Milieu in Dental Schools and Practice

Impact of Underreporting on the Management of Occupational Bloodborne Exposures in a Dental Teaching Environment

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Abstract: The objectives of this study were to determine the rates of bloodborne exposures experienced by junior and senior dental students at a large dental teaching institution during 2001-02 and the percentages of these bloodborne exposures that were reported by the students to their designated counselors. Two hundred and four third- and fourth-year students voluntarily and anonymously filled out a questionnaire on the numbers of bloodborne exposures they had experienced and reported. Sixty-seven (32.8 percent) reported experiencing 109 occupational exposures (OEs) to blood or other potentially infectious materials. This corresponds to an OE rate of 80 ± 7.7 exposures/100 person-years, far in excess of the highest recorded student rate (7.18 ± 0.52) in a previous study. Twenty-six students (39 percent) reported two or more exposures each. Only 19 percent of exposures were reported to the school counselor, with 35 percent reported by third-year students and only 14.5 percent by fourth-year students. Thus the large differential in reported exposure rates between third- and fourth-year students found in our earlier study might have been an artifact of the sharply different reporting rates of these two groups. These results suggest an urgent need to re-examine the reliability of the present reporting system for such OEs. Also this study indicates that the gender differences in OE rates reported in our earlier study were due primarily to differential reporting by male and female students, not differences in their underlying OE rates.

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The first article in this series, published in 2001, concerned occupational bloodborne exposures in a dental teaching environment, and provided important information about the circumstances contributing to the occurrence of these exposures over the course of a ten-year period.1

At the end of that article, we identified three issues that merited further examination, namely, the role and effects of student inexperience, student underreporting of their exposures, and observed gender differences in reported exposure rates. In the present article, the latter two issues are explored. Specifically, the objectives of this study were to determine the rates of bloodborne exposures experienced by junior and senior dental students at a large dental teaching institution during 2001-02 and the percentages of these bloodborne exposures that were reported by the students to their designated counselors, including variations in these percentages by gender.

Dental practitioners like other health care workers face a recognized risk of occupational exposure to bloodborne pathogens such as the Human Immunodeficiency Virus (HIV), the hepatitis B virus (HBV), and the hepatitis C virus (HCV). In dentistry, sharps injuries are likely to occur due to a small operating field, frequent patient movement, and the variety of sharp dental instruments used in everyday practice.2 The likelihood of sharps injuries may be greater for dental students due to their lack of experience and clinical skills.1,3 Because of the potential for exposure to bloodborne infections during the clinical dental training, consequences of nonreporting and lack of adequate follow-up or even infection
should carefully be evaluated by dental institutions. The risk of HIV transmission to health care workers has been estimated to range from 0.2 to 0.3 percent for parenteral exposures and 0.1 percent or less for mucosal exposures.\(^4,7\) In a recent report published by the Centers for Disease Control and Prevention (CDC), of the 208 dental exposures (percutaneous, mucous membrane, and prolonged skin exposures) reported to the CDC from 1995 to 2001, 13 percent involved known HIV positive source patients and did not lead to a seroconversion (75 percent of exposed individuals took the three-drug PEP regimen for variable lengths of time).\(^3\) The transmission risk associated with percutaneous exposure to HBV is estimated to be 2 percent for HBeAg negative and about 30 percent for HBeAg positive blood. Although effective HBV vaccination programs have significantly reduced the risk for HBV transmission among health care workers, confirmation of anti-HBs antibody response following HBV vaccination is critical to all care workers, confirmation of anti-HBs antibody response following HBV vaccination is critical to all vaccinated individuals with high-risk professions.\(^4,9,10\)

With a 1.8 percent transmission risk, HCV is the most serious viral hepatitis infection because of its ability to produce chronic infection in as many as 85 percent of those infected.\(^11-15\) The U.S. Public Health Service (PHS) recommendations for HCV exposures include careful follow-up of the exposed individuals and referral for antiviral therapy if an infection should occur.\(^16\)

There are several published reports on the frequency of occupational exposures in dental schools. A longitudinal study by Osborne et al. demonstrated that a significant proportion of medical students by the virtue of their clinical training remain at risk for bloodborne exposures despite a strong institutional commitment to training and targeted prevention interventions.\(^20\) The same research group also showed that despite intensive interventions such as creation of a reporting “warmline” (i.e., message machines that are regularly monitored), the reporting rate for exposures only increased from 45 percent to 65 percent over the seven-year study period. It is important to emphasize that if the training period in dentistry is associated with a greater frequency of exposure to bloodborne pathogens than in medicine,\(^28\) then dental training institutions must realize their responsibility for ensuring students’ safety even more so than medical schools. Institutional responsibilities include teaching and enforcing standard precautions,\(^29\) implementing appropriate protective measures, ensuring technical proficiency before assigning patient responsibilities to students, and improving the reporting rates among the student populations.

