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# Nurses' sharps, including needlestick, injuries in public and private healthcare facilities in New South Wales, Australia

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**Abstract.** ***Background*:** The aim of this paper is to determine factors associated with sharps-related injury rates in nurses by analysing the combined data from two state-wide cross-sectional studies of nurses and comparing rates between public and private sectors and between different nurse practice areas in NSW.

***Methods*:** The data from two studies conducted in 2006 and 2007 were combined for 44 similar data items and for similar nurse participants (registered nurses, registered midwives and enrolled nurses). Both studies had recruited nurses from membership of the NSW Nurses' Association. Data for 256 and 1100 participants respectively were combined for this comparative analysis.

***Results*:** The sharps-related annual injury rate was 7.2% (95% CI: 5.9, 8.7). It was significantly higher in operating theatres, renal, mental health and paediatric practice areas in private compared with public facilities (17.9% versus 5.2%). Positive aspects of sharps safety practices included: 90% of nurses reported their injuries, were aware of processes required for dealing with sharps injuries and found their managers to be approachable. Areas for improvement included the provision of information about persons responsible for follow-up (21% unsure), increased provision of safety-engineered medical devices (SEMDs) (50% not available), decreased provision of non-SEMDs (75% available) and a focus on the highly-resistant practice of recapping needles (35% report recapping non-SEMDs).

***Conclusions*:** There are significant differences in sharps-related injuries between public and private facilities. Opportunities exist to improve safety practices across various nursing practice environments.

**Additional keywords:** health and safety, healthcare-acquired infection, needlestick injuries, nursing, occupational exposure, occupational health.

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## Introduction

Needlestick injuries are recognised as a significant occupational hazard for healthcare workers.[1] Bloodborne pathogens, including the human immunodeficiency virus (HIV), are known to be associated with needlestick injuries.[2] Of great concern internationally is the Hepatitis C virus (HCV)[3] since both prevalence and seroconversion rates are higher for HCV than for HIV.[4] In addition, there is no vaccine and no post-exposure prophylaxis for HCV.[5] As a consequence, 2.2% of acute HCV infections in the United States in 2007 resulted from occupational blood exposures.[6] The USA Exposure Prevention Information Network (EPINet) data for 2011 showed that: 93% of injuries were caused by sharps that were contaminated, 42% of sharps injuries were reported by nurses and 34% of injuries occurred in the operating room or recovery with a further 33% in a patient's room.[7]

The high rate of sharps injuries among nurses has attracted the attention of researchers internationally. In the UK, a large study of nurses in 2008 found that 48% of nurses had sustained sharps injuries in their careers, with 10% having at least one in the previous year.[8] In Australia, a 10-year

 

**Implications**

- It is recommended that there be a legislated requirement for the provision of SEMDs and removal of non-SEMDs.
- A review of why injury rates are higher in the private sector is warranted.
- Awareness should be promoted among nurses of the designated persons within their workplace responsible for responding to sharps incidents.

prospective study ($n = 215$) by Whitby and McLaws[9] at a large Australian public teaching hospital, reported that 22% of nurses sustained a needlestick injury in 2001 and that 72% of these were incurred post patient use. Also in Australia, Peng *et al.*[10] conducted a 1000-bed tertiary hospital study between 2000 and 2003 that examined sharps injury and body-fluid exposure among healthcare workers, reporting that nurses sustained 47% of sharps injuries. These studies reported data from nurses working in public hospitals, owned and administered by their state governments. To date no studies in Australia before 2007 have reported data from nurses working in privately-owned hospitals.

Two multi-institutional cross-sectional studies of nurses and midwives concerning sharps injuries were carried out in the Australian state of NSW in 2006–07. They were:

(1) The New South Wales (NSW) Health Sharps Safety Project (referred to below as Study 1), conducted in 2006–07.[11]
(2) The University of Newcastle, in collaboration with the NSW Nurses' Association (NSWNA), conducted in 2007, a sharps including needlestick injuries study (referred to below as Study 2).[12]

The aim of this paper was to determine factors associated with sharps-related injury rates in New South Wales nurses, by analysing combined data from two studies of registered nurses, enrolled nurses and registered midwives who worked in public and private health facilities on the forty-four items common to both studies' questionnaires. Of particular interest were injury rates in public versus private facilities and how they varied by nurse practice area.

## Methods

### *Study 1: the New South Wales Health Sharps Safety Project*

Study 1 sought to minimise and eliminate risks related to sharps in the NSW public health system through a review of risk-reduction strategies.[11] This was a cross-sectional study that collected data on occupational injuries, including needlestick or other sharps injuries and blood or body-fluid exposures, and the perspectives and practices of healthcare workers regarding sharps safety during the previous 2 years. A questionnaire was developed for selected groups of staff and distributed to clinical product managers, staff health personnel, senior managers, clinicians and clinical support workers. The questionnaire was based on six themes: workplace safety culture, education, risk-control strategies, product-evaluation committees, reporting of occupational exposure and post-exposure management.

