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Occupational exposure to blood-borne or body fluid pathogens among medical interns at Addington Hospital, Durban

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Abstract

Background: Healthcare workers are at risk of transmission of hepatitis B and C and human immunodeficiency viruses following accidental exposure to blood and body fluids. Interns are a vulnerable group of healthcare workers, cited as having the highest incidence of accidental needle-stick injuries and splashes with blood or body fluids. The main reason is thought to be a lack of experience and confidence, and underdeveloped dexterity skills, all of which increase risk of exposure. Since the introduction of the new two-year internship, to date no study has been carried out in South Africa comparing the incidence of occupational exposure between first- and second-year interns.

Methods: A descriptive study design was devised and a structured questionnaire distributed to all interns employed at Addington Hospital in December 2008. All the interns had completed either one or two years of internship. Data were analysed using the SPSS software package and chi-square tests were applied for comparable variables.

Results: The response rate was 83% (53/64). During 2008, 29 (55%) interns had at least one incident of accidental exposure to blood or body fluids. Eighteen (62%) were first-year interns and 11 (38%) were second-year interns ($p < 0.01$). In total, there were 42 exposures, of which 64% (27/42) were percutaneous and 36% (15/42) mucosal. First-year interns experienced 70% (19/27) of the needle-stick injuries and 73% (11/15) of the mucosal exposures ($p < 0.01$). A significant difference was noted between the first- and second-year interns ($p < 0.01$).

Conclusion: The high level of exposure of interns to blood and blood products highlights the need for improvement in occupational health safety to prevent transmission of pathogens. Closer supervision of first-year interns and more focus on undergraduate awareness and skills development is necessary.

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Introduction

Occupational exposure to blood and body fluids is a recognised mode of transmission of blood-borne pathogens such as hepatitis B virus (HBV), hepatitis C virus (HCV) and human immunodeficiency virus (HIV).[1-4] It is estimated that through occupational exposure, 2.6% of healthcare workers are exposed to HCV, 5.9% to HBV and 0.5% to HIV, annually. This equates to approximately 16 000 HCV infections, 66 000 HBV infections and 200-600 HIV infections worldwide.[5]

Occupational exposure to blood-borne and body fluid pathogens may occur following accidental needle-stick injuries, or accidental splashes of blood or body fluids to mucous membranes, i.e. mucosal exposure. The risk of seroconversion to HIV infection following a needle-stick injury has been estimated to be 0.3%, and 0.09% following a mucosal exposure.[5] Post-exposure prophylaxis has been reported to reduce the risk of seroconversion by 80%.[6]

Only HBV vaccination is available, leaving healthcare workers at significant risk of morbidity and mortality when exposed to HCV and HIV.[7] HIV/AIDS is among the top 10 causes of death in developing countries, and the leading cause of death in sub-Saharan Africa.[8] It has been estimated that up to 60% of patients admitted to public sector hospitals in South Africa are HIV infected.[9] In this high prevalence environment, healthcare workers investigating and managing these patients are at risk of contracting HIV during the course of their duties.

Studies carried out in several countries have reported varying rates of needle-stick injuries or exposure to body fluids among different healthcare worker categories. The number of occupational exposures to HIV in Estonia, Lithuania and Hungary is reported to be less than 10 annually in each of these countries.[10] Patterson et al (2003)[11] reported a 30% rate of needle-stick injury among senior medical students in the United States. In a study carried out in the United

Kingdom among nursing staff, 74% of respondents reported having had at least one needle-stick injury.[12] The incidence of needle-stick injury among healthcare workers in Turkey over a one-year period was found to be 68%.[13] The rate of needle-stick injuries reported in Egypt and Uganda in 2002 was 36% and 55% respectively.[14,15] According to a study carried out in an emergency department in the USA in 2003, 60% of healthcare workers were exposed to blood and body fluids.[16] In South Africa there are limited reliable data relating to the incidence of needle-stick injuries or exposure to body fluids among healthcare workers.[1,17-22] Only Karstaedt and Pantanowitz[1] have specifically reported on interns. No study compares occupational exposure between first- and second-year interns specifically.

