A Survey of Final-Year Dental, Medical and Nursing Students: Occupational Injuries and Infection Control

· **Gillian M. McCarthy,** BDS, M.Sc.·
· **Jonathan E. Britton,** B.Sc., DDS ·

Abstract

This study investigated nonsterile occupational injuries and infection control practices reported by final-year dental, medical and nursing undergraduates. Data from an anonymous, self-administered questionnaire were analyzed using ANOVA and chi-square tests. Nonsterile occupational injuries in the previous year were reported by 82% of dental, 57% of medical and 27% of nursing respondents, including one hepatitis B virus (HBV) and one human immunodeficiency virus (HIV) exposure. Although students received appropriate management for known HIV and HBV exposure, 48% of dental, 77% of medical and 59% of nursing students reporting injuries also reported no postexposure follow-up. Dental students were more aware of postexposure protocols ($p < 0.001$) and also reported more frequent use of gloves ($p < 0.05$), masks ($p < 0.001$) and protective eyewear ($p < 0.001$) than other students. Students who reported 2-handed recapping of needles had twice the number of percutaneous injuries (mean = 1.9/year) than those who avoided recapping or recapped with one hand using a device or scoop technique ($p < 0.05$). All dental, and 99% and 95% of medical and nursing students, respectively, reported HBV immunization; however, 6% of dental students had inadequate response (i.e., titre of antibodies to HBV surface antigen [anti-HBs] ≤10 mIU/mL) and 13% of dental, 24% of medical and 41% of nursing students did not know whether their postimmunization anti-HBs titre was adequate. The majority of students reported occupational injuries that increase risk of exposure to pathogens. Educational interventions are required to improve postexposure follow-up, handling of sharps, use of barriers and HBV postimmunization serology.

MeSH Key Words: *infection control; occupational diseases/prevention & control; students*

© J Can Dent Assoc 2000; 66:561

The provision of health care is not without risk. Of concern to both health care workers and the public is the risk of exposure to bloodborne pathogens, including hepatitis B and C viruses (HBV and HCV) and human immunodeficiency virus (HIV). Most exposures are accidental and can be avoided by using safe work practices and following infection control guidelines. However, because some exposures are not preventable, immunization and appropriate postexposure management become the key defense.

As student health care workers become more involved in patient contact during their training, they are at risk of exposure to pathogens. It is the responsibility of academic institutions to facilitate appropriate preclinical immunization and provide training in infection control to protect patients and the health and careers of undergraduates, and to lay the foundation for safer work practices in health care. Studies monitoring occupational injuries and infection control practices among student health care workers are necessary to assess the efficacy of infection control training and facilitate the development of educational interventions to improve adherence to guidelines and reduce injuries.

The objectives of this study were to investigate nonsterile occupational injuries and compliance with recommended infection control procedures reported by undergraduate dental, medical and nursing students in their final year at The University of Western Ontario. This preliminary cross-sectional study will serve as a needs assessment for the development of interventions to improve infection control practices at this institution.

Table 1 **Nonsterile occupational exposures during the last year reported by final-year undergraduate student health care workers by profession**

Type of Injury	Category	Dentistry (n = 33)[a]	Medicine (n = 77)[a]	Nursing (n = 64)[a]	p
Blood splashes to eyes, nose or mouth	Total no. injuries Mean no./student Range	18 0.545 0–10	34 0.442 0–6	7 0.109 0–2	0.107
Percutaneous injuries[b]	Total no. injuries Mean no./student Range	82 2.485 0–10	94 1.221 0–8	49 0.766 0–9	< 0.001*
Needlestick injuries	Total no. injuries Mean no./student Range	9 0.273 0–2	82 1.065 0–8	9 0.141 0–2	< 0.001*
Cuts	Total no. injuries Mean no./student Range	11 0.333 0–5	12 0.156 0–2	40 0.625 0–8	0.037*
Dental bur injuries	Total no. injuries Mean no./student Range	62 1.879 0–10	—	—	—

[a] *Number of respondents.*

[b] *Percutaneous injuries include needlestick injuries, cuts and dental bur injuries.*

* *Indicates significant difference between student heath care workers.*

Methods

The study population included all final-year dental (n = 45), medical (n = 96) and nursing (n = 78) undergraduates at The University of Western Ontario. During the final term of undergraduate training, at the end of a regular class period, all students present were asked to complete a self-administered, anonymous questionnaire. The questionnaire included 71 items covering sociodemographics, attitudes and knowledge related to HIV and HBV, infection control practices and occupational health adapted from a previous survey instrument.[1,2] For the purposes of this study, an occupational injury was defined as any needlestick injury or cut; or a blood or body fluid splash to eyes, nose or mouth or broken skin. Data analyses included descriptive statistics, ANOVA, Pearson's Chi-square and Fisher's exact test (SAS, SAS Institute Inc., Cary, NC). Only data related to occupational health and infection control are presented. A probability value of 0.05 or less was considered statistically significant.