#### *Study participants*

Recruitment of study participants for Study 1 was conducted by selecting randomised samples of fee-paying members of professional organisations for clinical personnel. Of the 1150 questionnaires distributed by mail, 700 were sent to nurses. The response rate from this group was 59% ($n = 410$), consisting of: 95 ambulance personnel who held registration as nurses, registered nurses, enrolled nurses, and registered midwives. Of these, only the responses from registered nurses, registered midwives and enrolled nurses who worked in the public health system were used for the purposes of this analysis ($n = 256$).[11]

### *Study 2: the Sharps Including Needlestick study*

Study 2, known as the Sharps Including Needlestick (SIN) Study, was a cross-sectional study of needlestick injury among members of the NSWNA.[12] Ethical approval for the study was provided by the human research ethics committee of the University of Newcastle. Nurses were randomly selected from the membership based on their sector of work (public and private hospitals, aged-care facilities, disability services and community nursing) and geographic region. The geographic regions were classified using the Australian Standard Geographic Classification Accessibility/Remoteness Index of Australia (ARIA) which groups geographic areas into five categories: 'major cities', 'inner regional', 'outer regional', 'remote' and 'very remote'. These categories are based on census collection districts and use accessibility by road to services to develop a remoteness index for Australia, where distance is an important factor in delivery of health services. The categories were subsequently collapsed to four to represent city, regional, rural and remote areas.

The objectives of the study were to determine: occurrence of sharps-related injuries within a 1-year period, reporting and follow-up of injury, perceptions of risks associated with sharps-related injuries, access to SEMDs, and the perception that these devices prevent sharps-related injuries in public and private healthcare facilities. In addition, it sought to gauge the perception of nurses regarding employer risk-control measures to prevent injury. Findings were published elsewhere.[12,13]

#### *Study participants*

Study 2 also recruited participants who were members of the NSWNA. From the 7423 questionnaires sent to

contactable members who had worked within the previous year, 1301 (18%) completed the questionnaire. One-hundred-and-sixty-five responses from nurse executives, 36 assistants in nursing (AINs) and those with unknown nursing roles were excluded, leaving 1100 responses used in this analysis. The type of facility recorded was public hospital, community services, disability services and private hospital or aged-care facility.[12,13]

### *Recall of injury*

The recall period used in these two retrospective studies differed: the recall period in Study 1 was 2 years, whereas the Study 2 recall period was 1 year. While it is mathematically correct to divide the 2-year recall rate in half to produce a 1-year rate, the literature suggests there are other considerations to keep in mind when comparing self-reported recall rates over long periods. Self-reported occupational injury rates have been shown to decrease significantly as time since the event increases from 4 weeks to 1 year,[14,15] although the decline is not as great for more serious injuries, such as fractures.[16] By utilising both short-term (1-day) and longer-term (1-month) questionnaires concerning injuries by contaminated needles, Aiken *et al.* found that the 1-month recall was accurate.[17] In 2005, Moshiro *et al.*[18] found that for severe occupational injuries (i.e. causing disability of 30 days or more), a recall period of 1 year does not affect recalled injury rates. When studying recall of amateur football injuries in Australia, Gabbe *et al.*[19] found that all players were accurately able to recall whether or not they had had an injury in the last 12 months, but that the accuracy declined as the level of detail required increased. Thus, given that the majority of sharps injuries result in little or no bleeding,[7] even though each injury may have potentially serious consequences, both the 1- and 2-year recall rates are likely to under-report the actual rate of injury.

It is reasonable to assume that the rate of decline in the second year is not as great as that in the first year. Forward telescoping is the tendency to report events as occurring more recently than they actually occurred. In a study comparing 2-month to 4-month recall of doctor's visits, it was found that the amount of forward telescoping was much greater for the shorter period; the event rate only increased from 57% to 62% despite a doubling of the length of the recall period.[20] Similarly, when comparing recalled doctor's visits to patient records, Jinks *et al.*[21] found that visits that were recalled to have occurred within 12 months, actually occurred up to 36 months previously. To summarise, the 1-year recall rate may suffer from two problems: forgetting (resulting in some under-reporting), and some forward telescoping (resulting in over-reporting). Since forgetting is more of a problem with longer recall periods and the forward telescoping is more of a problem with shorter recall periods, it is reasonable to assert that the 2-year recall rate is comparable to the 1-year recall rate. Therefore, we made no adjustment to the number of injuries reported.

### *Statistical analysis*

In these two studies, 44 questions in common were identified in the questionnaires used. The questions relating to injury differed slightly in the two studies: Study 2 asked respondents about the occurrence of needlestick injuries as did Study 1. The Study 1 question had four responses: yes (due to a needlestick), yes (due to another type of sharp), yes (other bloodborne exposures) and no; thus the first two responses were included as equivalent to the 'yes' response to the Study 2 question.

Injury rates were calculated by dividing the number of injuries by the number of nurses at risk. Before further statistical analysis we first determined that the injury rates in the two datasets did not differ using a Fisher's exact test.

To compare public versus private facilities Fisher's exact tests were used for categorical responses. Multivariable logistic regression modelling was used to identify factors that were associated with sharps-related injuries. Exact binomial intervals, at the 95% level, were reported for observed injury rates. Significance was determined at the 5% level. All data manipulation and analyses were performed using Stata MP Version 12.2.[22]

## Results

### *Comparison of studies*

Of the 1356 nurses in the combined dataset, 98 reported sustaining a sharps-related injury (7.2%, 95% CI: 5.9, 8.7). Of the 1100 nurses in Study 2, 80 recalled being injured in the last 1 year (7.27%, 95% CI 5.8, 9.0), and of the 256 nurses in Study 1, 18 recalled being injured in the last 2 years (7.03%, 95% CI 4.2, 10.9). The Study 1 rate is lower, although not significantly so according to a Fisher's exact test ($P = 1$).

