

## Scientific Research Report

## A Retrospective Analysis of Non-Sharps-Related Injuries in a Dental School



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## ABSTRACT

**Objectives:** Workplace non-sharps injuries are a common occurrence in a dental school setting. In dentistry, the importance of preventing non-sharps injuries is often overlooked due to emphasis on sharps-related injuries. The aim of this research was to analyse the incidences of non-sharps injuries over an 11-year period in a dental school to identify trends and the possible causative factors for these injuries.

**Methods:** Injury reports lodged with the University of Queensland Workplace Health and Safety databases between 2009 and 2019 were categorised and analysed.

**Results:** Of 1156 incidents reported, 35.7% (n = 413) were non-sharps injuries, and the most common type of non-sharps injury was general incidents (48.4%, n = 200). The most common body site for injury was the hands (19.4%, n = 80), and the most common location where an injury occurred was in clinical patient care (53.8%, n = 222). The personnel type most at risk of a non-sharps injury fluctuated between students and staff throughout the study period.

**Conclusions:** All personnel, including students and staff, are at similar risk of experiencing a non-sharps injury within a dental school setting. The equipment and facilities of a dental clinic as well as the level of adherence to safe working procedures are contributing factors. Continuous quality improvement is essential for minimising these injuries.

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## Introduction

Workplace injuries include any harm to an individual that arises in the course of their normal occupation or employment.<sup>1</sup> Despite most modern workplace environments having introduced various systems to prevent such incidents, acute injuries sustained whilst at work remain a common occurrence.<sup>2</sup> Injuries can occur in a dental practice setting as well as in the training environment where future dental practitioners are developing their skills.<sup>1</sup> Each year, there are 319 million workers subjected to workplace accidents globally, and more than 2.3 million of those incidents result in death or severe disability.<sup>3,4</sup> Allied health professionals report an average of 500 workplace-related claims annually, at a cost of \$14 million AUD.<sup>4</sup>

For dental professionals, workplace mishaps are largely made up of sharps-related injuries, but they also include non-sharps injuries such as blunt force trauma, thermal or chemical burns, and medical emergencies.<sup>1</sup> There is great emphasis on the prevention of needlestick injuries because of risks of transmission of bloodborne viral infections, and this topic is prominent both in everyday clinical practice as well as in dental research.<sup>1,5</sup> Despite this, a clear understanding of the importance of non-sharps injuries and their management is vital to a healthy and long-standing career.<sup>6</sup> Such incidents have considerable associated direct and indirect costs and contribute to a significant waste of human capital, time, and resources as well as emotional trauma.<sup>7</sup> Greater emphasis on preventing such incidents is needed.

All practice owners and workplace supervisors have core obligations to provide and support safe systems of work and be cognisant of the risks that exist in the workplace so that appropriate control measures can be introduced. A key aspect of appreciating the nature of the hazards present comes from having in place systems to identify hazards and to reduce the

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associated risks.<sup>8</sup> Understanding the nature of injuries in a work environment informs the process of risk assessment. Statistical data on near misses, incidents, and injuries can help employers and managers target areas of concern, address their legal duty of care, and target educational programmes at the workplace to appropriate areas. Within any given workplace, claims made under worker insurance impact future insurance premiums, so there are financial as well as legal and moral reasons to build a strong culture around workplace safety. Moreover, negligence on the part of owners and managers makes them exposed to considerable penalties under work health and safety legislation.<sup>9</sup>

Past studies of workplace injuries have examined skin-penetrating injuries.<sup>10-13</sup> A 2009 study by Smith et al. of incidents involving dental students at the University of Queensland (UQ) categorised incidents into 3 groups: sharps injuries, musculoskeletal disorders, and chronic occupational skin diseases. The latter was encountered commonly.<sup>8</sup> Although this study provides insight into the types of injuries that can occur in a dental school setting, it does not include non-sharps injuries. Another study at UQ by McDonald et al. examined the direct and indirect costs associated with all injury types between 1992 and 1994.<sup>14</sup> Both studies predate the introduction of nationally consistent work health and safety legislation in Australia but provide a platform for comparison with more recent data.

