A Work-Systems Analysis of Compliance With Universal Precautions Among Health Care Workers

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Universal precautions are work practices designed to protect health care workers from occupational exposure to HIV and other bloodborne pathogens. However, despite aggressive dissemination efforts by CDC and regulatory action by OSHA, compliance remains less than satisfactory. This article argues that the minimization of risk from bloodborne pathogens requires a multilevel or work-systems perspective that considers individual, job/task, and environmental/organizational factors. The available literature on universal precautions suggests the potential of such an approach and provides insight into the limited success of current worker-focused mitigation efforts. In particular, specific opportunities exist to develop and apply engineering controls, to improve the design and organization of jobs and tasks, and to create organizations that facilitate and reinforce safe behavior.

INTRODUCTION

Universal precautions (UP) are recommended work practices designed to protect health care workers (HCWs) from exposure to bloodborne pathogens. In essence, HCWs should assume that all patients are infectious for the human immunodeficiency virus (HIV), hepatitis B virus (HBV), or other bloodborne pathogens. Specific precautions include proper disposal of needles and other sharps, not recapping used needles, and using disposable latex gloves and other protective garments and equipment. The Centers for Disease Control and Prevention (CDC) issued formal guidelines related to UP in 1987,[1] and UP became mandatory in 1991 with the passage of the OSHA Blood-Borne Pathogens Standard.[2] The OSHA standard requires employers to establish, among other things, an exposure control plan and to offer training to workers.

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These actions notwithstanding, a number of studies indicate that compliance with UP is inconsistent and often quite poor. Kelen and colleagues found only 44% adherence to UP in an observational study conducted in the emergency room at Johns Hopkins University Medical Center.[3] Hammond and colleagues reported that among house officers only 16% strictly adhered to UP guidelines.[4] Becker and colleagues found that the rate of recapping in four large medical centers was greater than 25% during all measurement periods and higher than 50% in some instances.[5] A recent national survey of over 3,000 HCWs found that only 43% of patient care staff "always" wore gloves to draw blood and only 63% "always" washed their hands after removing their gloves. Rates of compliance for outer garments, masks, and protective eyewear were even lower.[6]

Noncompliance with UP is a significant occupational health problem. The risk of HIV infection has been estimated at about 0.3% following percutaneous exposure to HIV-contaminated blood.[7,8,9] The cumulative lifetime risk of infection for certain high-risk subgroups of HCWs, such as emergency medical service personnel, surgeons, and trauma teams, may be as high as 1% to 2%.[10,11,12] CDC surveillance reports indicate that there have been 120 (both fully documented as well as presumed) occupationally acquired HIV infections in HCWs.[13] The risk of hepatitis B infection (HBV) after exposure is much greater, ranging from 6% to 30%.[14] Approximately 2,500-5,000 acute cases of HBV infection are reported among HCWs each year, resulting in an estimated 400 hospitalizations and 250 fatalities.[15,16,17]

Thus far, strategies to prevent occupational exposures to bloodborne pathogens have focused on modifying worker behavior and work practice controls. This approach may be problematic in two important respects. First, interventions that show promise but are not worker oriented may not be developed or implemented. And second, in the face of continued poor compliance, increasingly more intense and punitive measures may be used in the attempt to alter worker behavior.[18] This type of "blame and train" response can initiate a vicious cycle of heightened internal attributions and punitive actions that can compromise safety and create unnecessary and counterproductive conflict within the organization.[19]

The topic of UP raises inevitable questions about individual worker responsibility versus the provision of safe and healthful working conditions—a dichotomy that is virtually endemic to occupational safety and health[20,21] and health education.[22] The present article argues that the minimization of risk from bloodborne pathogens should not be guided by either/or thinking, but should proceed from a comprehensive analysis of the total work situation. This type of approach is needed to support the development of complementary behavioral and environmental/organizational interventions that will have mutually reinforcing effects. The available literature on UP suggests the potential of such an approach and provides insight into the limited success of current regulatory and related actions in this area.