### *Characteristics of study participants*

Employment characteristics and injury rates of 1356 responding nurses are shown in Table 1 by the type of facility: public or private. The injury rate for nurses working in private facilities was 8.4% and in public facilities was 6.7%; the difference was not significant according to a crude Fisher's exact test ($P = 0.3$). Similar proportions of registered nurses (80%), enrolled nurses (15%) and midwives (5%) were found in the private and public facilities. The injury rate for registered nurses was somewhat higher at 8%, compared with 6% and 3% for enrolled nurses and midwives, although not significantly so ($P = 0.3$).

In private facilities most nurses practiced in aged care, operating theatres and surgical wards. The injury rate for nurses practicing in operating theatres was significantly higher than that in public facilities: 17% versus 4%, $P = 0.03$

The injury rate for nurses working in a remote region was higher than that for other regions (15% versus 6%,

**Table 1. Employment characteristics: nurse counts, percentages and injury rates by employment characteristics and facility type**

Note: while the sum of the percentages of nurses in categories do sum to 100%, injury rates do not.*and** indicate Fisher's exact test of injury rate by public *v*. private significant at 5 and 1%, respectively. † and †† indicate Fisher's exact test of injury rate by variable significant at 5 and 1%, respectively.

| Variable | Nurses (percent %) | | | Injuries (rate %) | | |
|---|---|---|---|---|---|---|
| | Public $n=950$ | Private $n=406$ | Total $n=1356$ | Public $n=64$ | Private $n=34$ | Total $n=98$ |
| Study | | | | | | |
| Study 2 2007 | 694 (73%) | 406 (100%) | 1100 (81%)** | 46 (7%) | 34 (8%) | 80 (7%) |
| Study 1 2006 | 256 (27%) | 0 (0%) | 256 (19%)** | 18 (7%) | 0 (0%) | 18 (7%) |
| Nursing role | | | | | | |
| Enrolled nurse | 143 (15%) | 56 (14%) | 199 (15%) | 9 (6%) | 3 (5%) | 12 (6%) |
| Reg. nurse | 770 (81%) | 321 (79%) | 1091 (80%) | 53 (7%) | 31 (10%) | 84 (8%) |
| Reg. midwife | 37 (4%) | 29 (7%) | 66 (5%)* | 2 (5%) | 0 (0%) | 2 (3%) |
| Practice area | | | | | | |
| Paediatrics | 42 (5%) | 2 (1%) | 44 (3%)** | 1 (2%) | 1 (50%) | 2 (5%) |
| Renal | 16 (2%) | 3 (1%) | 19 (1%) | 2 (13%) | 1 (33%) | 3 (16%) |
| Operating theatre | 71 (8%) | 72 (19%) | 143 (11%)** | 3 (4%) | 12 (17%) | 15 (10%)* |
| Mental health | 63 (7%) | 7 (2%) | 70 (5%)** | 4 (6%) | 1 (14%) | 5 (7%) |
| Intensive care | 24 (3%) | 23 (6%) | 47 (4%)** | 4 (17%) | 0 (0%) | 4 (9%) |
| Pathology | 27 (3%) | 1 (0%) | 28 (2%)** | 4 (15%) | 0 (0%) | 4 (14%) |
| Medical ward | 81 (9%) | 16 (4%) | 97 (8%)** | 8 (10%) | 0 (0%) | 8 (8%) |
| Maternity | 53 (6%) | 31 (8%) | 84 (7%) | 5 (9%) | 1 (3%) | 6 (7%) |
| Community | 125 (14%) | 6 (2%) | 131 (10%)** | 6 (5%) | 0 (0%) | 6 (5%) |
| Emergency | 84 (9%) | 10 (3%) | 94 (7%)** | 11 (13%) | 1 (10%) | 12 (13%) |
| Surgical ward | 58 (6%) | 119 (31%) | 177 (14%)** | 4 (7%) | 11 (9%) | 15 (8%) |
| Aged care | 74 (8%) | 67 (17%) | 141 (11%)** | 3 (4%) | 3 (4%) | 6 (4%) |
| Other | 183 (20%) | 32 (8%) | 215 (17%)** | 7 (4%) | 2 (6%) | 9 (4%) |
| Not reported | 49 (5%) | 17 (4%) | 66 (5%) | 2 (4%) | 1 (6%) | 3 (5%) |
| Region †† | | | | | | |
| Not reported | 91 (10%) | 62 (15%) | 153 (11%)** | 10(11%) | 11 (18%) | 21(14%) |
| Remote | 61 (6%) | 6 (1%) | 67 (5%)** | 10(16%) | 0 (0%) | 10(15%) |
| Rural | 150 (16%) | 17 (4%) | 167 (12%)** | 7 (5%) | 1 (6%) | 8 (5%) |
| Regional | 259 (27%) | 153 (38%) | 412 (30%)** | 15 (6%) | 10 (7%) | 25 (6%) |
| City | 389 (41%) | 168 (41%) | 557 (41%) | 22 (6%) | 12 (7%) | 34 (6%) |
| Employment status | | | | | | |
| Full-time | 490 (52%) | 134 (33%) | 624 (46%)** | 32 (7%) | 14 (10%) | 46 (7%) |
| Part-time | 383 (41%) | 228 (57%) | 611 (45%)** | 26 (7%) | 19 (8%) | 45 (7%) |
| Casual | 70 (7%) | 39 (10%) | 109 (8%) | 5 (7%) | 1 (3%) | 6 (6%) |
| Hours worked per week † | | | | | | |
| 38h or more | 355 (38%) | 99 (25%) | 454 (34%)** | 27 (8%) | 9 (9%) | 36 (8%) |
| 24–37 h | 315 (33%) | 165 (41%) | 480 (36%)** | 25 (8%) | 18 (11%) | 43 (9%) |
| Less than 24h | 276 (29%) | 138 (34%) | 414 (31%) | 12 (4%) | 7 (5%) | 19 (5%) |
| Number of years of experience | | | | | | |
| Less than 2 | 34 (4%) | 9 (2%) | 43 (3%) | 3 (9%) | 0 (0%) | 3 (7%) |
| 3–6 years | 76 (8%) | 32 (8%) | 108 (8%) | 9 (12%) | 4 (13%) | 13 (12%) |
| 7–10 years | 77 (8%) | 28 (7%) | 105 (8%) | 7 (9%) | 1 (4%) | 8 (8%) |
| 11–20 years | 193 (21%) | 66 (17%) | 259 (20%) | 11 (6%) | 6 (9%) | 17 (7%) |
| More than 20 | 543 (59%) | 255 (65%) | 798 (61%)* | 33 (6%) | 21 (8%) | 54 (7%) |

