Epidemiol. Infect. (2006), **134**, 465–471.
doi:10.1017/S0950268805005212 Printed in the United Kingdom

Occupational blood and body fluid exposure in an Australian teaching hospital

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(*Accepted 21 June 2005, first publihed online 30 September 2005*)

SUMMARY

To examine work-related blood and body fluid exposure (BBFE) among health-care workers (HCWs), to explore potential risk factors and to provide policy suggestions, a 6-year retrospective study of all reported BBFE among HCWs (1998–2003) was conducted in a 430-bed teaching hospital in Australia. Results showed that BBFE reporting was consistent throughout the study period, with medical staff experiencing the highest rate of sharps injury (10·4%). Hollow-bore needles were implicated in 51·7% of all percutaneous injuries. Most incidents occurred during sharps use (40·4%) or after use but before disposal (27·1%). Nursing staff experienced 68·5% of reported mucocutaneous exposure. Many such exposures occurred in the absence of any protective attire (61·1%). This study indicated that emphasis on work practice, attire, disposal systems and education strategies, as well as the use of safety sharps should be employed to reduce work-related injuries among HCWs in Australia.

INTRODUCTION

Blood and body fluid exposure (BBFE) remains a prominent concern for health-care workers (HCWs) since the heightened recognition of occupational transmission of blood-borne pathogens (BBP) during the early stage of the AIDS epidemic in the 1980s. At least 20 different pathogens have been documented as having been transmitted via sharps injury through body fluid exposure [1, 2], with human immunodeficiency virus (HIV), hepatitis B virus (HBV) and hepatitis C virus (HCV) posing the greatest occupational risk to HCWs [3, 4].

Work-related BBFE varies greatly among HCWs and hospital settings, ranging from 31% to 40% of sharps injuries among nurses and 40% in doctors [1, 5]. Numerous factors such as the use of safety devices, procedures performed, patient BBP status, size of hospital and staff workloads are likely to contribute to the risk of occupational blood exposures [6–8]. Risk of occupational transmission of BBP following a percutaneous injury or significant blood exposure has been estimated to range from 0·3% to 0·5% for HIV [8–10], from 10% to 35% for HBV [1, 9, 10], and from 1·8% to 10% for HCV [9–11]. Despite seemingly low transmission rates, employers have a duty of care to provide a safe workplace as the consequences of BBP infection are potentially life threatening [12]. Thus, HCWs should be alert to the risk of work-related BBFE.

Surprisingly, occupationally acquired sharps injury and mucocutaneous exposure have received comparatively far less attention in Australia than internationally [13]. A recent study in a teaching hospital in Queensland indicated it was a substantial occupational health and safety issue [14] and provides a

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Table 1. *Frequency of reported sharps injury by year for staff*

	Nursing Staff range (FTE) (833·2–1028)		Administration Staff range (FTE) (349·2–379·1)		Paramedical Staff range (FTE) (154·0–202·6)		Scientist and technician Staff range (FTE) (189·4–245·1)		Other non-medical Staff range (FTE) (176–194·6)		Medical Staff range (FTE) (352·4–403·5)			
Year	No.	Rate/yr	No.	Rate/yr	No.	Rate/yr	No.	Rate/yr	No.	Rate/yr	No.	Rate/yr	Year total	Year rate
1998	48	5·69	0	0	2	1·3	16	6·71	2	1·07	46	12·59	114	5·33
1999	49	5·4	1	0·28	3	1·9	9	3·67	1	0·54	35	9·68	98	4·42
2000	34	4·08	0	0	2	1·22	4	2·11	3	1·7	32	9·08	75	3·62
2001	50	5·7	0	0	4	2·4	4	1·88	7	3·96	30	8·19	95	4·39
2002	53	5·29	0	0	1	0·57	8	3·51	3	1·61	34	8·74	99	4·19
2003	41	3·99	0	0	3	1·48	8	3·62	4	2·06	57	14·13	113	4·66
Total	275	5·03	1	0·05	15	1·48	49	3·58	20	1·82	234	10·4	594	4·44

FTE, Full time equivalent.
Reported sharps incidents χ^2 for linear trend: $\chi^2 = 2{\cdot}21$, D.F. = 5, $P > 0{\cdot}05$.

useful comparison for the present study. This study describes the epidemiology of BBFE among HCWs in a teaching hospital in South Australia. The study results will provide important policy suggestions to health authorities and hospital management.

