

Epidemiology of sharp instruments injuries at a dental school in Sudan

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Abstract

Dental practice represents an occupational hazard for injuries and transmission of serious infections and dental students are generally considered at a higher risk because they undertake exposure prone techniques during their training years. No published literature is available on sharp injuries among dentists in Sudan. The aim of this survey was to describe the epidemiology of sharp instruments injuries in dental students at a dental school in Sudan. An anonymous self-administered questionnaire was used to collect data on prevalence, protective strategies, hepatitis B immunization, health status following injuries and post-exposure prophylaxis. The response rate was 100% and females constituted 89.1% (41) of the sample. Thirty-two (69.6%) students reported being exposed to a sharp instruments injury and most injuries (22, 68.8%) occurred in the conservative dentistry department. The main tools causing injury are the syringe needle (16, 50%) and endodontic file (16, 50%). Endodontic treatment was the principle procedure causing injury (15, 46.9%). Twenty-five (78.1%) of students did not report their injury. None have tested for a blood borne virus after injury. Anxiety and stress was reported by 19 (59.4%) students. Thirty-five (76.1%) students were fully vaccinated against hepatitis B. Seven (15.2%) were aware of full details on standard precautions. Forty-two (91.3%) students practiced needle re-capping. The findings of this survey indicate the need for efficient training of dental students that encourages prevention of sharp injuries; compliance with standard precautions; preclinical HBV testing, immunization and efficacy testing; reporting of injuries and follow-up with provision of PEP.

Keywords: Needle stick injuries and epidemiology; Students dental; Dental instruments and microbiology; Occupational exposure; Sudan

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Introduction

It is estimated that there are 35 million healthcare workers (HCWs) worldwide representing 12% of the working population.¹ Two million injuries are believed to occur each year among HCWs.¹ Although sharp instruments injuries are preventable, a minor injury can carry the risk of transfer of over twenty pathogens of which the most serious are Hepatitis B virus (HBV), Hepatitis C virus (HCV) and Human Immunodeficiency virus (HIV). These injuries result in 66,000 HBV; 16,000 HCV and 1,000 HIV infections each year among HCWs.^{1,2} Other estimates indicate that occupational injuries have resulted in 2.5% of HIV and 40% of HBV and HCV cases among HCWs worldwide.³ These blood borne viruses (BBVs) have serious consequences, including long-term illness, disability and death.²

Dental practice represents an occupational hazard for injuries and transmission of serious infections.⁴ Healthcare students are exposed to a number of occupational hazards in the workplace and injuries are a major concern. There is a high risk of exposure to pathogens among healthcare students while they become involved in patient's investigation and treatment during their clinical training.^{5,6} Dental students are generally considered at a higher risk because they undertake exposure prone techniques during their training years and use sharp instruments more often.^{4,6} Several studies have highlighted that knowledge and compliance among dental students is inadequate regarding prevention and management of sharps injuries.⁷ Lack of experience and skill in performing dental procedures during clinical training places dental students at risk of exposure to blood-borne viruses (BBVs).⁷ The carrier rate following transmission is 20% for HBV, 80% for HCV and almost 100% for HIV.⁸

The likelihood of being infected by a virus after a single exposure is low. However, the consequences for the dental student who becomes infected are potentially serious, and include the potential of transmission of blood-borne pathogens and associated detrimental effects on their personal and professional lives.⁹ The emotional impact of needle stick injuries (NSIs) can be severe and long lasting, even if a serious infection is not resulted.³

Sharps injuries are a hidden problem and the vast number go unreported and are virtually undocumented in developing countries, but probably equal or exceed those in the industrialized world.⁸

Despite the growing body of knowledge concerning NSIs among practicing dentists, there is no research on sharp instruments injuries among the dental student population in Sudan. The primary objective of this survey was to describe the epidemiology of sharp instruments injury among dental students receiving clinical training at a university in Sudan. The secondary objectives were to describe: protective strategies, hepatitis B immunization, health status following injuries and post-exposure prophylaxis.

