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Medical students and infection control: risks and precautions

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Purpose. **To investigate factors associated with medical students' use of infection control measures to protect themselves from HIV and other blood-borne infections.**
Methods. **All clinical students in the academic year of 1993–94 at the University of Washington, Seattle, were surveyed on the percent of time they use Universal Precautions (UPs), their sense of control and concern over HIV risk, estimates of occupational HIV risk and career plans.**
Results. **Responses of 294 students (86%) were studied. Most students use UPs most of the time but only 25% do so universally. Women (88.1%) use UPs more often than men (82.8%). Use of UPs was not related to the factors that actually predict risk of infection: incidence of exposure accidents and prevalence of HIV among patients. UP use was not associated with demographic characteristics of the student, specialty choice or level of concern about HIV. Students with greater sense of control over their risk reported greater use of UP. Those who plan to restrict patient services because of HIV risk use UP less often than others.**
Conclusion. **Students use UPs but could do more to protect themselves. Infection control among young clinicians may be improved by education about the reality of the risk and the efficacy of precautionary measures.**

INTRODUCTION

Unlike some countries such as Japan, the number of HIV cases and related risk to health care workers of occupationally acquired transmission in the United States is a major concern for for the public as well as the medical community and educational institutions. The history of transmission of infectious disease (such as leprosy, syphilis, the bubonic plauge, and more recently Hepatitis, HIV, and MSRA/VRE) has repeatedly shown that despite varying degrees of negative attitudes and unwillingness to care for patients by the public and medical community (nurses, physicians and students), proper education about risks and advances in methods of prevention have served to change negative attitudes and promote a safer care-giving environment.

Since the first case of needlestick transmitted HIV infection in 1984, health care workers (HCWs) in a growing number of both industrialized and non-industrialized countries have been exposed to infection with the Human Immunodeficiency Virus (HIV) and other blood-borne pathogens in their work caring for patients.

At least 94 documented cases and 170 possible cases of occupationally acquired HIV infection have been documented worldwide [1]. Conclusions from this study include the following and can be viewed as pertinent to other forms of infection transmission: all health care workers regardless of job category face a low but real risk of occupational infection from HIV exposure; infections most often occur following puncture injuries from blood filled, hollow-bore needles but have also been caused by cuts from solid objects and contamination of non-intact skin or mucous membranes by at-risk biological substances (blood and other body fluids); adherence to universal precations, modifications in procedural techniques, and improvements in the designs of sharp medical instruments are critical prevention measures for creating a safer workplace; all HIV-positive patients regardless of stage of infection present a transmission risk the exposed

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health care worker must be followed serologically and clinically for at least 6 months following exposure.

Current estimates of the rate of HIV infection among HCWs after needle stick injuries from HIV-positive patients range from 0.3% to 0.6% [2-4]. The rate of transmission from blood infected with Hepatitis B Virus is much higher.

In a recently published international case-control study of HIV seroconversion in HCWs after percutaneous exposure to HIV-infected blood [5] the following variables for potential HIV transmission were identified: "deep" injury (device visibly contaminated with blood; procedure involving a needle placed directly in a vein or artery; and a terminal illness in the source patient.

To help reduce these bloodborne risks blood and body fluid Universal Precautions (UPs) were developed universally to all persons regardless of their presumed infection status. These measures were promoted by the Centers for Disease Control (CDC) in 1987 and adopted as regulations by the U.S. Occupational Safety and Health Administration in 1988.

UPs recommend use of gloves, gowns, masks and eye coverings, individual ventilation devices for resuscitation and list "certain" body fluids (blood, body fluids) as posing possible risks for transition of blood borne pathogens. Gloves are recommended for anticipated contact with blood and body fluids, and hands to be washed immediately after removal of gloves. More recently in 1996 the CDC instituted revised regulations called "Guidlenes for Isolation Precautions in Hospitals" or Standard Precautions (SP). These regulations are broader offering infection control precautions that are standard for all patients and include bloodborne, airborne, and epidemiologically important pathogens. In particular, these new guidelines were developed in response to possible drug-resistant organism spread (MRSA, VRE) and are based on the latest epidemologic information on transmission of infection intended primarily for use in acute-care hospitals [6].

