

BRIEF REPORTS

Blood and Body Fluid Exposures During Clinical Training:

Relation to Knowledge of Universal Precautions

Daniel J. Diekema, MD, MS, Mark A. Albanese, PhD, Sandra S. Schuldt, MAT,
Bradley N. Doebbeling, MD, MS

To investigate the relation between knowledge of universal precautions and rates of exposure to blood and body fluid during clinical training, a cohort of 155 students was surveyed following training in universal precautions and 18 months later. A total of 127 students (82%) participated; 58 (46%) experienced at least one exposure during the first clinical training year. Knowledge of universal precautions was inversely associated with the frequency of mucous membrane exposures ($p = .001$); an apparent "dose-response" effect was evident (one-way analysis of variance; $F = 5.2$, $p = .007$). Students are frequently exposed to blood and body fluid during clinical training. Higher levels of retained knowledge about universal precautions are associated with a decreased risk of mucous membrane exposure.

KEY WORDS: education; medical students; needlestick injuries; universal precautions.

J GEN INTERN MED 1996;11:109-111.

The Association of American Medical Colleges has recommended that all medical schools take steps to protect students from the risks associated with patient care, including mandatory training in universal precautions.¹

Received from the Division of General Medicine, Clinical Epidemiology and Health Services Research, Department of Internal Medicine, University of Iowa College of Medicine, Iowa City (DJD, BND); Office of Medical Education, Research and Development, University of Wisconsin, Madison (MAA); Introduction to Clinical Medicine, Medicine Administration, University of Iowa College of Medicine, Iowa City (SSS); Employee Health Department, Veterans Affairs Medical Center, Iowa City, Iowa (BND). Dr. Diekema is currently at the Maine Medical Center, Portland, Maine.

This study was supported in part by an Educational Development Grant from the University of Iowa College of Medicine. Results of this study were presented in part at the 34th Inter-science Conference on Antimicrobial Agents and Chemotherapy (ICAAC), Orlando, FL, October 1994. Dr. Doebbeling is the recipient of a Special Emphasis Research Career Award, 1 K01 OH00131-03, from the National Institute for Occupational Safety and Health (NIOSH).

Address correspondence and reprint requests to Dr. Doebbeling; C-31 GH, Department of Internal Medicine, University of Iowa College of Medicine, 200 Hawkins Drive, Iowa City, IA 52242.

Although universal precautions training programs appear to improve medical students' knowledge,² little is known about whether such knowledge is retained through clinical training. Indeed, several studies have documented inadequate knowledge of universal precautions among graduating senior medical students.^{3,4} Furthermore, it is unclear whether knowledge of universal precautions reduces rates of hazardous exposure among students.

To investigate these issues, we surveyed a previously trained cohort of medical and physician assistant (PA) students at our institution after completion of their first clinical year.

METHODS

Study Population

All medical and PA students completing their first year of clinical training in July 1993 were surveyed by mail. Three serial mailings were performed to improve the response rate. Eighteen months before the survey, the same cohort had received didactic and practical training in universal precautions.⁵ The students' universal precautions knowledge had been assessed before and after these training sessions.⁵

Study Instrument

Universal precautions knowledge was assessed with 12 true-false questions adapted from the Centers for Disease Control and Prevention update on universal precautions.⁶ The outcome measures of interest were the number and type of blood and body fluid exposures experienced during the previous year.

Students reporting exposure to blood or body fluid were asked whether the exposure had been reported to the Student Health Service. Reporting rates were validated by review of exposure records from all sites providing exposure management care to the students.

Statistical Methods

Knowledge changes over time were evaluated with a paired *t*-test comparing the sum of true-false questions

answered correctly. Pearson's χ^2 was used to compare universal precautions knowledge by blood and body fluid exposure rate. One-way analysis of variance (ANOVA) was performed to compare mean rates of exposure to blood and body fluid by knowledge score. Alpha was set at .05, and all *p*-values are two-tailed. All statistics were performed using SPSS for Windows.⁷

RESULTS

Questionnaires were mailed to all 155 students who had undergone preclinical universal precautions training and proceeded directly to clinical training (138 medical and 17 PA students). Of the 155 questionnaires, 127 (82%) were returned. One hundred twenty-two students completed and returned both this questionnaire and the questionnaire administered after universal precautions training 18 months earlier.

