Abstract: Needle-stick and sharps injuries (NSIs) can happen even when dental health care workers (DHCWs) act in compliance with standard precautions to prevent transmitting blood-borne infections. The objective of this study was to investigate causes of NSIs that had occurred at a dental specialty university hospital during the past 12 academic years. A total of 215 NSIs were reported during the investigation period, and NSIs ascribed to female DHCWs (n = 148; 68.8%) were significantly (P < 0.05) more common than those ascribed to male DHCWs (n = 67; 31.2%). One hundred twenty-six NSIs (58.6%) were caused by DHCWs with little experience (P < 0.05), and 37 of those (17.2% of the total) were ascribed to undergraduate students during clinical training (P < 0.05). The NSIs occurred both during treatment (n = 119; 55.3%) and during cleaning up used devices (n = 89; 41.4%). The NSIs at the dental hospital occurred with a probability of 0.004% of total therapeutic opportunities. Prevention of NSIs should be the responsibility of dental students and DHCWs, and should be a part of education about infection control to prevent the nosocomial transmission of blood-borne pathogens.

Keywords: clean-up procedures; clinical experience; dental health care worker; needle-stick and sharps injury.

Introduction

Needle-stick and sharps injuries (NSIs) are hazardous for health care workers (HCWs) and potentially dangerous in that blood-borne infectious pathogens may be transmitted by the contaminated used devices. Dental care entails the use of various small and sharp instruments that are quite different from those used in medical care. The actual conditions in which NSIs had occurred at dental care facilities have been analyzed in few published articles. Thus NSIs caused by dental health care workers (DHCWs) might have occurred under conditions different from those in which NSIs were caused by medical HCWs. In addition, some conditions in which NSIs were caused by undergraduate students in clinical training might be different from those in which NSIs were caused by experienced DHCWs.

During patient care, HCWs must comply with standard precautions for infection control, and education on how to prevent NSIs would be helpful, inasmuch as the workers themselves would be better protected against blood-borne infectious pathogens (1-3). Among the general population in Japan, the prevalence of blood-borne viruses such as hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV) is presumed to be approximately 1.25%, 1.75%, and 0.02%, respectively. Individuals with these infec-
tions sometimes visit dental clinics for oral care services and dental treatments without disclosing their infection status. Thus when taking oral care of patients, DHCWs are potentially exposed to infectious pathogens that could be present in the patients’ saliva.

Current education in clinical dentistry includes information about the pathology and treatment of infectious diseases (4), but practical training in the actual methods to prevent their transmission has not been provided. Therefore, students must receive clinical training to prevent incidents involving occupational exposure.

The objectives of this study were to investigate the factors related to NSIs at the Dental Hospital of Tokyo Medical and Dental University (TMDU-DH), during the past 12 academic years and to discuss the implications of the findings for infection control, especially the prevention of NSIs.

### Materials and Methods

The TMDU-DH is a dental care specialty center for outpatients and also an advanced treatment center for maxillofacial and oral surgery, where more than 1,850 outpatients daily receive their oral care services, dental treatments, or both. It is also a teaching hospital for undergraduate and postgraduate trainees to improve their clinical skills.

Causes of NSIs were analyzed using the items documented in each incident report submitted to the infection control office of the TMDU-DH during the 12 academic years from 1 April 2005 to 31 March 2017. The following characteristics of NSIs involving DHCWs were clarified: a) information about injured DHCWs (gender, age, length of working experience as a DHCW, position in the hospital, and serological anti-hepatitis B virus antibody [anti-HBsAb] level); b) place in the hospital where the NSIs occurred; c) rate of NSI occurrence (monthly and daily incidences); d) degree of injury from NSIs; e) causative equipment involved; and f) anatomical site of injury.

### Results

A total of 215 DHCWs, including undergraduate and postgraduate students, caused NSIs during the surveillance period of 12 years at the TMDU-DH. The number of NSIs in each academic year was between 12 and 29 (mean ± standard deviation [SD]: 17.9 ± 5.63), and the NSI rate ranged from 0.00261% (the academic year 2013-2014) to 0.00601% (2005-2006; Table 1).