Methods

An institutionally-based cross-sectional survey was conducted during March 2014. The survey was conducted among fourth and fifth year dental students receiving their clinical training at the Faculty of Dentistry of the University of Medical Sciences and Technology. Students receive their clinical training in years 4 and 5. The total dental student population is forty-eight of which 23 students are in year four and 25 students are in year five. All 48 students were eligible to participate in the survey.

The prevalence of sharp injury was measured using the definition provided by Hussain *et al.* A sharp injury was defined as "the par literal introduction into the body of a healthcare worker, during the performance of his/her duties, of blood or potentially infectious material by a hollow-bore needle or sharp instrument, including but not limited to needles, lancets, scalpels and contaminated broken glass".⁵

Data were collected through an anonymous self-administered questionnaire. The questionnaire was distributed at the end of a lecture and collected on the same day. The questionnaire was used to collect demographic data, prevalence of sharps injury, frequency of sharps injuries, department of injury occurrence, mechanism of injury, type of device causing injury, reporting of injury, reasons for not reporting injury, protective practices, prevalence of hepatitis B immunization, prevalence of hepatitis B status immunization, perception of risk of acquiring

BBVs from dentistry, level of awareness of rate of transmission of BBVs HIV; and level of knowledge of prevalence of BBVs in Sudan. A 12-month recall period was used throughout the questionnaire.

The study was approved by the Academic Secretary, Dean of Faculty of Dentistry and Dean of the Graduate

College. Verbal informed consent was obtained from the students after the purpose of the survey was explained to them. Confidentiality of the students' data was ensured and no personal identification such as the student's name or index number was recorded on the questionnaire.

Table I. Epidemiology of sharp instruments injury

	Frequency	Proportion
Prevalence of injury		
Yes	32	69.6
No	14	30.4
Number of injuries		
1 time	9	28.1
2 times	9	28.1
More than two times	14	43.8
Department of reported injury		
Conservation	22	68.8
Periodontics	16	50
Surgery	13	40.6
Orthodontics	11	34.4
Pedodontics	4	12.5
Prosthodontics	1	3.1
Tool causing injury		
Needle	16	50
Endodontic file	16	50
Explorer	15	46.9
Orthodontic wire	13	40.6
Scaler	12	37.5
Bur	9	28.1
Orthodontic band	2	6.3
Suture needle	1	3.1
Surgical elevator	1	3.1
Mechanism of injury		
Endodontic treatment	15	46.9
Scaling	12	37.5
Collision with sharp instrument	9	28.1
Local anesthesia administration	8	25
Needle re-capping	7	21.9
Needle exchange	3	9.4
Sharp instruments disposal	3	9.4
Washing of sharp instrument	3	9.4

Data was checked for consistency and completeness before being analyzed using IBM SPSS ver. 20 (Chicago, IL). Descriptive analysis was performed for all variables and Chi-square test or Fischer's exact test was used to test for significant differences in proportions. Alpha level was set at 5% level.

Results

The student response rate was 100%. There were 5 (10.9%) males and 41 (89.1%) females who participated in the survey. The mean age (\pm SD) was 21.2 (\pm 1.2) years. Twenty-five (54.3%) and 21 (45.7%) of the students were in year 4 and year 5 respectively.

