

# Needle stick injuries among dental students: risk factors and recommendations for prevention

Kamis Gaballah<sup>1\*</sup>, Dorothy Warbuton<sup>2</sup>, Kamal Sihmbly<sup>3</sup> and Tara Renton<sup>1</sup>

<sup>1</sup>Department of Oral Surgery, King's College London Dental Institute, London, UK; <sup>2</sup>Dental Institute, King's College Hospital NHS Trust, London, UK; <sup>3</sup>Dental Institute Guy's and St Thomas, Hospital NHS Trust, London, UK

**Aim:** To evaluate the risk factors of needle stick injuries (NSIs) sustained by undergraduate dental students and nurse students at the King's College London (KCL) Dental Institute.

**Materials and methods:** A retrospective study evaluated the incident reports relating to NSIs reported over a period of 2 years. Factors including the dental department, study year, and when the injury took place during administration of local anaesthesia (LA) and recapping conventional syringe or clearing work surface or during disposal.

**Results:** This report showed that students are at the highest risk of NSIs at the fourth year of their 5-year BDS course. About one-third of injuries were reported among this group of students followed by year 5 students (25%). Oral surgery clinics were the major source of incident reporting when compared with other specialised dental clinics within the institute. The left hands of the students were the most frequently affected by such injuries and then the right hands of student dental nurses. The attempt of needle recapping of conventional syringes was the least reported mechanism of injuries and constituted only 15% of the total injuries and mainly occurred in third year students. The most frequent injuries among student nurses were during disposal of the needle.

**Conclusion:** Less NSIs occur when using safety syringes. A non-recapping policy with immediate disposal of either the conventional or safety syringe systems after injection would prevent all clearance-related NSIs sustained by nurses. To avoid NSIs, education plays a vital role particularly with effective implementation of the change to safety syringes with appropriate training.

**Keywords:** *needle stick injuries; local anaesthetic syringes; safety syringes; dental students; occupational hazards; dental anaesthetic syringes*

Received: 20 February 2012; Accepted in revised form: 5 May 2012; Published: 25 June 2012

Numerous published reports (1–6) have examined occupational injuries in dental healthcare settings across different provider populations. These highlight that dental healthcare workers (DCHWs) are at a high risk of injuries by sharps and, of these, the most common are due to needle sticks. Needle stick injuries (NSIs) may be sustained during injecting local anaesthesia or recapping or disposal of the needle and syringe. Thus commonly these hollow bores are already contaminated causing dirty NSIs with the attendant significant risks of work acquired infections (7–9). Dental students are trained at various dental departments during the third, fourth and fifth years of their 5-year course with maximum clinical load during their fourth year as they complete a significant number of their clinical cases

requirements, and thus they are generally considered at a higher risk of such hazards as compared with their medical counterparts who rarely undertake exposure-prone techniques as undergraduates. On other hand, the dental nurse students receive a foundation training course which leads to registerable qualifications. The nurse students prepare and maintain environments, instruments, and equipment for clinical dental procedures. They also provide chair-side support during the various aspects of dental care.

The risk of injuries by sharps are usually faced at various fronts including student immunisation, adequate safety-based clinical induction and training, dissemination of safety protocols and guidelines and finally introduction of safer technologies that contribute to

elimination or at least significant reduction of such incidents (10–12).

DHCWs may have certain perceptions about occupational injury risks based on the likelihood of an untoward outcome (seroconversion) from such an injury. While the actual risk of an occupational exposure varies (2–4, 6, 7, 9, 11, 13, 14), the risk of HIV seroconversion remains very small in dentistry (15, 16). With the advent of the hepatitis B vaccine, the risk of HBV seroconversion is effectively zero for those practitioners with appropriate blood titres. Hepatitis C has no vaccine as yet, so it remains a concern for those who receive an occupational exposure (12). However, its seroconversion rate is much lower than HBV (17).