The analysis of the NSI incident reports revealed the following:

### Table 1 The number of the dental health care workers (DHCWs) who caused NSIs during the surveillance period of 12 academic years from 1 April 2005 to 31 March 2017

| Position                      | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Total | Mean  | S.D.  | %   |
|-------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-----|
| Injured male DHCWs †          | 10   | 8    | 4    | 9    | 5    | 11   | 2    | 4    | 4    | 3    | 2    | 5    | 67    | 5.58  | 3.11  | 31.2|
| Injured female DHCWs †         | 19   | 17   | 12   | 14   | 15   | 10   | 10   | 8    | 7    | 11   | 13   | 11   | 148   | 12.5  | 3.56  | 68.8|
| All injured DHCWs              | 29   | 25   | 16   | 23   | 20   | 21   | 12   | 12   | 14   | 15   | 16   | 215   | 17.9  | 5.63  | 100 |
| Teaching staff                 | 4    | 1    | 1    | 2    | 2    | 3    | 0    | 2    | 2    | 2    | 2    | 23    | 1.92  | 1     | 10.7|
| Hospital dental staff          | 0    | 2    | 1    | 2    | 1    | 3    | 1    | 3    | 0    | 0    | 3    | 16    | 1.33  | 1.23  | 7.44 |
| Dental resident *              | 5    | 6    | 4    | 5    | 2    | 2    | 1    | 0    | 2    | 0    | 1    | 30    | 2.5   | 20.27 | 14   |
| Part-time dentist              | 0    | 0    | 1    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0     | 1     | 0.08  | 0.29 |
| Nurse                         | 3    | 3    | 0    | 1    | 3    | 1    | 1    | 1    | 1    | 1    | 2    | 1     | 18    | 1.5   | 1     | 8.37 |
| Nurse aide                    | 2    | 0    | 0    | 1    | 1    | 1    | 1    | 0    | 0    | 2    | 0    | 1     | 10    | 0.83  | 0.83  | 4.65 |
| Dental hygienist              | 1    | 2    | 1    | 0    | 1    | 0    | 1    | 0    | 0    | 0    | 0    | 0     | 6     | 0.5   | 0.67  | 2.79 |
| Dental technician             | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0     | 0     | 0     | 0    | 0   |
| Clinical laboratory technician | 1    | 0    | 0    | 0    | 0    | 1    | 1    | 0    | 2    | 1    | 0    | 0     | 8     | 0.67  | 0.78  | 3.72 |
| Radiology technician          | 0    | 0    | 0    | 0    | 0    | 1    | 0    | 0    | 0    | 0    | 0    | 1     | 0.08  | 0.29  | 0.47 |
| Graduate student *            | 6    | 2    | 1    | 1    | 2    | 4    | 1    | 2    | 4    | 1    | 2    | 12    | 22    | 2.25  | 1.6   | 12.6 |
| Diploma student               | 1    | 3    | 3    | 2    | 2    | 4    | 0    | 0    | 1    | 2    | 2    | 22    | 1.83  | 1.19  | 10.2 |
| Dental course student *       | 5    | 5    | 3    | 8    | 2    | 2    | 1    | 3    | 0    | 2    | 3    | 37    | 3.08  | 2.11  | 17.2 |
| Oral hygienist course student | 0    | 0    | 1    | 0    | 2    | 0    | 0    | 0    | 0    | 1    | 4    | 1     | 9     | 0.75  | 1.22  | 4.19 |
| Pharmacist                    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0     | 0     | 0     | 0    | 0   |
| Cleaning staff                | 0    | 0    | 0    | 1    | 0    | 0    | 0    | 1    | 0    | 0    | 0    | 2     | 0.17  | 0.39  | 0.93 |
| Others                        | 0    | 1    | 0    | 0    | 0    | 1    | 0    | 1    | 0    | 0    | 0    | 1     | 4     | 0.33  | 0.49  | 1.86 |

