clinic at all, with only a third of them completing the six-month follow-up. None of the occupations had all exposed health care workers completing the six-month follow-up. The nurses, specifically SPN and CPN, had the highest number of those who completed their six-month follow-up, 75% and 74%, respectively. Among the interns, only 16% of them completed their six-month follow-up. Although there were only a small number of radiography students (4), three of them did not attend the clinic at all after an HIV positive exposure.
Table 10: Staff health clinic attendance of HCW or student after exposure to HIV positive or unknown source patients by occupation

<table>
<thead>
<tr>
<th>Occupation of exposed health care workers</th>
<th>No attendance N=143 (32%)</th>
<th>Follow-up to 3 months N=76 (17%)</th>
<th>Completed 6-month follow-up N=197 (45%)</th>
<th>Missing N=25 (6%)</th>
<th>Total N=441 (100%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registrar</td>
<td>40 (48%)</td>
<td>16 (19%)</td>
<td>25 (30%)</td>
<td>2 (2%)</td>
<td>83 (19%)</td>
</tr>
<tr>
<td>MS</td>
<td>20 (25%)</td>
<td>23 (28%)</td>
<td>37 (46%)</td>
<td>1 (1%)</td>
<td>81 (18%)</td>
</tr>
<tr>
<td>GA</td>
<td>15 (31%)</td>
<td>8 (17%)</td>
<td>18 (38%)</td>
<td>7 (15%)</td>
<td>48 (11%)</td>
</tr>
<tr>
<td>EN</td>
<td>8 (21%)</td>
<td>6 (15%)</td>
<td>25 (44%)</td>
<td>0 (0%)</td>
<td>39 (9%)</td>
</tr>
<tr>
<td>Intern</td>
<td>22 (58%)</td>
<td>8 (21%)</td>
<td>6 (16%)</td>
<td>2 (5%)</td>
<td>38 (9%)</td>
</tr>
<tr>
<td>CPN</td>
<td>3 (9%)</td>
<td>3 (9%)</td>
<td>26 (74%)</td>
<td>3 (9%)</td>
<td>35 (8%)</td>
</tr>
<tr>
<td>Other</td>
<td>6 (23%)</td>
<td>2 (8%)</td>
<td>15 (58%)</td>
<td>3 (12%)</td>
<td>26 (6%)</td>
</tr>
<tr>
<td>MO / SHO</td>
<td>8 (40%)</td>
<td>2 (10%)</td>
<td>9 (45%)</td>
<td>1 (5%)</td>
<td>20 (5%)</td>
</tr>
<tr>
<td>Consultant</td>
<td>6 (35%)</td>
<td>2 (12%)</td>
<td>9 (53%)</td>
<td>0 (0%)</td>
<td>17 (4%)</td>
</tr>
<tr>
<td>Paramedics</td>
<td>3 (20%)</td>
<td>2 (13%)</td>
<td>8 (53%)</td>
<td>2 (13%)</td>
<td>15 (3%)</td>
</tr>
<tr>
<td>RN</td>
<td>2 (15%)</td>
<td>2 (15%)</td>
<td>8 (62%)</td>
<td>1 (8%)</td>
<td>13 (3%)</td>
</tr>
<tr>
<td>LT</td>
<td>2 (25%)</td>
<td>0 (0%)</td>
<td>4 (50%)</td>
<td>2 (25%)</td>
<td>8 (2%)</td>
</tr>
<tr>
<td>NS</td>
<td>2 (40%)</td>
<td>0 (0%)</td>
<td>3 (60%)</td>
<td>0 (0%)</td>
<td>5 (1%)</td>
</tr>
<tr>
<td>SPN</td>
<td>1 (25%)</td>
<td>0 (0%)</td>
<td>3 (75%)</td>
<td>0 (0%)</td>
<td>4 (1%)</td>
</tr>
<tr>
<td>RS</td>
<td>3 (75%)</td>
<td>0 (0%)</td>
<td>1 (25%)</td>
<td>0 (0%)</td>
<td>4 (1%)</td>
</tr>
<tr>
<td>Radiographer</td>
<td>1 (50%)</td>
<td>1 (50%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>2 (0.5%)</td>
</tr>
<tr>
<td>Missing</td>
<td>1 (33%)</td>
<td>1 (33%)</td>
<td>0 (0%)</td>
<td>1 (33%)</td>
<td>3 (1%)</td>
</tr>
</tbody>
</table>

MS=Medical student  EN=Enrolled nurse  SPN= senior professional nurse
CPN= chief professional nurse  MO= Medical officer  SHO= Senior house officer
GA= General assistant  NS= Nursing student  LT= Laboratory technologist
RN= Registered nurse  RS=Radiography student  Other= porters, physiotherapists, security officers, visitor in the hospital
Looking at the numbers in Table 11, the type of exposure (needle-stick or splash) had a moderate influence on post-positive HIV exposure clinic attendance of the exposed health care workers. The difference between the 40% with splash exposure and the 32% with sharp exposure that did not attend the clinic was not statistically different (p=0.16). However, the difference between those with sharp exposure (48%) and those with splash exposure (35%) who completed their six-month follow-up was statistically significant (p=0.03).