It is important to note that Universal Precautions or Standard Precautions are only recommnedations and guidelines suggested for use. Therefore, acceptance and use of UPs or SPs by physicians, medical students, and other HCWs is not universal [5, 7].

A recent study investigating compliance with UPs by over 5000 physicans in the US [8] found that despite regulatory standards, compliance varied from over 90% on such practices as glove wearing and disposal of sharps, to under near 55% for wearing protective clothing and recapping needles. Furthermore, non-compliance was associated with age greater than 37, high work stress, and a conflict of interest between providing care and protecting themselves, while compliance was associated with knowledge and training in UPs, perception of effectiveness of UPs, and a commitment to safety. The purpose of this study is to document the rate and to investigate the factors that influence the use of UPs by medical students (at the time of the study SPs were not in effect).

METHODS

During the Academic year of 1993-94, each student in the clinical years at the University of Washington School of Medicine was mailed a confidential, two-page questionnaire which asked the questions detailed below and for demographic information. A second questionnaire was mailed to students who failed to return the first within two weeks.

Students' reports of their use of Universal Precautions were treated as continuous data and mean percent of use was calculated for groups. In addition, students were divided into two groups for categorical comparisons: "Low Users" who used UPs less that 80% of the time and "High Users" who used UPs 80-100% of the time. In our comparisons between student groups on their use of UPs, we report that no difference exists when analysis of both the mean percent use and the proportion of Low Users found no statistically significant difference. Differences between groups were tested with the Chi-square test for categorical data. Differences between two groups in continuous data were tested with the t-test. ANOVA was used to test means among multiple groups. Two tailed tests were used with the criterion for statistical significance $p = 0.05$.

RESULTS

The survey achieved an overall response rate of 85.5%, with 294 responses from the

total of 344 students. Respondents were 61% male and 41% married with a mean age of 27.5 years (range 22 to 43 years, Std. Dev. 3.84). All students were in their final two years of clinical training: 46% juniors, 48% seniors and 6% in special programs. Table 1 summarizes the demographic description of the respondents.

Each student answered the question, "What percent of the time in your work do you use strict Universal Precautions when there is a risk of exposure to any blood or body fluids?" by marking a percentage category from 0% through 100% in increments of 10% (Figure 1). Most students (37.7%) reported using UPs 90% of the time, but reports ranged from 0% of the time (2 students or 0.7%) to 100% of the time (74 students or 25.3%). Female students reported using precautions more frequently (88.1% of the time) than did male students (82.9%) (unpaired t-test, $p = 0.0083$). There were 241 "High Users" (82.8%) and 50 "Low Users" (17.2%) of UPs. Use of UPs was not associated with student age, marital status or year in medical school.

The factors that predict the actual risk of acquiring HIV infection from occupational exposure are the number of exposure accidents and the prevalence of HIV infection in the patient population. Students' use of UPs to protect themselves from such infection was not associated with either of these factors.

Students' use of UPs was not associated with their reported number of needle stick accidents. Each student answered the question, "How many times in the past year have you been percutaneously exposed to blood or body fluids in the course of your work (for example, from a needle stick injury) ?" Only one student reported a single accidental exposure to a patient known to be infected with HIV. Accidental exposures to any patient were reported by 23.8% (69) of students, with 17.9% (52) reporting one, 4.5% (13) reporting two and 1% (3) reporting three such accidents in the previous year. One student reported 10 accidental exposures. The other 76.2% (221) denied such

Table 1 Medical Students Reporting Use of Universal Precautions

Students	Number	Percent
Male	174	61%
Female	113	39%
Junior	133	46%
Senior	137	48%
Other	17	6%
Married	118	41%
Not Married	169	59%
TOTAL	294	100%
Age	Mean	27.5 years
	Range	22-43 years
	Std. Dev.	3.84

N = 294 survey respondents. Only 287 students reported their demographic data; percentages are calculated with this denominator.

accidents.

Students' use of UPs was not associated with the number of HIV positive patients for whom they provided care in the past year. Most students reported caring for from one to ten patients, with a mean of 12.9 patients (std. dev. 16.47). Only 8.7% (25) reported no such patients. One student claimed 500 HIV/AIDS patients over the past year.