Results

The response rates were 73% for dental, 80% for medical and 82% for nursing students. The mean age in years (± standard deviation) was 26.1 (±2.6) for dental, 26.5 (±2.1) for medical and 28.5 (±8.0) for nursing students ($p < 0.05$). Women constituted 35% of dental, 37% of medical and 91% of nursing respondents ($p < 0.001$).

Nonsterile occupational injuries were reported by 82% of dental, 57% of medical and 27% of nursing students ($p < 0.001$). Table 1 summarizes students' reports of nonsterile occupational injuries incurred in the previous academic year. Percutaneous injuries were more frequently reported than blood splashes to the eyes, nose or mouth. The highest frequency was reported by dental students ($p < 0.001$). The types of exposures reported most frequently were from burs among dental students; needlesticks (90% suture, 10% hollow-bore) among medical students; and cuts among nursing students. There were single reports of known exposure to each of HIV and HBV from medical students.

Of those who reported injury, 26% of dental, 50% of medical and 47% of nursing students were unsure of the bloodborne pathogen carrier status of the source patient. Although students received appropriate management for known HIV and HBV exposure, 77% of medical, 48% of dental and 59% of nursing students reporting injuries, also reported using no follow-up procedures ($p < 0.05$). Dental students (97%) were more aware of postexposure protocol than medical (45%) or nursing (58%) students ($p < 0.001$).

Students' self-reported infection control practices are presented in Table 2. Dental students reported more frequent use of gloves ($p < 0.05$), masks ($p < 0.001$) and eye protection ($p < 0.001$) than medical and nursing students. Students who reported 2-handed recapping of needles had twice the number of percutaneous injuries (mean, 1.9/year) than those who avoided recapping or recapped with one hand using a device or scoop technique (mean, 1.1/year) ($p < 0.05$). Data related to students' self-reported HBV immunization status are presented in Table 3.

Discussion

Many students reported nonsterile occupational injuries that increase risk of infection. It has been proposed that student health care workers are at increased risk of occupational injury because of inexperience in performing invasive procedures.[3] The finding that dental students reported significantly more injuries ($p < 0.001$) than medical and nursing students confirms a previous report.[4] It is possible that dental students have a higher

Table 2 **Proportion of final-year undergraduate student health care workers who reported infection control practices by profession**

Practice	Dentistry (n = 33)[a] %	Medicine (n = 77)[a] %	Nursing (n = 64)[a] %	p
When treating patients and contact with blood or body fluid is expected				
Routine hand washing before patients	90.9	73.7	81.3	0.113
Routine use of gloves	100.0	84.2	78.1	0.016*
Routine hand washing after removing gloves	84.8	88.2	90.6	0.697
Changing gloves routinely after each patient	100.0	98.7	96.9	0.500
Never recapping needles using both hands	66.7	58.7	81.3	0.016*
Always using puncture-proof containers for sharps disposal	90.9	90.7	93.6	0.814
To protect against blood or body fluid splashes				
Always wearing a mask	90.9	31.2	20.6	< 0.001*
Always wearing protective eyewear	93.5	32.3	13.7	< 0.001*
Use of extra infection control measures[b] for patients with				
HIV	27.3	78.7	52.4	< 0.001*
HBV	21.9	65.3	49.2	< 0.001*

[a] *Not all respondents completed every item.*
[b] *Types of added precautions reported include double gloving, being more cautious, using universal precautions and using specific barriers, such as gloves, masks or gowns.*
* *Indicates significant difference between categories of student health care workers.*

risk because they routinely perform invasive procedures and use sharp instruments more frequently.

The differences in distribution of injuries among student health care workers most likely reflect differences in clinical environments. Bur injuries were reported only by dental students and were the most frequently reported exposure among this group, confirming other studies of dental students[5] and dentists.[2,6] Although there are no reports linking virus transmission with bur injury, burs often become contaminated with blood and thus pose a potential risk. Given that bur injuries most often occur extraorally[6] and anecdotal evidence suggests that the operatory design at our institution may contribute to accidental bur injury, re-evaluating design of equipment or operatories may prove beneficial.