In a dental school setting, inexperienced operators may be involved in a wide range of incidents, some of which, like accidental inhalation or ingestion of foreign objects, are rare in dental practice but may be more common with junior clinicians.<sup>15-17</sup> Other unique factors such as the higher demands for students reaching the end of a session, running late, and needing to have work checked off are unique to the dental education setting and may explain why many injuries occur towards the end of a working session.<sup>10</sup>

As a major clinical service facility for public patients in Queensland, the UQ School of Dentistry (SoD) was the focus for the present study, leveraging the strong reporting framework and a long-standing culture focussing on work health and safety, with all injuries, illnesses, and near misses reported into a central UQ database. The present study was a retrospective analysis of non-sharps-related workplace injuries at the UQ SoD from 2009 to 2019.<sup>18</sup> The aim of this study is to determine the incidence of non-sharps injuries to aid in their prevention in a dental school setting.

## Materials and methods

### Study design and ethics

The study was approved by the UQ Human Research Ethics Committee (Approval Number #2019002103). Archived de-identified reports of all injury and incident entries from the UQ Health and Safety database from 2009 to 2019 inclusive were examined in this retrospective study.

### Data collation and analysis

Incident reports were divided into sharps and non-sharps injuries, and the latter was then subdivided into 7 categories

of non-sharps injuries: general incidents, medical emergencies, chemical-related injuries, thermal burns, inhalation, near misses, and other incidents, as shown in [Table 1](#). The criteria for the exclusion of incidences were as follows: (1) injuries that did not occur on school grounds were excluded as this study was confined to onsite injuries only, (2) duplicated reports of the same incident were excluded, and (3) reports that did not pertain to an injury or resulted in near misses were excluded. It should be noted that chronic injuries, including musculoskeletal injuries and chronic fatigue, were not included in this study, as the paper focussed on acute incidences. Furthermore, musculoskeletal disorders have multiple causative factors such as poor posture, pre-existing musculoskeletal conditions, and injuries obtained from other activities (including sport and recreation) outside the dental setting and were not included. The data retrieved for each incident included injury type/category, year, month, personnel type, location of the workplace, and the site of the injury on the body. Descriptive statistics were collated using SPSS Statistics for Windows (version 23; IBM Corp.) and GraphPad Prism (version 8, GraphPad).

## Results

A total of 1156 injuries were reported over the 11-year period of the study. Of these, 618 were sharps-related injuries (53.5%) and 413 were not related to sharps handling (35.7%). Types of incidents are summarised in [Table 1](#). Of non-sharps injuries, “general incidents” was the most common type of injury, with 48.4% (n = 200). This was followed by “chemical and substance/allergic reactions” with 16.2% (n = 67). Uncommon incident types were “chemical and substance/allergic reactions” (n = 67; 16.2%) and “inhalation” (n = 21; 5.1%).

The site distribution of injuries is summarised in [Table 2](#). The most common part of the body that was affected by non-sharps injuries was the hands (19.4%), followed by the head and neck region (12.9%). Together the upper limbs and the upper extremities (including fingers, thumbs, hands, wrists, forearms, elbows, upper arms, and shoulders) accounted for 25.7% of all reported non-sharps injuries, and of this group of injury sites, “general incidents” (57.5%) and “burns” (31.1%) constituted the vast majority of those injuries.

The affected persons included dental students (both undergraduate and postgraduate), dental practitioners, and clinical support staff as well as the patients or other visitors

**Table 1 – Type of injuries across the 11-year period (2009-2019).**

Type of injury	Incidence, n (%)
General incident	200 (48.4)
Chemical/substance/allergic reaction	67 (16.2)
Near miss	41 (9.9)
Burns	38 (9.2)
Medical emergency	27 (6.5)
Inhalation	21 (5.1)
Other	19 (4.6)
Total non-sharps injuries	413 (100)
Sharps	618
Excluded	125

**Table 2 – Body site for recorded injuries over the 11-year period.**

Site of injury	Hand	Head and neck	Leg	Arm	Eye	Torso	Multiple locations	Other	Total
Incidence n (%)	80 (19.4)	53 (12.9)	30 (7.3)	26 (6.3)	26 (6.3)	18 (4.4)	11 (2.7)	169 (40.9)	413 (100)

to the clinics (Figure 1). Which group was most affected changed over time, with students accounting for most injuries in 2009 and 2010 (46.2% and 40.4% of all non-sharps injuries, respectively). During the period of transition from the SoD from its Brisbane CBD location to the UQ Herston campus (from 2011 to 2016), staff accounted for more injuries. The pattern then changed back with students accounting for more incident reports from 2017 to 2019 (72.2% to 81.3%; Figure 2).