WORK-SYSTEMS MODEL OF OCCUPATIONAL HEALTH AND SAFETY

A number of authors have argued for a multidimensional or systems approach to worker health and safety.[21,23-26] In general terms, this basic approach emphasizes environment-behavior linkages and underscores the importance of comprehensive work-situation analysis in attempting to preserve and enhance worker health and safety. The model shown in Figure 1 features three interactive and interdependent systems or compo-

nents that affect work behavior: (1) job/task demands, (2) worker characteristics, and (3) environmental/organizational factors. All three systems have the potential to affect worker health and well-being, either directly or by interacting with other factors or systems. The defining characteristic of a systems or multilevel approach is that complex actions and events cannot be fully understood by examining them in isolation. The UP-related actions of individual workers should not be analyzed without detailed consideration of job demands and broader organizational and environmental influences.

WORK-SYSTEMS MODEL APPLIED TO UNIVERSAL PRECAUTIONS

The following analysis is organized according to the three systems or components depicted in Figure 1. Within each system, two or three questions are posed to organize the presentation and to highlight the major aspects of how that particular system contributes to the problem under study. The overarching goal of this analysis is to organize pertinent research on UP and to set the stage for a more comprehensive approach to worker protection from bloodborne pathogens.

Analysis of Job and Task Demands

Job/task demands include the physical and psychosocial requirements of particular jobs, and this analysis can be organized around the three questions contained in Figure 1. The order of these questions is important, in that analysis should begin with an assessment of worker risk, proceed to an examination of source controls, and conclude with an assessment of the impact of applicable control strategies on work performance.

Job/Task Demands and Risk of Exposure

The UP literature contains relatively little information derived from direct observation and analysis of specific patient care or other relevant tasks (maintenance, housekeeping, etc.). The problem of needlesticks, however, is a notable exception to this conclusion, and provides a good illustration of the way in which careful analysis of specific job tasks can provide insights into prevention/intervention strategies.

Needlestick injuries are a serious risk to HCWs. The number of needlestick injuries among hospital workers exceeds 800,000 per year,[27] and it has been estimated that about 40% of HCWs' occupational exposure to HIV may occur as a result of needlesticks.[28] Since 1983, CDC has advised against recapping used needles,[29] and this recommendation was incorporated into the OSHA standard on bloodborne pathogens. Ready access to puncture-resistant disposal containers (sharps containers) was also recommended at this time as a way to facilitate the quick and safe disposal of used needles. Prior to these actions, recapping used needles was considered part of good safety practice. So the situation is this: a major strategy in the prevention of needlesticks has been to prohibit recapping, a behavior that was once considered standard and even encouraged. The challenge for many HCWs is not simply performing a new work practice, but also extinguishing a previously learned and rehearsed practice.

Key Questions

Job/Task:	1. Do job/task demands contribute to risk of exposure? 2. Can jobs/tasks be modified to mitigate risk? 3. Do control strategies interfere with job/task performance?
Worker:	1. Do workers have knowledge and skills to recognize and avoid hazards? 2. Are workers' attitudes and beliefs consistent with safe job performance?
Environmental/ Organizational:	1. Is work environment designed and organized to facilitate safe job performance? 2. Does the safety climate support and reinforce safe worker behavior?

Figure 1. Work-systems model of occupational safety and health.

A further complication is that studies of needlestick injuries indicate that many needlesticks occur through handling or coming into contact with exposed needles and not

Table 1. Work Tasks Associated With Needlestick Injury in Four Studies (in percentages)

Study	Needle Disposal	Injection	Blood Draw	Waste Disposal	Recapping	Other
McCormick et al.[30]						
1975-1979	24.5	21.9	17.0	16.7	9.2	10.7
1987-1988	3.5	15.7	13.3	19.7	10.1	37.7
Ruben et al.[31]						
1977-1980	32.0	19.0[a]		NA	25.0	NA
Krasinski et al.[32]						
1983-1985	10.0	22.0	NA	17.0	16.0	35.0
Yassi and McGill[33]						
1988-1989	14.7	6.7	12.2	15.3	16.5	11.2

a. This result combined both injection *and* blood draw.

during recapping per se.[30-33] Table 1 summarizes results from four of these studies, which show that somewhere between 9% and 25% of needlesticks occur during recapping. Jagger and Pearson use these results to argue that "the consequence of eliminating recapping is a trade-off in which the risk of recapping is replaced by the risk of handling exposed needles" (p. 212).[34] This trade-off may help to explain why recapping continues despite the wide dissemination of UP guidelines prohibiting it.[5,6,35] In certain instances there may be valid reasons for recapping; for example, some needled devices, such as certain types of intravenous tubing/needle assemblies, must be disassembled prior to disposal.[36,37] By not recapping, the HCW is forced to handle or work in close proximity to exposed needles during disassembly.

