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Does clinical experience affect medical students' knowledge, attitudes, and compliance with universal precautions?

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DOES CLINICAL EXPERIENCE AFFECT MEDICAL STUDENTS' KNOWLEDGE, ATTITUDES, AND COMPLIANCE WITH UNIVERSAL PRECAUTIONS?

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ABSTRACT

OBJECTIVE: To investigate differences in second-, third-, and fourth-year medical students' knowledge of bloodborne pathogen exposure risks, as well as their attitudes toward, and intentions to comply with, Universal Precautions (UP).

DESIGN: Cross-sectional survey.

PARTICIPANTS AND SETTING: Surveys about students' knowledge, attitudes, and intentions to comply with UP were completed by 111 second-year (preclinical), 80 third-year, and 60 fourth-year medical students at Washington University School of Medicine in the spring of 1996.

RESULTS: Preclinical students knew more than clinical students about the efficacy of hepatitis B vaccine, use of antiretroviral therapy after occupational exposure to human immunodeficiency virus, and nonvaccinated healthcare workers' risk of infection from needlestick injuries ($P<.001$). Students' perceived risk of occupational exposure to bloodborne pathogens and attitudes toward hepatitis B vaccine did not differ, but preclinical students agreed more strongly that they should double glove for all invasive procedures with sharps ($P<.001$). Clinical students agreed more strongly with reporting only high-risk needlestick injuries ($P=.057$) and with rationalizations against using UP ($P=.008$). Preclinical students more frequently reported contemplating or preparing to comply with double gloving, wearing protective eyewear, reporting all exposures, and safely disposing of sharps, whereas students with clinical experience were more likely to report compliance. Clinical students also were more likely to report having "no plans" to practice the first three of these precautions ($P<.001$).

CONCLUSIONS: Differences in knowledge, attitudes, and intentions to comply with UP between students with and without clinical experience may have important implications for the timing and content of interventions designed to improve compliance with UP (*Infect Control Hosp Epidemiol* 1998;19:767-771).

Medical students, like other healthcare workers, are at risk for occupational exposure to bloodborne pathogens.[1,2] Students may be at greater risk for occupational exposure to infections because they are relatively inexperienced in clinical and infection control procedures.[3] Medical students with less experience performing invasive procedures with sharp instruments reportedly have higher rates of percutaneous exposures to bloodborne pathogens early in their first clinical year than in the months subsequent to their first rotation.[2,4] Knowledge and sense of competency among medical students improves following training sessions in practical techniques and use of Universal Precautions (UP).[5] Little, however, is known about students' knowledge of exposure risks, their attitudes toward UP,[6-8] or their readiness to comply with UP.

METHODS

Sample

In the first year of a 3-year cooperative agreement with the Centers for Disease Control and Prevention's National Institute of Occupational Safety and Health, we surveyed medical students at Washington University School of Medicine about their knowledge, attitudes, and readiness to comply with UP. Surveys were distributed to all second-year, preclinical students (n=116) and to third- (n=129) and fourth-year (n=104) students between March and May 1996. Women constituted 47% of the second-, 45% of the third-, and 44% of the fourth-year classes. Surveys were completed prior to preclinical students' attendance at the medical school's clinical orientation program in June. Third- and fourth-year students were completing their first

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TABLE 1
ITEMS ON FACTORS MEASURING STUDENTS' PERCEIVED RISK AND RATIONALIZATIONS AGAINST USING UNIVERSAL PRECAUTIONS

Perceived risk
1. I am likely to be exposed to HIV because of my work.
2. I believe I am at high risk for HIV infection because of my job.

Rationalizations against using Universal Precautions
1. I don't need to wear protective goggles in the OR/ER because I am very careful.
2. Prescription eyeglasses without side shields are a sufficient barrier to prevent exposure to a patient's blood and body fluid.
3. I do not wear two pairs of gloves because it diminishes my sense of touch.
4. Wearing double gloves every time I perform a surgical or trauma procedure is unnecessary.
5. I don't like to wear double gloves when I operate on patients.
6. I have gotten so used to working in bloody conditions that I don't take as many precautions as I should.

Abbreviations: ER, emergency room; HIV, human immunodeficiency virus; OR, operating room.
Note: Cronbach alpha coefficients, measuring the internal consistency of items on each factor, were .61 for perceived risk and .73 for rationalizations against using Universal Precautions, indicating a satisfactory level of reliability.