The workplace locations with the highest proportion of incident reports were the clinics (53.8%), rather than laboratories, other teaching spaces, offices, or common areas (Table 3). The yearly number of reported incidents was stable between 2010 and 2014, with an average of 43 incidents per year. However, when the relocation to the much larger new facility occurred for the start of the 2015 academic year, the number of reports rose in 2015 to 78, then declined to stabilise from 2017 onwards at an average of 17 incidents per year (Figure 2).

## Discussion

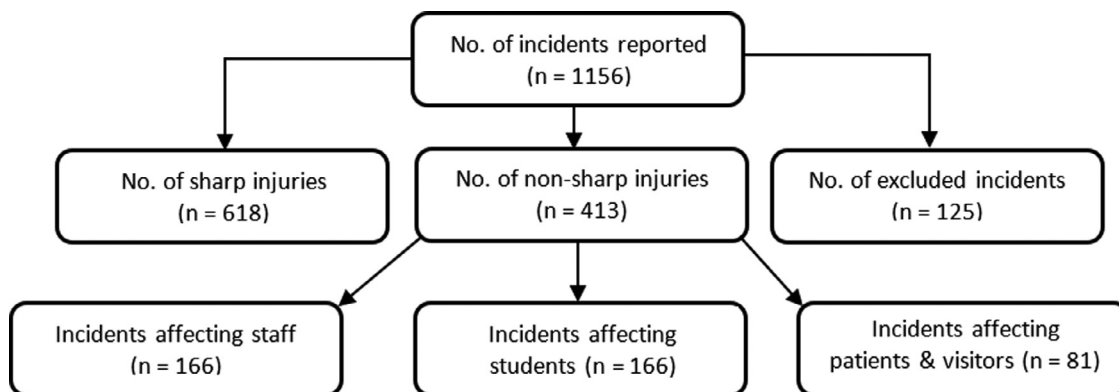
This study provides several insights into the patterns of incidents in a dental school setting over an 11-year period, during which there was a relocation to a new facility and a growth in the overall student and staff complement. The transition of the UQ SoD to the UQ Oral Health Centre in late 2014 meant that students and staff were working from January 2015 with completely different equipment in the simulation laboratories as well as in the clinics. At the same time, there was growth in the student cohort size and changes in its composition, with more international students joining progressively over time. Such factors could all contribute to changes in the nature of workplace incidents for staff and students.

The most common type of injury reported fell under the category of “general incidents.” This finding was consistent with other published reports as they concluded that other