Thirty-two (69.6%) students reported being exposed to a sharp instruments injury during the past twelve months (Table I). Nine (28.1%) students were injured one time, 9 (28.1%) were injured two times and 14 (43.8%) were injured three or more times. Most injuries (22, 68.8%)

were reported to occur in the conservation department, followed by periodontics (16, 50%), surgery (13, 40.6%), orthodontics (11, 34.4%), pedodontics (4, 12.5%) and prosthodontics departments (1, 3.1%). The main tools causing injury are the hollow bore needle (16, 50%) and endodontic file (16, 50%). Other tools reported to cause injuries were explorer (15, 46.9%), orthodontic wire (13, 40.6%), scaler (12, 37.5%), bur (9, 28.1%), orthodontic band (2, 6.3%), suture needle (1, 3.1%) and surgical elevator (1, 3.1%). Endodontic treatment was reported by 15 (46.9%) students as the principle procedure causing injury. Twelve (37.5%) students were injured during scaling, 9 (28.1%) through collision with a sharp instrument, 8 (25%) while administering local anesthesia and 7 (21.9%) were injured while recapping needles. Less commonly reported procedures resulting in injury were needle exchange (3, 9.4%), sharps disposal (3, 9.4%) and washing of instruments (3, 9.4%).

Table II. Post sharps injury reaction and reporting

	Frequency	Proportion
Immediate post injury reaction		
Anxiety and stress	19	59.4
Anger directed at oneself	9	28.1
Indifferent/I didn't care	4	12.5
Reporting of injury		
Yes	7	21.9
No	25	78.1
Reasons for not reporting injury		
Not knowing how or to whom to report injury	8	32
Used self-care	5	20
Injury was minor	5	20
Item was unused	4	16
Being busy	3	12

Anxiety and stress was the most frequent immediate post injury reaction reported by 19 (59.4%) students (Table II). Nine (28.1%) directed anger to themselves and 4 (12.5%) felt indifferent following the injury. Only 7 (21.9%) reported their injury. Seven (21.9%) reported an injury while 25 (78.1%) did not. Reasons provided for not reporting injury were: not knowing to whom to report injury (8, 32%), using self-care (5, 20%), injury was minor (5, 20%), item being unused (4, 16%) and being busy (3, 12%).

With regards to knowledge and awareness of standard precautions, most students reported knowing some details of standard precautions (29, 63%) as shown in table III. Seven (15.2%) were aware of full details, but 10 (21.7%) only heard of standard precautions without knowledge of the details. Thirty-one (67.4%) students noted the prime source of information on standard precautions was a supervising doctor, student colleague, nurse or dental assistant. For 8 (17.4%) students the source of information was classroom

Table III. Awareness of/and sources of information regarding standard precautions

	Frequency	Proportion
Awareness of the standard precautions		
Only heard about them but don't know details	10	21.7
Know some details about them	29	63
Know full details about them	7	15.2
Source of information on standard precautions		
Supervising doctor, student colleague, nurse or dental assistant	31	67.4
Classroom lectures	8	17.4
Personal study from books or journals	5	10.9
Seminars, workshops or posters	2	4.3

Table IV. Adherence to standard precautions

	Frequency	Proportion
Gloves		
Yes	46	100
No	0	0
Mouth masks		
Yes	46	100
No	0	0
Needle-recapping		
Yes	42	91.3
No	4	8.7
Needle-recapping technique		
Scooping	34	81
Two hands	8	19
Disposal of sharps and needles in sharps disposal		
Yes	3	9.4
No	29	90.6

lectures. Five (10.9%) students obtained information from personal study and only 2 (4.3%) students from seminars, workshops or posters. All students wore gloves (46, 100%) and mouth masks (46, 100%) while operating on patients (Table IV). Forty-two (91.3%) students practiced needle re-capping. Thirty-four (81%) used the scooping technique and 8 (19%) used the two hands technique to re-cap needles. Only 3 (9.4%) reported using sharps disposal containers.

Table V shows that the majority of students (30, 65.2%) was not aware of post-exposure prophylaxis (PEP) and did not know if there was a PEP protocol at their faculty (30, 65.2%). None of the students tested themselves for a

blood borne virus (BBV) after injury, but 2 (6.3%) reported that they had received PEP for HIV or HBV respectively.

