

Compliance with occupational exposure risk management procedures in a dental school setting

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In brief

Provides an insight into the working practices of student and staff groups within a UK dental school with regard to occupational exposure risk.

Highlights potential areas of concern regarding compliance with risk management procedures, and recommends ways to reduce these.

Discusses the limitations of conventional approaches to training and policy implementation, exploring the human factors perspective.

Background The Dental Institute at King's College London has recently implemented changes focusing on infection control, including safety needle provision, personal protective equipment campaigns, mandatory lectures and formal assessment for students. We explored the effect of these changes over a five-year period. **Methods** We observed 49 clinical consultations in 2010 and 50 in 2014, examining clinician attire, personal protective equipment, dental operatory management, sharps hazards and aseptic technique. **Results** One hundred percent of operators wore gloves, apron and masks, 94% wore eye protection, 98% had uncovered wrists and 88% had tidy hair. Ninety-four percent wore safe shoes, 86% were of appropriate material, and 70–82% demonstrated correct zoning technique. Safe sharps bin placement improved from 78% to 100%, 92% were not overfilled, and 96% were free from protruding items. Sixty-eight percent of bays were appropriately barrier wrapped, 78–88% were kept tidy and 96% were free of items that could have been disposed of immediately following use. Ninety to ninety-eight percent of ultrasonic tips and 64% of burs were removed from handpieces when not in use. **Conclusion** Dental healthcare workers are at risk of significant occupational exposures, which can be minimised by technological advances, implementation of best practice guidelines, optimisation of the clinical working environment and reinforcement of infection control policy.

Aims

The aims of this study are:

- To improve awareness of the significant risk of occupational exposure among dental healthcare workers
- To provide data on the working practices and clinical environment of a range of student and staff groups in a dental teaching hospital setting
- To highlight areas of concern regarding the issues of compliance with risk management procedures
- To identify and recommend potential ways to minimise occupational exposure risk
- To recommend future research exploring compliance with risk management systems among dental healthcare workers using a human factors perspective.

Introduction

Dental healthcare workers are at significant risk of occupational exposure to infections secondary to sharps injuries and mucocutaneous exposures. In Western countries the three most common blood-borne infections usually associated with transmission through sharps injuries are HIV, hepatitis B virus (HBV), and hepatitis C virus (HCV), the risk of infection ranging from 0.3% for HIV, 2.7–10.0% for HCV, and 5.0–45.0% for HBV.¹ Rarely, other infections such as malaria, human T cell leukaemia viruses (types I and II), and haemorrhagic fever viruses, such as Ebola virus, may be implicated. Mucosal exposure to body fluid carries a much lower risk (<1:1000 for HIV).²

According to the Health Protection Agency (HPA), in the UK between 2004–2013 there were 4,830 reported occupational exposures to a blood-borne virus among healthcare workers, increasing from 373 in 2004 to 496 in 2013, of which half were exposed to HCV, a third to HIV and one in ten to HBV. Seventy-one percent of exposures involved a

percutaneous needlestick injury, the majority of which involved a hollowbore needle.^{3,4} Since 1997 a total of 21 HCV seroconversions and one HIV seroconversion has been reported in healthcare workers in the UK.² Surveillance data compiled by the Centres for Disease Control and Prevention (CDC) from 1981 to 1999 documented a total of 56 cases of occupationally acquired HIV infections reported in the United States.⁵

There is a growing body of literature on the incidence and importance of occupational exposures involving the potential for blood-borne infection in the dental clinical setting.⁶ Dental students are particularly at risk from occupational exposures, which may be due to their unfamiliarity with new dental procedures and infection control protocols, anxiety in performing the procedure to the satisfaction of the supervising faculty, and their inexperience handling dental instruments.^{6–8}

Approximately 100,000 sharps injuries occur in UK hospitals each year, making up approximately 17% of all accidents to NHS staff. Sharps injuries are common during surgery

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Refereed Paper. Accepted 30 January 2017
DOI: 10.1038/sj.bdj.2017.498

RISK EXPOSURE AUDIT

Date _____ Time _____ Appt Time _____ Floor _____

Treatment Provider ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ PG ☐ Other Male / Female

Nursing Assistant ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ PG ☐ None Male / Female

Shoes ☐ Top uncovered ☐ Trainers Leather / Suede / Cloth / Plastic

Dress ☐ Wearing watch ☐ Hair not neat/tidy/tied back

Bracket Table ☐ Burs still in hand pieces (if not currently in use)

☐ Burs facing outwards

☐ Untidy/disorganized ☐ Not all areas cling-filmed

☐ Other sharps hazards _____

Sharps Bin ☐ Free standing ☐ Obstructed access

☐ More than 2/3rds full ☐ Protruding items

Instrument Covers Missing _____

PPE Missing ☐ Gloves ☐ Mask ☐ Goggles ☐ Apron ☐ HVS (if appropriate)

