Variables influencing worker compliance with universal precautions in the emergency department

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Background: Emergency department health care workers frequently provide care to patients who are in unstable condition, bleeding, or in a crisis situation. To identify the variables described in the Health Belief Model affecting health care workers' compliance with practices and devices believed to reduce exposure to patients' blood, the staff of a level II trauma center were surveyed for knowledge, compliance, and training regarding universal precautions.
Methods: Fifty-three health care workers responded to an anonymous, self-report, 50-item questionnaire. Significant differences in mean scores were determined by use of a two-tailed *t* test.
Results: Health care workers estimated they were most likely to perform handwashing after contact with body fluids and to wear gloves if contact with blood was anticipated. The most common obstacles to compliance with universal precautions were lack of time, patients perceived to be at lower risk for HIV or hepatitis B infections, and interference with technical skills. Health care workers with more than three perceived obstacles to universal precautions were less likely to use gloves ($p < 0.05$) if contact with blood was anticipated. Health care workers with a higher number of training experiences in universal precautions were more likely to use gloves if contact with blood was anticipated ($p < 0.05$) and less likely to recap a needle after giving an intravascular injection ($p < 0.05$), drawing a blood gas sample ($p < 0.05$), or injecting medication into an intravenous line ($p < 0.05$).
Conclusions: The application of the Health Belief Model to this problem suggests that an integrated approach is appropriate. Such an approach should incorporate engineering controls, cognitive approaches, behavior modification strategies, and training experiences to improve skills and dexterity. (AJIC Am J Infect Control 1994;22:138-48)

Health care workers (HCWs) have been increasingly concerned about possible infection with pathogens such as hepatitis B virus (HBV), hepatitis C virus, and HIV as a result of occupational exposures to the blood of infected patients. The morbidity and mortality associated with these infections in HCWs are significant. Although there are regional variations in the reported acquisition of HBV by HCWs,[1] the Centers for Disease Control and Prevention (CDC) estimates that approximately 8700 HCWs are infected annually with HBV with acute fulminating hepatitis B or the sequelae of chronic HBV infection, resulting in death for 200 HCWs each year.[2]

The data regarding HCW infection with HBV are sobering, yet the risk of acquiring HBV has not generated the heightened concern in HCWs that the possibility of infection with HIV has created.

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Recent data from the CDC indicate that 37 HCWs have documented and 78 have probable infection with HIV as a result of an occupational exposure to HIV-positive blood or body fluids.[3]

The risk of becoming infected after a blood exposure also differs significantly between HIV and HBV. The risk of becoming infected after a needlestick exposure to HBV can be as high as three in 10, whereas the risk of infection with HIV after a similar type of injury is one in 250.[2] However, the reported fatality rate is more than 80% for those infected with HIV and in the range of 1% to 2% after infection with HBV.[4,5]

In response to reports of the first cases of occupational acquisition of HIV by HCWs in the mid 1980s, labor groups representing HCWs requested the federal government to identify techniques designed to minimize the risk of possible transmission of blood-borne pathogens and to issue a mandate requiring health care institutions to provide protective devices and apparel for HCWs.[6]

In 1987 and 1988, the CDC published recommendations in which practices and equipment believed to reduce the risk of HCW contact with blood were described and labeled "universal precautions" (UP).[7,8] Although groups representing HCWs and public service workers influenced the federal government to establish these recommendations, there was a paucity of information regarding the efficacy of the protective devices or procedures in preventing the transmission of blood-borne pathogens and on HCW compliance with UP.

The risk of transmission of blood-borne pathogens such as HIV or HBV to HCWs is influenced by the frequency and duration of HCWs' exposure to the blood of infected patients.[9] The risk of exposure is influenced by environmental factors such as increased contact with contaminated needles or sharps, availability of effective protective equipment, and the seroprevalence of HIV or HBV in the population. An environment such as the emergency department (ED) includes conditions and practices that may increase the duration and frequency of HCW exposure to blood.

Providing care to patients with trauma may expose HCWs in the ED to large amounts of blood when uncontrolled bleeding occurs. Procedures performed on patients in unstable or crisis situations may be initiated with a minimum of warning to the HCW, decreasing the opportunity for the HCW to locate and use protective devices or apparel. In a crisis situation, multiple HCWs may perform procedures simultaneously on the same patient, increasing the likelihood of worker-to-worker injury and of exposure to the patient's blood. It is noteworthy that two of the documented HIV seroconversions in HCWs occurred as the result of needlestick injuries to coworkers during resuscitative efforts.[10]

In 1991, Bell[11] reported the findings of a CDC study of six hospital EDs. This study placed ED workers who did not wear gloves in the same increased risk category for blood exposures as obstetricians and surgeons. In this study, the overall reported range of blood contact for all ED workers, stratified by type of procedure, ranged from 61% during a thoracotomy to 2% during suturing.