Job/Task Modification and Risk Reduction

Continuing with the needlestick example, detailed analysis of needlestick injuries has permitted the identification of specific high-risk tasks such as (1) insertion of IV catheters, (2) accessing IV ports, (3) injection, and (4) blood withdrawal.[38] Information at this level of specificity has helped to accelerate the development of engineering controls. Various shielded or needleless systems have been developed that show promise for reducing certain types of needlestick injuries.[38,39] Naturally, many questions remain about the reliability of these systems, their ease of use and acceptance, and possible unwanted side effects.

In summary, the first two questions of the job/task analysis provide some useful information about needlesticks. First, prohibiting recapping is likely to affect only a fraction of needlestick injuries. Moreover, this action requires some HCWs to change an established work practice. Because needlesticks are relatively rare in comparison to the number of needles handled, there may be limited motivation for behavior change. Second, for certain types of equipment and tasks, there may be built-in incentives to recap. Third, some categories of needlesticks, such as those associated with intravenous catheter systems, can probably be reduced through technically feasible engineering controls. Fourth, even with these work practice and engineering controls, many situations remain in which an exposed needle must be used to penetrate human skin (e.g., blood drawing). This residual risk provides the focal point for further analysis and targeted efforts involving safe work practices, training, workload analysis, incentives, and continued

technological development to minimize HCW risk. It is unfortunate that other aspects of UP practice have not received the kind of in-depth analysis that has been devoted to needlestick injuries.

Safe Work Practices and Job/Task Performance

The impact of UP requirements on job performance has been explored in broad terms in a number of surveys of HCWs. Lack of time and interference with skillful task performance are the most frequently reported reasons for noncompliance to UP.[3,5,40,41] Interference with the patient-practitioner relationship has also been mentioned in several studies.[42,43] Forgetting about UP,[4,5] lack of knowledge of UP protocols,[4] discomfort,[3] and lack of access to protective equipment[41] have also been noted in the literature. These findings parallel those from other workplace self-protective actions (respirators, hearing protectors, protective footwear, etc.), which also underscore the importance of job-related barriers in reducing compliance.[44,45,46]

Findings from recent NIOSH-sponsored research provides further support for the importance of job hindrances. This study involved over 1,700 HCWs (principally hospital-based nurses, physicians, and technicians) in three regions of the country, stratified by HIV/AIDS prevalence. In an analysis of overall compliance, HCWs who perceived a low level of conflict between job demands and self-protection were more than twice as likely to be compliant than those who perceived high levels of conflict.[47] In subsequent regression analyses, job hindrances were found to be the best predictor of compliance for both nurses and physicians.[48,49] Physicians reported greater job-related hindrances associated with UP than did nurses or technicians; they also had the lowest overall compliance. Interestingly, physicians also indicated less knowledge and information about UP and received less safety-related performance feedback than the other two groups.

The unique aspects of patient care as a work activity suggest that job hindrances may pose a special challenge to worker self-protection. To begin, the "product" is human health, and sometimes, life itself; and by tradition, the needs of the patient come first. In addition, emergency and critical care situations often require split-second, lifesaving actions where even minor delays or other encumbrances may be unacceptable. By their very nature, UP place physical barriers between provider and patient; they invariably alter interpersonal dynamics and complicate treatment to some extent. Finally, physicians, nurses, and other practitioners often do not know the HIV status of the patients they treat, and unlike some workplace hazards that are cumulative in impact, a single momentary lapse in compliance may be sufficient to produce devastating consequences.

Two conclusions about UP practices and job performance seem clear. First, HCWs believe that UP requirements interfere with the optimal performance of their jobs. These concerns are not necessarily confined to personal protective equipment, in that there have been anecdotal reports of efforts to disable or defeat some of the engineering devices designed to provide passive protection. Second, in contrast to most other jobs, there is very little tolerance in health care for performance decrements associated with the use of personal protective equipment or any other hazard control measure. An important caveat, however, is that these conclusions come almost exclusively from HCW self-reports. There has been very little direct observation and analysis of patient care activities. The patient's perspective is also noticeably lacking.