There was a statistical significance between the number of needle-stick and sharps injuries (NSIs) caused by female dental health care workers (DHCWs) and those caused by male DHCWs (†: \( P < 0.05 \), Student’s \( t \)-test). There were statistically significant differences among the injured DHCWs in different positions in the Dental Hospital of the Tokyo Medical and Dental University (TMDU-DH; *, \( P < 0.05 \), one-way analysis of variance [ANOVA], Fisher’s PLSD).
1) Female DHCWs caused 148 NSIs (68.8%) and the male DHCWs caused 67 NSIs (31.2%). Results of the t-test were significant (P < 0.05) for the number of actual occurrences, but those of the χ²-test for occurrence rate were not significant (see Table 1). The ages of injured DHCWs ranged from 20 to 59 years, and DHCWs younger than 35 years old caused significantly more NSIs (P < 0.05 by one-way ANOVA, Fisher’s PLSD) (Fig. 1). DHCWs with less than 2 years of clinical experience caused 126 NSIs (58.6%), which was a significantly high frequency (P < 0.05 by one-way ANOVA, Fisher’s PLSD). The undergraduate students in dental courses caused the highest number of NSIs (n = 37; 17.2%), followed by dental residents (n = 30; 14.0%) and graduate students (n = 27; 12.6%); these findings were significant (P < 0.05 by one-way ANOVA, Fisher’s PLSD). Diploma students caused fewer NSIs (n = 22; 10.2%; see Table 1).

2) From these data, the NSI-incident rates with the total number of the undergraduate dental course students were calculated to be at 2.76% for male (n = 398) (Odds ratio, OR = 0.32) and at 7.74% for females (n = 349) (OR = 2.42), and there was a statistically significant difference between the male’s NSI incidence and the female’s NSI incidence (P < 0.05 by t-test, but not significant by the χ²-test). This difference with respect to gender was also found in the dental resident group. The incident rates in the dental residents were calculated to be at 4.42% for male (overall total n = 226) (OR = 0.60) and at 6.56% for females (overall total n = 305) (OR = 1.32), and there was a statistical significance between them (P < 0.05 by t-test, but not significant by the χ²-test).

3) About three-quarters of the injured DHCWs were anti-HBs antibody positive (n = 159; 74.0%) (P < 0.05 by one-way ANOVA, Fisher’s PLSD) mostly by the HBV vaccine immunization, 30 injured DHCWs were anti-HBs antibody negative (14.0%) and 26 of them were unexamined (12.0%).

4) The analysis on the incident location in this hospital showed that about a half of the NSIs occurred at various specialized clinical departments for outpatients (n = 111; 51.6%) with statistically significance (P < 0.05, by one-way ANOVA, Fisher’s PLSD), followed by at the student clinic (n = 31; 14.4%), at the central operating room for inpatients (n = 23; 10.7%), and at the dental resident clinic (n = 20; 9.3%) (Fig. 2).

5) The NSI incident occurred anytime throughout the academic year starting on 1 April every year (Table 2), and no statistical significance was found in NSI’s annual occurrence time distribution. As for the daily occurrence time distribution of NSIs, 78 of NSIs (36.3%) occurred in the morning (from 9:00 am to 12:00 pm) and 127 NSIs (63.7%) occurred in the afternoon (from 12:00 pm to 18:00 pm) (P < 0.01 by t-test) (Table 2).

6) One hundred and nineteen incidents (55.3%) occurred due to the causative devices used during the treatment procedures, and 89 incidents (41.4%) occurred during the cleaning up afterward (P > 0.05). In April 2010, the clean-up system of the used devices at the student clinic was changed. Twenty NSIs occurred before this change (during the academic year 2005-2009) and
11 NSIs occurred after the change (during the academic year 2010-2016). The occurrence of NSIs significantly decreased after the change of clean-up system (*P* < 0.05, *t*-test).

7) The injection needle had a place in the highest rank of causative devices of NSI (n = 58, 27.0%), (*P* < 0.05 by one-way ANOVA, Fisher’s PLSD) (Table 3).

8) The left index finger was the most frequent injury site by the NSIs (n = 44, 20.4%) (*P* < 0.05 by one-way ANOVA, Fisher’s PLSD) (Fig.3).

**Discussion**

DHCWs must comply with standard precautions in order to prevent nosocomial infection. However, NSIs do happen with a certain probability, no matter how carefully the DHCWs may provide oral care with standard precautions. Although this study was limited by omission of declarations, the mean occurrence rate of NSIs at the TMDU-DH was estimated to be approximately 0.004% in all outpatient and inpatient treatments. Analysis of total NISs in this study yielded three major findings: i) The young and inexperienced DHCWs caused more NSIs than did older and more experienced DHCWs; ii) the female DHCWs caused more NSIs than did male DHCWs; and iii) the majority of NSIs at the TMDU-DH occurred in the afternoon.