### Table 11: Post-HIV positive exposure clinic attendance by type of exposure

<table>
<thead>
<tr>
<th>Type of exposure</th>
<th>No attendance N=146 (33%)</th>
<th>Follow-up to 3 months N=77 (17%)</th>
<th>Completed 6-month follow-up N=196 (44%)</th>
<th>Missing N=29 (6%)</th>
<th>Total exposures N=448 (100%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sharp</td>
<td>111 (32%)</td>
<td>60 (17%)</td>
<td>166 (48%)</td>
<td>8 (2%)</td>
<td>345 (77%)</td>
</tr>
<tr>
<td>Splash</td>
<td>34 (40%)</td>
<td>17 (20%)</td>
<td>29 (35%)</td>
<td>4 (5%)</td>
<td>84 (19%)</td>
</tr>
<tr>
<td>Missing</td>
<td>1 (1%)</td>
<td>0 (0%)</td>
<td>1 (5%)</td>
<td>17 (89%)</td>
<td>19 (4%)</td>
</tr>
<tr>
<td>p-value*</td>
<td>0.16</td>
<td>0.5</td>
<td>0.03</td>
<td>0.12</td>
<td></td>
</tr>
</tbody>
</table>

* Chi-squared two-sample test for difference in proportions in each category
Although there were 1 119 HCWs, each HCW had their hepatitis B antibody level tested with each exposure reported. There were thus a total of 1 293 hepatitis B antibody levels. The 1 293 exposed HCWs and students had an average hepatitis B serum concentration level of 504 IU/l (IQR: 0, 1001 IU/l).

Table 12 shows that of these only 65% of them had immunity, meaning that the serum concentration level was between 100 and 1001 IU/l. A total of 28% had an antibodies level <100 IU/l and 8% had unrecorded levels. A reassuring finding is that the high risk groups, namely the exposed registrars and the medical students, had high immunity coverage of 70% and 72%, respectively.

Although only 21 radiographers reported exposure, 81% of them had a serum hepatitis B antibody concentration between 100 and 1000 IU/l, making them the group with the highest proportion with immunity coverage. Overall, among the exposed occupations, more than 50% in each occupation had serum antibodies levels between 100 and 1001 IU/l.
Table 12: Serum hepatitis B antibody concentration of exposed HCWs and students by occupation (2001-2005)

<table>
<thead>
<tr>
<th>Occupation of exposed health care worker</th>
<th>Serum hepatitis B antibody concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 100 IU/l</td>
</tr>
<tr>
<td></td>
<td>N=358 (28%)</td>
</tr>
<tr>
<td>Registrar</td>
<td>32 (13%)</td>
</tr>
<tr>
<td>MS</td>
<td>48 (24%)</td>
</tr>
<tr>
<td>EN</td>
<td>61 (41%)</td>
</tr>
<tr>
<td>CPN</td>
<td>46 (34%)</td>
</tr>
<tr>
<td>Intern</td>
<td>28 (25%)</td>
</tr>
<tr>
<td>RN</td>
<td>23 (33%)</td>
</tr>
<tr>
<td>Consultant</td>
<td>15 (24%)</td>
</tr>
<tr>
<td>MO/SHO</td>
<td>12 (19%)</td>
</tr>
<tr>
<td>Other</td>
<td>23 (43%)</td>
</tr>
<tr>
<td>GA</td>
<td>23 (44%)</td>
</tr>
<tr>
<td>NS</td>
<td>16 (43%)</td>
</tr>
<tr>
<td>Paramedics</td>
<td>12 (38%)</td>
</tr>
<tr>
<td>LT</td>
<td>5 (21%)</td>
</tr>
<tr>
<td>Radiographer</td>
<td>4 (19%)</td>
</tr>
<tr>
<td>SPN</td>
<td>5 (45%)</td>
</tr>
<tr>
<td>RS</td>
<td>3 (38%)</td>
</tr>
<tr>
<td>Missing</td>
<td>2 (17%)</td>
</tr>
</tbody>
</table>

MS=Medical student  EN=Enrolled nurse  SPN= Senior professional nurse  CPN= Chief professional nurse  MO= Medical officer  SHO= Senior house officer  GA= General assistant  NS= Nursing student  LT= Laboratory technologist  RN= Registered nurse  RS=Radiography student  Other= porters, physiotherapists, security officers, visitor in the hospital, police officers at Salt River mortuary
Table 13 shows that HIV seroprevalence among the source patients for these reported exposures in the hospital and in other areas outside the hospital was 24% over the five years of exposure. A further 66% were HIV negative, while the HIV status was unknown in 10% of the blood- or bodily- fluid contaminated objects.