Unfortunately, healthcare workers do not always follow infection control protocols and guidelines. Sulzbach-Hoke found non-compliance for many reasons including habit, forgetfulness, influence of managers and perceptions that impede precautions and hinder performance (18). Sandman identified a number of additional reasons for non-compliance (therefore increasing risk), including the notion that ‘it can’t happen to me’, ignorance of precautions, being uncomfortable with change and cultural differences (19).

In this report, we aimed to investigate the pattern of NSIs related to the local anaesthetic injections and devices in our student population at the Dental Institute at King’s College London (KCL). This will enable us to identify the associated risk factors thus providing a basis for the development of a strategy to minimise and hopefully prevent NSIs.

## Materials and methods

The Dental Institute at KCL attracts about 185 new Bachelor of Dental Surgery (BDS) students and around 50 nurse students every year. The institute is unique in a sense of the clinical training is distributed over three London National Health Service (NHS) hospitals: King’s College (KCH) Hospital, Guy’s (GH) Hospital and St. Thomas’ Hospital (TH). The three trusts adopt different policies regarding clinical sharp management giving the KCL dental students an excellent exposure to various technologies and policies. For example; the dental institute at KCH utilises the conventional metallic dental syringe which normally requires the needle resheathing in order for the syringe to be dismantled and the metallic part is autoclaved. On the other hand, both GH and TH strictly employ non-resheathing policies throughout the hospitals including the dental clinics. They provide the students with modern safety dental syringes that do not require resheathing or removal of a needle from its syringe. This diversity was the motivation behind this report to analyse the pattern of needle stick injuries among the students who use both systems of syringes.

The study was approved by the local ethical committees and audit units at the dental institute and the hospitals.

In this retrospective study, we retrieved all incident reports of NSIs sustained by dental students and nurse students over the period between January 2007 and December 2008. The hospital, syringe type and department where the injury took place were noted and related to student’s course study year, the site of injury (right or left hand) and during which procedure the injury was sustained (administering LA, subsequent to the administration of LA and resheathing; or during clearance and disposal of the instruments at the end of the procedure).

The outcome data was analysed using a Statistical Package for the Social Services SPSS® version 13. Initially, the data were cross-tabulated and Chi-square test was used to determine the statistical significance with *P* value set at <0.05 for the significance.

## Results

### Department

When comparing NSI rates in the different dental departments (Table 1) Oral Surgery clinics were the major source of incident reporting (*P* = 0.143). The sources of reports ranged from 10% from Periodontology clinics to 53.3% from the Oral Surgery clinics. Within Oral Surgery clinics there was a trend for the highest incidence of NSIs to occur in BDS year 4 students compared with nurse students and other year BDS students.

### Site of injury

Most hand injuries (Table 2) occurred in the left hands of the dental students (*P* = 0.002). Typically, the left thumb is used for retraction of the buccal tissues during application of an infiltration or inferior dental nerve block. However, most dental nurse students experienced hand injuries to the right side (*P* = 0.03).

### Mechanism of the injury

The examination of the incident in detail showed that NSIs were more likely to take place during the injection of LA into the patient’s oral tissues (*P* = 0.002), accounting for more than half of all injuries reported by dental students (Table 3). Disposal of the LA equipment was the second most common cause of NSIs in the dental students. However, injuries to the nurse student group solely occurred during the clearance of instruments including the LA syringes and needles (*P* = 0.02). The attempt of needle recapping was the least reported mechanism of injuries and constituted only 15% of the total injuries but was solely related to the conventional syringe system.