The Health Belief Model (HBM), proposed by Rosenstock[12] in 1974, was used to describe the variables that influenced patient decisions related to health behavior. The variables identified by Rosenstock included a person's perceived susceptibility to a disease, perceived seriousness of the disease, and a personal evaluation of the impediments and benefits to the prevention or treatment strategies. HCW decisions regarding the use of protective barriers or compliance with recommended practices for reducing exposure to blood-borne pathogens are similar to patient decisions regarding health practices (Fig. 1).

Personal susceptibility is related to the individual's belief or fear that he or she is personally vulnerable to the disease. Perceived seriousness may be determined by the emotional response the concept of the disease arouses. This would include the perceived effects on the ability to work or on earning potential, on social relations, and on health (e.g., illness or death).

Impediments to compliance with the recommended behaviors are the negative consequences that the individual believes are associated with the behaviors. These may be physical, financial, or psychologic. Individuals weigh the obstacles to compliance, such as the expense, difficulty, pain, or risk, against the possible benefits, such as a reduction in the severity or a change in one's susceptibility to the disease. Individuals who believe that they are at risk for acquiring a disease are more likely to practice protective behaviors perceived as feasible and effective.

The variables described in the HBM operate in the interactions between HCW and patient: perceived personal susceptibility to the disease, perceived seriousness of the disease, and an analysis of the benefits and obstacles associated with

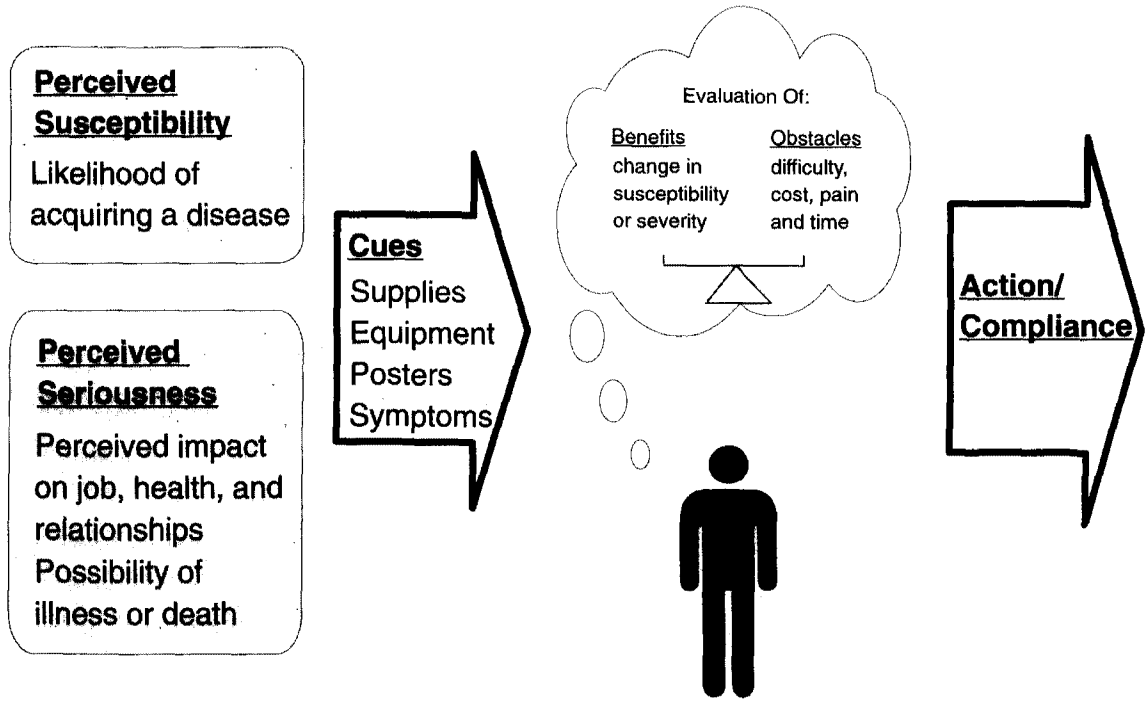

Fig. 1. Health Belief Model.

recommended actions. The purpose of this study was to identify the variables described in the HBM that influenced compliance of HCWs in the ED with UP and other practices believed to reduce the transmission of blood-borne pathogens.