Students' use of UPs was not associated with their estimates of the prevalence of HIV infection in the patients with whom they worked. Each student was asked to estimate the percent prevalence of HIV infection in "your own current patient population." Students' prevalence estimates ranged from zero percent to 100% with a mean of 6.88% (std. dev. 11.37), median of 3% and mode of 1%. Even when these widely-dispersed estimates of were split into those students estimating one percent or less and those estimating greater than one percent, students'

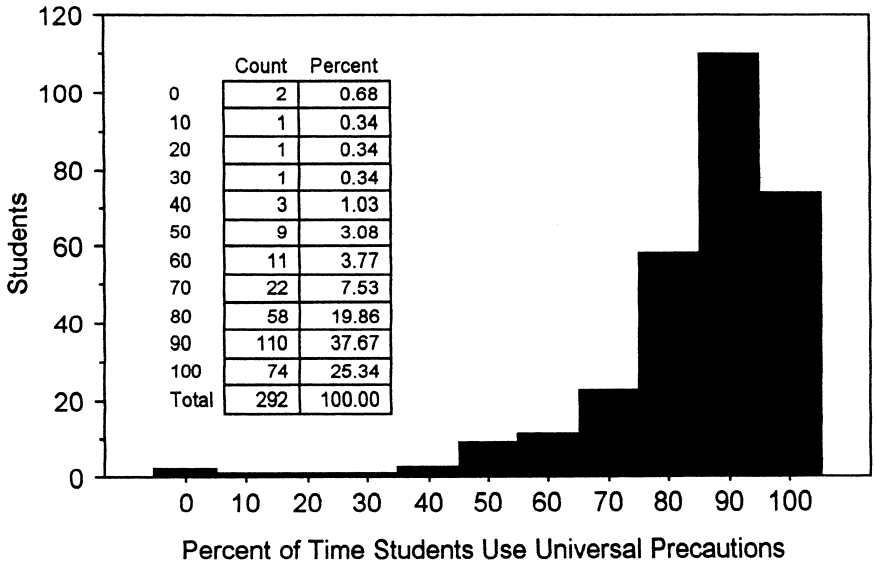

Fig. 1 Medical Students' Use of Universal Precautions.

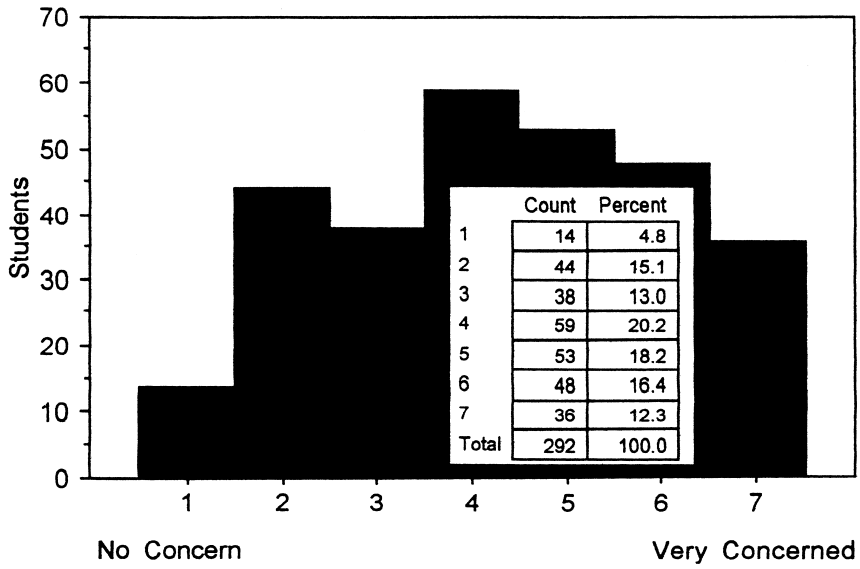

Fig. 2 Medical Students' Concern Over HIV Risk From Patient Care.

use of UPs was still not associated with their estimates of HIV prevalence in their patients.

Students were asked, "How concerned are you about your risk of acquiring HIV infection through your work?" (Figure 2). Their responses spanned the entire range of the seven-point Likert scale from "No Concern" (1) to "Very Concerned" (7), with a mean rating of 4.3 (std. dev. 1.74). Almost half (46.9%) of the students reported their level of concern to be above the midpoint of the scale. Despite these concerns about HIV infection from patient care, student UP use was not significantly associated with level of concern.