$P<0.01$). Very few nurses worked in private facilities in rural or remote areas. More nurses worked part-time in private facilities than public facilities (57% *v.* 41%, $P<0.02$), and fewer worked full-time than part-time (33% *v.* 52%, $P<0.01$), and a similar trend was found in the number of hours worked per week. Injury rates in the 24 to 37 h per week group were somewhat higher than the other groups (8.9% *v.* 6.5%, $P=0.08$). For nurses with between 3 and 6 years of experience we found a marginally higher injury rate than the other groups (12% *v.* 7%, $P=0.05$).

### *Workplace environment including availability of non-safety-engineered medical devices*

Results associated with the workplace environment are reported in Table 2. Nearly all respondents (94%) reported

**Table 2. Work environment: nurse counts, percentages and injury rates by management and safe equipment availability and facility type**

| Variable | Nurses (percent %) | | | Injuries (rate %) | | |
|---|---|---|---|---|---|---|
| | Public $n=950$ | Private $n=406$ | Total $n=1356$ | Public $n=64$ | Private $n=34$ | Total $n=98$ |
| Information available about the management process of injuries or exposures | | | | | | |
| Yes | 891 (97%) | 380 (97%) | 1271 (94%) | 60 (7%) | 32 (8%) | 92 (7%) |
| No | 30 (3%) | 11 (3%) | 41 (3%) | 3 (10%) | 1 (9%) | 4 (10%) |
| Designated person or department responding to sharps incidents | | | | | | |
| Other | 95 (10%) | 56 (14%) | 151 (11%)* | 9 (9%) | 8 (14%) | 17 (11%) |
| Infection control | 255 (27%) | 121 (30%) | 376 (28%) | 20 (8%) | 9 (7%) | 29 (8%) |
| Staff health | 152 (16%) | 8 (2%) | 160 (12%)** | 10 (7%) | 1 (13%) | 11 (7%) |
| Nurse manager | 131 (14%) | 110 (27%) | 241 (18%)** | 13 (10%) | 4 (4%) | 17 (7%) |
| Emergency department | 75 (8%) | 1 (0%) | 76 (6%)** | 5 (7%) | 0 (0%) | 5 (7%) |
| Risk manager | 38 (4%) | 31 (8%) | 69 (5%)** | 0 (0%) | 4 (13%) | 4 (6%)* |
| Not sure | 204 (21%) | 79 (19%) | 283 (21%) | 7 (3%) | 8 (10%) | 15 (5%)* |
| Managers approachable about any concerns relating to injuries or exposures | | | | | | |
| Yes | 859 (93%) | 377 (95%) | 1236 (91%) | 54 (6%) | 32 (8%) | 86 (7%) |
| No | 64 (7%) | 19 (5%) | 83 (6%) | 7 (11%) | 2 (11%) | 9 (11%) |
| Managers provide safe working environment in terms of sharps safety | | | | | | |
| Yes | 771 (85%) | 335 (86%) | 1106 (82%) | 49 (6%) | 29 (9%) | 78 (7%) |
| No | 141 (15%) | 53 (14%) | 194 (14%) | 14 (10%) | 5 (9%) | 19 (10%) |
| Non-safety-engineered medical devices available | | | | | | |
| Yes | 694 (73%) | 339 (83%) | 1033 (76%)** | 52 (7%) | 29 (9%) | 81 (8%) |
| No | 256 (27%) | 67 (17%) | 323 (24%)** | 12 (5%) | 5 (7%) | 17 (5%) |
| Point-of-use disposal container available in work area | | | | | | |
| Yes | 856 (90%) | 377 (93%) | 1233 (91%) | 58 (7%) | 33 (9%) | 91 (7%) |
| No | 94 (10%) | 29 (7%) | 123 (9%) | 6 (6%) | 1 (3%) | 7 (6%) |
| Types of sharps and safety-engineered medical devices available in work area | | | | | | |
| Syringes and injection equipment | | | | | | |
| Yes | 584 (61%) | 195 (48%) | 779 (57%)** | 40 (7%) | 15 (8%) | 55 (7%) |
| No | 366 (39%) | 211 (52%) | 577 (43%)** | 24 (7%) | 19 (9%) | 43 (7%) |
| Blood collection | | | | | | |
| Yes | 472 (50%) | 209 (51%) | 681 (50%) | 35 (7%) | 19 (9%) | 54 (8%) |
| No | 478 (50%) | 197 (49%) | 675 (50%) | 29 (6%) | 15 (8%) | 44 (7%) |
| IV access insertion equipment | | | | | | |
| Yes | 488 (51%) | 186 (46%) | 674 (50%) | 32 (7%) | 16 (9%) | 48 (7%) |
| No | 462 (49%) | 220 (54%) | 682 (50%) | 32 (7%) | 18 (8%) | 50 (7%) |
| IV delivery systems | | | | | | |
| Yes | 507 (53%) | 204 (50%) | 711 (52%) | 34 (7%) | 20 (10%) | 54 (8%) |
| No | 443 (47%) | 202 (50%) | 645 (48%) | 30 (7%) | 14 (7%) | 44 (7%) |
| Lancets | | | | | | |
| Yes | 580 (61%) | 168 (41%) | 748 (55%)** | 40 (7%) | 15 (9%) | 55 (7%) |
| No | 370 (39%) | 238 (59%) | 608 (45%)** | 24 (6%) | 19 (8%) | 43 (7%) |
| Suture needles (blunt) | | | | | | |
| Yes | 582 (61%) | 346 (85%) | 928 (68%)** | 39 (7%) | 28 (8%) | 67 (7%) |
| No | 368 (39%) | 60 (15%) | 428 (32%)** | 25 (7%) | 6 (10%) | 31 (7%) |
| Surgical scalpels | | | | | | |
| Yes | 252 (27%) | 103 (25%) | 355 (26%) | 16 (6%) | 11 (11%) | 27 (8%) |
| No | 698 (73%) | 303 (75%) | 1001 (74%) | 48 (7%) | 23 (8%) | 71 (7%) |