Analysis of the Worker

This analysis includes the various psychological and physical characteristics of workers that may influence job performance and/or job safety. Two questions guide this inquiry (see Figure 1).

Knowledge and Skills Pertinent to Hazard Avoidance

Information regarding UP has been widely disseminated in the health care community, and recent worker surveys suggest that most HCWs possess adequate knowledge of UP practices and occupational transmission of bloodborne pathogens. This was not the case just a few years ago. In one early study,[3] 87% of providers felt they were knowledgeable about UP, but only 26% could indicate the appropriate barrier precautions to use for at least three to five scenarios that involved a major procedure or dealt with a patient with profuse bleeding. Another study reported that only 56% of those surveyed strongly disagreed with the statement that UP policies recommend the recapping of used needles.[5] In a third study,[43] 45% of certified midwives claimed not to follow UP guidelines, and 10% of respondents indicated that they were totally unaware of UP.

More recent studies reflect improvements in both information dissemination and knowledge levels. In their recent national survey,[6] Hersey and Martin found that 89% of patient care staff had attended at least one training session on infection control precautions. Fifty-one percent reported attending three or more sessions, and almost one-half of respondents (46%) had attended a training session within the previous 6 months. Unfortunately, knowledge of UP was not directly assessed in this study. In the NIOSH study,[47] approximately 75% of respondents had participated in some type of UP-related training, and 95% were classified as having a high level of knowledge about UP.

Training is almost always justified as an approach to improve worker health and safety, but knowledge by itself is seldom sufficient to produce or sustain safe behavior. Although the large majority of HCWs in the Hersey and Martin survey had participated in training activities, only 43% of patient care staff "always" wore gloves to draw blood, 55% recapped at least sometimes after giving an injection, and only 63% "always" washed their hands after removing their gloves. In the NIOSH study, three-fourths of respondents had taken part in training, but only about 24% were classified as fully compliant. Compliant workers were those who indicated that they "always" or "often" adhered to each of 11 UP-related practices. Across the 11 behaviors, compliance varied from about 97% for glove usage to about 73% for not recapping to about 56% for wearing disposable face masks.

Aggressive information dissemination and mandated HCW training have produced undeniable benefits in terms of improved awareness and knowledge. However, at this point, additional information-based training is likely to show diminishing value in producing further improvements in compliance. On the other hand, relatively little is known about the actual skill levels of HCWs in practicing UP and in avoiding or managing high-risk situations. Skills- and strategies-oriented training may yield considerable benefits, especially in view of the apparent importance of job hindrances in noncompliance. The emphasis in this type of training would be on showing HCWs how to overcome or reduce the barriers associated with following UP in the course of performing specific tasks and procedures.

Attitudes and Beliefs Related to Self-Protective Action

Most theoretical models of self-protective behavior assign considerable importance to the individual's threat-related beliefs and to the processing of costs and benefits associated with taking or not taking preventive action.[50,51] Key elements in these models include the individual's perceptions related to susceptibility, severity, the effectiveness of preventive action, and his or her ability to perform the necessary behaviors (self-efficacy). Threat- and outcome-related beliefs have been shown to be important in predicting compliance with a variety of medical regimens,[52,53] and evidence is accumulating for their contribution to workplace self-protective behavior.[54]

From available data, it appears that most HCWs do not dismiss or underestimate their personal risk (susceptibility) of bloodborne infection. In a study of emergency medical service professionals, over 50% of respondents considered their chances of becoming infected with HIV to be "somewhat high" or "very high."[55] Becker and colleagues found that 66% of nurses and physicians in their sample agreed with the statement, "I worry that my work activities put me at risk of contracting AIDS."[5] In a 1988 study by Cooke,[56] 18% of medical residents believed they had symptoms of AIDS. Hoffman-Terry and colleagues, in a study of medical and surgical residents in a nonurban area, found that over 80% of the residents judged their risk to be "moderate to high," both during their residencies and during their subsequent professional careers.[41] Some health care workers consider themselves to be at such high risk that they would prefer not to treat persons with HIV infection.[57,58,59] At least one study has shown that in-service training in UP can produce decreased levels of stress and perceived risk in health care workers.[60]

However, some of these same studies also suggest that HCWs may sometimes act on the basis of situation-specific as opposed to aggregate or overall risk.[41,42] In the above study of medical and surgical residents, the most frequent reason (65%) for not reporting exposures was not perceiving the exposure as a health risk. Some HCWs may think that they can discriminate the level of risk associated with a particular patient or treatment situation. This, of course, is in direct opposition to the fundamental tenet of UP—that all patients should be assumed to be infectious. The tendency of HCWs to make situation-specific risk assessments is not particularly surprising and may reflect the operation of the overconfidence heuristic.[61,62] A considerable amount of research suggests that almost regardless of prior experience or expertise, people tend to have excessive and unwarranted confidence in their interpretation of events. Overconfidence, like other judgmental biases, has also proven to be quite resistant to debiasing efforts.