Students were asked, "How much control do you feel you have in reducing your risk of HIV through the use of Universal Precautions?" (Figure 3). They rated their sense of control on a 7-point Likert scale from "1 = No Control" to "7 = Great Control". Students reported a mean sense of control of 5.58 (std. dev. 1.19) and median of 6.0. Students who reported a greater sense of control over their risk also reported greater use of UPs in their clinical work (ANOVA, $p = 0.035$). Those who felt their control was lowest used UPs only 70.0% of the time, while those with the greatest sense of control reported using Universal Precautions 89.4% of the time. The Low Users, students who use UPs less than 80% of the time, rated their sense of control significantly lower at 5.26 than did the High Users, who rated their sense of control at 5.65 (unpaired t-test, $p = 0.035$).

Students identified the specialties they planned for their future careers. There were no significant differences between specialty groups in their use of UPs.

Students' use of Universal Precautions was not associated with their scaled response to the question, "How strongly has the risk of HIV infection from occupational exposure influenced your career plans?" Students further identified, "the areas of practice plans that have been influenced by the risk of occupational HIV infection," including: choice of specialty, limiting services or procedures provided within their chosen specialty, limiting care of HIV-infected patients or limiting care of patients at high risk of HIV infection. Students who said that their concern over HIV risk made them plan to restrict the services they would provide within their chosen specialties reported less frequent use of UPs (62.5% of the time) than other students (84.8% of the time) (t-test, $p = 0.013$). The other areas of influence of HIV risk upon students' career plans were not significantly associated with UP use.

Students' use of UPs was not associated with whether or not "they know of any health care worker in your community who

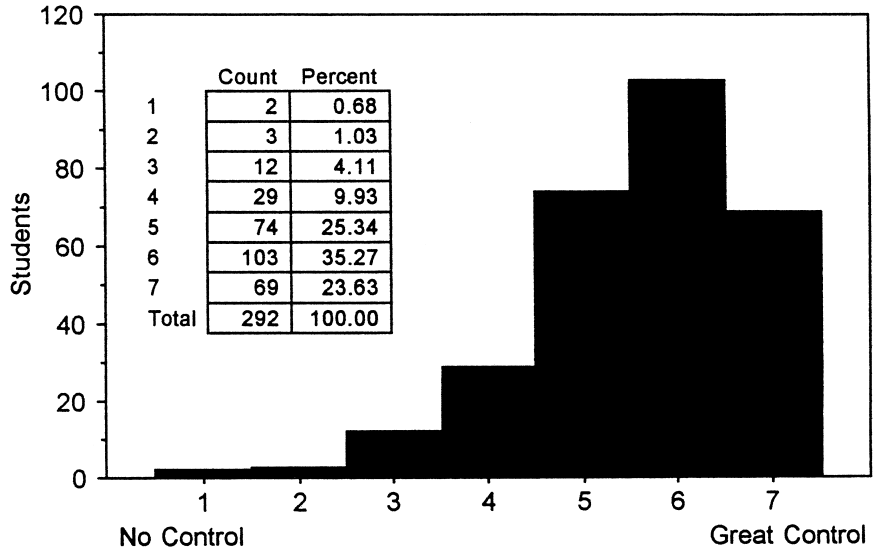

Fig. 3 Medical Students' Sence of Control Over HIV Risk Through UP Use.

has acquired HIV infection through occupational exposure?" Only 12.5% (36) of students reported that they knew of any infected health care worker that had definitely or maybe acquired HIV from patient care activities. Only two students responded "yes" and six "maybe" when asked if the personally knew such an infected health care worker.

DISCUSSION

There are many studies on the use of UPs in the prevention of blood-borne infections but relatively few focus on medical students [8-15, 18]. Yet these young clinicians (as well as beginning interns and residents) are at significant risk of infection; perhaps more than others due to their lack of experience and training in clinical procedures.

Most of the extant studies on medical students show that exposure incidents occur more often than reported, needle and sharp related injuries are the predominant cause of exposures, time constraints and inconvienence of glove use contribute significantly to precautions non-adherence, and general complacency toward precautions among most medical personel [8-15, 18].

Furthermore, it is at this early stage in their training that physicians develop the knowledge, skills and attitudes that will influence their patient care and practice precautions for the rest of their careers.