**Table 1.** Distribution of NSIs among various departments

			Department				Total
			Oral surgery	Restorative dentistry	Periodontology	Others	
Study year	Third	Count	7	3	3	0	13
		% within study year	53.8%	23.1%	23.1%	0.0%	100.0%
		% within department	21.9%	17.6%	50.0%	0.0%	21.7%
	Fourth	Count	14	6	0	0	20
		% within study year	70.0%	30.0%	0.0%	0.0%	100.0%
		% within department	43.8%	35.3%	0.0%	0.0%	33.3%
	Fifth	Count	7	4	1	3	15
		% within study year	46.7%	26.7%	6.7%	20.0%	100.0%
		% within department	21.9%	23.5%	16.7%	60.0%	25.0%
	Nurse students	Count	4	4	2	2	12
		% within study year	33.3%	33.3%	16.7%	16.7%	100.0%
		% within department	12.5%	23.5%	33.3%	40.0%	20.0%
Total	Count	32	17	6	5	60	
	% within study year	53.3%	28.3%	10.0%	8.3%	100.0%	
	% within department	100%	100%	100%	100%	100%	

**Study course year**

This report showed that dental students are at the highest risk of sustaining needle stick injuries at the fourth year of their 5-year BDS course with one-third of injuries (33.3%) being reported among the fourth year group followed by year 5 students (25%), but the difference between injuries reported among both groups was not statistically significant ( $P=0.14$ ). On the other hand, injuries were more frequent especially among our nurse students during disposal of the needle as compared with

the needle recapping ( $P=0.01$ ). Needle recapping was the main issue for the year 3 students claiming 42.9% of injuries of this student group. This mechanism of injury was noted to drop as the course advanced to reach only 14.3% of all injuries reported by fifth year students. Overall 11.7% of NSIs occurred during recapping and were exclusively reported with use of the conventional syringes. Similarly, the disposal of the needle was more dangerous among the conventional syringe users (74.1%) as compared with the safety syringe users (25.9%) in

**Table 2.** Details of the hand injuries

			Left	Right	Total
Study year	Third	Count	10	2	13
		% within study year	76.9%	15.4%	100.0%
		% within injured hand	22.7%	13.3%	21.7%
	Fourth	Count	15	5	20
		% within study year	75.0%	25.0%	100.0%
		% within injured hand	34.1%	33.3%	33.3%
	Fifth	Count	15	0	15
		% within study year	100.0%	0.0%	100.0%
		% within injured hand	34.1%	0.0%	25.0%
	Nurse students	Count	4	8	12
		% within study year	33.3%	66.7%	100.0%
		% within injured hand	9.1%	53.3%	20.0%
Total	Count	44	15	60	
	% within study year	73.3%	25.0%	100.0%	
	% within injured hand	100.0%	100.0%	100.0%	

**Table 3.** Reported mechanisms of injury

			Mechanism of injury			Total
			While injecting	While resheathing	Sharps disposal	
Study year	Third	Count	6	3	4	13
		% within study year	46.2%	23.1%	30.8%	100.0%
		% within MOI	23.1%	42.9%	14.8%	21.7%
	Fourth	Count	11	3	6	20
		% within study year	55.0%	15.0%	30.0%	100.0%
		% within MOI	42.3%	42.9%	22.2%	33.3%
	Fifth	Count	9	1	5	15
		% within study year	60.0%	6.7%	33.3%	100.0%
		% within MOI	34.6%	14.3%	18.5%	25.0%
	Nurse students	Count	0	0	12	12
		% within study year	0.0%	0.0%	100.0%	100.0%
		% within MOI	0.0%	0.0%	44.4%	20.0%
Total	Count	26	7	27	60	
	% within study year	43.3%	11.7%	45.0%	100.0%	
	% within MOI	100.0%	100.0%	100.0%	100.0%	

both staff and students, and a similar trend was seen with decline of these injuries in dental students as they progressed through their course (Table 3).

### Syringe system

Overall, 13 NSIs were reported with the use of the safety system and 47 with the conventional system thus significantly less NSIs were seen in the safety syringe system ( $P=0.006$ ). No injuries occurred with recapping for the safety system as it was not required. When using the safety system all the injuries occurred during the administration of LA or during clearance of the instruments. While disposing sharps, NSIs were relatively higher compared with conventional syringes ( $P=0.012$ ). NSIs during the administration of LA

were again more likely to occur using the conventional syringe system. However, the majority of these injuries occurred during the third year of dental training when all students were based at KCH for oral surgery (Table 4).