TABLE 2
DEMOGRAPHICS OF MEDICAL-STUDENT RESPONDENTS, BY YEAR OF TRAINING

Factor	No. (%) of Respondents		
	Second Year	Third Year	Fourth Year
Gender			
Male	57 (51.4)	41 (51.3)	27 (45.0)
Female	54 (48.6)	39 (48.8)	33 (55.0)
Race			
White	65 (58.6)	60 (75.0)	46 (76.7)
Black	8 (7.2)	1 (1.3)	1 (1.7)
Hispanic	2 (1.8)	1 (1.3)	0 (0.0)
Asian	33 (29.7)	16 (20.0)	12 (20.0)
Other	3 (2.7)	2 (2.5)	1 (1.7)

and second years of clinical training, respectively, at the time they were surveyed.

Measures

Data about medical students' gender, age, knowledge, attitudes, and readiness to comply with UP were collected using self-administered surveys. Surveys were completed anonymously.

Knowledge. We asked students about the risk of occupational infection among healthcare workers who are not vaccinated against hepatitis B if they sustain a needlestick injury from a patient who is positive for (a) human immunodeficiency virus (HIV) antibody, (b) hepatitis B surface antigen and e antigen, (c) hepatitis B antibody, and (d) hepatitis C antibody. We also asked about (e) the effectiveness of prophylactic antiretroviral therapy, eg, zidovudine, in reducing risk of transmission of HIV following a needlestick from an HIV-infected patient; (f) how soon antiretroviral therapy should be administered following a needlestick injury to be effective in reducing risk of HIV transmission; and (g) the effectiveness of hepatitis B vaccine in producing protective immunity. The response format for each question was multiple choice. Incorrect responses were coded zero; correct responses were each given one point, for a possible total knowledge score of seven points.

Perceptions and attitudes toward UP. Students also responded to items about their perceptions of risk and their attitudes and beliefs about UP. Five-point Likert-scaled responses ranged from "strongly disagree" (1) to "strongly agree" (5). A sixth response, "does not apply," was treated as missing data. Two multi-item factors were constructed to measure students' perceived risk of occupational exposure and injuries (two items) and their rationalizations against using UP (six items). The items used to construct these factors are shown in Table 1. A mean score for each of these factors was computed for each person, excluding those items with missing data. We analyzed these two factors, as well as four individual survey items: "Every hospital employee should get the hepatitis B vaccine," "Prescription eye-glasses without side shields are a sufficient barrier to prevent exposure to a patient's blood and body fluid," "I report needlesticks and other accidental injuries involving my being exposed to a patient's blood only if I know for sure that the patient was HIV-positive or had acquired immune deficiency syndrome, hepatitis B, or hepatitis C," and "I should wear two sets of gloves every time I have to perform an invasive procedure with sharp objects." Higher scores reflect stronger agreement.

Intentions to comply with UP. We used Prochaska's transtheoretical model of behavior change[9,10] to evaluate students' readiness (ie, their intentions) to comply with UP. This model conceptualizes readiness to engage in specific behaviors as five discrete stages of change: ***precontemplation,*** when a person is not thinking about changing his or her behavior; ***contemplation,*** when a person is thinking about changing and might do so in the next 6 months; ***preparation,*** when a person might change in the next 30 days and already has taken steps to make the change; ***action,*** if they already have begun engaging in the target behavior (eg, using protective goggles where they might be splashed with blood or body fluids); and ***maintenance,*** when engaging in the target behavior for at least 6 months. People can move through the stages in either direction; they can move forward toward the desired change (eg, from preparation to action) or relapse to a less desirable stage (eg, from action to contemplation). A person who is contemplating changing his or her behavior is more likely to change than a person who has no plans to change.[10] Efforts to improve compliance with UP might utilize this model not only to describe participants in terms of their readiness to use recommended precautions but also to design tailored interventions for participants at each stage.

TABLE 3
MEDICAL STUDENTS' ATTITUDES TOWARD UNIVERSAL PRECAUTIONS, BY YEAR OF TRAINING

Perceptions and Attitudes	Means (Respondents)		
	Second Year	Third Year	Fourth Year
Perceived risk*	3.0 (110)	3.1 (79)	3.3 (59)
Rationalizations against Universal Precautions*,†	1.9 (109)	2.1 (80)	2.2 (60)
Attitude about the hepatitis B vaccine	4.7 (110)	4.7 (80)	4.4 (60)
Attitude toward use of eyeglasses without side shields	2.0 (109)	2.1 (80)	2.0 (80)
Attitude toward selectively reporting only high-risk needlesticks‡	1.8 (64)	2.2 (70)	2.1 (55)
Attitude toward wearing double gloves for invasive procedures§,‖	3.8 (100)	3.2 (73)	2.7 (7)

Note: Responses to attitudinal items ranged from strongly disagree=1 to strongly agree=5. Tests of significance are Kruskal-Wallis *H* tests.
* See Table 1 for items in scale.
† P=.008.
‡ P=.057.
§ This item was incorporated into the survey after most of the fourth-year students completed the measures; only seven fourth-year students completed surveys with this item.
‖ P<.001.