there was a process for dealing with sharps injuries and blood or body fluid and they knew how to access information about it. The department or person responsible for responding to sharps incidents was most frequently reported to be infection control (28%) or the nurse manager (18%). However, 21% were unsure who to report to in the event of an injury, and among these nurses, the injury rate in private facilities was significantly higher (10% private versus 3% public, $P < 0.01$). Over 90% of nurses said managers were approachable with concerns about blood and body fluid or in the event of an

injury; 90% reported having point-of-use sharps disposal containers available in their work area, and 81% reported that there was a safety culture in their workplace.

Non-SEMDs (e.g. IV access insertion devices and delivery systems, blood collection devices, surgical scalpels and suture needles) were still available in the work areas of 76% of nurses, more frequently in private than public facilities: 83% versus 73% ($P < 0.01$). Furthermore, the injury rates were marginally higher when non-SEMDs were available: 8% versus 5% ($P = 0.06$).

### *Nurses' practices and perceptions*

Table 3 shows results concerning nurses' practices and perceptions about safety overall. Approximately 80% considered that infection is unlikely following an injury, 35% of nurses had recapped non-safety needles, 16% did not believe that SEMDs make them safer and 3% didn't usually wear gloves for risky procedures. They reported that if they were to sustain a sharps injury the main reasons for reporting that injury would be: to have the risk assessed (70%), fear of acquiring a bloodborne disease (69%), to be informed of blood test results (41%), and the need to have the hazard registered (35%).

### *Practices and perceptions of injured nurses*

In total, 7.2% (98 out of 1356) of nurses recalled an injury in the last 1 to 2 years. Of the 98 injured nurses, 79% believed infection was unlikely following an injury (80% public versus 76% private, $P = 0.6$). Ten (9.8%) of these nurses did not report their injury (12.5% public versus 5.9% private, $P = 0.5$). For the 88 nurses that did report, the most common reasons for reporting were the need to have the hazard registered (25%), to have the injury assessed (19%), and fear of acquiring a bloodborne disease (16%). Thirty-four per cent of these nurses felt they did not receive adequate counselling. The most common method of reporting was verbal (89%), although 40% completed an electronic report and 66% filed a report on paper. Electronic filing was significantly higher in public facilities (54% public versus 16% private, $P < 0.01$) and paper filing was marginally higher in private facilities (57% public versus 78% private, $P = 0.07$).

### *Injury rates*

Multivariable logistic regression models identified nurse practice area and facility type (public versus private) as significantly related to the likelihood of a sharps injury. All other variables in Table 1 to Table 3, including study, public or private facility, and nurse practice area were tested in a multivariable model and none were found to be significant at the 5% level. In this process of statistical modelling, injury rates among nurses practicing in operating theatres, renal, mental health, and paediatric areas were not significantly different ($P = 0.16$), and thus these groups were combined. Injury rates among nurses practicing in intensive care, pathology collection, medical wards, maternity, and community areas were not significantly different ($P = 0.65$), and thus these groups were combined. The third group of similar practice areas contained emergency, surgical, aged care, other, and not reported ($P = 0.49$).

It was found that nurses practicing in the first group had a significantly higher injury rate in private facilities compared with public facilities (17.9% private versus 5.2% public, $P < 0.01$). In contrast, nurses practicing in emergency, intensive care, pathology services, maternity, medical wards, and community were found to have a significantly lower injury rate in private facilities compared with public facilities (1.3% private versus 8.7% public, $P = 0.04$). The injury rate for nurses working in the remaining practice areas did not differ between public and private (7.3% private versus 6.0% public, $P = 0.53$). Table 4 shows observed injury counts and rates with exact binomial 95% confidence intervals, which are also displayed in Fig. 1, by practice area and facility type.

## Discussion

The aim of this analysis was to compare sharps-related injuries in nurses working in public versus private facilities and how they vary by nurse practice area, using data from two studies conducted in NSW during 2006–07. We found a significant difference in the rates of sharps-related injuries reported by nurses who worked in private facilities compared with those working in public facilities in some practice areas.