### Discussion

The awareness of the issue of occupational hazards has begun many decades ago, as it was estimated that more than 14,000 accidental deaths occurred in the work place in the United States in 1970 (15). This has led to the establishment of many organisations that formulate and enforce the guidelines of occupational safety such as the Center for Disease Control and Prevention (CDC) that estimates that up to 500,000 percutaneous occupational

**Table 4.** Reported mechanisms of injury with different syringe system

			Mechanism of injury			Total
			While injecting	While recapping	Sharps disposal	
La syringe system	Re-capping	Count	20	7	20	47
		% within syringe system	42.6%	14.9%	42.6%	100.0%
		% within MOI	76.9%	100.0%	74.1%	78.3%
	Safety	Count	6	0	7	13
		% within syringe system	46.2%	0.0%	53.8%	100.0%
		% within MOI	23.1%	0.0%	25.9%	21.7%
Total	Count	26	7	27	60	
	% within syringe system	43.3%	11.7%	45.0%	100.0%	
	% within MOI	100.0%	100.0%	100.0%	100.0%	

injuries are taking place every year in the US, with approximately 1% from patients who tested positive for HIV (20). As a consequence to such a high prevalence of injuries, it was reported that in the USA, more than 50 cases of occupational transmission of HIV and threefolds of this number are the cases of possible seroconversion in HCWs (12).

Current investigation showed that Oral Surgery clinics are the most frequent source of reporting NSIs as compared to other clinics. This may reflect the cautious approach of the nursing and teaching staff towards this subject which is taught to students by the same staff members. This observation was in agreement with Cleveland et al. (24) who found that more than one-third of percutaneous injuries are reported by Oral Surgery units. On the other hand, Wicker and Rabenau (21) recently reported the NSIs among German dental professionals and students and showed that the most frequent procedures involved with NSIs were the operative dentistry (36.2%) followed by Oral Surgery procedures which accounted for less than 20% of incident reporting. In this regard, the literature's NSI figures should be approached cautiously as many authors do not limit the definition of NSIs to the needle puncture but include any parental contact to non-intact skin, eye or mucous membrane. The course study year has influenced the incidence of occupational exposures due to the use of local anaesthetics but without a general statistical significance. One-third of NSIs was reported from year 4 teaching clinics with around two-thirds of these students sustained their injuries during their Oral Surgery training. This may be related to the significant surgical experience undertaken during the fourth year by the students having to complete 20 extractions over the year. The number of reports declines as the course advances with year 5 student clinics producing only 25% of the total number of reports. This observation supports the need for an increased instruction and handling practice of local anaesthetic syringes for the junior students to minimise NSIs. This approach is now adopted at KCL as the Oral Surgery department organises a comprehensive induction of the year 3 students to the use of various syringes, the safe ways of injecting local anaesthetic and disposing sharps. The effects of such measures on the incidence of NSIs is currently monitored and a topic of an ongoing audit. The increased rate of NSIs reported in year 4 is noticeably higher than among year 3 (21.7%). This might be explained by the increased workload at that stage of course, as most of the clinical requirements are concentrated at year 4 as compared with year 3 which is largely considered as an induction year to the clinical dentistry. The later observation was also reported by Stewardson et al. (22), but with a questionnaire-based survey in a UK equivalent dental