Over the past three decades, owing to the high incidence of HIV and the risk of occupational exposures, a number of strategies have been implemented in South African state hospitals to reduce the frequency of occupational exposure to blood and body fluid. These initiatives include training on the importance of preventing occupational exposures and the provision of containers for sharp objects, such as needles, and protective clothing.[1,22] Despite these efforts, a significant number of occupational exposures occur among healthcare workers at public sector hospitals (personal communication: Health and Safety Clinic, Addington Hospital). However, comprehensive surveillance data on the extent of the problem are limited. It would be indispensable in establishing and formulating policies to decrease the risk of occupational infection with HIV, HBV, HCV and other blood-borne pathogens.[23]

Medical interns in South Africa are employed after five or six years of undergraduate training. Because of their limited experience and underdeveloped practical skills, they are vulnerable to accidental exposures to blood-borne pathogens and contaminated body fluids. Furthermore, their background knowledge in appreciating the level of risk associated with occupational exposure to disease is limited.

In 2006, a two-year internship was introduced in South Africa to ensure that medical staff had the necessary skills to be able to work at a district hospital. Each year, 64 interns are allocated to Addington Hospital for their internship training, all of whom rotate through medicine, obstetrics and gynaecology, surgery, anaesthesiology, orthopaedics, paediatrics and family medicine. Addington Hospital is a regional and district hospital in Durban. It has 570 beds, with an average bed occupancy rate of 90% and an average of 50 000 outpatient visits per month.

The purpose of this study was to determine the prevalence of occupational exposures amongst first-year and second-year medical interns at this urban regional hospital, as well as factors contributing to the exposure, together with knowledge of and compliance with universal precautions and adherence to post-exposure prophylaxis.

Methodology

This study was conducted among interns working at Addington Hospital in December 2008, and included all exposures which occurred during 2008. Of the 64 interns, 30 were first-year interns and 34 were second-year interns. They were given questionnaires and invited to participate in the study. Using a structured questionnaire, data were collected on exposure, knowledge of post-exposure prophylaxis and use of post-exposure prophylaxis. Written consent to participate was obtained from the interns. Participation in the study was voluntary and anonymous.

Data were analysed using the SPSS software package. Descriptive statistics such as frequency tables, bar charts and summary statistics were used to examine the primary objectives ($p < 0.01$ was considered as statistically significant).

Ethics approval was obtained from the Research and Ethics Committee at the University of KwaZulu-Natal. Permission to conduct the study was obtained from the hospital manager of Addington Hospital and the KwaZulu-Natal Department of Health.

Results

Fifty-three interns (25 first years and 28 second years) completed the questionnaires, giving a response rate of 83%.

Twenty-nine (55%) interns reported at least one incident of accidental exposure to blood or body fluids in 2008: 18/29 (62%) were first-year interns and 11/29 (38%) were second-year interns ($p < 0.01$). Of these accidental exposures, 21/29 (72%) were percutaneous exposures and 8/29 (28%) were mucosal exposures. First-year interns experienced 13/21 (62%) of the needle-stick injuries and 5/8 (63%) of the mucosal exposures ($p < 0.01$) (see Table I). The relative risk of a first-year intern experiencing an accidental exposure to blood or blood products was 1.83 (CI 1.08-3.08) times greater than for a second-year intern.

Table I: Number of respondents who experienced occupational exposure

	Total number (%)	Percutaneous	Mucosal
First years	18 (62)	13 (62)	5 (63)
Second years	11 (38)	8 (28)	3 (44)
Total (%)	29 (100)	21 (72)	8 (24)

In total, there were 42 exposures, of which 64% (27/42) were percutaneous and 36% (15/42) were mucosal exposures. Seventy per cent (19/27) of the percutaneous exposures and 73% (11/15) of the mucosal exposures involved first-year interns. A significant difference was noted between the first- and second-year interns ($p < 0.01$) (see Table II). There were 13 (25%) interns who had more than one exposure to blood or body fluids.

Table II: Number of exposures experienced by first- and second-year interns

	Total number (%)	Percutaneous	Mucosal
First years	30 (71)	19 (70)	11 (73)
Second years	12 (29)	8 (30)	4 (27)
Total (%)	42 (100)	27 (64)	15 (36)

Most of the accidental exposures occurred during the rotation in the internal medicine department (36%). Only 19% of the exposures occurred in general surgery. There were no incidents of accidental exposure during the anaesthetic and orthopaedic rotations (see Table III).

Hollow needles contributed to 63% of the needle-stick injuries and solid needles, utilised for suturing purposes, contributed to 27% of the percutaneous exposures. Of the 15 mucosal exposures, blood splash to the interns' eyes occurred in seven (47%) incidents. Mucosal exposures to amniotic fluid (15%), urine (13%) and pleural fluid (15%), were the other contributing factors to accidental exposure to body fluids (see Table III).