### *High-risk areas of practice*

Nurses working in paediatric units, renal units, operating theatres and mental health in private facilities experienced a significantly higher rate of sharps-related injuries than their peers in public facilities. It could be surmised that this difference results from a higher rate of elective surgeries being conducted in private facilities in Australia, since the recent Australian Institute of Health and Welfare Australian Hospital Statistics Report noted that in NSW in 2006–07, 63% of elective surgeries occurred in private facilities.[23] This is likely a simplistic conclusion as we report there is a greater availability of non-safety sharps devices in private facilities. However, we also found that the greater availability of conventional non-SEMDs was not significantly associated with sustaining an injury once practice area and facility type had been included in a multivariable logistic regression model. It would appear that the cause of sharps injuries in the operating theatre in private facilities is a far more complex problem.

The international literature includes papers reporting high-risk practice areas for sharps-related injuries, although recent studies have identified sometimes conflicting data regarding the risk profile of nursing areas of practice. Data from the United States show that 40% of injuries occur in inpatient units, particularly medical floors, intensive care units, and in operating rooms[24] and that operating theatre staff have been reported to sustain 33.3% of sharps-related injuries.[25] A study of Chinese nurses found that operating theatre nurses have a

**Table 3. Nurse safety: nurse counts, percentages and injury rates by practices and opinions and facility type**
* and ** indicate Fisher's exact test of injury rate by public *v*. private significant at 5 and 1%, respectively. †and†† indicate Fisher's exact test of injury rate by variable significant at 5 and 1%, respectively.

| Variable | Nurses (percent %) | | | Injuries (rate %) | | |
|---|---|---|---|---|---|---|
| | Public $n=950$ | Private $n=406$ | Total $n=1356$ | Public $n=64$ | Private $n=34$ | Total $n=98$ |
| Do you ever recap non-safety needles? | | | | | | |
| Yes | 317 (33%) | 160 (39%) | 477 (35%)* | 21 (7%) | 12 (8%) | 33 (7%) |
| No | 633 (67%) | 246 (61%) | 879 (65%) | 43 (7%) | 22 (9%) | 65 (7%) |
| Do safety-engineered medical devices make you safer? | | | | | | |
| Yes | 800 (84%) | 345 (85%) | 1145 (84%) | 56 (7%) | 27 (8%) | 83 (7%) |
| No | 150 (16%) | 61 (15%) | 211 (16%) | 8 (5%) | 7 (11%) | 15 (7%) |
| Do you wear gloves for risky procedures? | | | | | | |
| Yes | 913 (96%) | 397 (98%) | 1310 (97%) | 62 (7%) | 34 (9%) | 96 (7%) |
| No | 37 (4%) | 9 (2%) | 46 (3%) | 2 (5%) | 0 (0%) | 2 (4%) |
| Chance of becoming infected following needlestick injury?[A] †† | | | | | | |
| Likely | 64 (20%) | 12 (24%) | 76 (21%) | 18 (28%) | 11 (92%) | 29 (38%)** |
| Unlikely | 253 (80%) | 39 (76%) | 292 (79%) | 44 (17%) | 22 (56%) | 66 (23%)** |
| What would influence you to report all injuries? The need to have my risk assessed | | | | | | |
| Yes | 682 (72%) | 262 (65%) | 944 (70%)** | 46 (7%) | 24 (9%) | 70 (7%) |
| No | 268 (28%) | 144 (35%) | 412 (30%)** | 18 (7%) | 10 (7%) | 28 (7%) |
| Fear of acquiring Hepatitis B,C, HIV | | | | | | |
| Yes | 642 (68%) | 291 (72%) | 933 (69%) | 35 (5%) | 26 (9%) | 61 (7%) |
| No | 308 (32%) | 115 (28%) | 423 (31%) | 29 (9%) | 8 (7%) | 37 (9%) |
| Being informed about blood test results | | | | | | |
| Yes | 376 (40%) | 176 (43%) | 552 (41%) | 23 (6%) | 17 (10%) | 40 (7%) |
| No | 574 (60%) | 230 (57%) | 804 (59%) | 41 (7%) | 17 (7%) | 58 (7%) |
| The need to have the hazard registered | | | | | | |
| Yes | 334 (35%) | 145 (36%) | 479 (35%) | 25 (7%) | 16 (11%) | 41 (9%) |
| No | 616 (65%) | 261 (64%) | 877 (65%) | 39 (6%) | 18 (7%) | 57 (6%) |
| Raised awareness from regular education | | | | | | |
| Yes | 199 (21%) | 116 (29%) | 315 (23%)** | 14 (7%) | 11 (9%) | 25 (8%) |
| No | 751 (79%) | 290 (71%) | 1041 (77%)** | 50 (7%) | 23 (8%) | 73 (7%) |
| Confidence in management to address cause | | | | | | |
| Yes | 213 (22%) | 118 (29%) | 331 (24%)* | 9 (4%) | 15 (13%) | 24 (7%)** |
| No | 737 (78%) | 288 (71%) | 1025 (76%)* | 55 (7%) | 19 (7%) | 74 (7%) |
| Assurance of confidentiality | | | | | | |
| Yes | 208 (22%) | 98 (24%) | 306 (23%) | 10 (5%) | 9 (9%) | 19 (6%) |
| No | 742 (78%) | 308 (76%) | 1050 (77%) | 54 (7%) | 25 (8%) | 79 (8%) |
| Not being blamed | | | | | | |
| Yes | 184 (19%) | 82 (20%) | 266 (20%) | 12 (7%) | 6 (7%) | 18 (7%) |
| No | 766 (81%) | 324 (80%) | 1090 (80%) | 52 (7%) | 28 (9%) | 80 (7%) |
| Counselling about the incident | | | | | | |
| Yes | 177 (19%) | 74 (18%) | 251 (19%) | 9 (5%) | 5 (7%) | 14 (6%) |
| No | 773 (81%) | 332 (82%) | 1105 (81%) | 55 (7%) | 29 (9%) | 84 (8%) |
| Knowing who would manage incident | | | | | | |
| Yes | 112 (12%) | 48 (12%) | 160 (12%) | 7 (6%) | 5 (10%) | 12 (8%) |
| No | 838 (88%) | 358 (88%) | 1196 (88%) | 57 (7%) | 29 (8%) | 86 (7%) |
| An easier reporting process | | | | | | |
| Yes | 124 (13%) | 69 (17%) | 193 (14%) | 9 (7%) | 4 (6%) | 13 (7%) |
| No | 826 (87%) | 337 (83%) | 1163 (86%) | 55 (7%) | 30 (9%) | 85 (7%) |