METHODS

The study design included an observational period in June, July, and August of 1990 to determine HCWs' compliance with UP in a level II trauma ED of a midwestern, suburban hospital. A follow-up questionnaire, in which the HCWs estimated their compliance with UP, was sent to all participants 30 days after completion of the observation phase. The face validity of the questionnaire was established by means of a modified Delphi technique. The procedure and questionnaire had previously been used with ED workers in a study of UP compliance at a public teaching hospital.[13] The results of observation phase have been reported elsewhere.[14]

UP, as recommended by the CDC in 1987, was implemented in 1989. Implementation was followed by mandatory in-service training for all HCWs except physicians in 1989. The only attempt to inform physicians of the UP system was through the medical staff newsletter. Signs with the elements of UP were displayed in the patient care areas and in the equipment decontamination areas. Protective equipment was available at central locations in the ED. Specific items, such as gloves, needle-disposal containers, and resuscitation devices, were available at each bedside or in each treatment area.

Notices regarding the study were posted in the ED and included the general information that the study was related to health and safety strategies for ED personnel. The self-report survey was a 50-item questionnaire that took approximately 20 minutes to complete. A combination of closed-response categories and open-ended short responses was used. In addition to questions addressing demographics, the survey form asked the worker to assess personal compliance with UP, obstacles to compliance with recommended practices, beliefs regarding the efficacy of the available devices or protective equipment, history of receiving hepatitis B vaccine; to estimate the frequency of personal exposure to patients' blood or body fluids, their knowledge of the appropriate use of the barrier devices, the institution's postexposure reporting and treatment protocol, the risk of occupational acquisition of HIV or HBV; and training experiences regarding UP.

A significant blood or body fluid exposure was defined as an injury resulting from contact with a needle or sharp contaminated with blood or body fluids, open skin or mucous membrane exposure

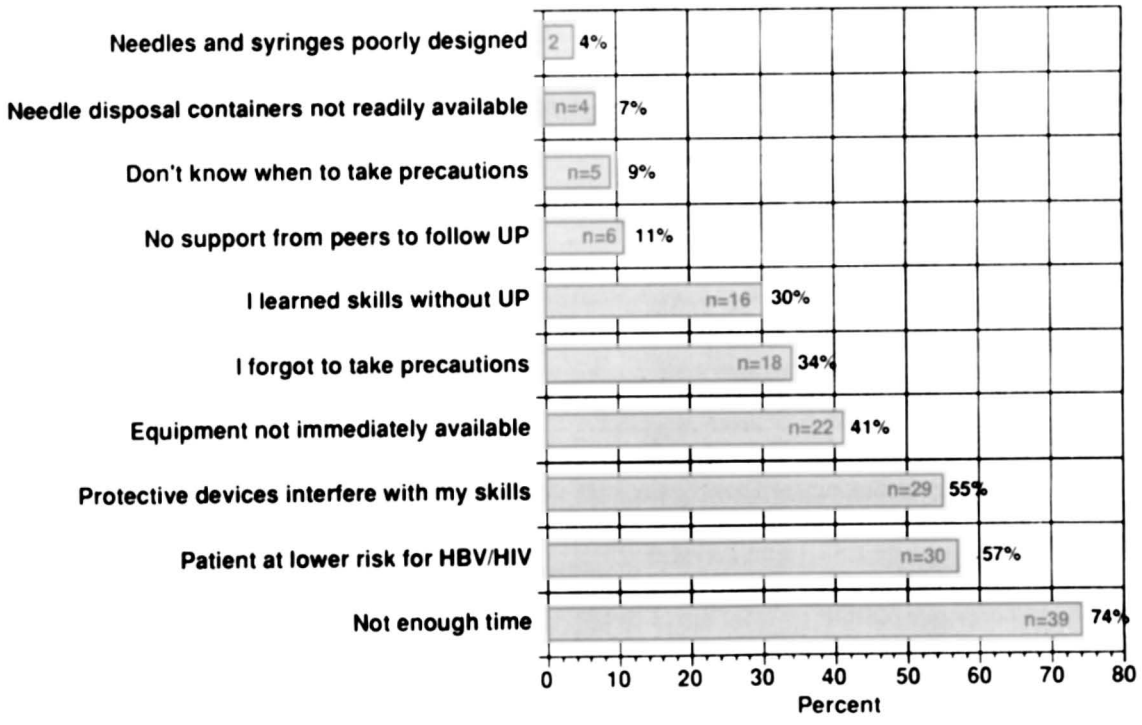

Fig. 2. Perceived obstacles to universal precautions (n = 53).

to blood or body fluids, aerosol exposure to blood or body fluids, or a human bite resulting in broken skin.