Injuries associated with taking blood and putting up intravenous lines occurred in 16 (38%) and eight (19%) interns, respectively. Nineteen per cent (8) of the interns were injured with solid needles while assisting with suturing in theatre. Other accidental exposures related to procedures involving lumbar puncture (5%), pleural tap (7%), urine catheter insertion (5%) and obstetric deliveries (7%) (see Table III).

Of the 42 exposures, 26 patients (71%) were HIV positive and 17 (40%) were positive for HBV antibodies. No source patient was positive for HCV. All interns had been vaccinated for HBV and prophylaxis against HBV was not necessary. Eighty-six per cent of the interns reported exposure to the relevant authorities (see Table IV). In all reported incidents, antiretroviral drugs were commenced within one hour of exposure.

In the 10 incidents (28%) in which the source patient was HIV negative, interns continued post-exposure prophylaxis for five days or until the p24 antigen result from the source patients was confirmed as negative.

Despite 26 patients being confirmed as HIV positive, the 28-day mandatory post-exposure prophylaxis was only completed in 23 of the 26 exposures reported. The main reason given for non-compliance was intolerance to the side-effects of the medication.

Table III: Univariate analysis of exposures

	Number of exposures (%) n = 42	First years	Second years
Department			
Internal medicine	15 (36)	9 (60)	6 (40)
Obstetrics and gynaecology	12 (29)	8 (67)	4 (33)
General surgery	8 (19)	5 (63)	3 (37)
Paediatrics	6 (14)	4 (66)	2 (33)
Family medicine	1 (2)	0 (0)	1 (100)
Percutaneous exposure			
Solid needle	8 (37)	5 (62)	3 (37)
Hollow needle	19 (63)	12 (63)	5 (26)
Mucosal (splash)			
Amniotic fluid	3 (15)	2 (66)	1 (33)
Blood	7 (47)	5 (71)	2 (28)
Urine	2 (13)	2 (100)	0 (0)
Pleural fluid	3 (13)	2 (66)	1 (33)
Causes of exposure			
Taking blood	16 (38)	10 (62)	6 (37)
Putting up IV lines	8 (19)	4 (50)	4 (50)
Assisting in theatre	8 (19)	3 (37)	5 (62)
Lumbar puncture	2 (5)	2 (100)	0 (0)
Pleural tap	3 (7)	2 (66)	1 (33)
Catheter associated	2 (5)	2 (100)	0 (0)
Obstetric delivery	3 (7)	1 (33)	2 (66)

Table IV: Adherence to post-exposure prophylaxis protocol

	Exposure : All n = 42 (%)	Exposure First-year interns n = 30 (%)	Exposure Second-year interns n = 12 (%)
Post-exposure prophylaxis			
Reporting of incident	36 (86)	26 (87)	10 (83)
Initiated first aid	36 (86)	26 (87)	10 (83)
First ARV dose (< 1 hour)	36 (86)	26 (87)	10 (83)
Compliance with ARVs	33 (91)	24 (92)	9 (90)

Discussion

Exposure to blood and body fluids carrying potentially infectious pathogens is a recognised threat to healthcare workers.[24] In this study, 55% of the interns were exposed to blood-borne and body fluid pathogens via the percutaneous and mucosal routes. This is lower than the 69% reported in South African interns by Karstaedt and Pantanowitz (2001),[1] but similar to the 54% reported by a maternity unit in Durban in 2001.[17]

Kermode et al (2005)[25] reported high levels (69%) of occupational exposure to blood and other body fluids among doctors in rural North India. A Korean study, carried

out in 2008, reported that interns accounted for the highest incidence of needle-stick injuries in a tertiary hospital.[26] Wada et al (2007)[27] reported a significant difference in occupational exposure between first-year interns (55%) and second-year interns (31%) in Japan. A study carried out in Pune, India, reported the highest number of exposures among first-year interns.[28] Interns in Taiwan had the highest incidence for needle-stick injuries.[29]

There are no reported studies in South Africa comparing occupational exposure to blood-borne or body fluid pathogens among first-year and second-year interns.

The significant difference in the rate of accidental exposure among first-year interns compared to second- year interns in this study is comparable to international study results.[27] The high rate of accidental exposure among interns presumably relates to their lack of experience, skill and confidence. The five-year curriculum allows for completion of medical studies after that amount of time, discharging younger graduates into patient care. The two-year internship is a new development in the South African medical school curriculum. This study noted that first-year interns had significantly higher rates of exposure for both percutaneous and mucosal exposure ($p < 0.01$).

The finding in this study that 64% of the exposures involved a percutaneous injury is similar to other study findings.[29] The procedural nature of intern work, involving venesection, phlebotomy and suturing, predisposes interns to needle-stick injuries. This, combined with inexperience, long working hours and a high volume of procedures, places interns at a high risk of needle-stick injury.[28] Interns work long hours and it is likely that fatigue, with resulting impaired cognitive performance, may also contribute to the accidental exposures.