☐ Rubber dam absent (if appropriate)

Items in wrong area/zone _____

Items that could have been put directly into a bin _____

Comments: _____

Fig. 1 Revised questionnaire proforma

with rates cited at 1.7–6.9% of all surgical procedures. However, sharps injury reporting remains a continuing problem among healthcare workers, varying from 15–90%. Surgeons show consistently low reporting rates, reasons given including a low perceived risk of transmission of infection, no spare time, no utility in reporting and not being bothered.^{9–11} Myers *et al.* (2012) claimed that dental students may underreport occupational exposures, so appropriate post-exposure management may not be properly administered.¹²

McDonald *et al.* (1997) reported that the most common sharps injury to dental students resulted from a bur puncture when reaching across a bracket table to pick up an instrument, while most needlestick injuries occurred during disposal of needles and re-sheathing attempts using a two-handed technique, most often after they have been contaminated with body fluids. Compliance problems regarding the use of protective eyewear in the clinical setting have also been identified.¹³ Younai *et al.*

(2001) reported that 89% of exposures involved instruments visibly contaminated with blood, and observed that third-year students experienced a considerably higher rate of injury compared to fourth-year students, reporting that 31–36% of percutaneous injuries result from needlesticks, burs are involved 8–26% of the time, with scalers and curettes accounting for another 12%.^{5,14}

In 2000 the United States introduced a Needlestick Safety and Prevention Act, which required that healthcare employers use safety engineered sharps in preference to traditional sharps, where they were available. In July 2009, The European Hospital and Healthcare Sector Social Partners signed a framework agreement to harmonise measures across Europe to prevent sharps injuries in the healthcare sector. The initiative was proposed as a European Union (EU) Directive to the Council of Ministers and subsequently adopted on 8 March 2010, requiring implementation of the Directive in the UK by May 2013.^{4,15,16}

Partly in response to this, there has been an increase in the availability of alternatives to traditional sharp medical instruments, commonly known as ‘safer sharps technologies’, which include cannula and needles incorporating mechanisms that recap or otherwise eliminate the sharp point after use.⁴ Evidence shows that a change to safety needles does result in a substantial change in the number of needlestick injuries occurring in a dental school, especially if combined with increased awareness.^{17,18} However, their use is not regarded as a complete solution to reducing sharps-related injuries among healthcare workers.³

The King’s College London Dental Institute is the largest dental school in Europe, training 20% of all dentists qualifying in England, and has in recent years implemented a number of changes to the clinical environment and academic course structure in line with an increasing focus on infection control. These have included the widespread provision of improved safety needles, campaigns to encourage appropriate dress and the correct use of personal protective equipment, mandatory annual infection control lectures and formal assessment for undergraduate students, and improving the availability and placement of sharps bins. The purpose of our audit was to explore the effect of these changes over a five-year period.

Methods

We observed 49 clinical consultations taking place across a range of student and staff groups within the dental school in February 2010, examining clinician attire, personal protective equipment, barrier wrapping and organisation of the dental operator, highlighting sharps hazards and aseptic technique in particular.

Questionnaires were completed by the observer during 49 separate randomly sampled clinical consultations, encompassing a range of operators including third-year, fourth-year and final-year undergraduate dentistry students, as well as qualified dentists undergoing postgraduate training, across a range of disciplines including restorative dentistry, prosthodontics, periodontology, acute dental care and oral surgery.

The questionnaires collected data on year group and gender of the operator and assistant, noting shoe design and material, organisation of the bracket table, the incidence of inactive ultrasonic scalers or burs left in handpieces, and the presence of dangerously unprotected

sharps. Sharps bins were scrutinised according to location within the clinical area, ease of access, remaining capacity and presence of protruding items. We also noted adherence to personal protective equipment policy including the use of gloves, apron, mask and eye protection, as well as the presence of rubber dam where appropriate. Finally, we observed whether correct zoning and waste disposal practice were being practiced.

After the initial round of data collection in February 2010, the proforma was modified, adopting a tick box approach for speed and ease of data entry, also adding new sections on bur orientation within the instrument holder, and the presence of wrist jewellery, inappropriate hairstyle and the correct use of barrier wrapping (Fig. 1). We then observed another random sample of 50 clinical consultations across the dental school in November 2014.

Results

A total of 49 clinical consultations were observed in February 2010 and 50 in November 2014. The breakdown of the student groups observed in each of the samples is shown in Table 1. Key findings are shown in Table 2.