### Methods

In academic year 2002, the following post-exposure protocol was implemented: Any occupational exposure was treated as a medical emergency. The injured parties stopped working, excused themselves from the patient’s care, notified their faculty supervisor, and quickly washed the wound or flushed the splashed skin or mucous membranes. The student then reported to a trained on-site counselor, who interviewed the student, completed the college’s stan-
standardized report form, assessed risk, and referred the student to a physician at the student health services for a medical evaluation and second opinion. The physician would then follow up with blood work and medications, as needed.

The on-site counselor is a full-time faculty member: a group practice director (GPD) at the College of Dentistry who has received special training regarding occupational exposures and reports to/consults with the school’s infection control coordinator. A decision was made to train more on-site counselors due to the large student body at the school. GPDs were thought to be an excellent group from which to select counselors since they supervise undergraduate students in the clinics and therefore can offer immediate attention to affected students and have an existing rapport with them.

As part of the post-exposure protocol, two source patient reviews were undertaken. The initial review of the source patient’s medical history was done by the student (injured party) along with the supervising faculty member. A second review of this history, with emphasis on known or possible bloodborne conditions, was done when the injured party reported to the counselor for interview, completion of the occupational exposure report, and medical referral.

At the end of the 2001-02 academic year, third- and fourth-year dental students were given a one-page questionnaire, consisting of eleven questions, and asked to fill it out voluntarily and anonymously. The questionnaire had previously been field-tested by one of the authors (DK) among medical interns and residents. An occupational exposure was defined in the questionnaire as “an exposure to blood or other potentially infectious materials through stick, cut, or splash.” Key questions included: “During this academic year (9/01-4/02) approximately how many occupational exposures have you had (include even minor ones)?” Students had to check off one of seven mutually exclusive answers: 0 to 5 or >5. The next question was “During this academic year (9/01-4/02) how many of these exposures did you report to a counselor (faculty listed on the needlestick protocol)?” Respondents were asked to choose among the same seven choices. Students were also asked to rank various contributors to these exposures and to rank reasons why they did not report some or any of the exposures. The full text of the questionnaire is available upon request from dkotelch@hunter.cuny.edu. Standard statistical techniques were used to analyze the resulting data.

Results

Rates of Reporting Percutaneous and Mucous Membrane Exposures

Questionnaires were distributed in classes by the infection control coordinator during the spring semester of 2002 (4/17/02-5/30/02) to third- and fourth-year undergraduate dental students. Two hundred and four students volunteered to fill out these questionnaires, which were anonymous. Sixty-eight (33 percent) of them were third-year students and 136 (67 percent) fourth-year students. Based on enrollments of 360 predoctoral dental students in each of these two years, the overall response rate was 28 percent. The response rate for fourth-year students was considerably greater at 38 percent, but that for third-year students was only 19 percent. (Because these response rates were relatively low, conclusions based on them have to be viewed with some caution.)

The average age of the respondents was 29.5 years, with similar proportions of female and male students responding at 47 percent and 53 percent, respectively. These percentages are similar to those of the student body, with 49 percent female students and 51 percent male, according to school registration data. The respondents had spent a median of 3.75 years in dentistry, including their years in dental school, and saw a median of 8.1 patients per week.

Of the total of 204 respondents, sixty-seven (32.8 percent) reported experiencing occupational exposures (OEs) to blood or other potentially infectious materials. (See Table 1.) These sixty-seven students reported a total of 109 exposures; thus, many who reported experiencing exposures reported multiple exposures. These results correspond to an average of 0.53 exposures per responding student (109/204) and of 1.63 exposures per student among those who reported an exposure (109/67). The students filled out the questionnaires in late April and May, near the end of the academic year, and each was asked for the number of exposures he or she experienced during that academic year from 9/01 to 4/02. Thus in terms of person-years, based on a twelve-month academic calendar, the responding students reported experiencing 80 exposures/100 person-years ((109/204) x (12/8)), with standard deviation 7.7/100 person-years.
One student reported greater than five occupational exposures (OEs), the highest category on the questionnaire. His number of OEs was conservatively counted as six in the calculations above. If this person were dropped from the analysis, the results become 103 OEs reported by sixty-six persons, an average of 1.56 (103/66) exposures per student among those who reported an exposure.