Venipuncture and intravenous catheter placements accounted for 57% of the reported causes, and hollow-bore needles were associated with 63% of the percutaneous injuries. These findings are similar to those of Talas (2009),[30] who reported that 72% of percutaneous injuries recorded in their study involved hollow-bore needles. Barrier devices are not always adequately protective,[30,31] necessitating the development and mastery of procedural skills.

Mucosal exposure is preventable by the use of goggles, face masks or face shields.[32] In this study, the rate of exposure to mucous membranes of the eyes, nose and mouth was 31%. This differs from the findings of Leiss et al (2006),[32] who found similar rates for mucosal and percutaneous exposures. The lower rate of mucosal exposure detected in this study may relate to better adherence to universal precautions among interns at Addington Hospital, as all the interns reported using protective barriers (see Table IV).

The recapping of contaminated needles is a dangerous practice. It increases the risk of needle-stick injuries and occupational exposure to blood and blood products significantly.[33] Azap et al (2005)[34] reported that recapping of needles was the highest cause of sharps injuries among Turkish health care workers. It is of interest that needle recapping was not listed as a cause for accidental exposure in this study, suggesting adherence to the hospital's protocol and guidelines.

The department in which most exposures took place was internal medicine. This was unsurprising, as other studies have suggested that this surgical discipline is associated with high rates of accidental exposure to blood and blood products.[35] However, the high volume of patients in this department may be the reason for this finding. The number of accidental injuries in the obstetrics department was similar to that of internal medicine, despite lower patient volumes in the former. However, there are acute staff shortages in the obstetrics department, leading to overworked staff, which places the interns at a much higher risk for accidental exposure to blood-borne pathogens.

Under-reporting is common among healthcare workers and results in underestimation of the overall occupational risk of acquiring blood-borne pathogen infection.[36] In this study, 86% (36) of interns reported their exposure, compared to other studies in which the rate of reporting was in the region of 30-48%.[22,36-38] A comprehensive orientation programme and strict implementation of policy and guidelines at the hospital may account for this difference.

Universal precautions require healthcare workers to regard all blood and body fluids as potentially infectious, irrespective of the status of the source patient.[11] The introduction, implementation and maintenance of these precautions have been reported to decrease occupational exposure to blood and body fluids significantly.[33] In this study, adequate awareness and knowledge of post-exposure prophylaxis and universal precautions were demonstrated by all interns, yet needle-stick injuries and accidental exposure to body fluids continue to occur.

There are educational and training policies in place at this hospital. Regular in-service training is seen as a priority. Hospital management has taken a decision that prevention of needle-stick injuries must remain a primary strategy with which to decrease potential infection. Other initiatives at the hospital have been shown to decrease the number of needle-stick injuries. These include use of needleless equipment, self-capping intravenous catheters, retractable lancets and needle guards.

The high level of exposure to needle-stick injuries among interns highlights the need for improvement in occupational health safety, to prevent transmission of potentially infectious pathogens. The pathogenesis of the initial exposure and infection provides an important opportunity to prevent seroconversion by the provision of post-exposure prophylaxis.

Conclusion

Despite awareness of the morbidity and mortality associated with occupational exposure to pathogens and knowledge of universal precautions and post-exposure prophylaxis, junior doctors remain a vulnerable group of health workers, at risk of occupational acquisition of blood-borne and body fluid pathogens and disease.

High levels of occupational exposure to infectious diseases highlight the need for improvement in occupational health safety to prevent transmission of blood-borne pathogens. Although tremendous advances have been made with the promotion of universal precautions and post-exposure prophylaxis, accidental injuries continue to occur.

More research needs to focus on the development of engineered safety devices, injury surveillance and enforcement of the relevant legislation. Further studies are needed on the risks faced by interns and junior healthcare workers working in public sector hospitals in South Africa.

Awareness of the risks and challenges associated with occupational exposure to blood-borne pathogens needs to be introduced into the undergraduate curriculum. Appropriate training and confidence in practical aspects of medicine, through the use of skills-training laboratories, need to be provided and instilled in undergraduate medical students. Medical interns must be closely supervised by senior doctors during procedures.

Limitations

This study was carried out at one site, the study population was small, and only one category of healthcare worker was involved. It was a retrospective study, which may have been influenced by recall bias. However, a needle-stick injury is a significant event, and one that it is unlikely an intern would forget.

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