METHODS

A retrospective study was conducted in a 430-bed teaching hospital with about 2200 HCWs. This is a public hospital providing a variety of medical services. Data were obtained from the Occupational Health Safety and Injury Management (OHSIM) Department of the Hospital, under the agreement that the hospital's identity was not revealed. Data comprised self-reported blood or body fluid exposure (BBFE) by staff over the period 1998–2003 as part of the hospital's BBFE legislation and mandatory follow-up procedure. Prior to the study period the hospital had initiated a 24-h BBFE pager hotline that served to facilitate immediate treatment, staff support and counselling, and recording of accident details.

HCWs have been grouped into nursing, medical, paramedical, scientists and technicians, administration and other non-medical staff. Hospital divisions were classified as emergency and perioperative, surgical, medical, women's, support services, and outpatient. The present staff and department categorization method is used by the hospital for internal classification purposes. BBFE reports in the division of mental health were excluded from analyses as staff numbers were not available over the study period. Similarly, human resources staff in the planning and clinical support division were excluded from analyses, as they have no direct contact with patients or medical products, and did not report any BBFE. Annual (and overall over the study period) frequency and rates of BBFE were calculated using the numbers of full-time equivalent (FTE) staff positions as denominators. The hospital payroll provided staff FTEs for all hospital divisions. Data were initially collated and coded manually; rates and χ^2 analysis for trend were conducted using SPSS 12.0 [15] and Epi-Info [16].

RESULTS

A total of 931 BBFE were reported: 594 percutaneous exposures and 337 mucocutaneous exposures, over the 6-year study period. Thirty-five percutaneous injuries involving 'clean' sharps, prior to use, were excluded from analyses as they pose little risk to HCWs [14]. During the study period, no staff were reported to have seroconverted to HIV, HBV or HCV after follow-up management from the OHSIM.

Percutaneous exposures

Medical staff experienced sharps injury at a higher rate (10·40/100 FTE), followed by nurses (5·03/100 FTE), scientists and technician (3·58/100 FTE), other non-medical staff (1·82/100 FTE), paramedical staff (1·48/100 FTE) and administration (0·05/100 FTE) over the study period (Table 1). There was no significant trend over the study period.

Table 2. *Frequency of reported sharps injury by year and division*

	Emergency and perioperative Staff range (FTE) (264·2–332·7)		Surgical Staff range (FTE) (316·7–399·1)		Medical Staff range (FTE) (282·2–605·3)		Women's Staff range (FTE) (305·1–356·4)		Support services Staff range (FTE) (588·3–694·7)		Outpatient Staff range (FTE) (79·6–126·8)			
Year	No.	Rate/yr	No.	Rate/yr	No.	Rate/yr	No.	Rate/yr	No.	Rate/yr	No.	Rate/yr	Year total	Year rate
1998	29	9·45	26	8·05	27	7·07	12	3·37	13	1·98	7	6·32	114	5·33
1999	23	8·16	17	5·23	26	5·36	21	6·19	8	1·2	3	2·52	98	4·42
2000	18	6·81	15	4·74	22	4·52	6	1·97	10	1·7	4	3·64	75	3·62
2001	30	10·76	21	5·67	19	3·86	7	2·28	8	1·26	10	12·56	95	4·39
2002	27	9·84	21	5·62	24	3·96	14	4·58	5	0·74	8	6·31	99	4·19
2003	33	9·92	26	6·52	29	4·94	11	3·58	8	1·15	6	5·91	113	4·66
Total	160	9·16	126	5·97	147	4·95	71	3·66	52	1·34	38	6·21	594	4·44

FTE, Full time equivalent.
Reported sharps incidents χ^2 for linear trend: $\chi^2 = 2{\cdot}21$, D.F. = 5, $P > 0{\cdot}05$.

Nearly half (48·1%) of the incidents were reported in emergency and perioperative, and surgical divisions. The emergency and perioperative, and also the outpatient division had the highest sharps injury rates (9·16/100 FTE and 6·21/100 FTE), followed by surgical (5·97/100 FTE) and medical (4·95/100 FTE) (Table 2). There was, however, no change in reporting of sharps injury across the surveillance period.