Compliance with School Reporting Protocols

Of the sixty-seven students who reported exposures on the questionnaires, only twenty (30 percent) followed the school’s protocols by reporting them to the designated counselor (Table 1). However, in most cases even this compliance was partial. Of the twenty-six students who experienced two or more OEs, none reported all of their OEs to the counselor. Only three of the twenty-six who experienced two or more OEs (12 percent) reported any of these OEs to the counselor: two reported only one of their multiple OEs to the counselor, and one, who experienced three OEs, reported two of them to the counselor.

Of the sixty-seven students who reported any OEs on the questionnaire, only the seventeen who experienced one OE and reported it to a counselor were fully compliant with the school’s protocols. Thus full compliance was achieved only among 25 percent (17/67) of the students who reported experiencing OEs.

Also, the twenty students who experienced one or more OEs and reported any of them to the counselor reported a total of twenty-one OEs to the counselor. Thus, the reporting rate for exposures was only 19 percent (21/109) ± 3.8 percent (SD).

Among those who experienced OEs but did not report any to the counselor, ten (another 18 percent) did report the OEs to their supervising faculty. Thus, thirty (20+10) of the sixty-seven, almost half (45 percent) of those who experienced OEs reported the problem to someone in authority. Twenty-four of the sixty-seven (36 percent) reported the OEs solely to other students, and one reported the needlestick both to a fellow student and a supervising faculty member. Thus, fifty-four (20+10+24) of the sixty-seven students (81 percent) reported their needlesticks to someone else. The remaining thirteen did not respond to this question.

Factors That Contributed to Injuries and to Reporting Them

Among the sixty-seven students who reported needlestick and sharps injuries on the questionnaires, the main cause reported was feeling rushed (Table 2). All other causes were reported only by much smaller percentages of the students.

Among the forty-seven students who reported experiencing needlestick and sharps injuries but did not report them to the counselor, the three leading causes for not reporting to the counselor were, in order (Table 3):

1. The injury or splash was minor,
2. The patient was at low risk, and/or
3. The instrument or device was clean.
Results by Academic Year of Students

Third-Year Students. Of the sixty-eight third-year students who answered the questionnaire, eighteen reported having experienced an OE, that is a needlestick injury or mucous membrane exposure, during the academic year. These eighteen third-year students reported twenty-six OEs. The distribution of these OEs among the students is given in Table 4. Thus, third-year students experienced 0.38 (26/68) OEs per student. Among those who reported an OE, the average number reported per student was 1.44 (26/18).

Five of the third-year students who suffered one OE were in full compliance with school reporting protocols by reporting the OE to the counselor. Thus full compliance in reporting OEs was achieved among 28 percent (5/18) of the third-year students.

In terms of exposures, five reported their sole exposure, and three third-year students who experienced multiple exposures reported four of their seven total exposures to the counselor. Thus the reporting rate for exposures was 35 percent (nine of the twenty-six OEs experienced were reported to the counselor), with standard deviation = 9.3 percent.

Fourth-Year Students. Of the 136 fourth-year students who filled out the questionnaire, forty-nine reported an OE. These forty-nine reported eighty-three OEs. The distribution of these OEs among the students is also given in Table 4. Among all fourth-year students, the average number of OEs reported per student was 0.61 (83/136). Among those who reported experiencing OEs, the average number of OEs reported per student was 1.69 (83/49).

Twelve of the fourth-year students who suffered one OE were in full compliance with school reporting protocols by reporting the OE to the counselor. Thus full compliance in reporting OEs was achieved by 24.5 percent (12/49) of the fourth-year students who experienced occupational exposures. Since none of the fourth-year students who experienced multiple exposures reported any of their OEs, the reporting rate for exposures for fourth-year stu-
students was 14.5 percent (twelve of the eighty-three OEs experienced were reported to the counselor), with a standard deviation of 3.9 percent.