Analysis of the data revealed that undergraduate students in clinical training —both in the School of Dentistry and in the School of Oral Health Care Sciences, Faculty of Dentistry, Tokyo Medical and Dental University— turned out to have the highest risk of causing NSIs (46 NSIs; 21.4%), followed by dental residents (see Table 1). This indicates that NSI-preventive strategies, such as the proper methods of handling sharp instruments, must

**Table 2** Monthly and daily numbers of needle-stick and sharps injuries (NSIs)

| Month   | April | May | June | July | August | September | October | November | December | January | February | March |
|---------|-------|-----|------|------|--------|-----------|---------|----------|----------|---------|----------|-------|
| 2005    | 5     | 5   | 3    | 2    | 3      | 0         | 0       | 2        | 3        | 1       | 4        | 0     |
| 2006    | 3     | 1   | 4    | 2    | 3      | 0         | 0       | 1        | 2        | 1       | 1        | 0     |
| 2007    | 2     | 0   | 4    | 2    | 0      | 0         | 1       | 1        | 5        | 2       | 0        | 1     |
| 2008    | 2     | 2   | 0    | 2    | 7      | 0         | 0       | 1        | 3        | 1       | 2        | 1    |
| 2009    | 3     | 3   | 2    | 0    | 0      | 0         | 1       | 0        | 1        | 2       | 1        | 2    |
| 2010    | 3     | 0   | 0    | 0    | 0      | 1         | 0       | 1        | 0        | 1       | 0        | 1    |
| 2011    | 0     | 3   | 3    | 0    | 1      | 0         | 0       | 1        | 0        | 0       | 1        | 0    |
| 2012    | 2     | 3   | 0    | 0    | 0      | 0         | 1        | 2        | 0        | 0       | 1        | 0    |
| 2013    | 2     | 1   | 2    | 3    | 1      | 1         | 2        | 2        | 2        | 1       | 0        | 2    |
| 2014    | 1     | 1   | 2    | 2    | 4      | 1         | 2        | 2        | 1        | 0       | 1        | 0    |
| 2015    | 1     | 1   | 2    | 1    | 1      | 1         | 0        | 1        | 0        | 0       | 1        | 0    |
| 2016    | 1     | 1   | 2    | 3    | 1      | 2         | 2        | 2        | 1        | 0       | 1        | 0    |
| Total   | 17    | 17  | 17   | 17   | 17      | 17        | 17       | 17       | 17       | 17      | 17       | 17   |

**Table 3** The devices involved in needle-stick and sharps injuries (NSIs)

| Devices               | 2005  | 2006  | 2007  | 2008  | 2009  | 2010  | 2011  | 2012  | 2013  | 2014  | 2015  | 2016  | Total | Mean  | S.D.  | %   |
|-----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-----|
| Endodontic file       | 4     | 4     | 1     | 1     | 1     | 1     | 1     | 0     | 0     | 0     | 2     | 0     | 1     | 15    | 1.25  | 1.42 | 6.98 |
| Suture needle         | 6     | 1     | 0     | 0     | 0     | 4     | 1     | 1     | 2     | 2     | 0     | 5     | 22    | 1.83  | 2.08 | 10.2 |
| Wire                  | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 1     | 0     | 1     | 0     | 1     | 0.08  | 0.29 | 0.47 |
| Bur                   | 2     | 1     | 4     | 1     | 2     | 0     | 0     | 1     | 0     | 2     | 2     | 0     | 15    | 1.25  | 1.22 | 6.98 |
| Scaler for hand use   | 1     | 5     | 1     | 4     | 4     | 2     | 0     | 2     | 1     | 1     | 1     | 0     | 22    | 1.83  | 1.64 | 10.2 |
| Injection needle *    | 5     | 7     | 3     | 4     | 7     | 7     | 6     | 5     | 5     | 1     | 6     | 2     | 58    | 4.83  | 1.99 | 27   |
| Ultrasonic scaler chip| 3     | 1     | 1     | 0     | 2     | 1     | 1     | 2     | 0     | 1     | 4     | 2     | 18    | 1.5   | 1.17 | 8.37 |
| Explorer              | 3     | 1     | 1     | 4     | 1     | 0     | 1     | 0     | 1     | 0     | 0     | 1     | 13    | 1.08  | 1.24 | 6.05 |
| Saliva                | 5     | 0     | 1     | 8     | 2     | 0     | 2     | 0     | 0     | 0     | 0     | 0     | 17    | 1.42  | 2.54 | 7.91 |
| Others                | 0     | 5     | 4     | 1     | 1     | 1     | 6     | 3     | 1     | 4     | 3     | 2     | 4     | 34    | 2.83  | 1.85 | 15.8 |
| Total                 | 29    | 25    | 16    | 23    | 20    | 21    | 12    | 12    | 12    | 14    | 15    | 16    | 215   | 17.9  | 5.63 | 100  |