Thirty-five (76.1%) of students were fully vaccinated against hepatitis B, 10 (21.7%) did not complete their vaccination and 1 (2.2%) was not vaccinated (Table VI). Reasons provided by students who did not complete their vaccination or were not vaccinated were: being busy (8, 72.7%), not being aware that full vaccination requires three doses (2, 18.2%) and other (1, 9.1%). Of the students who are fully vaccinated, 7 (20%) had their HBsAg titer levels measured. Three (42.2%) reported titer levels above 100 IU/ml and 4 (57.1%) could not recall their titer levels.

Table V. Awareness of post exposure prophylaxis (PEP) protocols and prophylaxis for BBV

	Frequency	Proportion
Aware of PEP protocols		
Yes	16	34.8
No	30	65.2
Awareness of PEP protocol at faculty		
Yes	8	17.4
No	8	17.4
I don't know	30	65.2
Testing for BBV after injury		
Yes	0	0
No	32	100

Table VI. Hepatitis B vaccination

	Frequency	Proportion
Hepatitis B vaccination status		
Full vaccination	35	76.1
Incomplete vaccination	10	21.7
Not vaccinated	1	2.2
Reasons for not completing vaccination		
Being busy	8	72.7
Not aware that full vaccination requires three doses	2	18.2
Other	1	9.1
HBsAg antibody titer testing after completion vaccination		
Yes	7	20.0
No	28	80.0
Level of HBV antibody titer status		
Above 100 IU/ml	3	42.9
I don't know / I can't recall	4	57.1

Discussion

Several studies have reported on occupational injuries among dental students with variable findings. Differences in reporting can be attributed to the operational definitions used for investigating occupational injuries. While some studies have focused solely on NSIs, others have described percutaneous and occupational injuries to include other forms of injuries to which dentists can be exposed to in their work environment. The divergence of results reported in the literature has also resulted from variations in definition of the recall period, samples sizes, academic years surveyed and study design approaches.

Epidemiology of sharp injuries

The overall prevalence of sharp instruments injuries of 69.6% reported in this study is considered to be high. The most common form of injury among dentists is NSIs.⁴ NSIs remain a hidden but prevalent problem among health care workers.³ The prevalence of NSIs among dental students in this survey was 50%. Prevalence rates of NSIs ranging from 23% - 75.4% were reported in dental schools.^{5,7,10} As in other studies, most students were exposed to multiple injuries.^{3,5,10} It has been reported that inadequate staff, lack of experience, insufficient training, duty overload and fatigue may lead to occupational injuries.¹⁰

Dental students work in various dental departments where they can be exposed to injuries. The most frequently reported places for injuries have varied across the literature. Endodontics, surgery, prosthodontics, operative dentistry, pediatrics and periodontics departments were reported as places for injury occurrence.^{3,4,10} In this study, most injuries were reported to occur in the conservation followed by periodontics, surgery, orthodontics, pedodontics and prosthodontics departments.

In dental practice, multiple injections are usually given and syringe use is the major cause of NSIs among dental professionals. These activities place dentists at an increased risk of sustaining NSIs.⁷ Almost half the students in the survey were injured during endodontic treatment. Injuries may happen during injection of local anesthetics, IV/IM injection or sampling.^{4,5,7,10} In this study, 25% of students reported injury during administration of local anesthetic. A ten year prospective study in the United States has shown that more than 70% of local anesthetic-related NSIs occur during needle insertion or withdrawal and the remaining during patient movement at time of injection.¹¹ Other procedures for injuries identified in this study such as sharps disposal, needle re-capping, washing instruments, scaling, wound suturing were also reported in similar studies.^{3,4,7,10}

In this survey, half the students reported injuries through needles. Significant risks of work acquired infections can be attributed to hollow-bore needles that are already contaminated.^{4,5} This is because a larger volume of blood remains inside the bore of the needle as compared to a suture needle which is a solid core needle.⁵ When a student is exposed to NSIs, the risk of transmitting various types of blood-borne pathogens from an infected patient is greatly increased.⁷ In this survey students reported other instruments such as the orthodontic wire, scaler, bur, orthodontic band, suture needle and surgical elevator as causing injuries which were also reported in similar studies.⁵⁻⁷