Knowledge of key universal precautions concepts as measured by 12 true-false questions was high and unchanged from results obtained immediately after universal precautions training (mean correct = 92%).

At least one blood or body fluid exposure occurred during the first clinical year in 58 students (46%), with 34 students (27%) sustaining two or more exposures. Thirty-nine students (31%) had one or more percutaneous exposures, while 32 students (26%) reported a mucous membrane exposure. One student reporting 20 mucous membrane exposures was excluded from analysis as an extreme outlier. Only 13 of 128 total exposures (10%) were reported. Review of clinic records demonstrated that only those exposures students claimed to have formally reported were reported to any of the available medical care sites.

Higher levels of universal precautions knowledge (as assessed by test scores) were inversely associated with fewer mucous membrane exposures ($\chi^2 = 10.8$, $p = .001$), but not with percutaneous exposure rates ($\chi^2 = 0.6$, $p = .4$). However, the study sample was inadequate to detect a significant difference in percutaneous exposure rates (power <0.20). An apparent "dose-response" effect of universal precautions knowledge on mucous membrane exposure rates was evident (Table 1 and Figure 1, one-way ANOVA; $F = 5.2$, $p = .007$).

DISCUSSION

Our findings confirm a disturbingly high incidence of exposure to blood and body fluid during clinical training among medical and PA students who had been trained in universal precautions. Almost half of the students in our study reported experiencing at least one exposure during their first clinical year, and over one-quarter experienced two or more. Other studies have found even higher exposure rates.^{8, 9} In this study, students formally reported only 10% of their exposures. Similar surveys of housestaff and medical students have also documented poor rates of reporting, ranging from 9% to 19%.⁸⁻¹⁰ On the basis of

Table 1. Rates of Exposure to Blood and Body Fluid by Knowledge Score (N = 126)

Knowledge Score	Mucous Membrane Exposure*		Percutaneous Exposure†	
	Rate‡	Proportion with Exposure (%)	Rate§	Proportion with Injury (%)
≤10	1.03	13/31 (42)	0.61	12/31 (39)
11	0.70	16/50 (32)	0.40	15/50 (30)
12	0.16	4/45 (9)	0.38	12/45 (27)

* $p = .007$ for difference in exposure rates between groups.

†Exposures per student per year.

‡ $p = .4$ for difference in exposure rates between groups.

§Injuries per student per year.

these data, students undergoing clinical training are at significant risk of bloodborne pathogen exposure, a risk likely to be underestimated if judged solely on the basis of formally reported exposures.

How can such hazardous exposures be prevented? Previous data have suggested that universal precautions training may reduce exposure rates.¹¹⁻¹⁴ Our findings support the importance of such training. Stronger evidence for the effectiveness of universal precautions training would require comparing trained and untrained students, an unethical study design. Nonetheless, the demonstration of a relation between better knowledge and decreased frequency of mucous membrane exposures suggests that improving knowledge through training should decrease these exposures. Our observation that improved knowledge was associated with reduced mucous membrane but not percutaneous exposures is also consistent with previous literature suggesting that mucous membrane and nonintact skin exposures are more readily reduced by universal precautions than are percutaneous exposures.^{11, 14} While the use of barrier precautions can be expected to prevent many mucous membrane and nonintact skin exposures, sharp instruments

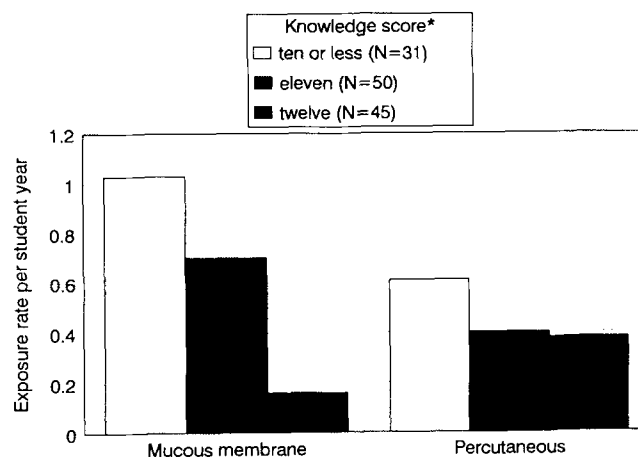


FIGURE 1. Rates of percutaneous and mucous membrane exposure to blood and body fluid by knowledge score. *Knowledge score equals number correct of 12 true-false items on universal precautions concepts test.

often penetrate gloves or other barriers despite these measures.