Of the 1293 reported exposures, 79% of the source patients were hepatitis B negative. Although only 5% and 1% of source patients were hepatitis B and hepatitis C positive respectively, 16% of them had unknown status for each virus.

**Table 13: Characteristics of the blood- or bodily-fluid contaminated objects from the source patients of the reported exposures**

<table>
<thead>
<tr>
<th>Characteristics of blood- or bodily-fluid contaminated objects</th>
<th>HIV status N=1293 (100%)</th>
<th>Hepatitis B status N=1293 (100%)</th>
<th>Hepatitis C status N=1293 (100%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>847 (66%)</td>
<td>1023 (79%)</td>
<td>1061 (82%)</td>
</tr>
<tr>
<td>Positive</td>
<td>312 (24%)</td>
<td>57 (4%)</td>
<td>12 (1%)</td>
</tr>
<tr>
<td>Unknown</td>
<td>129 (10%)</td>
<td>204 (16%)</td>
<td>211 (16%)</td>
</tr>
<tr>
<td>Missing</td>
<td>5 (0.4%)</td>
<td>9 (1%)</td>
<td>9 (1%)</td>
</tr>
</tbody>
</table>
Although not shown in the analysis, exposed health care workers received post-exposure prophylaxis (PEP) on average 65 minutes after the exposure (IQR: 10 minutes, 48 hours).

Almost half of them accessed PEP between 08h00 and 16h00 (Table 14). A further 18% of exposed HCWs received PEP between 16h01 and 24h00 and only 9% received PEP between 24h01 and 07h59.

It is notable that 6% of the exposed health care workers were not given PEP. This was for various reasons such as refusing PEP, accessing the clinic after the stipulated 72 hours or the staff health clinic doctor or trauma unit doctor deciding that exposure was very low risk.

There was no recording of the time PEP was accessed in relatively high percentage (18%) of exposed health care workers with 51% of this group being doctors.

Table 14: Time of access of post-exposure prophylaxis by occupation

<table>
<thead>
<tr>
<th>Time post-exposure prophylaxis (PEP) accessed after the injury</th>
<th>Occupation of exposed HCW or student</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nurses (N=368 (28%))</td>
</tr>
<tr>
<td>08h00-16h00</td>
<td>181 (49%)</td>
</tr>
<tr>
<td>16h01-24h00</td>
<td>75 (20%)</td>
</tr>
<tr>
<td>24h01-07h59</td>
<td>39 (11%)</td>
</tr>
<tr>
<td>PEP not given</td>
<td>19 (5%)</td>
</tr>
<tr>
<td>Missing</td>
<td>54 (15%)</td>
</tr>
</tbody>
</table>
Figure 4 was an attempt to examine effect of the introduction of the safety devices on needle-stick exposures in 2002. There was an increase in the incidence rate of 7 per 100 nurses per year in 2002 that then decreased in the subsequent years after the introduction of the safety devices to a stable 5 per 100 nurses per year. However, the confidence interval in 2001 includes those of 2003 to 2005.

**Figure 4: Incidence rate per year for nurses (2001-2005)**
CHAPTER 4

DISCUSSION

4.1 LIMITATIONS

Before interpreting our results, it is important to discuss the limitations to our study and how they influenced our results. These limitations were:

4.1.1. Selection bias

Our sample is not representative of the population in the hospital since over the five years some HCWs left the institution while others were employed afresh during the same period, thus producing the constant number of 3 550 employees over the years. The constant turnover of HCWs means that we do not have a cumulative denominator thus making it difficult calculate the overall hepatitis B immunity coverage and HIV seroprevalence among the HCWs over the five years.

There is likely to be self-selection in that the 1 119 health care workers and students who reported their exposures could have considered the exposure high risk, in contrast to those who did not report the exposure considering it to be low risk. This bias would cause overestimation of the seroprevalence of HIV and hepatitis B and C among the patients admitted in the hospital, but would could underestimation of incidence rate of needle-stick and splash exposures in the hospital.

Self-selection bias is also likely with regards to poor follow-up attendance of HCW or student at the staff health clinic after HIV positive or unknown HIV status exposure. The reason could be that those who did not attend despite knowing the source patient’s HIV results assumed that the likelihood of HIV seroconversion is low. This poor follow-up attendance might underestimate the HIV seroconversion rate among HCWs and students. Since this
study involved analysing available records, HCWs and students were not interviewed to determine the possible reasons for re-exposure to needle-stick or splash exposure, poor staff health clinic attendance for hepatitis B vaccination and post-HIV or unknown status exposure follow-up. These reasons must therefore remain speculative.