The worker estimated his or her level of compliance with specific recommended precautions by selecting from a scale of 0% to 100%, in increments of 10 percentage points.

Perceived obstacles to compliance were measured by asking the workers to check any of the 10 factors that they believed contributed to their noncompliance. The choices listed included items such as "not enough time," "materials not immediately available," and "gloves interfered with my patient skills." Respondents listing three or more reasons for noncompliance were classified as having a "high" number of perceived obstacles, a "low" level was 0, 1, or 2 obstacles. Beliefs regarding the efficacy of the recommended devices were determined by the subjects' rating of the devices as adequate or inadequate.

Respondents estimated the number of occupational exposures to blood or body fluids they had experienced within their entire ED work history. They were also asked whether they had received the hepatitis B vaccine series of injections.

Questions assessing the workers' knowledge of the appropriate use of the protective devices and practices were completed by selection of an answer from a 3-point scale, "always, sometimes, or never." Knowledge of the possible negative consequences of infection with blood-borne pathogens was addressed by having the workers select the probability of becoming infected with HIV or HBV after a needlestick exposure.

Workers were also asked to designate all training experiences from a list that included hospital in-service programs, policies, procedures, professional journals, orientation lectures, and posters or signs in the work environment. Those with three or more training experiences were placed in the "high" category and those with two or fewer were considered to have "low" training experiences.

Item and scale distributions and cross tabulations of discrete variables were examined initially. Differences between means were analyzed with a two-tailed t test.

RESULTS

For the questionnaire, 56% of the 95 ED workers participated. Results are based on 53 surveys. Of the 51 completing the question on job category, nine (18%) were physicians, 35 (69%) were registered nurses, five (10%) were nursing assistants or licensed practical nurses, and two (4%) were classed as "other." Information on years of ED experience was available for 37

Table 1. Self-reported frequency of compliance with specific UP practices

Precaution	Frequency			
	0%–50%	51%–80%	81%–100%	TOTAL
Handwashing when in contact with body fluids without gloves	0	2 (4%)	51 (96%)	53
Handwashing after contact with body fluids with gloves	4 (8%)	16 (30%)	33 (62%)	53
Handwashing practiced after patient contact/no body fluids	11 (21%)	21 (40%)	20 (38%)	52
Use of gloves if hands may get bloody	4 (8%)	15 (28%)	34 (64%)	53
Use of gown when appropriate	17 (33%)	12 (23%)	23 (44%)	52
Use of mask if splashing with blood likely	30 (57%)	10 (19%)	13 (24%)	53
Use of goggles if splashing with blood likely	34 (64%)	7 (13%)	12 (23%)	53

Table 2. HCW self-reported adherence to precautions according to number of perceived obstacles ($n = 53$)

Precaution	High no. of perceived obstacles (≥ 3, $n = 37$)	Low no. of perceived obstacles (< 3, $n = 16$)	*p* Value
Handwashing when in contact with body fluids without gloves	94% ± 11%	99% ± 2.5%	0.08
Handwashing after contact with body fluids with gloves	74% ± 26%	79% ± 20%	0.52
Handwashing practiced after patient contact, no body fluids	62% ± 25%*	66% ± 24%	0.62
Use of gloves if hands may get bloody	74% ± 22%	87% ± 10%	0.02†
Use of gown when appropriate	61% ± 31%*	58% ± 35%	0.78
Use of mask if splashing with blood likely	38% ± 31%	40% ± 42%	0.86
Use of goggles if splashing with blood likely	26% ± 34%	46% ± 44%	0.10

Values given are percentage of time in compliance, mean ± standard deviation.
*$n = 36$.
†p significant at 0.05 level.

subjects; of that number, 19 (51%) reported experience of 3 years or longer.

Workers estimated the frequency with which they personally complied with UP (Table 1).

The factor most frequently cited as an obstacle to UP was lack of sufficient time to use precautions, at 39 (74%). This was followed by 30 (57%) who indicated that they were less likely to use precautions if the patient appeared to be at a lower risk for HBV or HIV infection (Fig. 2).