[A]Question only answered by those who had sustained an injury.

**Table 4. Sharps injury rates, by practice area and facility type, with exact binomial 95% confidence intervals**

| Practice area | Total | Injured | Injury rate % | 95% CI | *P*-value[A] |
|---|---|---|---|---|---|
| Paediatrics, renal, operating theatre and mental health | | | | | |
| Private | 84 | 15 | 17.86 | 10.4, 27.7 | |
| Public | 192 | 10 | 5.21 | 2.5, 9.4 | 0.004 |
| Total | 276 | 25 | 9.06% | 5.9, 13.1 | |
| Intensive care, pathology collection, emergency, medical ward, maternity and community | | | | | |
| Private | 77 | 1 | 1.3 | 0.0, 7.0 | |
| Public | 310 | 27 | 8.71 | 5.8, 12.4 | 0.041 |
| Total | 387 | 28 | 7.24% | 4.9, 10.3 | |
| Emergency, aged care, surgical, other, not reported | | | | | |
| Private | 245 | 18 | 7.35 | 4.4, 11.4 | |
| Public | 448 | 27 | 6.03 | 4.0, 8.6 | 0.53 |
| Total | 693 | 45 | 6.49% | 4.8, 8.6 | |
| Grand total | 1356 | 98 | 7.23% | 5.9, 8.7 | |

[A]*P*-value for Fisher's exact test of public versus private.

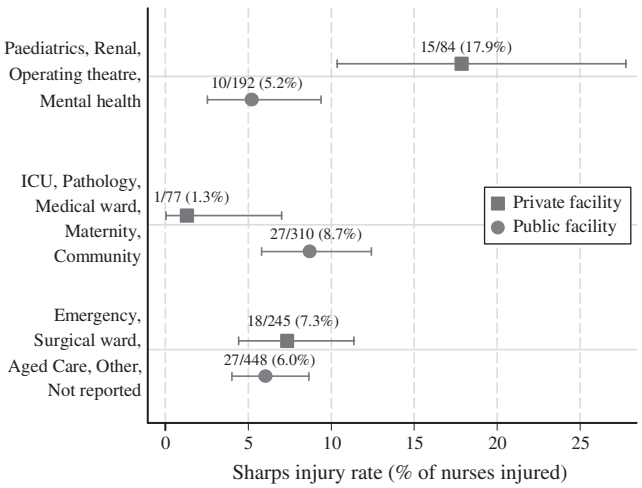


**Fig. 1.** Sharps injury rates, by practice area and facility type, with exact binomial 95% confidence intervals.

higher risk of sharps-related injuries compared with nurses working in other clinical areas.[26] Bilski reported results of a study of 232 Polish nurses who reported 130 needlestick injuries over a period of 2 years, and found that the highest percentage of needlestick injuries occurred in surgical wards, operating theatres, renal units, emergency and intensive care units.[27] A large multi-country study of nurses by Clarke *et al*.[28] found that nurses practicing in operating theatres, recovery and anaesthesia, were twice as likely as nurses in other specialties to experience sharps-related injuries. Rates were also elevated in emergency and intensive care units. The same author reported in a United States study that operating theatre nurses had significantly higher injury rates than those in paediatric, neonatal and mental health.[28] Consistent among these findings is that operating theatres and surgical settings are a high-risk area for sharps, including needlestick injuries.[29]

Jagger *et al*.[30] provide an insight into the types of devices and circumstances associated with injuries in the surgical setting. In reviewing percutaneous injury surveillance data from 87 hospitals in the United States from 1993 to 2006 they compared injury rates in surgical and nonsurgical settings before and after passage of the Needlestick Safety and Prevention Act of 2000[31] (which mandated the provision of SEMDs) and found that after the enactment of the legislation, injury rates in nonsurgical settings dropped 31.6%, but increased 6.5% in surgical settings. The types of injuries and circumstances reported by Jagger *et al*. provides some understanding: most injuries were caused by suture needles, scalpel blades and syringes, and nurses and surgical technicians were typically injured by devices originally used by others.

These differences in what constitutes high-risk areas of practice for nurses sustaining a sharps-related injury were discussed by Smith *et al*.[32] and they suggested the causes of these differences may be that some previous researchers merely listed the prevalence by department and found differing rates, but very few conducted logistic regression analysis adjusted for confounding variables. They suggested that demographic differences would exist between nurses who work in different hospital departments and more rigorous statistical analysis to adjust for confounding variables is required.