*: *P* < 0.05, one-way ANOVA, Fisher’s PLSD.
be taught to students in the dental school curriculum (3,5). According to a German study, approximately 50.9% of the trainee students had caused NSIs by the end of clinical training (Siegmann S et al., Gesundheitswesen 78, 22-27, 2016, doi.org/10.1055/s-0034-1387716). Another report in the United Kingdom showed that a large number of students had experienced occupational exposure to nosocomial infection more when they were working alone than when they were assisting others (6). Many authors have reported that the trainee students and dental interns had probably caused NSIs in other countries as well (3,7-9). Therefore, young DHCWs and undergraduate students must learn methods of proper handling of sharp instruments. In general, DHCWs have to handle more kinds of small and sharp devices in the clinic than do any other MHCWs, and so DHCWs should get accustomed to using these sharps and cleaning them afterward as part of a set of therapeutic practices (3). For example, when the HCWs carry out patients’ care, wearing double gloves can reduce the risks of causing the NSIs (10). Also, the DHCWs should avoid placing hands and fingers in the direction of forward movement by a sharp instrument and should use the tweezers to separate the small sharps instead pinching them with their fingers.

It was reported that at the National Taiwan University Hospital, a high number of NSIs occurred during the outpatient’s surgical procedure in the division of periodontics or the division of oral and maxillofacial surgery, and they occurred during the clean-up procedure in the division of general dentistry (3). DHCWs should remove the cutting bur from the dental hand-piece and the scaler tip from the ultrasonic device immediately after use before placing the hand-pieces on the hanger of the dental chair unit; they should also clean used small instruments, such as dental burs and points, endodontic files, and various probes, as quickly as possible with tweezers.

As in other hospitals, the recapping of the used injection needle by both hands has been strictly prohibited at the TMDU-DH; it should be never recapped before disposal. If the used injection needle must be re-sheathed, the one-handed scoop technique has been recommended as a method of recapping on the used needle. Blood was identified in the lumen in 39% of needles and on the surface of 16% of needles, according to analysis after local anesthetic administration (11); thus the injection needle after use has been one of the riskiest devices for transmitting the blood-borne infections. According to the Centers for Disease Control and Prevention (CDC) in the United States, rates of NSI-related injury involving hollow-bore needles during use, after use, and before disposal were 52%, 19%, and 22%, respectively (U.S. Department of Health and Human Services, The national surveillance system for healthcare workers [NaSH], pp.1-25, CDC, 2011). Because dental devices for injecting local anesthetic are made of metal and generally cannot be made disposable, DHCWs routinely remove used needles from the cartridges by unscrewing them. This study, however, clearly showed that the removal of the used injection needle from the cartridge-type injector was one of the risky procedures causing NSI during the cleaning up of used devices. This complex operation might be one key cause of NSIs involving injection needles; therefore, after
use, the needle should be removed from the cartridge-type injector with the aid of forceps to avoid NSIs.

Various safety devices have been developed and applied in clinics (12,13). A safety-engineered injection system in the dental fields should be developed in which either needles would not be used to inject the medicine or they would be attached to the syringe barrel easily, used safely, and removed easily and safely from the cartridge-type injector. In other words, a self-sheathing system should be added to disposable dental injection needles. However, the introduction of new injection needles into routine clinical work would not necessarily reduce the incident rate of the NSIs (14), and the new devices would have to be used properly (15).