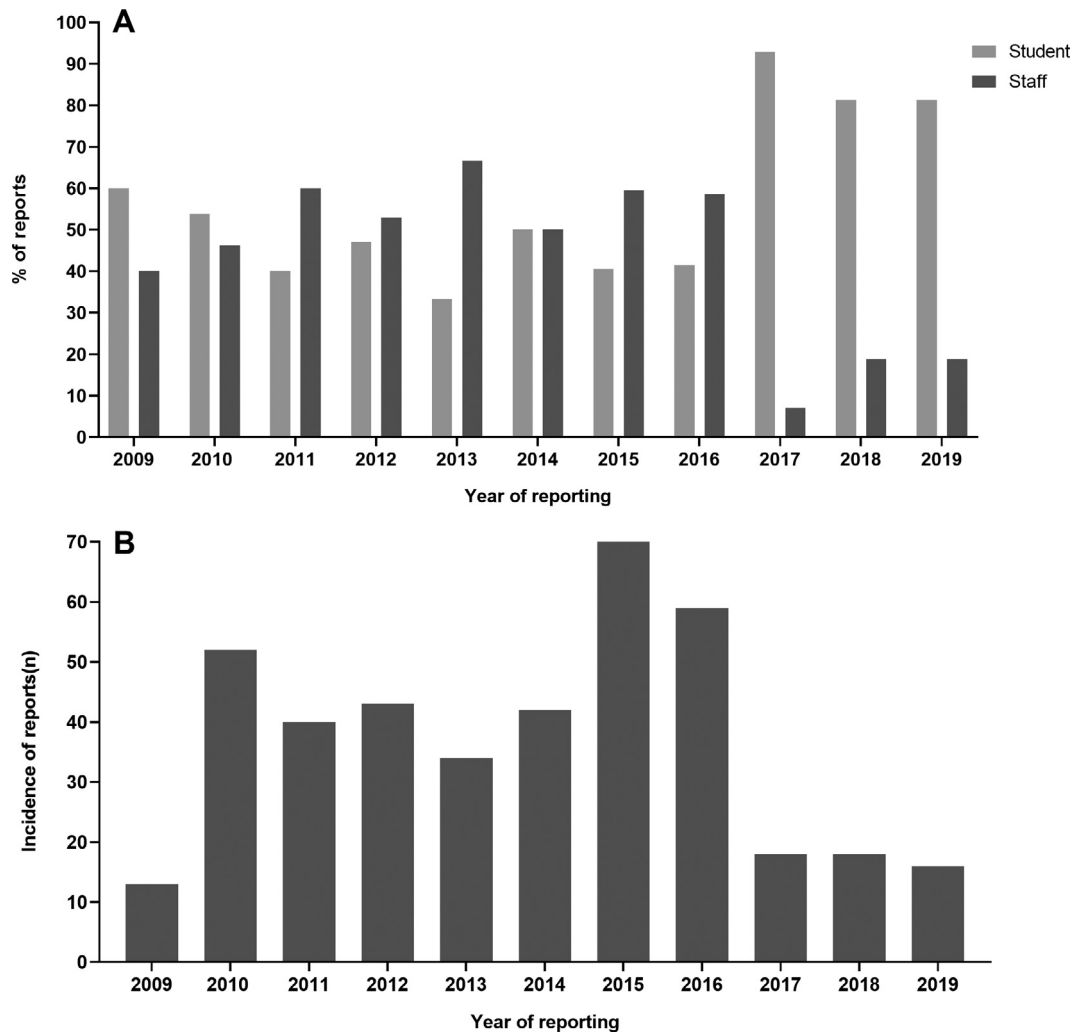
types of incidents such as inhalations were a rare occurrence.<sup>19</sup> This is most likely due to the risk factors of “general incidents” such as walking, reaching, and performing administrative tasks being experienced by all. It should be acknowledged that risk factors for general incidents occur for a larger proportion of time in comparison to more specific risk factors such as sodium hypochlorite-related chemical burns. They are also often overlooked in a fast-paced environment of a dental clinic. For this reason, dental personnel and their attitudes about safety often impact their ability to avoid these preventable injuries. Evidence suggests that programmes targeting the whole organisational body to reduce these preventable “general incidents” can reduce the rate of injuries.<sup>10</sup> All workers should be reminded frequently of these injuries and should be trained to recognise risk factors.

It is not unexpected that the hands emerged as the most likely body part to sustain a non-sharp-related injury, accounting for 19.4% of all incidents of this type. This result is consistent with other investigations and highlights the hands-on nature of dentistry.<sup>10</sup> The majority of incidences affecting the hands were “general incidents” and “burns,” which contributed 88.6% of all non-sharps injuries involving the hands. Changes in school policies regarding ergonomic practices and the use of magnifying loupes may influence this rate in the future, as will the use of different types of instruments and devices that alter the nature of manual manipulation in laboratory and clinical tasks. The progression of digital technologies in dentistry will also likely influence the situation for dental students in the future, as it changes the nature of preclinical learning activities.

The present results highlight the importance of protecting the face and head; the head and neck region was the second most common site for an injury (12.9%). Examples were seen of situations where eye injuries occurred from splashes of fluid, raising questions about protective eyewear for protection from projectiles vs protective face shields for protection from splashes of fluid. The same aspect has also been



**Fig. 1 – Flow diagram categorising the injury experience at the University of Queensland School of Dentistry into injury type and personnel involved over an 11-year period (2009-2019). Injury incidences that did not occur on school grounds and did not fit into either a sharps injury or a non-sharps injury were excluded as this study was confined to on-site injuries only (n = 125).**



**Fig. 2 – The yearly incidence of non-sharps injuries at the University of Queensland School of Dentistry over an 11-year period (2009-2019). A, The percentage (%) of non-sharps incidents reported by staff and students within each year. B, The total number (n) of non-sharps incidents reported by year.**

highlighted in the COVID-19 pandemic. It is certain that attention will continue to centre around personal protective equipment (PPE) for the face and the eyes. In contrast to earlier studies, compliance with the use of PPE at the UQ SoD was high and in line with current guidelines.<sup>20</sup> There may be benefits for certain procedures where fluid splashes are likely to move to a full face shield.<sup>21</sup>

An interesting finding in the present study was how the annual number of incidents declined once the cohort of staff and students had settled into the new facility and become accustomed to operating its equipment. Dramatic changes in building design, including the flow of patients and students through public areas, and different layouts of the clinical areas and equipment can all contribute to changes in injury