Universal precautions training alone is not sufficient to reduce exposure rates to acceptable levels. All of the students surveyed had undergone training in universal precautions immediately before beginning their clinical training, and their knowledge of key concepts at the time of follow-up was excellent.

Like all questionnaire studies, ours is subject to recall and participation bias. However, hazardous exposures are usually emotionally charged experiences and not soon forgotten. In addition, we validated reporting by reviewing student and employee health services records. Likewise, our high response rate (82%) should minimize participation bias.

In summary, students are at considerable risk of blood exposure during clinical training. Universal precautions training should help decrease that risk, as students with the best knowledge of universal precautions concepts are exposed less frequently. Nonetheless, other measures are necessary to further decrease students' risk. Exposure reporting must also be improved, in order to provide an accurate assessment of the magnitude of the problem, to initiate appropriate prophylaxis, and to document that an infection, if one occurs, is training-related for the purposes of compensation and disability.

REFERENCES

1. Association of American Medical Colleges Executive Council. Recommendations regarding health services for medical students. Memorandum, June 25, 1992.
2. Sokas RK, Simmens S, Scott J. A training program in universal precautions for second-year medical students. *Acad Med.* 1993; 68:374-6.
3. Goetz A, Yu CM, Muder RR. Entering first-year residents' experiences and knowledge of infection control of hepatitis B and HIV, at five university-affiliated hospitals. *Acad Med.* 1992;67:275-6.
4. Koenig S, Chu J. Senior medical students' knowledge of universal precautions. *Acad Med.* 1993;68:372-4.
5. Diekema DJ, Schuldt SS, Albanese MA, Doebbeling BN. Universal precautions training of preclinical students: impact on knowledge, attitudes and compliance. *Prev Med.* 1995;24:580-5.
6. Centers for Disease Control. Update: Universal precautions for prevention of transmission of human immunodeficiency virus, hepatitis B virus, and other bloodborne pathogens in health-care settings. *MMWR.* 1988;37:377-88.
7. SPSS for Windows, version 6.1. Chicago, IL: SPSS. 1994.
8. O'Neill TM, Abbott AV, Radecki SE. Risk of needlesticks and occupational exposures among residents and medical students. *Arch Intern Med.* 1992; 152:1451-6.
9. McGeer A, Simor AE, Low DE. Epidemiology of needlestick injuries in house officers. *J Infect Dis.* 1990;162:961-4.
10. Heald AE, Ransohoff DF. Needlestick injuries among resident physicians. *J Gen Intern Med.* 1990;5:389-93.
11. Wong ES, Stotka JL, Chinchilli VM, Williams DS, Stuart CG, Markowitz SM. Are universal precautions effective in reducing the number of occupational exposures among health care workers? A prospective study of physicians on a medical service. *JAMA.* 1991; 265:1123-8.
12. Haiduvén DJ, DeMaio TM, Stevens DA. A five-year study of needlestick injuries: significant reduction association with communication, education, and convenient placement of sharps containers. *Infect Control Hosp Epidemiol.* 1992;13:265-71.
13. Beekman SE, Vlahov D, Kozial DE, McShalley ED, Schmitt JM, Henderson DK. Temporal association between implementation of universal precautions and a sustained, progressive decrease in percutaneous exposures to blood. *Clin Infect Dis.* 1994;18:562-9.
14. Saghaei L, Raselli P, Francillon C, Francioli P. Exposure to blood during various procedures: results of two surveys before and after the implementation of universal precautions. *Am J Infect Control.* 1992;20:53-7.