institute with more frequent NSIs reported by the same students during fourth year of the study course. This investigation shows that two mechanisms of injury were equally reported as the most frequent reason for NSIs sustained by dental students. Nearly 90% of injuries took place either during administration of the anaesthetic or during disposal of the used needles. On the other hand, only 11.7% of injuries were sustained during recapping of the syringe needles. This is similar to the reported observation by Younai et al. (6). A 10-year surveillance study of NSIs in the US dental institutes showed that more than 70% of local anaesthetic-related NSIs occur during needle insertion and/or needle withdrawal. The other one-third of injuries occurred owing to sudden patient movement at the time of attempted injection, similarly reported by Ramos-Gomez et al. (5). In contrast, earlier reports (18) have shown that the classical NSIs usually take place during recapping of the used dental needles. The reported incidence of NSIs caused by this mechanism is between 22 and 52% of needle-stick injuries (are the injuries the result of such practices?). The use of a portable recapping device has been shown to decrease NSIs fourfold, from 1 in 4,000 to 1 in 16,000 injuries per blood drawing event (19), but obviously introduction of such equipment is not widely adopted owing to the added cost and administrative effort needed for implementation. Other approaches have included a change in the recapping method without the need for any new equipment. Anderson et al., 1991 (23) described the gravity-resheathing method where the sheath is placed over the tip of needle and dropped into place. Another suggestion described by the same authors is the scooping-resheathing or the single-hand resheathing method. The introduction of such techniques has shown a significant reduction in the incidence of NSIs among the undergraduate medical students (18).

The field of dentistry has responded to the challenge of the frequent NSIs with more revolutionary engineering solutions, thus eliminating injuries taking place either during resheathing or during disposal of the used needle with the introduction of safety dental syringes. Unlike the non-disposable metallic syringes where needles must be resheathed in order for the syringes to be dismantled and the appropriate parts autoclaved, the safety syringe totally eliminates the need for needle re-sheathing and both self-recapped needle and attached local anaesthetic cartridge barrel are disposed together without the needle to dismantle the latter from the syringe.

This study highlights that the highest risk of NSIs to dental students and student nurses occurs within surgical departments, with the conventional syringe system, when nurses clear the instruments, and to dental students when performing LA. Our results also show that the

introduction of such syringes has resulted in elimination of injuries caused by resheathing of needles and significantly reduced the injuries reported during disposal of used needles. However, not ALL injuries are prevented by using safety syringes and this highlights a possible deficiency in training with this type of equipment. Conflicting results have been published regarding the effectiveness of the safety syringes in reducing NSIs. Taking our results into consideration, we suggested that—to minimise the incidence of NSIs—both adequate training and introduction of effective engineering tools have to be implemented.

### Conflict of interest and funding

The authors have not received any funding or benefits from industry or elsewhere to conduct this study.