Reporting of sharp injuries

Non-reporting of NSIs is a contentious issue within the dental profession.⁷ The under-reporting is an established fact because HIV, HBV and HCV infections have implications for personal relationships, future

employment and insurance coverage.¹² All injuries require reporting and evaluation. Reporting of incidents is important to ensure appropriate counseling and treatment of healthcare students.⁵

In this study, 78.1% of students did not report their injury. Similar studies have reported high rates of under-reporting and in one study 85% of students have acknowledged that they did not report their injuries.^{6,7,10} Reasons provided by students in this survey for not reporting injury were using self-care, injury being minor, item being unused and student being busy. Additional reasons reported in other studies by dental students for not reporting were: fear of stigmatization and discrimination, feeling embarrassed, fear of the consequences, the patient was low risk, good local anti-sepsis undertaken at time of injury, heavy clinical schedule, students more concerned with finishing their clinical requirements and not knowing that there is a reporting protocol, negative faculty reaction and negative patient reaction.^{7,13,14} The literature has also revealed that that "most students indicate that they do not see routine universal precautions undertaken by staff and residents, and no requirement for the compliance is enforced".¹⁵ Additional reasons cited by the WHO for not reporting injuries were ignoring that PEP is available and efficient, uncertainty regarding the confidentiality of the results and a lack of support and encouragement to report.^{14,16} Fear of testing may also play an important role in the underreporting of occupational exposure.¹⁶ It has been suggested that such a high rate of under-reporting requires students' need for education on prevention, with the emphasis of reporting injuries and the possibilities of prophylaxis against BBVs.^{3,10} Low compliance among students, especially in reporting of injuries, may be partly explained by the perception that they are insignificant and pose no risk to them and this may be due dental students doing their own risk assessment.⁷

Health status following sharp injuries

Students exposed to injuries experience fear of contracting BBVs and low self esteem as a consequence of getting the infection.⁷ The emotional impact of NSIs can be severe and long lasting, even if a serious infection is not occurred.⁷ The health status reported by most of our students immediately following the injury was anxiety, stress and anger. It has been reported that

the psychological stress and emotional impact after an injury can affect the students performance and career if infection results.⁵

Knowledge and Adherence to Standard Precautions

Disturbingly, this study showed that 15.2% of students reported knowing full details about standard precautions. Lectures were not the prime source for information on standard precautions. This reflects inadequacy of educational training provided to the students. In other studies the proportion of students who had received information about standard precautions ranged from 85% - 92%.^{7,10}

Strict adherence to universal precautions among health students is imperative to avoid sharp injuries.⁵ This study revealed that all students wore gloves and mouth masks while operating on patients. In one study, most dental students reported not being encouraged by clinical staff to double glove while using needles.¹⁰ Common reasons given by students for not wearing gloves routinely included: inability to manipulate, inadequate facilities, changed sensation/hand tingling and numbness.¹⁰ Unsafe handling practices of needles prior to disposal increase the risk of sharp injuries.⁵ Procedures such as two-handed re-capping can be associated with frequent injuries.⁶ In this study, 91.3% of students practiced needle re-capping and 81% used the one handed scoop technique. The literature consistently shows that it is during the process of recapping and disposing of the needles that most NSIs occur.⁷ The one handed 'scoop' technique for recapping has been promoted widely and there is evidence that it is highly effective, even for non-experienced users.⁷ The scoop technique offers a greater amount of protection as students are frequently required to give multiple injections. With regards to use of sharps disposal containers, only 9.4% of the students surveyed reported using sharps containers compared to 35% of dental students in a similar study.¹⁰