Gender Distribution of Those Reporting OEs

Of the sixty-seven respondents reporting OEs in the questionnaires, thirty-three (49 percent) were male, thirty (45 percent) female, and four (6 percent) did not report their gender. Considering only the sixty-three who reported their gender, 52 percent of the respondents reporting OEs were male and 48 percent female. Twenty-four percent (8/33) of male students and 23 percent (7/30) of females who experienced OEs were in full compliance with school reporting requirements. Thus, the full-compliance reporting rates for male and female students were quite similar.

As noted above, these sixty-seven respondents had a total of 109 OEs. Of the 104 OEs reported by the sixty-three students who identified their gender, ten OEs of the fifty-eight experienced by males (17 percent) were communicated to counselors, while nine OEs of the forty-six experienced by females were reported (20 percent). Again these rates are similar for male and female students.

Discussion

Rates of Reporting by the Dental Students

The most striking findings in the responses to the questionnaires were both the relatively high rates of occupational exposures reported by the students and the very low rate of reporting of these OEs to the designated school counselors. In the period from 1987 to 1997, students at this institution were reporting to counselors rates of occupational exposures to blood and other potentially infectious materials (BOPIM) of 4.02 ± 0.22 exposures per 100 person-years, with the highest student rates being reported among third-year predoctoral students (7.18 ± 0.52). In the anonymous questionnaires for this study, third- and fourth-year students reported far greater rates of occupational exposures, fully 80 ± 7.7 exposures/100 person-years.

Table 4. Distribution of occupational exposures reported on the questionnaires by academic year of student

<table>
<thead>
<tr>
<th>Number of OEs Reported by Each Student on Questionnaire</th>
<th>Number of 3rd-Year Students Who Experienced This Number of OEs</th>
<th>Number of 4th-Year Students Who Experienced This Number of OEs</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>50</td>
<td>87</td>
</tr>
<tr>
<td>1</td>
<td>13</td>
<td>28</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>&gt;5</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>68</strong>*</td>
<td><strong>136</strong></td>
</tr>
</tbody>
</table>

*Of the 68 3rd-year respondents, the number who reported experiencing any OEs = 18.
**Of the 136 4th-year respondents, the number who reported experiencing any OEs = 49.

The results in this and the previous study, however, cannot directly be compared. The earlier set of rates was based on reports to counselors, while the rates here were based on anonymous self-reports; the earlier set was based on the experiences of student populations from 1987 to 1997, while the rates here were based on a different, 2001-02 student population; and the earlier populations reported their experiences and were medically treated at the dental school, while in the one studied here the study population had to travel to the employee health service, located on another campus of this institution. The change of venue for delivery of care alone would discourage reporting by the students.

Nevertheless, the ratio of the OE rate reported in this study to the highest rate in the earlier study is 11.1 (80/7.18). Thus the results reported here are an order of magnitude larger than the highest value reported in our first article of 7.18 per 100 person-years for third-year students. This discrepancy seems too great to have developed within the five-year period from 1997 to 2002. And indeed the rate of occupational blood and other potentially infectious materials (BOPIM) exposures reported to the counselor during the academic year 2001-02 was only 5.3 exposures per 100 third- and fourth-year students, comparable to the rates reported in the earlier article. This suggests significant underreporting of such occupational exposures, a concern expressed earlier. The extent of underreporting among dental students in this study is considerably greater than that in studies.
on medical students, which found reporting rates between 30 and 40 percent,\textsuperscript{20-22} and hence under-reporting of about 60 to 70 percent. Studies of dental clinic providers have also found very low reporting rates of 20-30 percent,\textsuperscript{3,17} but still somewhat higher than reported here for dental students.

Other evidence of underreporting is the low rate of reporting of OEs experienced by the students in 2001-02 to their counselors. Of the 109 OEs reported by these students on the questionnaires, only nineteen (21 percent) were reported to the counselor. It would seem unlikely that such a low reporting rate developed only recently, thus suggesting that our earlier OE results reported for 1987-97 may have reflected this phenomenon as well. However, the rates for OEs reported to the counselor published in 2001 were “consistent with published reports from several other educational settings,”\textsuperscript{17} suggesting that other reports in the literature may have reflected significant student underreporting as well.