However, while most medical schools and hospitals provide education and attempt to enforce compliance of UP or SP use, a recent report [18] indicates that medical students like other health care workers are under great stress and time constraints which tend to create an atmosphere of poor safety behavior. This report describes the largest study to date of UP use by medical students.

Our study had a high response rate (greater than 85%), better than a recent study [18]. Possible factors leading to drop outs in our study may be related to factors such as time constraints, lack of incentive to complete the study, the fact that the study was not a requirement by the school administration, and the need to follow-up better on drop outs. Most medical students claim to use UPs most of the time.

Most are concerned about their risk of occupational HIV exposure. Yet, most could do more to protect themselves. Sudents in our study commented that education in the use of UP was inadequate and that attending physicians themselves served as "poor role models" by ignoring UPs.

Female students use UPs modestly but significantly more often than males. Previous studies have not documented this difference. Possibly female students comply better with the recommendations for use of UPs (or report that they do). Possibly females have greater fear of the consequences of blood-borne infections. However, females did not report greater levels of concern over HIV risk.

There was a direct association between a student's sense of control over HIV risk through use of UPs and a student's use of UPs. A student's sense of control is presumably related to their belief in the effectiveness of UPs and their ability to use the precautions at appropriate times.

Some authorities question the effectiveness of UP's, recognizing that gloves give little protection against the needle sticks and other sharp injuries that are responsible the majority of occupationally acquired cases of HIV in HCWs. Students in our study commented that UPs are not effective in preventing percutaneous injuries and that "common sense" and "increased awareness" are more important in preventing accidents. Educational efforts to improve students' sense of control, belief in the efficacy of UPs and ability to put UPs into use in the clinical care of patients may improve students' rate of use of UPs, with resulting improvements in their protection. Perhaps improvements in equipment and techniques that offer better protection than the currently recommended UPs or SPs would have even more impact.

There was little relationship between students' career plans and their use of UPs. Those bound for specialties at higher risk of blood-borne infections —surgery or obstetrics for example— did not report more frequent use of UPs. However, those students who said that their fear of HIV risk made them plan to avoid certain high risk procedures within their chosen fields reported that they used UPs less often that other students. Perhaps these students feel that is easier to limit infection risk by avoiding procedures than by using UPs. Such students could actually be at greater risk of exposure because of

their failure to use precautions universally. Many clinicians complain of the inconvenience of using gloves, goggles and other precautions during invasive procedures and other patient care activities.

In addition, in a recent review of the literature [16] on the impact of attitudes to care and the barriers affecting the quality of care for people with HIV, several persistent concerns by health care workers were identified: fear of becoming infected; homophobia; burnout (high HCW job-related stress); religious attitudes; unwillingness to care and the absence of touch. One aspect identified in improving negative attitudes was increased knowledge and clinical experience.

A possible limitation in our study was in regrouping of the data. For instance, if student data regarding degree of HIV prevalence and planned specialty was organized in terms of medical versus surgical specialty perhaps the above conclusions would be different.

Another limitation in our study was in documenting the experience in one medical school. Our findings may not be representative of the national population of medical students, but it seems unlikely that our school or students, or the patients for whom they provide care, are atypical of the general medical education experience nationwide. Our study also relies upon student self-report of UP use and other important behavioral outcomes. Other studies have shown that clinicians may over-report UP use [19] and under-report needle stick injuries [17, 20]. Although self-reports may not be entirely reliable, they probably reflect students' beliefs and attitudes regarding HIV risk and their responses to it. Student estimates of other data may be inaccurate as well. HIV prevalence among patients varies widely across time and place in the clinical settings where these students work. Despite uncertainties about these quantitative estimates, students' own reports of their level of concern and its influence upon them are probably meaningful.

Students' use of UPs was not related to the factors that predict their actual level of risk: rate of needle stick accidents, prevalence of HIV infection in patients and number of HIV-positive patients. Their use of UPs was not affected by knowledge of health care workers in the community that have been infected through clinical work. Thus, students' perceived level of personal risk did not influence their efforts to reduce that risk through the use of UPs. In other papers we examine more fully students' estimates of their own occupational HIV risk. These estimates vary widely, are not related to actual risk factors and are often inaccurate. Efforts to teach students about the actual risks involved in patient care may encourage them to better use UPs and SPs to protect themselves from HIV and other serious blood-borne infections.