Several researchers have tried to assess health care worker beliefs about the risk reduction benefits (effectiveness) of UP. Becker and associates found that over 80% of the doctors and nurses in their study believed that following UP decreases risk of HIV.[5] Kelen and associates found that only 2.7% of emergency room personnel felt that UP do not work.[3] Hoffman-Terry and associates found that 97% of medical and 69% of surgical residents strongly disagreed with the statement, "Precautions are ineffective."[41] Gershon and colleagues found that 95% of hospital workers agreed with the statement, "If UP are followed, my risk will be low."[47]

In general, HCWs appear to possess adequate levels of perceived susceptibility to the hazards associated with bloodborne pathogens. This observation notwithstanding, the possibility that HCWs may sometimes act on the basis of situation-specific perceived risk should not be ignored. HCWs also appear to possess a reasonable degree of confidence in the effectiveness of UP as a preventive measure. Considerably less is known about the dimension of self-efficacy, or the extent to which HCWs believe that they can successfully

perform UP behaviors and comply with UP guidelines. The potential link between self-efficacy and job hindrances requires further study. Indeed, an important leverage point for improving compliance may rest with altering the benefits-barriers trade-off, and the key to this may be to enhance the self-efficacy expectancies of HCWs through skill- and strategies-based training. It also follows that further efforts to increase overall levels of perceived susceptibility could prove counterproductive without commensurate attention to self-efficacy enhancement and/or barrier reduction.

A final area of consideration within this category of worker-related factors concerns the general attitudes of HCWs toward HIV/AIDS patients. In the NIOSH study,[47] an 11-item scale adapted from Shrum and colleagues[63] was used to measure HCW tolerance toward HIV/AIDS patients. Compliance was significantly higher among workers reporting tolerant rather than less tolerant attitudes; however, this measure failed to reach significance in the multivariate model of compliance.

Analysis of Environmental and Organizational Factors

This analysis provides a broader examination of the physical and social factors that transcend specific jobs. In part, this analysis focuses on the macro-task environment and the interactions and interdependencies that exist within any grouping of workers and equipment and facilities.[64] This analysis also examines influences related to organizational structure and climate, such as management decision making, organizational norms and values, intergroup rivalries, and union-management relations.

Workplace Design and Organization

The need for both micro- and macro-task analyses of medical care environments has been pointed out by several authors,[65,66] but to date there has been relatively little direct research activity. The basic argument is that the same systems engineering and human factors techniques that have been applied with considerable success to complex military and industrial systems should also be used to study the delivery of modern medical care. A preliminary study of an intensive care unit in an Israeli medical center found numerous error-likely situations related to documentation and information transfer between staff, lack of standardization in equipment composition and layout, and inadequate marking and labeling of equipment and materials.[67] Based on the complexity of care being offered in this environment, the array of equipment and technology in use, and the apparent disorganization of the work environment, it was surprising that there were not more errors—and more serious errors.

Most health care settings involve groups of specialized and interdependent workers interacting with each other and with various types of equipment and devices. In such environments, safety performance can decline in a nonlinear fashion as total group workload and situational demands increase. Pertinent to UP, Kelen and colleagues found that in the emergency department at a large medical center, compliance with UP was 44.7% for situations involving no bleeding, 57.7% with active bleeding, but only 19.5% in the presence of profuse bleeding.[3] Similarly, compliance was only 16.7% for major interventions, as compared to 56.4% for minor interventions and 44.1% for exams. Hammond and colleagues found a strict compliance rate of only 16% among surgical residents engaging in trauma room resuscitation.[4] Even for highly invasive procedures,

such as inserting chest tubes, compliance was less than 40%. These results suggest that adherence may often be poorest when the risk of exposure is greatest. The identification and analysis of special compliance requirements and high-risk task situations should be an important feature of a comprehensive infection control program.