Researches have demonstrated that nursing is the riskiest profession of all kinds of health care work because it involves factors that induce various NSIs in the care of both outpatients and hospitalized patients (5,16). In this investigation, the NSIs caused by nurses at the TMDU-DH were relatively few in number (see Table 1) and the rate of NSIs by nurse was calculated to be 2.6%. This might be due to the characteristics of the TMDU-DH. As mentioned, female DHCWs caused more NSIs than did male DHCWs; this is because the majority of nurses at TMDU-DH are female, and female DHCWs at TMDU-DH had more opportunities to assist the main practitioner and clean the instruments afterward than did male DHCWs (6). Another possible reason for this finding was that female DHCWs might have been more inclined to report the NSIs because they were more concerned with their own health than were the male DHCWs (3,17,18), and the male DHCWs might not report or might underreport all the NSIs that involved them.

Some reports showed that NSIs occurred more often in the afternoon than in the morning (3,19). Our results showed the same pattern. At the TMDU-DH, relatively minor operations, such as extraction of teeth (including horizontal impacted mandibular third molars) and cystectomy of radicular cysts, were usually performed in the afternoon and involved more use of sharps, such as injection needles for local anesthetics, surgeon’s knives, and suture needles. In addition, workers’ fatigue could have led to distraction, which might be involved in the occurrence of many NSIs (19).

Of the 215 NSIs studied in this survey, 8 were eye-related accidents. In dentistry, bacterial aerosol or small debris is commonly produced during patient treatment; the use of eye-protective equipment, such as eye guards or goggles, can prevent infection in the eyes. In addition, appropriate suctioning should be performed during treatment in the oral cavity.

Any person who visits hospitals and clinics to receive health care services may be in an incubation period of an unknown viral infection. DHCWs are at some inevitable risk of acquiring these infections from the contaminated devices through NSIs because the dental provider cannot force every patient to undergo serological testing for blood-borne infections. According to one amazing report, of 129 HIV-infected individuals, only 53% had told their dentists about their HIV status, whereas 89% of them had told their physicians (20). Patients may tend to report infection status incorrectly to HCWs, especially to DHCWs. Thus it is extremely important for the HCWs to comply with standard precautions and to avoid causing NSIs to prevent the spread of nosocomial infections of blood-borne viral diseases such as HBV, HCV, or HIV. If an NSI has occurred, the injured DHCW and the involved patient should undergo serological testing as soon as possible after the NSI. The anxiety level of HCWs after NSI was found to be significantly higher when the index patient was known to have a chronic infection (21).

Hepatitis B is an infection that still poses a threat to DHCWs, although it can be prevented with vaccines and immune globulin therapy. It should be noted, however, that the anti-HBsAb titers acquired by vaccination decrease with time. Moreover, it was reported that immunosuppressive or antineoplastic drug therapy could cause reactivation of HBV in asymptomatic carriers, which would result in severe de novo hepatitis (22). As for hepatitis C, therapy involving direct-acting antivirals (DAAs) has been introduced and could be effective enough to cure the disease in some patients, depending on the genotypes (23). No evidence currently available, however, indicates whether the body fluids of patients treated with DAAs are infectious, even when the HCV RNA cannot be detected by blood tests. Of more importance is that there is a detection limit with every medical examination or immunological assay for the pathological viral factors; that is, no examination can completely detect pathogens in amounts below the measurable limits (24,25).

Thus DHCWs, especially less-experienced ones such as dental trainee students, must receive education on NSI prevention methods and perform them repeatedly in daily clinical training to prevent nosocomial infectious accidents.

In conclusion, close contact with patients enhances DHCWs’ risk for the various infections during daily routine work in clinical sites. NSIs do happen during the dental treatment practice and during the clean-up afterwards, even when the DHCWs act in compliance with
the standard precautions. Like dental students during clinical training, DHCWs should practice the proper methods of handling or cleaning up dental sharp instruments, especially used injection needles, to prevent NSIs.

Acknowledgments
The authors express gratitude to the office clerks of the infection control team of the TMDU-DH for their work on incident reports. The authors report no financial support to perform this surveillance study.

Conflict of interest
The authors declare no conflict of interest.

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