REFERENCES

1) Ippolito, G., Puro, V., Heptonstall, J., Jagger, J, De Carli, G., and Petrosillo, N. Occupational Human Immunodeficiency Virus Infexction in Health Care Workers: Worldwide Cases through September 1997. *Clin. Infec. Diseses.* **28** (1999): 365–83.
2) Marcus, R., Kay, K., Mann, J. M. Transmission of HIV in Health-Care Settings Worldwide. *Bull. World Health Org.* **67** (1989): 577–582.
3) Henderson, D. K. *et al.* Risk for Occupational Transmission of HIV-1 Associated with Clinical Exposure —A Prospective Evaluation. *Ann. Int. Med.* **113** (1990): 740–746.
4) Tokars, J. I. *et al.* Surveillance of HIV Infection and Zidovudine Use Among Health Care Workers After Occupational Exposure to HIV-Infected Blood. *Ann. Int. Med.* **118** (1993): 913–919.
5) Cardo, DM, Culver, DH, Ciesielski, CA, *et al* and the CDC. Needlestick Surveillance Group: A Case-control Study of HIV Seroconversion in HCWs after Percutaneous Exposure. *NEJM.* **337** (1997): 1485–90.
6) Garner, JS. Guidlines for Isolation Precautions in Hospitals. *Infec. Control and Hosp. Epidem.* **January** (1996): 54–80.
7) Hammond, J. S., Eckes, J. M., Gomez, G. A., Cunningham, D. N. HIV, Trauma, and Infection Control: Universal Precautions Are Universally Ignored. *J. Trauma* **30** (1990): 555–561.
8) Ros, S. P., Cabrera-Ros, B. L. Poor Compliance with Universal Precautions: A Universal Phenomenon? *Pediatr. Emerg. Care* **6** (1990): 183–185.
9) Michalsen, A, Declos, GL, *et al.* Compliance with Universal Precautions among Physicians. *J. Emerg. Med.* **39 (2)** (1994): 130–37.
10) Gompertz, S. Neddle-stick injuries in medical students. *J. Soc. Occup. Med.* **40** (1990): 19–20.
11) Jones, D. B. Percutaneous Exposure of Medical Students to HIV. *JAMA* **264** (1990): 1188.
12) Stotka, J. L., Wong, E. S., Williams, D. S., Stuart, C. G., Markowitz, S. M. An Analysis of Blood and Body Fluid Exposures Sustained by House Officers, Medical Students, and Nursing Personnel on Acute-Care General Medical Wards: A Prospective Study. *Infect. Control Hosp. Epidemiol.* **12** (1991): 583–590.
13) Buergler, J. M. *et al.* Risk of HIV in Surgeons, Anesthesiologists, and Medical Students. *Anesth. Analg.* **75** (1992): 118–124.

14) O'Neill, T. M., Abbott, A. V., Radecki, S. E. Risk of Needlesticks and Occupational Exposures Among Residents and Medical Students. *Arch. Int. Med.* **152** (1992): 1451–1456.
15) Koenig, S., Chu, J. Senior Medical Students' Knowledge of Universal Precautions. *Acad. Med.* **68** (1993): 372–374.
16) Robinson, N. People with HIV/AIDS: who cares? *J. Adv. Nursing.* **28 (4)** (1998): 771–78.
17) Vergilio, J. A., Roberts, R. B., Davis, J. M. The Risk of Exposure of Third-Year Surgical Clerks to HIV in the Operating Room. *Arch. Surg.* **128** (1993): 36–39.
18) Ganguly, R, Holt, DA, Sinnott, JT. Exposure of Medical Students to Body Fluids. *J. Am. Coll. Health.* **47 (5)** (1999): 207–10.
19) Freeman, S. W., Chambers, C. V. Compliance with Universal Precautions in a Medical Practice with a High Rate of HIV Infection. *J. Am. Board Fam. Pract.* **5** (1992): 313–319.
20) Mangione, C. M., Gerberding, J. L., Cummings, S. R. Occupational Exposure to HIV: Frequency and Rates of Underreporting of Percutaneous and Mucocutaneous Exposures by Medical Housestaff. *Am. J. Med.* **90** (1991): 85–90.