Regarding clinical attire and the use of personal protective equipment, 100% of operators correctly wore gloves, apron and masks for all observed procedures, and 94% wore appropriate eye protection. Ninety-eight percent of operators had uncovered wrists, free from watches and bracelets, and 88% had appropriately tidy hair, tied back where indicated. In 2014, 94% of operators wore shoes of a fully 'closed-in' design that covered vulnerable areas such as the top of the foot and toes, improving from 88% in 2010. Similarly, in 2014, 86% of operators wore shoes made of appropriately fluid repellent material (leather, plastic or rubber), improving from 82% in 2010.

In terms of the clinical environment, the safe placement of sharps bins improved from 78% to 100%. In 2014, 92% of sharps bins were less than two-thirds full, compared to 84% in 2010, and 96% of sharps bins did not have items protruding from them, improving from 90% in 2010.

With regard to clinical aseptic technique and management of the dental operator, 70–82% of operators demonstrated correct zoning technique between high-risk and low-risk contamination areas. Sixty-eight percent of bays were appropriately barrier wrapped

Table 1 Student groups observed in 2010 and 2014

		2010	2014
Undergraduate	Year 3	7	20
	Year 4	11	24
	Year 5	19	1
Postgraduate		12	5

Table 2 Key audit findings from 2010 and 2014

	2010	2014
Wrist jewellery	–	2%
Protruding sharps bin items	10%	4%
Items that could have been binned	12%	4%
Shoes uncovered	12%	6%
Sharps bin more than 2/3 full	16%	8%
Exposed ultrasonic tips	2%	10%
Hair untidy	–	12%
Inappropriate shoe material	18%	14%
Untidiness	12%	22%
Items in wrong area	18%	30%
Incomplete barrier wrapping	–	32%
Missing covers	–	32%
Burs still in handpieces	36%	36%
Burs facing outwards	–	78%
Adequate eye protection	98%	96%
Safe sharps bin placement	78%	100%
Gloves present	100%	100%
Mask present	100%	100%
Apron present	100%	100%

throughout, including application of cling film to surfaces and the use of instrument covers. Seventy-eight to eighty-eight percent of bays were deemed by the observer to have been maintained in an organised and tidy state during treatment. In 2014, 96% of dental operatories were free of items that could have been disposed of immediately following use, an improvement from 88% in 2010. Ninety to ninety-eight percent of ultrasonic tips and 64% of burs were removed from handpieces when not in use. When inactive burs were found to have been left in handpieces, they were not facing outwards in a dangerous manner in 22% of cases.

We found no significant correlation by student year group, gender, or speciality.

Discussion

Overall compliance with infection control procedures and general occupational exposure risk management remained consistently high at King's College London Dental Institute across the five year period, and improved in certain key areas such as sharps bin placement and management, clinical attire and organisation of the dental operator, following the implementation of various interventions, such as the provision of improved safety needles and their mandatory use throughout the whole dental institute, awareness campaigns and regular infection control updates for undergraduate students.

Younai *et al.* (2001) noted in a ten-year surveillance study in a dental teaching

environment, 31% of exposures were due to needlestick injury, 26% from burs and 10% from scalers.⁵ In our audit we did not observe any exposed needle hazards, possibly due to the widespread introduction of safety syringes throughout the dental school. Our findings for the incidences of exposed burs and scalers show similar results to previous studies. Callan *et al.* (2006) observed that in a dental school setting, the most common sharps injury to students resulted from a bur puncture when reaching across a bracket table to pick up an instrument.¹⁴ Further technological advances incorporating similar safety features for exposed burs and scalers may help reduce this risk further. It is important to note that while the use of safer sharps devices is considered to improve safety and reduce the incidence of healthcare worker needlestick injuries, their use should not be regarded as a complete solution to reducing sharps related injuries among healthcare workers. Studies showed that when educational programmes were implemented alongside a safer sharps device, lower rates of sharps injuries were sustained for longer.⁴ Within the dental institute at King's College London a significant proportion of students, both undergraduate and postgraduate, as well as staff, both junior and senior, change each year, further emphasising the importance of continuing training and education across the dental hospital.

Injuries which do not carry a risk for acquiring an infectious disease from patients can still pose a threat to the health of dental workers, most notably the value of protective eyewear to prevent injuries sustained from particulate matter and projectiles. Compliance problems regarding the use of protective eyewear in the clinical setting have been previously identified.¹³ Stewardson *et al.* (2003) reported that during mucocutaneous exposure in third year students, 60% did not wear protective glasses during their last occupational exposure, with 27% of their last occupational exposures due to aerosol or splatter of fluids onto mucous membranes.¹⁹ Our audit showed consistently high compliance rates, with 94% of clinicians wearing appropriate eye protection, possibly aided by widespread awareness campaigns throughout the dental school environment reinforcing the importance of protective personal equipment. During our observations, we noted that violations to these policies were mostly in operators that wore spectacles without additional eye protection. Such practice is to be discouraged, as spectacles do not carry sufficient protection from mucocutaneous exposures, particularly from side angles.