Of the 10 obstacles to compliance listed, 16 (30%) of the HCWs reported two or fewer and 37 (70%) had three or more obstacles. Workers with three or more perceived obstacles to compliance with UP were less likely to use gloves for anticipated contact with blood ($p < 0.05$; Table 2).

A belief that the gloves and gowns supplied were inadequate as protective barriers was reported by 53% of the workers. The goggles were considered adequate by 35 (73%) of 48 workers. Masks were reported as adequate by 40 (77%) of 53 respondents.

The most common educational experiences for 35 respondents (64%) were hospital in-service training on UP and reading the UP recommendations in professional journals. Written hospital policies and procedures had been read by 57%, with 49% indicating that they had read and understood the UP signs posted in the ED. All UP knowledge questions were answered correctly by more than 70% of the respondents. Fig. 3 indicates that these workers were informed about UP.

The mean number of training experiences was 2.7. As presented in Table 3, those having more training in UP ($n = 26$) were more likely to wear gloves when anticipating contact with blood ($p < 0.05$). No significant differences were noted between the groups in responses regarding use of gowns, goggles, or masks.

Those with more training were also less likely to recap needles after drawing blood from a patient's artery ($p < 0.05$), administering an intramuscular injection ($p < 0.05$), or injecting medication into an intravenous line ($p < 0.05$; Table 4).

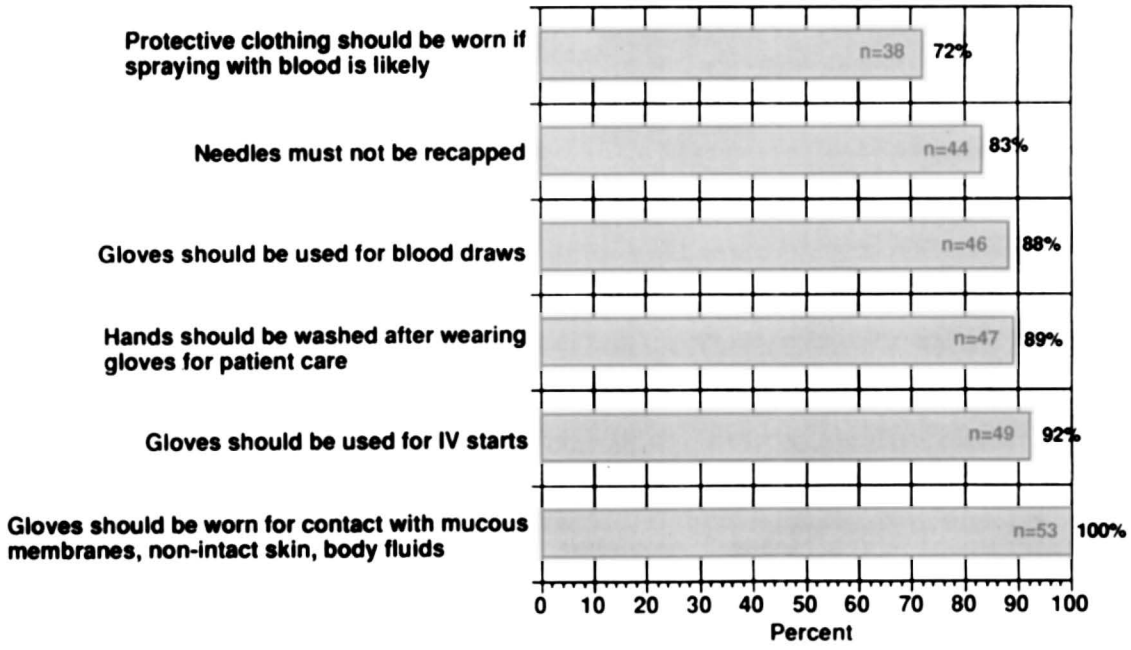

Fig. 3. Worker knowledge of universal precautions (n = 53). *IV*, Intravenous line.