4.1.2 Missing data

The information required in the study was found in most of the records, thus proving that the method used to collect the information was reliable. However, there was a problem in finding some records while other records had incomplete information. For example there was a problem in the reporting of the time of the incident and how the injury occurred. It is more likely that this introduced random error than systematic error in that loss of information occurred unpredictably and randomly.

The missing data would also have introduced random error into the determination of the prevalence of seroconversion HIV among HCWs and students, the prevalence of hepatitis B and hepatitis C infection among patients admitted to the hospital and the proportion of HCWs and students who accessed PEP within the required 72 hours after exposure.

The original plan was to describe the data from 2000 to 2005, but 2000 had to be dropped as most of the information was missing for that year. The inclusion of 2000 data could have improved the results on the effect of the safety devices by looking at two years prior to their introduction and three years thereafter instead of looking at only one year prior their introduction. The final study thus covered 2001 to 2005.

The other limitation regarding missing data was the lack of annual denominators for most occupations, with nurses, doctors and medical students being the only ones with annual denominators. This unavailability of annual denominators for other occupational categories resulted in the inability to calculate annual incidence rates for occupations other than the three above-mentioned. Furthermore, the lack of incidence rates led to the inability to perform a regression analysis so as to determine predictors associated with either needle-stick
and/or splash injuries.

The prevalence of side effects of the PEP was not ascertained owing to poor recording. This, as reported by the Occupational Health nurse at the staff health clinic, is as a result of most of health care workers reporting their side effects, such as nausea, telephonically thus be authorized medication or given advice telephonically without the side effect being recorded.

4.2 INTERPRETATION OF RESULTS

The results will be interpreted according to the objectives set out in Chapter 1.

4.2.1 Characteristics of exposed HCWs and students and the exposure by type, task performed, area of work and time of exposure

Occupational needle-stick and splash exposures are unavoidable in hospital settings. From the results obtained above, Groote Schuur hospital is no exception. In most studies that have been conducted, more female HCWs and students reported exposures than male ones, presumably because most of the employees working in the hospital are women.

Our results showed more needle-stick exposures reported than splash exposures. This is similar to the finding reported by Romea et al. (1995) in their longitudinal study conducted in a teaching hospital in Spain that between January 1986 and October 1992, 71.8% of the exposures resulted from needle-stick and suture needles. The Health Protection Agency (2005) also reported that between July 1996 and June 2004, 63% of the reported exposures were due to needles with splash exposures accounting for only 9% among HCWs in 150 centres in England, Wales and Northern Ireland.

The overall higher proportion of needle-stick exposures reported than splash exposures in our study could be indicative of the perception by the health care workers that needle-stick exposure poses higher risk of transmission of HIV, hepatitis B and hepatitis C infections than splash exposure, thus reporting them more than splash exposure. However, the lower number of splash exposures could be because they occur less frequently than needle-stick exposure.
Despite being fewer in number than nurses in the hospital, more doctors reported needle-stick and splash exposures than nurses. This is different from what has been reported by the National Surveillance for Health Care Workers (NaSH) in USA, namely that most of the exposures were reported by nurses due to their being the largest occupational group in the hospital. However, the fact that in this study registrars and medical students were the ones who reported more exposures indicates that exposure is related more closely to tasks being performed in the hospital than to the number of employees in each occupational category.

This task-related risk is evident in our finding that most of the exposures occurred while performing procedures which involved working with sharp objects such as operating in theatre, suturing, draining abscesses or performing ascitic taps. These tasks are carried out mainly by registrars in our hospital and thus the high number of exposures reported by registrars, followed by medical students who are responsible for drawing blood and performing some of the above-mentioned tasks as part of their training. Tarantola et al. (2003) reported in a study conducted in hospitals in France that 60% of the reported exposures were by nurses, since they were responsible for nearly all blood sampling and other IV access procedures in hospitals in France.

Of concern in this study is that cleaning procedures such collecting refuse bags, cleaning instruments, mopping the floor, closing sharps containers, cleaning resuscitation trolleys, which are mainly performed by general assistants in the hospital, accounted for the fourth highest proportion of reported needle-stick and splash exposures. The reason could be that general assistants may be more anxious about reporting exposures than doctors and nurses thus producing a relatively high number of exposures. Whatever the case, the high number indicates carelessness in disposing of sharp objects, with them being left in refuse bags, on the floor, on resuscitation trolleys and overfilling the sharps container.