Additionally, the low rates of reporting to the counselor differed significantly among third- and fourth-year students. The reporting rate for exposures of fourth-year students (14.5 ± 3.9 percent) was about half that for third-year students (35 ± 9.3 percent), yielding \(p<0.001\). But in our previous study, the reported rate of BOPIM exposures for fourth-year students was about half that of the third-year students (3.42 ± 0.57 vs. 7.18 ± 0.52, respectively).\textsuperscript{1} If the reporting rates of exposures to counselors during 1987-97 were similar to that at present, the corrected rates of BOPIM exposures would have been similar. Specifically, the:

\[
\text{Corrected rate of exposures} = \frac{\text{Rate of exposures reported to counselor}}{\text{Proportion of all exposures reported to counselor}}.
\]

Hence the corrected rate per 100 third-year students would be 20.5 (7.18/0.35), and that per 100 fourth-year students would be 23.6 (3.42/0.145). The large differences in the reported exposure rates between third- and fourth-year students reported in our previous article\textsuperscript{1} may have been an artifact of the differential reporting rates of such exposures to their counselors. Certainly the different reporting rates of these students to the counselor had the effect of exaggerating the differences reported in the previous article.

In general, though, because all student response rates were relatively low, the above conclusions based on them have to be viewed with some caution.

**Students at Elevated Risk: Those with Multiple Exposures**

As noted above, twenty-six of the sixty-seven students (39 percent) who reported experiencing BOPIM exposures reported multiple exposures (two or more). The average number of exposures for each of those who reported an exposure in the questionnaire was 1.63. Furthermore, the students who reported experiencing these multiple exposures did not report as great a percentage of them to their counselor as those who experienced only one. Thus 41 percent (17 reported/41 experienced) of those who reported experiencing one exposure reported it to their counselor, as required at the school, whereas only 11.5 percent (3/26) of those who reported multiple exposures reported any of the exposures to their counselor, and none of the twenty-six reported all of them. This is particularly disturbing in that those who experienced multiple exposures might be expected to include some (but not all) who are perhaps less dexterous and/or less skilled in calming upset patients. These students would appear to be among those in greater need of safety counseling by faculty and infectious disease counselors, yet because of their nonreporting of exposures, this need is not known by the responsible infection control counselors and faculty. (As at many dental schools, every effort is made by school officials to provide assistance and counseling in a supportive, nonpunitive environment, but as indicated in this study, hesitation and perhaps fear of reporting remain.) Students who failed to report multiple exposures pose a particular challenge to dental school faculty and administration to reach and assist.

We believe that to improve the reporting rates among the students, dental teaching institutions must more effectively communicate to their students the reality of the associated risks and the importance both to themselves and their schools of reporting occupational exposures and adequate follow-up, as well as the confidential nature of the reporting process. The current lack of effective safety devices\textsuperscript{30} coupled with anecdotal evidence that the majority of dentists in private practice continue to use conventional syringe and needle systems reinforces the need for other preventive strategies, such as professional education, to reduce percutaneous injuries in dentistry.
Gender Differences for Occupational Exposures

In our previous article,1 we observed that 57 percent of the student exposures during 1987-97 were reported by female students, even though these students made up only 38 percent of the total student population during this period. This could be due, it was noted, either to the female students experiencing a greater rate of OEs or to female students reporting these exposures more frequently or both.

However, the results presented in this article also show that male and female students reported OEs at rates of 52 and 48 percent, respectively, similar to their representation in this dental school’s population (51 and 49 percent, respectively). On the other hand, among the OEs reported to the counselor in calendar years 2001 and 2002, 56 percent of all reports were by female students and 44 percent by males, almost identically the same percentages as in our earlier report.1 Since self-reporting of OEs by gender was similar to the population distribution by gender, but the percentages reported to a counselor were greater for females, this suggests that the differences in OE rates by gender are due primarily to differential reporting of OEs by male and female students. In particular, males appear to underreport their OEs compared to female students.

Conclusions

The rates of bloodborne exposures among medical and dental students have by now been studied extensively, based on incidents reported by the students to school faculty and staff. Student self-reports have played an important role in developing procedures and protocols to protect students and instruct them in safe procedures during their later professional practice. However, the present study found an unexpectedly high extent of underreporting of occupational bloodborne exposures by this cohort of dental students and differential levels of underreporting among third- and fourth-year students. These data suggest an urgent need to re-examine the reliability of the present reporting system for such OEs and more fully characterize the extent of student underreporting under this system. Further research, with higher response rates among the students, is needed.

REFERENCES