It is discouraging that more than half the students who reported injury in this survey also reported using no follow-up procedures. It is likely that students have been unknowingly exposed to bloodborne pathogens as a result of injury, as medical histories, examinations and laboratory tests cannot reliably identify all infected patients. At The University of Western Ontario, appropriate postexposure management for student health care workers receiving a nonsterile occupational injury involves immediate wound care, reporting of the exposure and contact with student health services for evaluation by a staff physician. The staff physician is responsible for determining the appropriate course of management and will arrange for collection of laboratory specimens and the provision of medications as indicated.

Dental students were significantly more aware of postexposure protocols ($p < 0.001$) and were also more likely to use follow-up procedures for injury ($p < 0.05$) than medical and nursing students. Because nursing and medical students may be required to complete their clinical experience at more than one institution with a variety of arrangements for postexposure management, there is potential for some confusion related to postexposure protocol. Knowledge of postexposure protocols is crucial as prophylaxis for HIV, which can reduce risk of infection by 79%, is recommended within 2 hours of exposure.[7] There are also time constraints for the administration of hepatitis B immune globulin to those who have inadequate HBV antibody protection.[8]

Approximately one-third of all dental students reported recapping needles with both hands, a practice that was associated with a 2-fold increase in percutaneous exposures. A national survey of health care workers in the United States found that recapping is the most common cause of percutaneous injury.[9] Generally, recapping of needles by health care workers is not recommended; however, dentists and dental students may recap syringe needles several times if multiple injections of local anesthetic are required for one patient. In such a situation, one-handed recapping using a device or scoop technique is recommended. Comprehensive educational interventions based on safer recapping methods, reinforcement of the use of puncture-proof containers for disposal, and adoption of safer devices are required and have been effective in decreasing the incidence of needlestick injuries at some health care institutions.[10]

The importance of washing hands and the appropriate use of protective barriers have been described elsewhere.[11] Dental students reported more frequent hand washing before treating each patient than medical and nursing students; however, this difference was not significant. The less-frequent use of barriers by medical and nursing students is a concern. Compliance with universal precautions has been found to be lower among health

Table 3 **Proportion of final-year undergraduate student health care workers who reported HBV immunization and follow-up by profession**

Question	Answer	Dentistry (*n* = 33)[a] %	Medicine (*n* = 77)[a] %	Nursing (*n* = 64)[a] %	*p*
Have you been immunized against hepatitis B?	Yes	100.0	98.7	95.3	0.407
	No	0.0	0.0	3.1	
	Acquired immunity	0.0	1.3	1.6	
What was your anti-HBs titre after HBV immunization?	10 mIU/mL[b]	80.7	71.6	54.2	0.060
	< 10 mIU/mL	6.5	4.1	5.1	
	Don't know	12.9	24.3	40.7	

[a] *Not all respondents completed every item.*
[b] *Protection against HBV is associated with serum anti-HBs titre ≥ 10 mIU/mL.*[8]

care workers with a lower perception of risk.[12] Low compliance among medical and nursing students, especially in using masks and protective eyewear, may be partly explained by the perception that they are exposed to blood splashes or aerosols less frequently. However, the incidence of blood or body fluid splashes is often underestimated, and student health care workers who do not routinely wear protective barriers for all patients, when the potential for blood or body fluid contact exists, are at risk of exposure. Interventions to improve and maintain optimal compliance with infection control guidelines are required and must take into consideration personal factors as well as organizational and administrative factors.[13]

Compared with dental students, a far higher proportion of medical and nursing students reported using extra infection control measures when treating HIV patients, indicating that dental students have a better comprehension of the concept of universal precautions, i.e., all patients should be treated as infective using appropriate infection control procedures, because infected patients cannot always be identified. Any lower standard increases the risk of cross-infection, and exceeding these standards in patients with HIV can result in charges of discrimination.[14]

The almost universal compliance with HBV immunization can be attributed to the requirement that all students complete a HBV immunization series. However, a significant proportion of students failed to confirm the adequacy of their postimmunization anti-HBs titre. These results agree with a previous report from the United Kingdom.[15] This is a concern as HBV immunization does not always produce an adequate response; 6% of dental students in this study reported an anti-HBs titre of < 10 mIU/mL after immunization. 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.

As a result of reports of HBV transmission to patients from health care workers who were hepatitis B e antigen-positive, Health Canada now recommends mandatory HBV immunization and postimmunization testing for all health care workers and students performing procedures that make them prone to exposure.[16] However, this remains a controversial issue. Currently, faculties of dentistry are debating the screening of dental school applicants for hepatitis B e antigen seropositive status, a marker for increased infectivity.[17]

Our results must be interpreted with consideration of recall bias as self-reports of occupational exposures and infection control practices may not be accurate. In addition, information related to specific circumstances associated with injury was not collected, and more research is required to further investigate occupational exposures among students.