With regards to area of work, registrars reported that exposures occurred while performing most of the tasks mentioned above in the operating theatres, explaining the high number of cases from this area. The second most common area of exposures reported was from medical
wards because that is where medical students (responsible for the second highest number of reported cases) perform tasks such as drawing blood (one of the high risk tasks reported other than performing procedures). In the surveillance study conducted by NaSH (2004) they reported that nurses sustained the highest number of exposures were they work, namely medical floors, in intensive care units and operating rooms 22.

Of interest is that there were a relatively low reported number of exposures from Casualty. This is unlike what has been reported by other studies that have identified it as one of the high risk areas 6. The reason for underreporting could be that the staff has direct access to PEP in Casualty. However, staff in the operating theatres also has access to PEP but still appear to have reported their exposures. Alternatively it could be that Casualty staff see fewer patients than to the theatre staff or perform fewer high risk procedures.

Other than the area of work and task performed by HCW and student and the area, fatigue and working long hours have been suggested as other causes of needle-stick and splash exposures. It would be expected that the long working hours are applicable to doctors, who are usually on call and work from morning and throughout the night, compared to other occupational categories such as nurses who work shifts.

However our results show that of the reported exposures that occurred after hours, 41% were among nurses compared to 29% among doctors. A quarter of nurses and medical students reported exposures between 16h00 and 24h00 compared to 18% of doctors. This could be because this is the busiest time for them, with the nurses taking patient’s vitals in the ward and medical students learning how to deliver babies in labour ward and midwife obstetric units (MOUs), suturing in trauma unit and drawing blood in general wards. Although only 29% of the doctors reported exposures after hours, this number could change since 19% of them did not record the time the exposure occurred.

The high percentage of exposures during office hours could be that there were more patients seen during this period, thus increasing the risk of exposure. Alternatively, it is possible that many of the health care workers who sustained exposures after hours did not report them
since they went-off shift before the staff health clinic opened.

4.2.2 Re-exposure, incidence rates and rate ratios among doctors, nurses and medical doctors

Although an equal number of medical students and registrars reported exposures, the doctors had more re-exposures thus reporting 38% of the incidents overall compared to 16% for medical students as shown in table 7. The low number of repeated exposure among medical students could be due to their graduating and leaving the institution.

The overall high proportion of single exposures (89%) could be indicative of HCWs and students learning from the first exposure and thus becoming more vigilant to avoid a second exposure by applying universal precautions such as avoiding recapping needle and wearing gloves and goggles when working with blood and bodily fluids. They could also have gained more experience in performing their tasks over time, thus less prone to needle-stick and splash exposures.

Although the reporting of 10 exposures by one registrar over the five year period in our study is an outlier, it is not different from a finding by Makary et al. (2007). They found that among 699 surgeons in training in 17 medical centres in USA the mean number of needle-stick exposures during residency increased according by postgraduate year, from 1.5 injuries per year one year post-graduate to 7.7 injuries per year five years post-graduate.

Of concern was the apparent increasing risk among medical students of reporting a needle-stick or splash exposure relative to nurses over the five years. The incidence rate for medical students increased annually from 5 per 100 persons in 2001 to 10 per person in 2005. This is in contrast to the constant higher incidence rate of 3 per 100 doctors per year over the same period.

An explanation for the apparently increasing risk among medical students could be that an increasing number of medical students reported their needle-stick and splash exposure as
relative to nurses over the five years. If the increase is real, it could be because less emphasis
during training of medical students on the importance of safe practices to prevent
percutaneous and splash exposures in health care institutions. Conversely, students could
have been taught safe practices but lack experience about performing procedures such as
drawing blood or suture. They may also be apprehensive about pricking themselves, thus
ending up pricking themselves.

Moreover, our results showed that doctors and medical students were relatively at greater risk
of needle-stick and splash exposures than the nurses. This could be due to the fact that the
former tend to perform procedures that put them at higher risk. On the higher hand, the low
risk identified among nurses could be due to underreporting amongst this group of health care
workers.

4.2.3 The HIV seroprevalence among source patients, HIV prevalence among exposed
HCWs and students and their follow-up clinic attendance after HIV positive exposure

Although the HIV seroprevalence among the source patients was 24% and 10% with
unknown status, there was no HIV seroconversion documented among the recorded 1 293
cases of exposure over the five years. However, only 45% of HCWs and students who were
exposed to blood or bodily fluids of source patients with unknown HIV status or HIV
positive completed their six-month follow-up at the staff health clinic. Of the 45%, those with
needle-stick exposures completed their six-month follow-up more than those with splash
exposure. The most likely reason is that the health care workers view needle-stick exposures
as having higher risk of HIV transmission than splash exposures.