**Table 3 – The workplace location of non-sharps injuries over the 11-year period.**

Location type	Clinic n (%)	Dental technician lab n (%)	Preclinic (%)	Sterilisation n (%)	Other n (%)
General incident	90 (40.5)	16 (45.7)	10 (52.6)	5 (41.7)	79 (63.2)
Chemical/substance/ allergic reaction	50 (22.5)	3 (8.6)	1 (5.3)	2 (16.7)	11 (8.8)
Near miss	15 (6.8)	4 (11.4)	7 (36.8)	1 (8.3)	14 (11.2)
Burns	12 (5.4)	12 (34.3)	1 (5.3)	4 (33.3)	9 (7.2)
Medical emergency	26 (11.7)	0 (0)	0 (0)	0 (0)	1 (0.8)
Inhalation	20 (9)	0 (0)	0 (0)	0 (0)	1 (0.8)
Other	9 (4.1)	0 (0)	0 (0)	0 (0)	10 (8)
Total n (%)	222 (53.8)	35 (8.5)	19 (4.6)	12 (2.9)	125 (30.3)

rates. In the design and planning process for the new dental school, there was a large emphasis on optimising ergonomics and workplace health and safety. These aspects influenced cabinetry design, the use of wall- and ceiling-mounted equipment, the type and positioning of dental chairs, and the types and locations of sharps containers.

Other workplace changes that can cause a marked change in injuries involve the processes involved in instrument recirculation, moving this more to an automated and mechanised system rather than a workflow driven by many manual steps. The mechanisation of instrument reprocessing at the UQ SoD in the mid 1990s reduced the rates of sharps injuries sustained by dental assistants, as noted in the 1997 study of Macdonald et al. At this stage, cassettes had been introduced for instrument storage, reducing their handling, and instrument washers replaced manual cleaning of dental instruments.<sup>14</sup> The same principles are used at much greater scale in the new facility, which is greater in size and the number of dental chairs than the previous facility by more than 60%. On that basis, with larger student cohorts and a greater staff complement, having lower annual incident rates in 2017-2019 than in 2010 indicates that real progress has been made over time.

Supporting this view, there were several types of injuries that occurred from 2010 to 2014 (before the dental school relocated) that disappeared from 2015, when the relocation was complete. These include knee injuries from the use of "knee-operated bins," lacerations from serrated paper towel dispensers, and slips and falls on stairs. It can be concluded that the physical infrastructure of a dental school has a significant impact on non-sharp injuries. Attention to this aspect is important when planning new facilities, upgrading existing facilities, acquiring new equipment, and planning workflow, as it can ultimately prevent or eliminate certain types of injuries.

One of the well-established limitations of archival data is that they are often underreported,<sup>10,21</sup> including student dental facilities.<sup>6,7</sup> Therefore, it is possible that the true incidence of non-sharps injuries at the UQ SoD may be higher than what is documented. Arguing against this, the UQ SoD leadership over the 11 years of the study and the clinical operations management team in particular have emphasised the need for accurate and timely incident reporting, and there is a strong culture of accident reporting within the school.

One consideration that was not examined in detail in this study was the influence of the level of experience of the staff member or the student, because the incident reports had been anonymised. It is likely that estimations of relative risk may reveal important effects of the student year level or the experience level of staff, relative to the complexity of the procedure being undertaken at the time of the accident. One would expect that more experienced clinical operators and support staff such as dental assistants would be less likely to sustain injuries as than novices to the particular workplace tasks.<sup>20</sup> Such aspects could be the focus for future studies.

In addition to improved education and training, facilities, equipment, work processes, and safety protocols should therefore be reviewed regularly to minimise injuries that are recurring on accident reports. Appropriate personnel should regularly assess incident records in a retrospective manner to

identify fundamental causes and basic trends, so that preventive measures can be put in place to protect all involved.

## Conclusions

Non-sharps injuries are commonplace in the dental school setting and every personnel member is at risk. Facilities, equipment, work processes, and safety protocols should therefore be continuously reviewed and improved on in order to minimise these injury experiences. Appropriate personnel should regularly assess incident records in a retrospective manner as completed in this study to identify fundamental causes and basic trends, so that preventative measures can take place to protect all involved. It should also be emphasised that careful adherence to workplace health and safety protocols for all staff remain that of fundamental importance.

## Conflict of interests

None disclosed.

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