Organizational Safety Climate

As the term is typically used, safety climate refers to the perceptions that workers share about safety in their organization.[68] The safety climate of an organization is thought to provide a frame of reference for guiding worker behavior and may help workers develop coherent expectations about behavior-outcome contingencies in their environment; safety climate may also represent a link between active and latent failures.[69] Active failures are errors and violations involving frontline personnel, while latent failures are often the consequences of decisions made at the higher echelons of the organization. Although the precise nature of safety climate requires further clarification, there is general agreement that the safety-related attitudes and actions of management play an important role in creating a good or bad safety climate.[68,70,71,72]

Studies of safety program effectiveness in non-health-care settings suggest that a positive or supportive safety climate is an important contributing factor to good safety performance.[73,74,75] The potential importance of climatelike factors has also been discussed with respect to health care in general,[76] and UP in particular.[77] Safety climate has emerged as an important consideration in the transfer of training.[78,79] The information and cues conveyed about safety at the organizational level can greatly facilitate or hinder how safety training is transferred to actual job performance. White and Berger[77] argue that the decision to follow infection control procedures occurs within a context that includes interactions with other workers making similar decisions; direct feedback on the consequences of use/nonuse; information received from the media, professional literature, and other sources; and messages from the organization such as policy and procedure statements, training programs, protective equipment availability and choices, and feedback from supervisors.

The NIOSH study[47,48,49] made a concerted effort to collect organizational safety climate data. Using a 13-item scale to measure safety climate, respondents who perceived a strong commitment to safety at their institution were over 2½ times more likely to be compliant than respondents who did not perceive a strong safety climate.[47] In a separate analysis of the nurses at the high-prevalence site (n = 482),[48] job hindrances were found to be the strongest predictor of compliance, and safety climate was the best predictor of job hindrances. Safety performance feedback and availability of personal protective equipment were the strongest predictors of safety climate, together accounting for 30% of the variance. Another aspect of this analysis that deserves mention pertains to the possible roles of knowledge of UP and the perceived value of prevention in facilitating UP-related behavior. Knowledge of UP was the best predictor of value of preventive action, and value of prevention made its strongest contributions to job hindrances and personal protective equipment. It appears reasonable to speculate that knowledge of UP may provide the worker with enhanced confidence about the value of adhering to UP, which, in turn, translates into greater effort and more effective coping with related job hindrances and the use of personal protective equipment.

DISCUSSION

The preceding analyses highlight several potential targets for action in the attempt to manage occupational exposure to bloodborne pathogens in health care settings. Fundamental to this discussion is the need to pursue a broader, more multifaceted intervention strategy that does not rely so heavily on the individual worker's ability to unfailingly follow safe work practices in all situations. Opportunities exist to develop and apply engineering or passive controls, to improve the design and organization of tasks, and to create organizations that facilitate and reinforce safe behavior.

The attention given to needlesticks has yielded several conclusions that support the need for a multifaceted approach to prevention. First, the analysis of needlesticks revealed that a centerpiece in the effort to prevent needlesticks (i.e., prohibiting recapping) is relevant to only a fraction of all needlestick injuries. Second, it showed that strong countervailing forces exist that support continued recapping in some situations. Third, it provided a better understanding of injury mechanisms, which has facilitated the development of engineering controls. Viewed together, these conclusions support complementary behavioral and environmental actions. Priority should be given to making maximum use of available engineering technology to reduce direct exposure to exposed needles. This would include needleless and shielded systems, as well as equipment and task redesign to minimize risk during such tasks as disassembly and disposal. A key aspect of redesign involves removing the need or incentive to recap. On the behavioral side, active prompts and reminders will be required to discourage recapping in general; this might involve peer and/or supervisor feedback, direct monitoring of needle disposal practices, warning labels, posters, and so forth. Management actions that clearly establish responsibilities for needle disposal and the importance of this aspect of UP are also needed.

The analysis of job/task factors also shows that job-related hindrances play an important role in noncompliance. Possible strategies for combating this problem may reside within the worker analysis. In assessing the benefits and barriers associated with UP, HCWs may well include the benefits received by the patient when treatment is unencumbered by personal protective equipment. A possible way to alter this calculus may be to enhance the self-efficacy expectancies of HCWs through skill- and strategies-based training. The objective is to make HCWs more confident and comfortable in using protective equipment while providing care.