There was more than one-third (32%) of them not attending the staff health clinic at all. This
poor follow-up after HIV positive exposure among HCWs was also reported by the Health
Protection Agency that 311 of the initial 551 reports for HIV positive exposure were received
at six months, indicating that the HCW did not complete the six-month follow-up 41.

This poor follow-up attendance among HCWs and students makes it difficult for us to
comment on the seroconversion rate among the HCWs and students. It is known that in the hospital most of the high risk groups, namely doctors and nurses, prefer to consult with their private doctors outside the hospital. It is thus possible that any of the 55% of the reported cases that did not complete their six-month follow-up could have had their HIV test done with their private doctors rather than the staff health clinic. It is possible that could have seroconverted and their HIV seroconversion be detected by their private doctors and not be disclosed to the staff health clinic.

Furthermore, it is possible that health care workers who already knew their HIV positive status did not report their needle-stick or splash exposure with the fear of their status being known. Should the latter be the case, it highlights the need for education to health care workers on confidentiality that is upheld in the staff health clinic with regards to health service provision, including HIV testing and disclosure. Furthermore, it highlights the importance to put systems in place to reduce HIV stigmatization in the workplace.

Romea et al. (1995) reported a 0.0% HIV seroconversion among 47 of 98 HCWs exposed to blood or bodily fluids of HIV positive source patient after being followed-up for six months. Smith at King Edward Hospital, Durban, South Africa, reported that in the five years after 1997, there were 1000 exposures with no HIV seroconversion reported. They did not report on the number of HCWs who completed their six-month follow-up. This is in contrast to the reporting of one HIV seroconversion among 122 HCWs reporting occupational exposures to blood-borne viruses to the Health Protection Agency in England, Wales and Northern Ireland between July 1996 and June 2004. This made the seroconversion rate 0.8%. They however warned that this seroconversion rate could be an overestimation due to an incomplete denominator.

4.2.4 The prevalence of HBV and HCV among source patient and prevalence of hepatitis B immunity coverage among exposed HCWs and students

The high percentage of unknown status (16%) of both hepatitis B and C viral infections among the source patients given the low prevalence of 4% and 1% respectively is
noteworthy. This moderately high percentage of unknown status of these two viral infections means that their prevalences among the source patients could be higher than those recorded.

However, it is unlikely that there could have been seroconversion with the higher prevalence has been reported in the following studies. A study conducted by Baldo et al. (2002) reported no transmission of neither HBV nor HCV to HCWs over five years after exposure to source patients of whom 11.4% were positive for HBV and 27.8% were positive for HCV over five years. Ciorkia et al. (2005) also reported no HBV and HCV seroconversion among 1,433 HCWs exposed to source patients of whom 21% were positive for both HBV and HCV infections between 1994 and 1999. Despite the fact that both our study and the aforementioned studies reported no seroconversion for these viruses, the high percentage of unknown status among the source patients in our study emphasises the need for HCWs and students to prevent the needle-stick and splash exposures by practicing universal precautions and having pre-exposure prophylaxis.

Unlike hepatitis C virus, hepatitis B virus has a vaccine for pre-exposure prophylaxis which is offered free of charge at the staff health clinic to health care workers and students. In spite of this, only 65% of the health care workers and students in our hospital had hepatitis B immunity (serum hepatitis B antibody concentration 100 IU/L). This is lower than the coverage reported in most of the studies globally. For example, Saffar et al. (2005) reported 87% hepatitis B immunity among the health care workers in Cina hospitals, Iran. Ciorlia et al. (2005) reported a similar coverage of 86% among health care workers working at Hospital de Base, Sao Jose do Rio Preto Hospital and a bloodbank in Brazil between 1994 and 1999. In the USA, the American Hospital Association reported 81% coverage among its health care workers.

On the other hand, our result of 65% immunity coverage is higher than that of 15.8% among 1,485 HCWs working in different types of health care facilities in two governorates in Egypt. Suckling et al. (2006) also reported low immunity coverage of 12.8% among 554 HCWs working in Thika district, Kenya. Although these two studies report on studies conducted among districts and more than one facility, they do reflect the magnitude of the problem.
faced by Departments of Health in areas where the hepatitis B vaccination policy is not well-implemented. This is especially so in areas such as Kenya which has a high prevalence of hepatitis B infection in the community.

Considering that 17% of registrars did not have their antibody levels recorded in our study, the immunity coverage could be higher than that recorded. Furthermore, some of the 28% of HCWs and students with serum hepatitis B antibody level less than 100 IU/l could have been vaccinated as required but remained non-responders.