### References

- Siew C, Chang SB, Gruninger SE, Verrusio AC, Neidle EA. Self reported percutaneous injuries in dentists: implications for HBV, HIV, transmission risk. *JADA*. 1992; 123: 36–44.
- Siew C, Gruninger SE, Miaw CL, Neidle EA. Percutaneous injuries in practicing dentists: a prospective study using a 20-day diary. *JADA*. 1995; 126: 1227–34.
- Gooch BF, Siew C, Cleveland JL, Gruninger SE, Lockwood SA, Joy ED. Occupational blood exposure and HIV infection among oral and maxillofacial surgeons. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 1998; 85: 128–34.
- McCarthy GM, Koval JJ, MacDonald JK. Occupational injuries and exposures among Canadian dentists: the results of a national survey. *Infect Control Hosp Epidemiol*. 1999; 20: 331–6.
- Ramos-Gomez F, Ellison J, Greenspan D, Bird W, Lowe S, Gerberding JL. Accidental exposures to blood and body fluids among health care workers in dental teaching clinics: a prospective study. *JADA*. 1997; 128: 1253–61.
- Younai FS, Murphy DC, Kotelchuck D. Occupational exposure to blood in a dental teaching environment: results of a ten-year surveillance study. *J Dent Educ*. 2001; 65: 436–48.
- Armstrong K, Gorden R, Santorella G. Occupational exposure of health care workers (HCWs) to human immunodeficiency virus (HIV): stress reactions and counseling interventions. *Soc Work Health Care*. 1995; 21: 61–80.
- Cardo DM, Culver DH, Ciesielski CA, Srivastava PU, Marcus R, Abiteboul D, et al. A case-control study of HIV seroconversion in health care workers after percutaneous exposure. Centers for Disease Control and Prevention Needlestick Surveillance Group. *N Engl J Med*. 1997; 337: 1485–90.
- Do AN, Ciesielski CA, Metler RP, Hammett TA, Li J, Fleming PL. Occupationally acquired human immunodeficiency virus (HIV) infection: national case surveillance data during 20 years of the HIV epidemic in the United States. *Infect Control Hosp Epidemiol*. 2003; 24: 86–96.
- Centers for Disease Control and Prevention. National Institute for Occupational Safety and Health alert: preventing needlestick injuries in health care settings. Cincinnati: US Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention; 1999. Available from: <http://www.cdc.gov/niosh/2000-108.html> [cited 26 April 2010].
- Centers for Disease Control and Prevention. Workbook for designing, implementing, and evaluating a sharps injury prevention program (2008). Available from: <http://www.cdc.gov/sharpsafety/index.html> [cited 26 April 2010].
- Centers for Disease Control and Prevention. Sample screening and device evaluation forms; 2002. Available from: <http://www.cdc.gov/oralhealth/infectioncontrol/forms.htm> [cited 14 December 2006].
- Kohn WG, Collins AS, Cleveland JL, Harte JA, Eklund KJ, Malvitz DM. Guidelines for infection control in dental health-care settings: 2003. *MMWR Recomm Rep*. 2003; 52 (RR-17): 1–61.
- Zakrzewska JM, Greenwood I, Jackson J. Introducing safety syringes into a UK dental school: a controlled study. *Br Dent J*. 2001; 190: 88–92.
- US Government Accounting Office. Occupational safety: selected cost and benefit implications of needle stick prevention devices for hospitals. Nov. 17, 2000. Publication GAO-01-60R. Available from: <http://www.gao.gov/new.items/d0160r.pdf> [cited 5 January 2007].
- US Census Bureau. Statistical abstract of the United States: 2005. Washington: US Census Bureau; 2005. Available from: <http://www.census.gov/prod/2005pubs/06statab/labor.pdf> [cited 20 June 2006].
- Centers for Disease Control and Prevention. National surveillance system for health care workers (NaSH). Atlanta: US Department of Health and Human Services, Centers for Disease Control and Prevention; 2000. Available from: <http://www.cdc.gov/ncidod/dhqp/nash.html> [cited 20 June 2006].
- Panlilio AL, Orelien JG, Srivastava PU, Jagger J, Cohn RD, Cardo DM. Estimate of the annual number of percutaneous injuries among hospital-based healthcare workers in the United States, 1997–1998. *Infect Control Hosp Epidemiol*. 2004; 25: 556–62.
- Porteous NB, Terezhalmay G. Use of the Septodont Safety-Plus syringe by dental school faculty and students: a pilot study. *Tex Dent J*. 2004; 121: 138–43.
- Trape-Cardoso M, Schenck P. Reducing percutaneous injuries at an academic health center: a 5-year review. *Am J Infect Control*. 2004; 32: 301–5.
- Wicker S, Rabenau HF. Occupational exposures to blood borne viruses among German dental professionals and students in a clinical setting. *Int Arch Occup Environ Health*. 2010; 83: 77–83.
- Stewardson DA, Palenik CJ, McHugh ES, Burke FJT. Occupational exposures occurring in students in a UK dental school. *Eur J Dent Educ*. 2002; 6: 104–13.
- Anderson DC, Blower AL, Packer JM, Ganguli LA. Preventing needle stick injuries. *BMJ*. 1991; 302: 769–70.
- Cleveland JL, Lockwood SA, Gooch BF, Mendelson MH, Chamberland ME, Valauri DV, et al. Percutaneous injuries in dentistry: an observational study. *JADA*. 1995; 126: 745–51.

#### \*Kamis Gaballah

Department of Oral Surgery  
King's College London  
Dental Institute  
Bessemer Road  
Denmark Hill  
London SE5 9RW  
UK  
Email: [kamisomfs@yahoo.co.uk](mailto:kamisomfs@yahoo.co.uk)