The circumstances associated with sharps injury, as summarized in Table 3, suggest that percutaneous injury from contaminated sharps most commonly occurred while handling a sharp such as during sharps usage (40·4%), after use but before disposal (27·1%), during the disposal process (11·3%), or during disassembly and cleaning (8·9%). Relatively few incidents occurred while recapping (5·1%) or after disposal (3·2%). Safety features were present in 8·9% of all sharps implicated in a reported percutaneous incident, most commonly intravenous needles and butterfly needles.

Of all 594 reported sharps incidents, 307 involved hollow-bore needles such as subcutaneous needles (96), intravenous needles (85), hypodermic needles (47), intravenous stylets (33), butterfly needles (26) and intramuscular needles (17) and other non-specified (3). Also, scalpel blades (53) can be considered as high risk even though they are not hollow-bore. A further 234 incidents involved relatively low-risk non-hollow-bore sharps such as suture needles (118), lancets (11), other sharps such as scissors, wire pins and other edged equipment (85) and non-specified and unknown non-hollow-bore sharps (20).

Table 3. *Circumstances associated with sharps injury over the study period*

Circumstances	Frequency	%	95% CI
During use	240	40·4	36·4–44·5
After use and before disposal	161	27·1	23·6–30·9
Disassembly/ cleaning sharp	53	8·9	6·7–11·5
Recapping	30	5·1	3·4–7·1
During disposal	67	11·3	8·8–14·1
After disposal	19	3·2	1·9–4·9
Other	16	2·7	1·5–4·3
Unknown	8	1·3	0·6–2·6
Total	594	100	

Different clinical procedures were identified as potential risk factors for percutaneous injuries. Of the 307 injuries from hollow-bore needles, most involved subcutaneous injection (68·7%), drawing venous or arterial blood (7·8%), vascular or arterial cannulation (5·2%), intramuscular injection (3·6%), direct intravenous injection (2·9%) and other procedures (7·2%). Percutaneous injury from non-hollow-bore sharps most commonly occurred during suturing (83·4%).

Mucocutaneous exposures

Over the study period, there were 337 mucocutaneous exposures. The exposure rates were 4·19/100 FTE among nurses, and 2·19/100 FTE in medical doctors, followed by others (Table 4).

Table 4. *Frequency of reported mucocutaneous exposure by year for staff*

	Nursing Staff range (FTE) (833·2–1028)		Administration Staff range (FTE) (349·2–379·1)		Paramedical Staff range (FTE) (154·0–202·6)		Scientist and technician Staff range (FTE) (189·4–245·1)		Other non-medical Staff range (FTE) (176–194·6)		Medical Staff range (FTE) (352·4–403·5)			
Year	No.	Rate/yr	No.	Rate/yr	No.	Rate/yr	No.	Rate/yr	No.	Rate/yr	No.	Rate/yr	Year total	Year rate
1998	33	3·91	1	0·29	3	1·95	5	2·1	4	2·14	2	0·55	48	2·25
1999	47	5·29	0	0	1	0·63	7	2·86	3	1·63	9	2·49	67	3·02
2000	28	3·36	2	0·56	1	0·61	5	2·64	2	1·14	9	2·55	47	2·27
2001	36	4·1	0	0	2	1·2	3	1·41	4	2·26	10	2·73	55	2·54
2002	36	3·59	0	0	4	2·28	5	2·19	2	1·07	13	3·34	60	2·54
2003	50	4·86	1	0·27	2	0·99	1	0·45	0	0	6	1·49	60	2·48
Total	231	4·19	4	0·19	13	1·28	26	1·94	15	1·37	49	2·19	337	2·52

FTE, Full time equivalent.
Reported mucocutaneous exposure χ^2 for linear trend: $\chi^2 = 0{\cdot}02$, D.F. $= 5$, $P > 0{\cdot}05$.

Similar to sharps injuries, the emergency and perioperative care division had the highest rate of mucocutaneous exposure (4·12/100 FTE), followed by the medical, surgical, and outpatient divisions. There was no change in reporting of mucocutaneous exposures across the surveillance period among divisions (Table 5).