4.2.5 Time PEP was accessed by HCWs and students

The exposed HCWs and students who reported their exposures and who did access the post-exposure prophylaxis did so on average within two hours (IQR: 10 minutes, 48 hours). This is similar to that reported by Health Protection Agency (see above) that HCWs in Wales accessed PEP within 24 hours. The short time to access PEP indicates that our HCWs and students are aware of post-exposure prophylaxis and where to get it. However, the high percentage (18%) of missing data for time that PEP was accessed could have over-estimated the range and thus give the wrong impression that the policy is working. The high percentage of 18% of missing data could be due to the fact that most of these health care workers did access PEP at the designated areas (operating theatre, trauma unit and maternity unit) without recording the time they accessed it. The non-recording of time PEP was accessed thus could not be recorded on reporting the exposure at the staff health clinic. This highlights the importance of educating HCWs about the importance of reporting and noting the time of exposure and accessing PEP.

4.2.6 Effect of introduction of safety devices on needle-stick exposures among nurses

One could argue, looking at Figure 3, that the safety devices prevented the continuing rise in the incidence rates of needle-stick exposures among the nurses by reducing the higher rate in 2002 back to the one in 2001 prior their introduction. Unfortunately we do not have data for earlier years to determine whether there was a rising trend incidence rates. Statistically, the
differences between the rates were not significant for the years presented here.

According to the literature these devices have been shown elsewhere to reduce the incidence of needle-stick and splash exposures among the high risk groups. Failure to reduce the incidence rate of needle-stick exposures among nursing staff after the introduction of the safety devices is thus disheartening. This could be due to lack of training in the proper use of the devices since this result is in contrast to that reported by Rogues et al (2004) who showed a 48% decline in incidence rate of needle-stick exposures among health care workers in a tertiary hospital in USA over seven years after the introduction of two safety devices.

Tarantola et al. (2003) reported in their study that there was a decreasing trend in incidence rate among nurses decreasing from 10.8 to 7.7 per 100 nurses per year between 1995 and 1998. They assumed the decrease to be due to improvements in exposure and risk-reduction policy and efforts. A study conducted by Radecki et al. (2000) also showed a decline in needle-stick injury rates among surgical residents and attributed this to the increased use of universal precautions.

The occurrence of exposures due to carelessness, such as in recapping of needles, a colleague handing a sharp object to another staff member, needles left in the patient’s bed, needles left in refuse bags or on the floor reported under the “other” tasks can be used to gage the effectiveness of education and training in the proper handling of sharp objects in the hospital. The low percentage of such reported exposures in this study could be thus indicative of the increasing awareness of safe handling of used sharp objects in the hospital.

4.3 RECOMMENDATIONS

When it comes to needle-stick and splash exposures in our study, doctors, nurses and medical students appear to be the high risk groups with general wards and operating theatres being the high risk areas. Needle-stick exposures are more prevalent than splash exposures.

There is quick access to HIV PEP and no HIV seroconversion was recorded although post-
HIV exposure six-month follow-up was lower than acceptable and this may have masked some seroconversion. Of some concern is that despite the ongoing risk to hepatitis B exposure at the institution, there was a lower than expected hepatitis B immunity coverage.

The introduction of safety devices in 2002 seems to have reduced the incidence rate of needle-stick exposures among nurses from 0.07 per 100 nurses per year in 2002 to a stable 0.05 per 100 nurses per year, the same as in 2001 before their introduction. However, the differences could have been due to random error and not to the introduction of the devices themselves.

It is the employer and university’s responsibility to stress the importance of safe practices to protect HCWs and students from acquiring occupational blood-borne infections such as HIV, HBV and HCV when working in all areas of the health care system. The inculcation of these safe practices, with support from hospital and other facility management, will assist HCWs and students in also protecting themselves when working in sites outside the hospital, thus reducing the 12% of the incidents in these other sites.

The following recommendations could assist in achieving these goals:

4.3.1 HCWs and students

(a) Education and awareness are required about the handling of sharp objects, namely: the wearing of gloves when working with sharp objects, the wearing of goggles if at risk of splash exposure, and how to pass a sharp object such as scalpel to a colleague especially in operating theatres. Although a relatively small proportion reported exposures due to recapping or discarding of needles, the importance of avoiding recapping and proper discarding of needles need to be reiterated.

(b) The fact that the fourth highest proportion of needle-stick exposures were reported to have occurred by while mopping the floors, collecting refuse bags and cleaning suture trays highlights the problem of improper discarding of sharp objects after use. Education and
training are recommended on the proper way of discarding contaminated sharp objects on the use of sharps containers provided in the hospital.

(c) Education and training of HCWs and students on the importance of attaining hepatitis B viral immunity are needed from the hospital and university management. Every effort should be made to increase immunity coverage to more than 80%, including investigating barriers to achieving such coverage.