Based on the findings of this study, student health care workers are at risk of nonsterile occupational injuries during their clinical training. Although known exposures to blood-borne pathogens are rare, infection with HBV, HCV or HIV can pose a serious threat to health, well-being and future careers. We have identified several areas of concern related to occupational health and infection control that warrant further emphasis in the undergraduate curricula. These include appropriate handling of sharps, compliance with use of personal protective barriers, adoption of the concept of universal precautions, the need to confirm the efficacy of HBV immunization and appropriate postexposure follow-up. Currently, we are developing interventions to improve compliance with infection control recommendations and to reduce occupational exposures. ◆

Acknowledgment: This study was supported by grants from the Medical Research Council of Canada and the London Health Sciences Centre Research Fund.

Dr. McCarthy is professor, School of Dentistry and the department of epidemiology and biostatistics, faculty of medicine and dentistry, The University of Western Ontario.

Dr. Britton is dental clinical fellow, School of Dentistry, faculty of medicine and dentistry, The University of Western Ontario.

Correspondence to: Dr. Gillian M. McCarthy, Divison of Oral Biology, Faculty of Medicine and Dentistry, The University of Western Ontario, London ON N6A 4C1. E-mail: gmccarth@julian.uwo.ca.

References

1. McCarthy GM, Koval JJ, MacDonald JK. Compliance with recommended infection control procedures among Canadian dentists: the results of a national survey. *Am J Infect Control* 1999; 27:377-84.

2. McCarthy GM, Koval JJ, MacDonald JK. Occupational injuries and exposures among Canadian dentists: the results of a national survey. *Infect Control Hosp Epidemiol* 1999; 20:331- 6.

3. Panagakos FS, Silverstein J. Incidence of percutaneous injuries at a dental school: a 4-year retrospective study. *Am J Infect Control* 1997; 25:330-4.

4. DeVries B, Cossart YE. Needlestick injury in medical students. *Med J Aust* 1994; 160:398- 400.

5. McDonald RI, Walsh LJ, Savage NW. Analysis of workplace injuries in a dental school environment. *Aust Dent J* 1997; 42:109-13.

6. Siew C, Gruninger SE, Miaw CL, Neidle EA. Percutaneous injuries in practicing dentists: a prospective study using a 20-day diary. *J Am Dent Assoc* 1995; 126:1227-34.

7. Centers for Disease Control and Prevention. Update: provisional public health service recommendations for chemoprophylaxis after occupational exposure to HIV. *MMWR* 1996; 45:468-72.

8. Centers for Disease Control and Prevention. Immunization of healthcare workers: recommendations of the Advisory Committee on Immunization Practices (ACIP) and the Hospital Infection Control Practices Advisory Committee (HICPAC). *MMWR* 1997; 46(RR- 18): 1-43.

9. Hersey JC, Martin LS. Use of infection control guidelines by workers in healthcare facilities to prevent occupational transmission of HBV and HIV: results from a national survey. *Infect Control Hosp Epidemiol* 1994; 15:243-52.

10. Seto WH, Ching TY, Chu YB, Fielding F. Reduction in the frequency of needle recapping by effective education: a need for conceptual alteration. *Infect Control Hosp Epidemiol* 1990; 11:194-6.

11. McCarthy GM, Koval JJ, John MA, MacDonald JK. Infection control practices across Canada: do dentists follow recommendations? *J Can Dent Assoc* 1999; 65:506-11.

12. Gershon RR, Vlahov D, Felknor SA, and others. Compliance with Universal Precautions among healthcare workers at three regional hospitals. *Am J Infect Control* 1995; 23:2252-2236.

13. Kretzer EK, Larson EL. Behavioural interventions to improve infection control practices. *Infect Control Hosp Epidemiol* 1998; 26:245-53.

14. Graham PE, Harel-Raviv M. The law ethics related to dentists treating HIV-positive patients: report on a recent U.S. Supreme court case. *J Can Dent Assoc* 1999; 65:27-30.

15. Sivarajasingam V, Laszlo J, Ogden GR. Extent of hepatitis B immunization among medical and dental students. *BMJ* 1995; 311:231.

16. Health Canada, Laboratory Centre for Disease Control. Proceedings of the consensus conference on infected healthcare workers: risk for transmission of bloodborne pathogen. *CCDR* 1998; 24(4 Suppl):S1-25.

17. Fredekind RE, Cuny EJ, Peltier B, Carpenter WM. The hepatitis B e antigen positive dental school applicant. *J Dent Ed* 1999; 63:766-71.