Table 3. Self-reported adherence to precautions according to number of training experiences (n = 53)

Precaution	High no. of training experiences (≥3, n = 26)	Low no. of training experiences (<3, n = 27)	p Value
Handwashing when in contact with body fluids without gloves	94% ± 5%	98% ± 13%	0.16
Handwashing after contact with body fluids with gloves	78% ± 23%	73% ± 25%	0.44
Handwashing practiced after patient contact, no body fluids	66% ± 27%	60% ± 22%*	0.44
Use of gloves if hands may get bloody	86% ± 11%	70% ± 24%	0.0032*
Use of gown when appropriate	65% ± 32%	55% ± 32%*	0.26
Use of mask if splashing with blood likely	36% ± 35%	42% ± 33%	0.54
Use of goggles if splashing with blood likely	33% ± 40%	31% ± 37%	0.82

Values given are percentage of time in compliance, mean ± standard deviation.
*n = 26.
†p significant at 0.05 level.

The probabilities of becoming infected with HBV and with HIV after a percutaneous injury with a contaminated needle or sharp were correctly stated by 40 (78%) and 16 (31%) of 51 workers, respectively. Of the 48 workers responding to the question on occupational exposures to contaminated sharps, 47 reported a total of 94 occupational exposures to contaminated needles or sharps during their ED work experience, with a range of no exposures to 20 exposures per person, a mean of 2.0 exposures, and a standard deviation of 3.3 exposures. Of the total significant exposures, only 47 (10%) of 475 events were reported to the employee health service. One HCW who reported working for longer than 20 years in the field and estimated 500 total exposures was excluded from the data analysis for occupational exposures as an outlying data point. Thirty-three of the respondents (62%) had received the hepatitis B vaccine.

Only 34 (69%) of 49 workers knew the procedure to follow if they had an occupational exposure to the blood of an HIV-infected patient. A relatively small number of respondents, eight (16%) of 49, believed that zidovudine could be administered after an occupational exposure to a patient infected with HIV.

Table 4. HCW self-reported needle/sharp practices, according to number of training experiences

Practice	High no. of training experiences (≥3)		Low no. of training experiences (<3)		
	No.	Freq.%*	No.	Freq.%*	*p* Value
Frequency of recapping after giving an intramuscular injection (*n* = 43)	21	19% ± 33%	22	47% ± 43%	0.02†
Frequency of recapping after starting an intravenous line (*n* = 46)	22	15% ± 34%	24	19% ± 35%	0.74
Frequency of recapping after drawing blood gas sample from an artery (*n* = 30)	15	11% ± 30%	15	45% ± 44%	0.02†
Frequency of recapping after drawing blood (not blood gas) (*n* = 41)	21	34% ± 43%	20	52% ± 43%	0.18
Frequency of recapping after injection of medications into an intravenous line (*n* = 45)	21	29% ± 39%	24	57% ± 35%	0.016†
Frequency of placing sharps in needle-disposal unit (*n* = 48)	23	98% ± 3.8%	25	92% ± 18%	0.12

*Mean frequency of practice (%) ± standard deviation.
†*p* significant at 0.05 level.

DISCUSSION

The possibility of occupational acquisition of HIV has increased the concern and interest in HCWs and public health officials in developing interventions to protect HCWs. Although there are few studies regarding the behavior factors related to worker compliance with infection prevention recommendations, the HBM may be applied to the worker in the health care environment.

Cues to action or stimuli, either external (media campaigns, posters) or internal (awareness of symptoms of a disease), need to occur if individuals are to perform the recommended behavior. As noted earlier in the HBM, the obstacles and benefits associated with the recommended action are weighed by the individual; if conflicting, they may be a source of stress.[15-17]

One of the tenets of UP is that the blood from all patients is to be considered infectious, reducing the opportunity for HCWs to be exposed to the blood of patients with undiagnosed infections. However, the report by workers in this study, in which the perception that a patient was not at risk for or infected with HIV or HBV was an obstacle to compliance with UP, is consistent with other studies, in which workers claim that they would comply with UP if they knew patients were either infected or at risk for infection with blood-borne pathogens.[18] The study by Kaczmarek and coworkers,[19] in which compliance with glove use was influenced by the prevalence of AIDS in the geographic area and the number of AIDS-related admissions to the hospital each year, may support the belief that compliance with UP improves if an infection is known.

Perhaps the difficulty in complying with the recommendation to treat all patients as if they were infected is related to the perceived susceptibility to disease, which also refers to the likelihood that one will acquire the disease. If the HCW perceives that most of the patients with whom he or she interacts are not infected, the likelihood of acquiring an occupational blood-borne infection is seen as low. The use of devices or protective apparel that may be cumbersome then becomes even more problematic.