(e) Although underreporting of needle-stick and splash exposure by health care workers and students was not proven in our study, it is likely that our population would behave the same as other populations in other studies globally where underreporting has been reported. The following recommendations are made to combat this problem:

- HCWs and students need to be continually reminded of the importance of reporting needle-stick and splash exposures and completing their six-month follow-up should they be exposed to objects contaminated with blood or bodily fluids of source patients who are HIV positive or unknown HIV status. Besides surveillance for the effectiveness of control measures, this information is required for compensation purposes, whereby should the health care worker acquire the infection post-exposure; he/she would be entitled to compensation. This can only be achieved if there is documentation of the reported exposure at baseline and of seroconversion during the six-month follow-up.

- Although the HIV seroconversion rate low globally, HCWs and students have to be made aware that it is not 0.0% but between 0.3% and 0.5%, in which range any of them could fall.

- A more effective proactive medical surveillance programme is required so as to identify health care workers at risk, thereby providing adequate protection. The programme should include pre-employment examination for all the newly employed health care workers followed by biennial periodic examination with the biological
monitoring involving measuring the hepatitis B antibodies. This would be more effective than testing the antibodies only when the health care worker reports needle-stick or splash exposures.

4.3.2 Students

(a) The high and rising incidence of exposures among medical students suggests that the existing curriculum on the prevention of needle-stick and splash exposures needs to be improved throughout the undergraduate programme, especially from fourth to sixth year of study.

(b) Preventive medicine needs to be given more emphasis in the teaching of health sciences. Occupational health is a good example. This means that health sciences students should learn not only about the causes, the diagnosis, management of biological hazards such as HIV, HBV and HCV, but also about the practice of safe procedures to prevent the risk of exposure to these hazards in the workplace for themselves and the population in the health care system.

4.3.3 Staff health clinic

Overall, the good record keeping system of the GSH staff health clinic made this analysis possible and thus the staff should be commended. However, we recommend that better record-keeping on PEP side-effects be established, thereby assisting in determining the reasons for poor post HIV exposure clinic attendance. This can be done by including a section about the side effects on the inoculation form.

4.3.4 Management

The recording of nearly half of the needle-stick and splash exposures as occurring after hours, when it is expected that the hospital is much less busy, is a cause for concern. Hospital management needs to look more closely into this problem and its implications for staffing and working conditions after hours.
4.3.5 Research

More information is needed on some of the barriers and problems found in this research. The following studies would help to fill these information gaps. Both quantitative and qualitative techniques are recommended.

(a) A cohort study of exposed staff and students to determine the reasons for poor follow-up at the staff health clinic after HIV positive or unknown status exposure.

(b) A study to determine the reasons for the relatively high proportion of exposures after hours.

(c) A study to assess whether safety devices are being used optimally.

(d) A study of the barriers to greater hepatitis B immune coverage, including uptake and effectiveness of the vaccination programme.
REFERENCES


APPENDIX 1: Pictures of the safety devices available at GSH
APPENDIX 2: Letter of approval from Ethics Review Committee of the UCT Health Sciences Faculty

UNIVERSITY OF CAPE TOWN

Health Sciences Faculty
Research Ethics Committee
Room E52-24 Groote Schuur Hospital Old Main Building
Observatory 7925
Telephone: 0011 (0) 46 1642 • Facsimile: 0011 (0) 46 6033
E-mail: Nicolo@uct.ac.za

19 December 2007
REC REP: 072/2007
Dr L Maiphetlho
Public Health & Family Medicine

Dear Dr Maiphetlho


Thank you for your letter to the Research Ethics Committee dated 12th March 2007.

The Ethics Committee has noted the approval letter from Dr Patel with reference to the above mentioned study.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the REC. REF in all your correspondence.

Yours sincerely

PROF M BLOCKMAN
CHAIRPERSON, HSE HUMAN ETHICS
APPENDIX 3: Letter of approval from GSH management

Dr L Maiphellho
Occupational Medicine Registrar
G32 Old Main Building
GROOTE SCHUUR HOSPITAL

Dear Dr Maiphellho


Your recent letter to the hospital refers.

You are hereby granted permission to proceed with your research.

Please note the following:

a) Your research may not interfere with normal patient care.
b) Hospital staff may not be asked to assist in the research.
c) No hospital consumables and stationery may be used.
d) Please introduce yourself to the person in charge of an area before commencing.

Please be informed that you have to submit your research proposal to the Research Ethics Committee as well.

I would like to wish you every success with your project.

Thanking you

DR B PATEL
SENIOR MEDICAL SUPERINTENDENT
### APPENDIX 5: The data capture form

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<tr>
<th>Occupation of HCW</th>
<th>0 = NR</th>
<th>1 = consultant</th>
<th>2 = registrar</th>
<th>13 = intern</th>
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<th>HCW’s HIV status</th>
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