Of the 337 mucocutaneous exposures, most involved splashes of blood/blood products (57%), saliva/sputum (19·6%), urine or faeces (8·97%), and others such as vomit and gastric fluid (2·7%). Possible parenteral mucocutaneous exposures, including mucous membrane exposure to blood or blood products, occurred on 167 occasions. A further 11 mucocutaneous exposures involved mucous membrane exposure to material likely to contain HIV, HBV or HCV. Moreover, numerous mucocutaneous exposures reported by staff occurred in the absence of any of three main safety precautions; namely, protective clothing, facemask or eye protection (206/337, 61·1%), and 111 of these splashes involved visible blood or blood products.

DISCUSSION

This study systematically reviewed self-reported work-related BBFE in a teaching hospital in Australia over a 6-year period. Study results indicate that rates of percutaneous exposure were 5·03/100 FTE among nursing staff and 10·4/100 FTE among medical doctors over the study period, which were similar to other Australian studies [12, 14]. The emergency and perioperative, outpatient and surgical divisions had the highest rates of percutaneous injury. This indicated that HCWs and hospital function units who had a close contact with patients had a higher chance of being exposed. Therefore, routine occupational health and safety education, not just an orientation programme should be conducted for all HCWs, which may include regular seminars, newsletters and training sessions.

Percutaneous exposures involving hollow-bore sharps pose the highest risk to HCWs [14], with over half of all sharps incidents in the present study implicating a hollow-bore needle. Safety hollow-bore sharps such as safety intravenous cannulas, and safety butterfly needles were implemented prior to the surveillance study in the targeted hospital. Despite these interventions, 8·9% of all reported sharps incidents implicated a sharp with a safety feature. Another study suggested that both unfamiliarity with and staff acceptance of these devices contribute to incidents with safety sharps and lack of introduction of new sharps procedures [17]. This could not be a sufficient explanation for the results of the present study, because some staff in the study hospital were likely to have had over 6 years' experience with safety butterfly needles and intravenous cannulas. Continued OHSIM education and staff feedback might be a means of promoting appropriate sharps use.

Although recapping is not recommended practice in the study hospital, 5% of all reported incidents were associated with this practice. However, the number of HCWs who recap is likely to be far greater

Table 5. *Frequency of reported mucocutaneous exposure by year and division*

	Emergency and perioperative Staff range (FTE) (264·2–332·7)		Surgical Staff range (FTE) (316·7–399·1)		Medical Staff range (FTE) (282·2–605·3)		Women's Staff range (FTE) (305·1–356·4)		Support services Staff range (FTE) (588·3–694·7)		Outpatient Staff range (FTE) (79·6–126·8)			
Year	No.	Rate/yr	No.	Rate/yr	No.	Rate/yr	No.	Rate/yr	No.	Rate/yr	No.	Rate/yr	Year total	Year rate
1998	10	3·26	11	3·4	12	3·14	5	1·4	9	1·37	1	0·9	48	2·25
1999	13	4·61	7	2·15	21	4·33	10	2·95	8	1·2	8	6·71	67	3·02
2000	7	2·65	11	3·47	13	2·67	5	1·64	8	1·36	3	2·73	47	2·27
2001	13	4·66	13	3·51	14	2·85	4	1·3	9	1·42	2	2·51	55	2·54
2002	13	4·74	16	4·28	19	3·14	3	0·98	6	0·89	3	2·37	60	2·54
2003	16	4·81	11	2·76	21	3·57	4	1·3	5	0·72	3	2·95	60	2·48
Total	72	4·12	69	3·26	100	3·28	31	1·6	45	1·16	20	3·03	337	2·52

FTE, Full time equivalent.
Reported mucocutaneous exposure χ^2 for linear trend: $\chi^2=0{\cdot}02$, D.F. = 5, $P>0{\cdot}05$.

than the number who reported injuries, as not every needle recap sustains an injury. Recapping remains a highly contentious practice, as both HCWs and researchers have questioned the risks involved with having to handle exposed needles [1, 18], and support for safe needle resheathing devices is evident in other studies [17, 19]. Similar results in an international study [2] suggest over 80% of sharps injuries were associated with use, disassembly and cleaning, recapping, and after disposal, indicating strong support for safer needle devices. The introduction of safety hollow-bore retracting needles would eliminate any need to recap. An unpublished study indicated that the implementation of these devices for procedures such as subcutaneous injections and venous/arterial blood sampling could reduce percutaneous injury by up to 40% (P. J. Tully et al., unpublished observations). However, such reductions are tempered by the cost of safety sharps devices and staff approval or acceptability must be sought prior to implementation of new systems.