Five items measured students' intentions to comply with recommended precautions, including: (1) using double gloves, (2) wearing protective goggles or glasses, (3) safe disposal of contaminated sharp instruments and supplies, (4) reporting all needlesticks and sharps injuries to Employee Health, and (5) being fully vaccinated against hepatitis B. Categorical responses were defined as follows: having "no plans" to change (precontemplation), "might in 3-6 months" (contemplation), "might in 1 month" (preparation), "currently do" (action), and "have for at least 6 months" (maintenance).

Statistical Analyses

Cronbach alpha coefficients measured the internal consistency of items on the two multi-item attitudinal factors measuring perceived risk and rationalizations against using UP. Because several variables were highly skewed or failed to meet other criteria for parametric tests (eg, the criterion of homogeneity of variance), the nonparametric Kruskal-Wallis *H* Test was used to analyze the significance of the differences between second-, third-, and fourth-year students' ages, attitudes, and total knowledge scores. Chi-square tests analyzed associations among those second-, third-, and fourth-year students whose knowledge scores were below or equal to the median versus above the median score and among the frequencies of students' responses to items about their readiness to comply with UP. Gender, race, and response-rate comparisons among students in the three classes also were analyzed by chi-square tests. All statistical tests were performed using SPSS (version 7.5, SPSS Inc, Chicago, IL).

RESULTS

Surveys were completed and returned by 111 second-year, preclinical students (96% response), 80 third-year students (62% response), and 60 fourth-year students (58% response, P<.0001). The gender and race distributions among respondents in each class are reported in Table 2. Mean ages (and ranges) were 25 (23-33) years among preclinical, 26 (23-36) years among third-year, and 27 (25-33) years among fourth-year respondents; the age difference between groups was significant (P<.001). Although a somewhat larger proportion of fourth-year respondents were women (55%) compared to second- and third-year classes (49% for each of them), the gender distribution among respondents did not differ significantly. The three respondent groups also did not differ significantly by race.

Mean age and race did not significantly differ between nonrespondents and respondents in each class (data not shown). However, 80% (4/5) of preclinical, 61% (30/49) of third-year, and 70% (31/44) of fourth-year nonrespondents were men. The gender difference between nonrespondents and respondents was significant only among fourth-year students, where the percentage of nonrespondents who were male exceeded that of respondents (P<.05).

Knowledge

Overall, preclinical students knew more than third- and fourth-year students about the efficacy of hepatitis B vaccine, use of antiretroviral therapy after occupational exposure to HIV, and nonvaccinated healthcare workers' risk of infection from percutaneous exposures to bloodborne pathogens (P<.001). Twice as many preclinical as third- and fourth-year clinical students scored 3 or better out of 7 points (45%, 21%, and 22%, respectively; P<.001). The median score was 2 in each of the three classes.

Perceptions and Attitudes Toward Universal Precautions

Variable means for the two multi-item factors and for each of the single attitudinal items are presented in Table 3. Kruskal-Wallis tests indicated that the three student groups did not differ in their perceived risk of occupational exposure to bloodborne pathogens nor in their attitudes about hepatitis B vaccine and about the barrier protection of eyeglasses without side shields. Preclinical students agreed