Hepatitis B vaccination

The risk of transmission of blood borne viruses depends on source patient, type of instrument used and degree of exposure.⁵ It is recommended that healthcare students be vaccinated against hepatitis B since it is more transmissible than HIV and ten times more

transmissible than hepatitis C.⁵ With regards to HBV vaccination, it was surprising to know that only 76.1% of students reported being fully vaccinated against hepatitis B. Other studies have reported complete vaccination rates ranging from 95% - 100%.^{6,7,10} More than 20% of students in this study did not complete their vaccination or were not vaccinated against hepatitis B. Similar studies have indicated non-vaccination rates ranging from 0% to almost 30%.^{3,17,18} Unvaccinated individuals may have a 6% - 30% risk of becoming infected with the virus following an injury.⁷ However, the effectiveness of the vaccine is the most significant factor that needs to be tested among healthcare students.⁵ Of the students who are fully vaccinated, 8.3% knew their immunization status and had reported effective immunity with titer levels above 100 IU/ml. However, between 80.7% - 89% percent of the immunized students in similar studies knew the status of their immunity.^{6,7} The reasons provided by students in this survey for not completing vaccination were being busy and not knowing that complete vaccination requires three doses. An additional reason reported in a similar study was simply forgetting to complete the process.⁷ Reasons for not completing immunization and reported in the literature were being already positive to HBV antibodies, being busy on the day of the vaccination, or simply forgetting to complete the process, lack of strict monitoring of the vaccination status prior to commencing of the clinical work.^{3,7} It is reported that students who are unaware that they have had an inadequate response to HBV immunization may have a false sense of security and may not use appropriate prophylaxis after exposure to HBV.⁶

It is disappointing to know that none of the students who reported injury in this survey underwent testing for HIV, HBV and HCV. The danger is that it is likely that students may have been unknowingly exposed to BBV as a result of injury, as medical histories, examinations and laboratory tests cannot reliably identify all infected patients.⁶

Post-exposure Prophylaxis (PEP)

The majority of students in this study was not aware of PEP and did not know if there was a PEP protocol at their faculty. Knowledge of PEP protocols is crucial as prophylaxis for HIV, which can reduce risk of

infection by 79%, is recommended within 2 hours of exposure and there are also time constraints for the administration of hepatitis B immune globulin to those who have inadequate HBV antibody protection.⁶

In conclusion, this survey indicates a high prevalence of sharp instruments injuries among dental students; worrying level of under-reporting of injuries; lack of formal institutional training on infection prevention and control; and sub-optimal HBV immunization rate. These findings place students at a considerable risk of detrimental adverse health consequences for the students and patient alike.

The CDC has quoted that “personnel are more likely to comply with an infection control program and exposure-control plan if they understand its rationale”. Education is key to prevention in a developing country such as Sudan where PEP is not readily available. This requires that curricula in dental schools be revised and adequate effective educational training in infection control be provided to dental students. This will enable dental students to uphold safe occupational health and infection control practices and promote patient safety when they become professional dental practitioners. Dental students must receive efficient training that encourages prevention of sharp injuries; compliance with standard precautions; preclinical HBV testing, immunization and efficacy testing; reporting of injuries and follow-up with provision of PEP. Prompt education can be delivered through seminars and workshops. It has been reported that comprehensive educational programs have been effective in decreasing the incidence of sharp instruments injuries at some health care institutions.⁵ Standard precautions and management of injury should be displayed in the dental departments.¹² Adequate and complete vaccination should be provided to all dental students.

This survey achieved a complete response rate. It is the first study to examine the epidemiology of sharp injuries in dental students in Sudan. This survey is without its limitations. Self-reports of sharp injuries may not be accurate because of the possibility of recall bias. Similarly, what students report may actually differ from what they practice, resulting in reporting bias. The results of this survey cannot be generalized to other dental schools in Sudan. Other dental schools may

follow different training programs and have different clinical requirements.

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