Work-related mucocutaneous exposures pose a lesser risk than percutaneous injury, and receive less research attention. Despite the relatively low BBP transmission risk via fluid exposures, a 20-year national surveillance in the United States indicated that 14% of occupationally acquired HIV infection involves mucocutaneous exposure [6]. In the present study, over half of all fluid exposures were defined as 'possible parenteral' involving a mucocutaneous exposure to visible blood or blood products, and thus posing as a potential BBP transmission route. Similar to sharps injuries in this hospital, the HCWs and function units with a close contact with patients had higher fluid splash rates. More attention should be paid to mucocutaneous exposures in the study hospital, given the HCWs' experience in the United States.

The high numbers of mucocutaneous exposures without adequate protection are of great concern, as such protective measures have the potential to reduce the risk of occupational transmission via mucocutaneous exposure, aside from fluid exposures to non-intact skin [20, 21]. Primary prevention such as use of splash glasses is recommended, and would reduce the need for follow-up of parenteral mucocutaneous exposures. Although routine face-mask and eye protection is ideal, it is often not possible in emergency situations where staff anecdotally report not having enough time to put on protective attire. Despite some authors' contention that not wearing protective clothing is inconceivable [17], it is a reality in healthcare settings and further study is required to assess this issue.

For virus transmission via mucocutaneous exposures to mucous membranes and non-intact skin, Do et al. [6] reported a mucocutaneous exposure to chapped hands by diarrhoeal stools, urine and coffee ground emesis from a patient who was confirmed as the source of their HIV and HCV infection. Thus, perhaps any significant mucocutaneous exposure to non-intact skin or mucous membrane with visible blood is a possible mode of virus transmission for HIV and HCV. This indicates that it is necessary to pay attention to the exposures to mucous membranes and non-intact skin. In our report, the possible and definite parenteral exposures of mucous membranes to blood have been included as they could be considered the high-risk exposures that may possibly lead to virus transmission.

Despite the low transmission rates of BBPs, the study hospital maintains a thorough BBFE post-exposure management protocol as reflected in over half of health-care staff reporting percutaneous and mucocutaneous exposures receiving follow-up blood tests. The high follow-up of mucocutaneous and percutaneous exposures is costly with some staff requiring several tests within 3–6 months. The present study hospital's 24-h pager hotline has remedied, at a certain level, underreporting and provided necessary help to the HCWs with occupational injury, although it is likely that staff continue to underreport incidents perceived as low risk [14] (P. J. Tully et al., unpublished observations).

With the implementation of retracting needles or resheathing devices, a conservative reduction of up to 40% of percutaneous injuries could be expected (P. J. Tully et al., unpublished observations). The HCWs in the present study are at lesser risk from high-risk hollow-bore injuries than was reported in another Australian study [14]. As administrators in larger hospital settings exhibit a tolerance for sharps injuries [21], the cost-effectiveness of reducing percutaneous injury risk needs to be addressed in comparison to the high follow-up rate of BBFE, and staff concerns. It is anticipated that price reductions outside the United States will make safety sharps a more viable option for administrators in Australia's health-care settings [13]. Hollow-bore needles are the devices most frequently implicated in occupational HIV/AIDS transmission [5] and pose substantial risk [1]. There will need to be post-exposure follow-up of staff until percutaneous injury is reduced by the implementation of improved safety devices, or practices. Further research and collaboration, involving government, hospital authority and HCWs, will provide impetus for improving HCW protection from BBFE and BBP transmission.

ACKNOWLEDGEMENTS

We thank the study hospital's Occupational Health and Safety and Injury Management staff who collected and provided the data.

DECLARATION OF INTEREST

None.

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