TABLE 4
NUMBER (%) OF MEDICAL STUDENTS REPORTING READINESS TO COMPLY WITH UNIVERSAL PRECAUTIONS

Precaution	No.	Pre-contemplation	Contemplation	Preparation	Action	Maintenance
Double glove*						
Preclinical	108	9 (8.3)	24 (22.2)	48 (44.4)	25 (23.1)	2 (1.9)
Third-year clinical	79	13 (16.5)	0 (0.0)	9 (11.4)	35 (44.3)	22 (27.8)
Fourth-year clinical	60	9 (15.0)	8 (13.3)	5 (8.3)	21 (35.0)	17 (28.3)
Protective eyewear*						
Preclinical	108	1 (0.9)	22 (20.4)	53 (49.1)	31 (28.7)	1 (0.9)
Third-year clinical	79	2 (2.5)	0 (0.0)	3 (3.8)	40 (50.6)	34 (43.0)
Fourth-year clinical	60	4 (6.7)	7 (11.7)	5 (8.3)	20 (33.3)	24 (40.0)
Safe sharps disposal*						
Preclinical	109	1 (0.9)	17 (15.6)	36 (33.0)	48 (44.0)	7 (6.4)
Third-year clinical	79	0 (0.0)	0 (0.0)	0 (0.0)	33 (41.8)	46 (58.2)
Fourth-year clinical	60	0 (0.0)	0 (0.0)	0 (0.0)	23 (38.3)	37 (61.7)
Report all exposures*						
Preclinical	108	4 (3.7)	21 (19.4)	47 (43.5)	33 (30.6)	3 (2.8)
Third-year clinical	75	11 (14.7)	3 (4.0)	10 (13.3)	33 (44.0)	18 (24.0)
Fourth-year clinical	57	7 (12.3)	7 (12.3)	6 (10.5)	19 (33.3)	18 (31.6)
Hepatitis B vaccine						
Preclinical	110	0 (0.0)	0 (0.0)	2 (1.8)	5 (4.5)	103 (93.6)
Third-year clinical	79	1 (1.3)	0 (0.0)	1 (1.3)	3 (3.8)	74 (93.7)
Fourth-year clinical	60	1 (1.7)	0 (0.0)	0 (0.0)	0 (0.0)	59 (98.3)

* Level of significance of 3×5 chi-square tests, $P<.0005$.

more strongly than third- and fourth-year students ($P<.001$) that they should double glove for all invasive procedures with sharps. Students with clinical experience reported stronger agreement with the factor measuring rationalizations against using UP ($P=.008$) and with the item about selectively reporting only high-risk needlestick injuries ($P=.057$), compared to students without clinical experience.

Readiness to Comply with Universal Precautions

Preclinical students more frequently reported contemplating or preparing to comply with UP compared to clinical students. Students with clinical experience were more likely to report compliance, but clinical students also were more likely to report having "no plans" to double glove, wear protective eyewear, and report all exposures (Table 4). Everyone in the third- and fourth-year groups reported compliance with safe sharps disposal, compared to half of the preclinical students. Differences between the preclinical and clinical students' readiness to comply with each of these four precautions were highly significant ($P<.001$). There was little variation, however, in students' compliance with receiving hepatitis B vaccine; nearly all of the preclinical and clinical students reported currently receiving the vaccine or being fully vaccinated.

DISCUSSION

Preclinical students had higher mean knowledge scores than clinical students about risk of infection from exposures to bloodborne pathogens, efficacy of hepatitis B vaccine, and use of antiretroviral therapy after occupational exposure to HIV. This difference may be attributable to preclinical students' more recent completion of the course in pathophysiology that covered these topics. But students' knowledge level, overall, was not impressive. Only 47% of preclinical students scored 3 or better out of 7 points. To increase students' understanding of their risk and modes of occupational transmission of bloodborne pathogens, this important information should be covered in both preclinical and clinical course work.

Although the three groups of students did not differ in many of their attitudes toward UP and perceptions of risk, clinical students gave significantly less desirable responses to three of the measures. They agreed more with reporting only high-risk injuries and with rationalizations against using UP, and they disagreed more with the need to double glove for all invasive procedures with sharps. (Although this latter precaution generally is recommended only for surgical and trauma personnel at high risk for occupational exposure to bloodborne pathogens, we emphasized this recommendation for medical students as well because they, too, are believed to be at risk.) Moreover, although students with clinical experience reported compliance with UP more frequently than did preclinical students, they also were more likely to report having "no plans" to double glove, wear protective eyewear, and report all exposures. Thus, it appears that the time to impress students with the criticality of using UP to prevent occupational exposures to bloodborne pathogens

is in the preclinical years, when they have limited experience.

Given these observations, we believe that knowledge about the need for UP and utilization of safe procedures (eg, "no touch" passing of sharps and not manipulating suture needles with one's hands) should be taught to students before they begin their clinical rotations. Their attitudes toward UP might remain more positive after gaining clinical experience if they are taught to use recommended precautions from the beginning. This hypothesis currently is being tested.