The worker analysis also suggests that most HCWs possess adequate levels of information about UP and modes of transmission in the workplace. As such, current efforts to alter beliefs about personal susceptibility and the theoretical effectiveness of UP may be adequate. However, the possibility that some HCWs may act on the basis of situation-specific perceived risk should not be ignored. Training materials that address HIV/AIDS stereotypes and make use of case reports and testimonials from other HCWs might be effective. Finally, there is some indication that tolerant attitudes toward HIV/AIDS patients may be associated with greater willingness to use UP. This possibility should be explored in subsequent research.

The environmental/organizational analysis underscores the importance of identifying and analyzing high-risk task environments. Compliance is clearly more problematic in some situations than in others, and compliance may actually be poorest when the risk of exposure is greatest. Macro-task analysis also suggests that the total risk faced by any given HCW is determined by situational factors and by the actions taken or not taken by

other workers. It is both incorrect and unfair to assume that HCWs have total control over their own compliance behavior.

Finally, organizational safety climate is likely to be a very important leverage point for improving UP-related behavior. In practical terms, a positive safety climate is one in which a high priority is assigned to safety, and where this commitment is demonstrated in both word and action. The safety literature offers several recommendations that appear to be applicable to health care settings and UP. First, safety should be integrated into the management system of the organization. This means that poor safety performance is equated with poor management control, and that the same tools used to address other central functions of the organization can also be applied to safety matters. Thus safety is taken very seriously, but, as is the case for other behaviors that are important to the organization (e.g., quality, innovation, and productivity), positive approaches offer greater potential than enforcement-based or punitive measures.

Second, a balanced view of accident/injury causation should be adopted; poor safety performance should not be viewed as simply a behavioral or a worker-focused problem. This is particularly important in reducing job hindrances as a factor in noncompliance. To date, training efforts in the UP arena have focused almost exclusively on frontline HCWs. Future efforts should also include supervisors and administrators, as they are critical when creating supportive safety climates. This training should not be limited to UP; it should also emphasize the importance of organizational-level action in achieving safety goals. One recent study concluded that many hospital administrators accept needlesticks as inevitable and believe that a certain needlestick frequency should be exceeded before intervention is warranted.[80] Managers who hold such views are not likely to invest in engineering or environmental controls and will probably address safety problems with traditional enforcement-based approaches.

And third, emphasis should be placed on improving safety-related communication and performance feedback systems. An important step in this regard is to provide opportunities for two-way communication. Posting notices and conducting training sessions do not usually allow for much two-way communication. Safety committees and other participatory strategies represent better approaches. Safety performance feedback involves both formal and informal channels. Formal feedback includes performance appraisals and other overt actions to disseminate information and reminders about safety matters. Informal feedback, on the other hand, tends to be more subtle and involves the operation of workplace norms and coworker interactions. Recent research[49] underscores the general importance of feedback to safety climate and suggests that certain groups of HCWs, most notably physicians, may be too far "outside the loop" in terms of regular safety communications and feedback.

CONCLUSION

Taking a work-systems approach to UP means that the self-protective actions of individual workers are analyzed in the context of specific job demands and broader organizational and environmental influences. This article focused on UP and HCWs, but the questions used to guide this analysis are pertinent to virtually any occupational safety and health problem. Even in situations in which the self-protective actions of workers are less central, important insights can be gained by examining worker—job/task—environmental/organizational linkages. In many respects, even engineering or passive hazard controls are effective to the extent that workers accept them, that they do not

disrupt or complicate job performance and productivity, and that they are not undermined by actions or strategic decisions at the organizational level.

The basic systems approach can also be extended to worksite health promotion in at least two ways. First, in many instances, job modification, workplace redesign, and organizational-level actions can be used to facilitate personal health behavior and lifestyle changes. Second, opportunities exist to use health promotion initiatives to support occupational safety and health goals. For example, a fitness program might be combined with ergonomic and management interventions in a broad-based approach to reduce musculoskeletal complaints among clerical workers. The essentially reciprocal relationship between behavioral and environmental factors suggests that significant potential exists for integrating the perspectives of occupational safety and health and health promotion.[21] A general work-systems or multilevel approach may be the best way to bring these functional domains together.

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