In terms of other aspects related to clinical attire and the use of personal protective equipment, 100% of operators correctly wore gloves, apron and masks for all observed procedures. Ninety-eight percent of operators had wrists free from jewellery, 88% had appropriately tidy hair, 94% wore safely covered shoes and 86% wore shoes made of appropriate material. These consistently high compliance rates may also be attributed to widespread awareness campaigns and their reinforcement by clinical tutors and nursing staff, though it is important to note that with regard to wrist jewellery, hair tidiness and shoe selection there is limited evidence on the impact of such aspects of clinical attire on reducing infections in students, staff and patients.

With regard to clinical aseptic technique and management of the dental operatory, 70–82% of operators demonstrated the correct zoning technique between high-risk and low-risk contamination areas, 78–88% of bays were deemed by the observer to have been maintained in an organised and tidy state during treatment, and 88–96% of dental operatories were free of items that could have been disposed of immediately following use. One possible factor may be the availability and use of self-adhesive paper waste bags, which can be conveniently attached to nearby surfaces such as the bracket table, eliminating the need for reaching further to dispose of items in a pedal-operated bin. However, at the time of writing, these were not widely available across the whole dental school, which may have resulted in the accumulation of disposable waste and compounding operatory untidiness and incorrect zoning technique.

Sixty-eight percent of bays were appropriately barrier wrapped throughout, including the application of cling film to clinical surfaces and the use of instrument covers for handpieces. We observed that moulded pulp trays used to transport items from dental storage compounds to individual bays were the most commonly misplaced item in zoning violations. The use of self-adhesive paper waste bags as described earlier may further eliminate this problem, as well as policies to prevent their re-use once initially provided by the dental storage compound. We also noted that some proprietary handpiece cover products tended to slide down the handpiece cables during use, rendering them obsolete. One solution may be to ensure the consistent delivery of effective commercial barrier wrapping products across all clinical departments.

However, despite the presence of well-established dental protocols and education campaigns to promote adherence, this audit demonstrates that policies and training alone cannot guarantee a 100% compliance rate with protective measures for infection and occupational risk hazards. Gluyas (2015) used a human factors perspective to explore elements that affect healthcare workers' compliance with hand hygiene, recognising that in situations where healthcare workers perceive low risk, deliberate hand hygiene violations can occur, which in some areas can become routine practice. Further improvements may thus require us to challenge healthcare workers' perceptions of low risk that lead to such violations. Gluyas classifies these violations as erroneous violations, caused by a lack of knowledge of healthcare-associated infection risk; exceptional violations such as in emergency situations where time is of the essence; situational violations related to constraints of environment, such as lack of equipment and staffing levels; and routine violations involving shortcuts or workarounds that happen on a regular basis, caused by a cultural climate that accepts poorer practice, poor role-modelling by senior staff, and a lack of organisational leadership commitment.²⁰

There were several limitations to our study design and methodology. Our sample sizes in 2010 and 2014 were relatively small and particularly unbalanced in 2014, skewed towards observing more year 3 and 4 undergraduate students. The range of clinical consultations selected for observation depended on academic timetabling and chair allocation by nursing and administrative staff, affecting the validity of our findings, which could be improved by better randomisation in sample selection. The addition of further study parameters to the questionnaire in 2014 also questions the relevance of our comparisons with the 2010 sample. The various interventions highlighted, such as improved safety needles, awareness campaigns and regular infection control updates were phased in over several years and it is unclear whether all student and staff groups received equal focus in their implementation, making it difficult to quantify the impact this specifically had on our findings.

Future research should attempt to explore compliance in a dental school setting using a similar human factors perspective. Tada *et al.* (2015) showed that specialisation in oral surgery, willingness to treat patients with HIV and AIDS, and knowledge about universal and standard precautions are important factors for

improved compliance with infection control procedures.²¹ McCarthy *et al.* (1999) showed that dentists in communities of <10,000 were less compliant with handwashing after degloving, while dentists >60 years of age were the least compliant with barrier wrapping, but reported the highest compliance with handwashing.²²

Conclusion

All dental healthcare workers are at significant risk of occupational exposure to infections with potentially severe implications for health. Issues of compliance with risk management procedures have been previously identified in several areas, the impacts of which can be minimised by technological advances, implementation of best practice guidelines and by frequently reinforcing infection control policies locally with training and awareness campaigns. Further developments in safer sharps innovations and optimisation of the clinical working environment may continue to improve outcomes. Future research should attempt to explore compliance among dental healthcare workers using a human factors perspective.

Acknowledgements

The authors wish to thank Sally Salter, David Buckland and Lynn Patmore for undertaking the first round of data collection, and Nimit Patel who assisted in the second round of data collection.

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