### *Public and private facilities*

This analysis, using multivariable logistic regression models, identified two significant covariates that influenced the likelihood of sustaining a sharps-related injury: nurse area of practice and facility type (private versus public). Other demographic factors were not found to be related to the likelihood of a nurse sustaining a sharps-related injury.

In NSW, the management of healthcare workers possibly exposed to blood or body fluid is outlined in the NSW Health Policy Directive on HIV, Hepatitis B and Hepatitis C – Management of Health Care Workers Potentially Exposed[33] and focuses on their immediate care, risk assessment and treatment required. Most nurses (79%) were aware of the designated persons or departments responsible for responding to sharps incidents. However, for the 21% of nurses not sure who in their facility was responsible for responding to these incidents, the injury rate was significantly higher in private facilities (10% versus 3% in public).

### *Reporting of incidents*

Recent research has shown that nurses were more likely to report a sharps or needlestick incident compared with other healthcare workers.[34–36] Regardless of this, several studies have indicated that exposures to blood or body fluid due to sharps incidents are considerably underreported,[9,37–39] although there is much variation in the reporting rate– from 39.5%[34] to 80.3%.[35] The tendency to underreport was lower in this study; over 90% of the injured nurses did report their injury to their employer.

Several studies have consistently reported that the main reasons nurses provide for not reporting incidents were: the lengthy procedure in reporting the incident, workload, fear of being blamed, and the perception that the risk was low and consequently it was not necessary to report the incident.[35,37] We found that electronic reporting of injuries was used more frequently in public facilities and paper-based reporting more often in private facilities. With only 10 study participants not reporting their sharps-related injuries, it was not possible to determine if mode (electronic or paper) of reporting affected the likelihood of reporting an incident.

### *Perceptions of risk*

The results presented in this analysis indicate the nurses working in private facilities were significantly more fearful about acquiring Hepatitis B, C and HIV, had more confidence in management to address the cause of their injury, and that these factors influenced them to report sharps-related injuries more than nurses in public facilities. This is consistent with the lower proportion of nurses in private facilities that did not report their injury.

### *Recapping*

It is clinically significant to recognise that nurses working in both public and private facilities are still recapping non-safety needles (35%); this data indicates that the practice is continued by more than one-third of nurses. NSW Health has identified recapping as an unsafe work practice for healthcare workers and maintains that injuries occurring as a result of this practice are preventable.[40] Furthermore, it has been reported that nurses who never recapped needles experienced a risk reduction of one-third.[41]

### *Safety-engineered medical devices*

The provision of SEMDs in workplaces in Australia, unlike some other countries such as the US, is not currently a legislated requirement. Recently a bid was submitted (in May 2013) to Federal Parliament to enforce the use of SEMDs following a report from the Medical Technology Association of Australia quoting research findings that claimed these devices can reduce injuries by between 22% and 88%.[42] These estimates were from studies that assessed the effectiveness of withdrawing non-SEMDs and replacing them with SEMDs.

In NSW, where this study was conducted, healthcare facilities use a mixture of SEMDs and non-SEMDs. Indeed, 35% of nurses reported recapping non-SEMDs and 16% believed that the use of SEMDs 'does not make you safer'. Our findings suggest that self-regulation alone, in both public and private healthcare facilities, is not sufficient to bring about appropriate uniform availability and use of SEMDs.

### *Study strengths and weaknesses*

A strength of this analysis is that it compares sharps-related injury data between the public and private sector and this has not previously been reported using cross-sectional study data for an Australian state. In addition, these two studies have reported data items that are consistent with national guidelines released in 2010 (NHMRC Australian Guidelines for the Prevention and Control of Infection in Healthcare),[43] and provide an indication of the level of compliance with sections of the guidelines and identify areas for improvement.

The difference in recall period in these two studies is a limitation; however the authors consider that this would have had a minimal effect on the data as previously discussed. The potential for recall bias is recognised and is a limitation in all similar studies of this type. If in fact these findings are biased, the direction of the bias would likely be to underestimate the annual injury rates. Second, we recognise that there was a potential response bias in Study 2, since the response rate was low.

### *Implications of study findings*

The implications for clinical practice require changes in policy and work practices. These changes include:

(1) Legislated requirement for the provision of SEMDs and removal of non-SMEDs. This would assist in the eradication of re-capping needles.
(2) Review of why injury rates are higher in the private sector of the healthcare industry.
(3) Promoting awareness among nurses of the designated persons within their workplace responsible for responding to sharps incidents, and
(4) Safe work practices should be encouraged and monitored by healthcare workplaces in response to the requirement to provide a safe work environment for staff.

## Conclusion

Overall, in analysing the data from these two state-wide studies, we found that there were significant differences in sharps-related injury rates between nurses working in public and private facilities in some practice areas. Aspects of sharps safety practices that require improvement include eradicating the practice of capping needles, increasing the availability of SEMDs, decreasing the availability of non-SEMDs, and promoting awareness among nurses of the designated persons within their workplace responsible for responding to sharps incidents.

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## Conflicts of interests

Maya Guest and Ashley Kable were employees of the University of Newcastle during the conduct of these studies. These authors and organisations have no financial interests that may be affected by the content of the manuscript.

May Boggess was an employee of Arizona State University during the statistical analysis of these studies. This author and organisation have no financial interests that may be affected by the content of the manuscript. Mark Friedewald was an employee of New South Wales Health during the conduct of these studies. This author and organisation have no financial interests that may be affected by the content of the manuscript.

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