In an observational study reported from a San Francisco hospital where approximately 30% of the patients were perceived to be at risk for blood-borne pathogens, knowledge of the patient's HIV or HBV status did not modify the rate of worker injury or exposure.[20] The findings from the studies of Kaczmarek and coworkers[19] and Gerberding and associates[20] also suggest that contact with a greater number of patients with AIDS provides visible reminders of the prevalence and seriousness of the disease, improving compliance with worker protection strategies such as UP.[19, 20]

When performing a benefit-obstacle analysis regarding UP, HCWs may perceive that the inconvenience and reduction in dexterity or performance is not justified unless the patient is either infected or likely to be infected. Frequently, HCWs are confronted with the expectations that intravascular lines or other devices will be swiftly and skillfully inserted into patients with trauma, de-

spite the use of protective devices that may impede the successful completion of the task. If the situation is perceived as unresolvable by HCWs–that is, they believe they cannot fulfill their obligations or job duties while using protective devices–they may ignore the risk or deny that the risk of infection is serious. To achieve congruence between actions and belief, HCWs may choose actions consistent with beliefs; that is, UP will not be routinely used except with patients clearly perceived to be infected or at high risk for infection.

Although HCWs may be motivated to enjoy an injury-free state, without risk of infection, the characteristics of the HCW-patient relationship may hinder compliance with UP as a safety strategy. In the ED, the patients are frequently in a health crisis, and may be vulnerable and at risk for negative outcomes if there are delays in treatment. The outcome of the injury or illness may be determined by the immediate or timely action of HCWs. The individual HCW's awareness of the time-sensitive, critical nature of his or her work is likely to have a negative effect on compliance with UP in certain situations. If the HCW takes the time necessary to comply with UP, on the other hand, discordance may arise between actions and beliefs. The obstacle most frequently cited by workers in this study was a lack of time. This finding is consistent with the report by Kelen and colleagues,[21] in which 47% of the ED HCWs claimed lack of time as the major impediment to compliance with UP. Wong and associates[22] also reported that physicians involved in emergency procedures used UP less frequently than when performing nonemergency procedures.

HCW compliance with UP may be facilitated by the identification of the perceived obstacles. The interference with technical skills as a result of the use of protective devices was identified as an obstacle by the respondents in this study. Historically, the development of health care devices has focused on the purpose and function related to patient care, rather than on the safety of the workers. More research is needed to determine the actual effect of gloving and other precautions on both the technical quality and the art of patient care, from the perspectives of both the patient and the HCW. Obstacles described by the HCWs could be used to direct engineering developments or practice innovations. For example, gloves need to be developed that provide increased tactile sensation yet resist punctures and cuts.[23,24]

Modifications can be made in the ED environment, devices, and practices that will decrease the risk of worker exposure and injury. The provision of supplies in areas immediately adjacent to the area of use may address the workers' concerns regarding time limitations. The installation of needle-disposal containers near patients' beds has been found to decrease the reported number of needlestick injuries. Packaging and placing UP supplies in the trauma resuscitation rooms has also resulted in an increase in compliance. The cost of providing the pack and purchasing protective devices specific to each of the various needle devices should be compared with the cost of occupational exposures.[25-27]

Needle guards or resheathing devices can potentially prevent 80% of injuries.[28] Considering most hospitals use a passive surveillance system for needlestick injuries, the rates reported in the literature are probably an underestimation of the actual number of needlestick injuries; the need for resources to be directed toward needle safety improvement is therefore critical. The findings of this study, in which only 10% of the blood exposures were reported to the employee health service, also suggest underreporting of injuries.

Postexposure management involves prompt assessment of the exposure and, if appropriate, administration of hepatitis B vaccine, hepatitis B immune globulin, and, if the HCW is exposed to HIV, possibly an antiviral agent. This study was consistent with other reports of workers in the literature, who also claim not to report all of their occupational exposures to blood to the employee health service. Mangione, Gerberding, and Cummings[29] found the major difficulties in reporting injuries were related to access to the system, concerns about confidentiality, and lack of knowledge of the injury reporting protocol.[29]

Most of the workers in this study scored high on the knowledge questions. This may be a reflection of the questions, which tested for knowledge of obvious principles of UP rather than more subtle applications. However, workers with more training experiences reported greater compliance with UP. This finding may suggest that increased opportunities for training results in the integration of concepts into practice. It is important to note, however, that this study is limited by the 56% response rate.