Several educational theories reinforce the importance of educating students about UP prior to their clinical training. Social learning theory[11] suggests that it may be more effective to teach medical students about the importance of UP and allow students time to become proficient in the use of UP before they become set in their ways than to change their practice patterns after years of experience. Self-determination theory[12] suggests further that educational methods that provide competence feedback in the absence of strong pressures to perform up to standards facilitate students' learning and performance of specific precautionary practices.[13] That is, conditions that nurture students' intrinsic motivation (ie, feelings of self-determination) to utilize UP should facilitate students' ongoing use of recommended precautions. When students feel they must change previously learned patterns of behavior, we might expect to observe more "controlling" conditions (or, at least, that students perceive these conditions as controlling) and, subsequently, greater resistance to change. For example, students who have learned to perform routine procedures (eg, phlebotomy, intravenous-line placement, and blood cultures) by imitation, following the lead of a resident or attending physician, might not have learned to do these procedures using UP. Having established certain habits in practice, pressures to change these habits likely will be perceived as controlling and therefore resisted. Thus, teaching students about UP practices before they begin their clinical rotations may be more effective in improving compliance with UP than interventions administered after they have adopted less safe practice patterns.

The generalizability of this study is limited by our use of a sample of students from only one medical school and by the cross-sectional design. The third- and fourth-year students in this study were not surveyed when they were second-year, preclinical students themselves, and they might differ from the present second-year class in unknown ways (eg, historical trends in training). The three classes did not, however, differ by gender, race, or demographic characteristics we were able to measure. Response rates for the three classes differed significantly as well, which could have biased our results. Nonrespondents, particularly among the clinical students, might have differed significantly from respondents in their knowledge, attitudes, and readiness to comply with UP. Respondents and nonrespondents did not differ by race or age, and, although a greater percentage of nonrespondents were men compared to women, this association was significant only among students in the fourth-year class. In addition, the trend for clinical students to report compliance with UP may reflect the bias of self-reported data toward self-protection (ie, overreporting desirable and underreporting undesirable attitudes and practice behaviors). Because preclinical students were not yet expected to be able to report compliance with UP, their responses might not reflect the same self-protection bias that one would suspect may be evident in responses from students with clinical experience.

Nevertheless, the unanticipated differences we observed in knowledge, attitudes, and intentions to comply with UP between students with and without clinical experience may have important implications for the timing and content of interventions designed to improve compliance with UP. Teaching medical students early in their clinical training about their risks of infection from occupational exposure to bloodborne pathogens and about specific preventive practices to reduce these risks may be associated with more positive attitudes toward, and better compliance with, UP. We currently are testing these hypotheses in a longitudinal study.

REFERENCES

1. O'Neill TM, Abbott AV, Redecki SE. Risk of needlesticks and occupational exposures among residents and medical students. *Arch Intern Med* 1992;152:1451-1456.
2. Vergilio JA, Roberts RB, Davis JM. The risk of exposure of third-year surgical clerks to human immunodeficiency virus in the operating room. *Arch Surg* 1993;128:36-38.
3. Wurtz R, Dolan M, O'Neal B, Azarcon E. Infection control instruction and screening for students. *Am J Infect Control* 1994;22:322-324.
4. Shalom A, Ribak J, Froom P. Needlesticks in medical students in university hospitals. *J Occup Environ Med* 1995;37:845-849.
5. Sokas RK, Simmens S, Scott J. A training program in Universal Precautions for second-year medical students. *Acad Med* 1993;68:374-376.
6. Elford J, Cockcroft A. Compulsory HIV antibody testing, Universal Precautions and the perceived risk of HIV: a survey among medical students and consultant staff at a London teaching hospital. *AIDS Care* 1991;3:151-158.
7. Koenig S, Chu J. Senior medical students' knowledge of Universal Precautions. *Acad Med* 1993;68:372-374.
8. Weyant RJ, Bennett ME, Simon M, Palaisa J. Desire to treat HIV-infected patients: similarities and differences across health-care professions. *AIDS* 1994;8:117-121.
9. Prochaska JO, Redding CA, Harlow LL, Velicer WF, Rossi JS. The transtheoretical model of change and HIV prevention: a review. *Health Educ Q* 1994;21:471-486.
10. Prochaska JO, Velicer WF, Rossi JS, Goldstein MG, Marcus BH, Rakowski W, et al. Stages of change and decisional balance for twelve problem behaviors. *Health Psychol* 1994;13:39-46.
11. Bandura A. *Social Learning Theory.* Englewood Cliffs, NJ: Prentice-Hall, 1977.
12. Deci EL, Ryan RM. *Intrinsic Motivation and Self-Determination in Human Behavior.* New York City, NY: Plenum Press, 1985.
13. Deci EL, Ryan RM. Intrinsic motivation to teach: possibility and obstacles in our colleges and universities. In: Bess J, ed. *New Directions in Teaching and Learning.* San Francisco, CA: Jossey-Bass, 1982.