Providing the HCWs with cues to the recommended action could be accomplished through chart reminders. Several studies have suggested a behavior change on the part of physicians after computer reminders were placed on patients' charts.[30-32] Although these studies were related to

disease prevention and treatment decisions for patients, it seems reasonable that the same limitations on the physician's ability to absorb, process and act upon all recommendations while focusing on the needs of the patients are present in the ED. The attention that can be given to the issue of personal protective devices and practices may be amplified by cues in the environment. This strategy may also address the frequently cited barrier to UP of "forgetting." Pettinger and Nettelman[33] also found that environmental cues improved compliance with isolation practices in an intensive care unit.[33]

A strategy for changing the behavior of HCWs and improving compliance was described by Kelen and colleagues[34] in 1991. A hospital policy mandating compliance with UP was enforced, with substantial improvements in compliance. Implementation of the policy included monitoring the compliance of the workers by direct observations at least twice a month, counseling HCWs not in compliance, and documenting repeated offenses in employee performance evaluations. Not only has an improvement in compliance been documented, but workers have been observed to remind each other and to restrict the access of noncompliant HCWs to the patients in nonemergency situations. Although a call for behavior change on the part of workers is often one of the responses to an injury problem in the workplace, the program described by Kelen and colleagues[34] may provide reminders and peer group support for the recommended behavior.

RECOMMENDATIONS

A type of needleless intravenous system should be used whenever the medications are compatible with this type of administration. HCWs should be provided with medication administration systems in which the needle is covered during and after use, such as by needle sheaths that are incorporated into the syringe and drawn over the needle as the needle exits the patient. These types of products are currently available and should be used until more advanced designs employing passive engineering strategies (such as syringes with spring-loaded resheathing devices) are available.

To reduce or eliminate the need for HCWs to move through the immediate patient environment with unsheathed needles, multiple needle-disposal containers should be placed within reach of the point of use.

To increase the comfort of the worker and improve compliance, the moisture-repellent clothing for long-sleeved gowns should be of a material that repels liquid but does not trap moisture, such as the water-resistant, "breathable" material used in sports or outdoor clothing. In addition, large and small sizes for gloves and gowns should be available for comfort, dexterity, and ease of movement.

Gloves made of a durable, puncture-resistant material should be available for use under latex gloves when performing a procedure in which the risk of injury to the HCW is increased, such as moving a patient with glass shards in clothing or skin. Workers in areas with a low seroprevalence of HIV may need to be reminded periodically of the seroprevalence of other blood-borne pathogens in their geographic area.

Before training sessions, precourse assessment of the learners' needs will help to provide programs that focus not only on knowledge but also on the HCWs' beliefs regarding personal susceptibility to infection and the efficacy of recommended protective measures. Periodic training sessions should be offered to the ED workers to provide information on technologic advances and to offer the opportunity to practice skills in nonemergency situations.

These training sessions should also address the concerns of HCWs regarding reduction in dexterity when using protective apparel. Opportunities should be provided for both HCWs and students to practice performing invasive procedures while using protective devices on anatomic models.

Timely and appropriate postexposure management of injured HCWs is critical to aborting infections with blood-borne pathogens. The employee health service and the ED should develop a system that facilitates convenient, confidential reporting and moves the injured HCW into the system for immediate evaluation, counseling, and postexposure treatment.

Hospital managers and persons responsible for students must incorporate compliance with UP into the performance evaluation. Monitoring activities should occur, possibly incorporated into existing quality improvement programs.

Reminder sheets or cards should be attached to the resuscitation chart forms in the trauma areas. Similar reminder sheets should be attached to the resuscitation carts used in many hospitals.

Although the system of UP is based on a logical extension of the understanding of the transmission routes and interventions for blood-borne pathogens such as hepatitis B, the strategies are

unproven. Additional studies must be done to demonstrate the efficacy of UP and engineering controls in preventing or reducing worker exposure to blood-borne pathogens.[35, 36]

Although available information suggests that the fear of occupational infection with HIV is present in many workers, the dilemma for the HCWs in the ED may be related not to a lack of motivation but rather to difficulty in integrating the protective procedures into crisis-based practices. The belief that knowledge has a large effect on behavior, especially in emergency situations, is not supported by data.[37] Considering the nature of the clinical practice setting and the data on worker compliance, the development and use of passive protective strategies – that is, provision of protection *before* the moment of use – are critical for this population of HCWs.

The application of the HBM to these data suggest that an integrated approach should be used. Such an approach would incorporate engineering controls, cognitive approaches, behavior modification strategies, and training experiences for the improvement of technical skills, thus both serving the patient and protecting the worker.

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